Synthesizing school curriculum and song: a practice-led model for creating educational songs for children - Dataset

Debreceny, Aniko

Debreceny, A. (2022). Synthesizing school curriculum and song: a practice-led model for creating educational songs for children - Dataset [Data set]. University of the Sunshine Coast.
https://doi.org/10.25907/00140
Document Type: Thesis

SYNTHESIZING SCHOOL CURRICULUM AND SONG: A PRACTICE-LED MODEL FOR CREATING EDUCATIONAL SONGS FOR CHILDREN

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A thesis submitted for the degree of Doctor of Philosophy at
The University of the Sunshine Coast in 2021
School of Education & Tertiary Access

Abstract

This practice-led research project investigates the process of creating subject-based songs for U.S. elementary and middle school students as an accessible medium for acquiring content knowledge and vocabulary. While considerable research has been conducted that shows that song enhances engagement, learning and retention, there is little current exploration of the process of creating educational songs. This exegesis discusses the use of song in the elementary and middle school classroom, then investigates and chronicles the process of developing subject specific songs, accompanied by embedded contextualising information. The methodology interweaves the commentary model and an annotated portfolio approach with a theoretical framework based on Wallas's (1926/2014) theory of creativity. This exegesis accompanies two creative artefacts: a series of 33 original songs, and a brief guide for teachers on how to create songs for, or in collaboration with their classes. The study aims to contribute to the body of knowledge about an under-researched area, the creation of educational song, by presenting an in-depth investigation into the praxis of creating age-appropriate pedagogic song materials for children using U.S. learning standards.

Declaration by author

This exegesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text.

I have clearly stated the contribution of others to my exegesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in my exegesis. The content of my exegesis is the result of work I have carried out since the commencement of my higher degree by research candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my exegesis, if any, have been submitted to qualify for another award.

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Acknowledgements

I wish to thank my supervisors Dr. Shelley Davidow and Dr. Paul Williams for their support and assistance, an especially challenging task over a distance of over 15,000 kilometres and fourteen time zones, while enduring fires, travel restrictions, and Covid.

I am eternally grateful to my husband Conrad Adelman for his endless patience and support, and for always doing the dishes.

Financial support

This research was supported by an Australian Government Research Training Program Scholarship.

Keywords

song, arts-integrated education, learning, composition, creativity, transdisciplinary

Australian and New Zealand Standard Research Classifications (ANZSRC)

ANZSRC code: 130299 Curriculum and Pedagogy

Fields of Research (FoR) Classification

FoR codes: 3699 Other creative arts and writing
3901 Curriculum and pedagogy

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Synthesizing school curriculum and song: a practice-led model for creating educational songs for children

Chapter 1 - Introduction

Education performance in schools has declined over the first two decades of the twenty-first century in Australia and the United States, as reported in several national and international assessments (DeSilva et al., 2017; Echazarra & Schwabe, 2019; National Center for Educational Stastistics, 2019; Pál et al., 2019). This may be the result of teachers facing the challenges of an increased emphasis on assessment and testing (Brett, 2021; Özturgut, 2011; Polesel et al., 2012), additional administrative duties (Easthope & Easthope 2000; K.-N. Kim, 2019; Stacey et al., 2020), an evolving and expanding curriculum with more demanding national or regional curricula (Headden & McKay, 2015), and a decrease in student engagement over time (Chan et al., 2015; Salmela-Aro, 2017; Smarcz, 2016).

In present-day Australian and U.S. education our students are required to not only learn to be creative problem solvers and communicators, but also to be able to retain essential facts and concepts. For many students this can be difficult for a variety of reasons, such as learning or reading disabilities, inattention in the classroom, lack of access to materials or even a suitable classroom environment, hunger, social peer pressure, lack of language proficiency, or materials being presented in a medium which does not mesh well with the students' preferred learning style(s). While 'teaching to the test' is abhorred by many educators and teachers, as long as standardised testing continues students will be expected to retrieve information to prove their 'knowledge' and content mastery. In today's underfunded and ever-increasingly crowded curriculum, the arts have been sidelined in favour of literacy, numeracy and STEM subjects (Science, Technology, Engineering and Mathematics) (Erduran, 2020; Russell-Bowie, 2012), but in fact can provide educational opportunities that enhance learning across disciplines (Chapman, 2015; Ewing et al., 2011).

Research shows that arts-based education can improve educational outcomes (R. A. Baker, 2011; Hardiman et al., 2019; Jones-Lewis, 2015) by enhancing test scores (Caldwell & Vaughan, 2012; Catterall, 2009), student engagement and motivation (Sener & Erkan, 2019; Yoon & Kim, 2017), and retention (Hardiman et al., 2014; Park & Shin, 2016; Pindale, 2013). Thus, a potential solution to these challenges in education may be arts integrated education.

A transdisciplinary pedagogical approach integrates artistic elements such as music, art or drama as part of the general curriculum, engaging students in a creative process and also teaching essential 21st century skills such as collaboration and communication (Belbase et al., 2019; Dowell & Goering, 2018; Liao, 2016; Silverstein & Layne, 2010; Singh, 2021). Transdisciplinarity results in “the generation of new knowledge or at least a new combination of established knowledge” (Drake & Reid, 2021, p. 2), which in this case is a description of the process of writing original educational songs which combine music with U.S. national learning standards.

This research project is intended for elementary and middle school teachers in the U.S. who are interested in integrating arts education into their classrooms, but have insufficient time, training and professional development, or appropriate materials. It utilises U.S. learning standards with extra materials from other countries and sources, including Australia, and could be used not only in the U.S. but also other English-speaking countries.

Though there is a large body of research documenting the positive effects of using curriculum-linked songs in the classroom (Arts Education Partnership, 2011; Ciecierski & Bintz, 2012; Cochran, 2008; Everett-Brown, 2017; Ortis, 2008), there is a current lack of research and information about the *process* of developing these materials. This inquiry fills that research gap by investigating and describing the creative process involved in generating developmentally appropriate subject-based songs and sharing that praxis with educators. This can be utilised to potentially write their own teaching songs specific to their subject(s) and students, either by themselves or in collaboration with their classes.

My passion for creating educational songs for children stems from my career as a musician and educator in Australia and the U.S., where I have created and taught songs for a variety of student populations and ages. I discovered how effective singing can be for learning, and how it can enable and empower both students and teachers. This experience is supported by multiple studies which document the benefits of song in learning for young students (Biggs et al., 2008; Busse et al., 2018; Gfeller, 1983; Governor, 2011; Moorehead-Carter, 2015; Wallace, 1994). Composing 'useful' songs that benefit learning fulfills my aspiration to use words and music creatively, and to positively affect others' lives.

This first chapter will present the research inquiry and significance and innovation of the research, followed by contextualising research. These are arts integration, student engagement, the benefits of students generating instructional materials collaboratively and using song in the classroom, the role of song in children's lives, music in schools, and teacher education. I then discuss the current research in educational song and the benefits of song in learning.

Research Inquiry

The purpose of this research is to investigate and refine the creative process of creating developmentally appropriate educational songs to be used as performative, integrative resources for children in elementary and middle school classrooms in the United States. The research is supported by an exegesis which presents a practice-led investigation into creating 33 original subject-specific songs for elementary and middle school students based on U.S. learning standards. This commentary is interwoven with relevant literature review materials supporting the research.

The creative artefact consists of two parts: the teaching song materials developed for this project, and a brief teachers’ guide to writing educational songs. The songs are presented as published lyrics and music lead sheets, which show the melody, lyrics and harmony chords. The lead sheets allow for teachers to create their own accompaniments appropriate to their performance skills if they wish. While the songs are intended for use in elementary and middle schools in the United States, they are also appropriate for other educational environments such as Waldorf/Steiner schools, home school communities, distance education, and in other English-speaking countries.

The second creative artefact is a short classroom teachers’ guide to writing songs for their own subject(s), presenting examples of songwriting methods, strategies, and materials. This is succinct because educators have very little available time to learn how to write or to develop new teaching materials. It provides educators with techniques to enable them to create songs in a short time frame, with no requirement for teacher training and at no cost. This methodology can be used either by the teacher alone or in collaboration with their students. The guide integrates links to contextualising academic sources, information and exemplars to offer practical solutions for subject-specific material development (Aguinis et al., 2021). These links provide academic justification for educators’ own creative decisions and are intended to promote understanding and confidence in the process. The artefact song collection also includes teachers’ notes and activities for several songs.

Usually, a dissertation or exegesis will include one or more separate literature review chapters. The exploration of the literature with reference to educational song and how it relates to my praxis can be found in the following section on significance and innovation of the project. However, I have chosen to embed the research supporting my personal practice and creative choices at relevant points of the commentary documenting the song-writing process as an integrated part of a holistic perspective (Achugwo, 2020).

This research project aims to offer teachers resources which offer a proven opportunity to learn and a methodology which can empower them to regain value as creative and artistic professionals, giving them autonomy to generate teaching materials for, and potentially with, their students. Importantly, when educators create their own pedagogical songs, they gain complete control of the content (Werner, 2018). This skill is especially valuable for elementary teachers who are expected to teach music as part of the arts curriculum but who lack sufficient training (Hocking, 2009; Powel & La Rocca, 2021), confidence (Hennessy, 2000; Mills, 1989) and materials (Garvis & Pendergast, 2010; Vermeulen, 2009). These issues are described in greater detail in the next section, which explores the difficulties faced by educators who wish to use arts integrated pedagogy, and the need for materials and song-crafting skills.

The trajectory of my research began with observing poor educational achievement, the lack of student engagement and the devaluation of music in schools in the U.S. It progressed through researching possible solutions such as arts-integrated education and linked with my personal experience in using song to teach. I identified the gap in existing knowledge in the area of educational songwriting.

This research project is innovative in that it examines the *process* of creative songcrafting rather than the learning outcomes of using song in the classroom. It presents an in-depth analysis of the elements of song and the creative process, illustrated by annotated exemplars as praxis models.

Since I commenced this project my original research questions have evolved from a general inquiry into the use of music in society and as a teaching tool into a more narrowly focused investigation. My work is guided by two central research questions:

- What are the creative processes involved in writing developmentally appropriate educational songs for elementary and middle school students in the United States?

- How can I best describe the educational songwriting process so that other educators can utilise the knowledge and skills?

Chapter 2 – Context

The following chapter would normally present a review of the relevant literature. However, the contextualising information is embedded throughout the exegesis, rather than residing in a single chapter. This chapter discusses the significance and innovation of the research, arts integration, song in children's lives, music in schools, educational songs, and the benefits of song in learning.

Significance and innovation of the research

This research project addresses the research gap in two areas. First is the lack of arts-based education and innovative teaching materials in U.S. and Australian classrooms (De Vries, 2011a; Garvis & Pendergast, 2010), and second, the lack of adequate training and professional development programmes in arts education for elementary teachers (Lowe et al., 2017; Power & Klopper, 2011; Russell-Bowie, 2009; Shin, 2019; Welch, 2020). The research documents the process of developing original educational songs for young students. It provides techniques, strategies and exemplars for educators to develop competence and confidence in their own role as creator of innovative educational resources. This investigation is supplemented by 33 original subject-specific songs based on U.S. learning standards to be utilised in elementary and middle school classrooms and lessons, easily transferable to Australia or other English-speaking countries.

The research is significant for several reasons. First, while song has been shown to improve learning, engagement and retention, it has frequently been relegated to the sidelines of education as a nonessential subject in Australia and the U.S. (Garvis & Pendergast, 2012; Russell-Bowie & Jeffrey, 2004). Classroom time is limited, with a narrow curriculum mostly based on STEM subjects, so there is often very little time available for music (Caldwell & Vaughan, 2012; Russell-Bowie, 2009). Also, as is discussed later in this section, most elementary teachers lack confidence in their abilities to teach music (Hennessy, 2000; van Vuuren, 2018), resources (Russell-Bowie, 2012) and training (Power & Klopper, 2011). Providing materials and a resource for songcrafting can alleviate the lack of professional development, offer a medium for educators to incorporate music in their classrooms, and place the teacher in the important role of creator.

The song writing exemplars and teachers' guide demonstrate the creative practice of writing songs. They include the skills of generating terms and concepts from lesson plans, learning standards and educational materials, creating word banks, rhyming couplets and verses, and choosing to write raps, parody songs, or to create an original melody and harmony. As well as writing songs, educators can collaborate with their students to write songs together, depending on available time. As class time is invariably limited, it may be most feasible to write a single additional verse with students. Another option is to task groups of students to write either entirely new lyrics, or new lyrics on the subject to a well-known or popular song as a parody.

Arts Integration

The strategy of connecting the arts and curriculum through students' creativity to build knowledge or combine knowledge in new ways is termed arts integration (Dowell, 2018). Hardiman et al. found that arts integration is shown to significantly benefit retention of content-knowledge, particularly for students with only basic proficiency (2014), as well as improving student motivation and engagement (2019). By participating in the arts, students can create a common language and understanding by interacting and engaging with their peers as well as their teachers (Fackler, 2016), thereby increasing group cohesion (Kagan & Kirchberg, 2016) through co-operative and mutual learning (Brunnhuber, 2017). Students' artistic creativity is also a key concept of STEAM education, where the arts are integrated into the traditional STEM subjects (science, technology, engineering, and mathematics) (Belbase et al., 2019; Nam-Hwa, 2019).

A potential creative collaboration is valuable because co-operative and mutual learning are found to be twice as effective as standard institutional teaching methods which evolved in the eighteenth and nineteenth centuries (Brunnhuber, 2017). Learning occurs not in isolation, but through interactions with the student's social and physical environments (Kupers et al., 2019). Crowe's investigation of performing arts education in Ballarat, Victoria found that "the best ways for children to learn are through participation, demonstration and modelling given by others – usually the teacher, but often their peers in a place where they feel secure" (2006, pp. 27-28).

Further, learning and motivation are enhanced when students engage with multiple modes of communication using transmediation in a "cross-platform structure" (Levitt & Piro, 2016, p. 133) such as videos, websites, podcasts, animations and microblogs (Berney & Bétrancourt, 2016; Borzekowski, et al. 2019; Taghizadeh et al., 2017), but only if the graphics are relevant (Sung & Mayer, 2012). An Australian study found that while presenting materials using multimedia did not result in improved learning performance, students enjoyed the multimodal lessons and felt their comprehension and retention were improved (Sankey et al., 2010). The arts become a conduit for learning (Gibson & Anderson, 2008), providing innovative learning activities and challenges to students who are frustrated and bored by traditional teaching methods (Buck & Snook, 2016).

As noted earlier, a major issue in education is the increasing lack of student engagement over time, especially for those from disadvantaged backgrounds (Smyth & Fasoli, 2007). Gallup polls in the U.S. find significant declines in student engagement, as seen in a 2012 poll of almost 500,000 students where only 76% of elementary school students, 61% of middle schoolers and 44% of high schoolers are engaged (Busteed, 2013), and a 2015 survey of over 900,000 students where student engagement dropped from 75% in grade 5 to 32% in grade 11 and 34% in grade 12 (Brenneman, 2016; Gallup, 2016). A study of 230,000 students in California 2012-17 found engagement dropped from 78% at the elementary school level to 59% at middle school and 60% in high school (Takahashi-Rial, 2017). Sadly, only one in three U.S.

middle- and high-schoolers view their school culture positively (Osborne, 2017). Music in the classroom leads to heightened motivation and sustained attention, sometimes termed “entrainment” (Lems, 2021; Posner & Patoine, 2009), and positively affects student engagement (Bengoechea et al., 2019; Sullivan, 2016; Yoon & Kim, 2017), providing a good reason to include song in lessons.

A positive student response to arts integration is evidenced in a study of group composition in a school in Iceland, where 87% of students reported extremely high levels of intrinsic enjoyment and a strong sense of “shared social identity and sense of ownership” (Faulkner, 2003, p. 109). Students also believed that composing collectively ensures more ideas are available and is more fun and more effective than composing alone (Faulkner, 2003). These results are echoed in the findings of a large U.K. study of composition students which found 86% preferred to compose in groups, though 59% admitted to cruising in the group setting and 68% found it difficult to concentrate with several groups creating noise in the classroom (Odam, 2000). The use of keyboards, computers and headphones can ameliorate the noise problem.

Songwriting enables a deeper encoding of information than reading, enhancing understanding and memory (Alves et al., 2017). Collaborative songwriting empowers students by providing a constructive form of risk-taking and increasing their confidence (Rizzi et al., 2020), as well as enabling their social interaction skills (Robinson & McMillan, 2017).

Educators may be concerned about their students’ notation or instrumental performance capabilities, but mobile technology has transformed music composition, allowing students to record themselves and share their music. This allows teachers to combine students into groups without having to include at least student who can play an instrument (Henley, 2015). Technology such as music software with pre-set samples “enables learners to interact with composition in a more immediate way and explore layering, arranging, reformulating, sampling and manipulating sounds, and sequencing to a far greater extent than pencil and paper might" (Henley, 2015, p. 166).

Students generating instructional materials develop independence, expertise, and are empowered to take responsibility for their learning (Coppola & Pontrello, 2020). Writing and composing in a group situation involves Vygotsky's concept of the Zone of Proximal Development, where students' developmental levels are awakened internally by interacting with their teachers, more skillful or experienced peers, or "more knowledgeable others" (McLeod, 2007), leading to future independent achievements (Vygotsky, 1978). Students can function more effectively in the zone of proximal development where learning takes place first on a social level, then individually (Faultey, 2005; Häggström et al., 2020).

Furthermore, when marginalised students' cultures and interests are validated, students are more academically successful. Minority students "respond favourably to pedagogy that incorporates and validates their cultural backgrounds" (O'Reilly, 2011, p. 8), such as rap or hip-hop.

Sharing a group musical experience boosts students' self-esteem as they see that they have valuable talents and builds community with their peer group (McCammon, 2008). Scaffolded learning with increasingly more challenging demands can be successfully navigated with collaboration or assistance at each stage, leading to continued individual student growth and skills (Eisner, 2002; S. Griffin, 2009). The teacher and students become partners in learning, where the teacher is more the "guide on the side" rather than the "sage on the stage" (Webster, 2002, p. 17). Using arts in the classroom teaches students that problems can have multiple solutions, and that there may be many correct solutions to a problem (Eisner, 2002). Performing original songs, chants or raps enables assessment, demonstrating the synthesis of research, creative writing and production (Felleman-Fattal, 2017).

The creative process of writing a song leads to deep processing of information, which enhances memory (Alves et al., 2017). University students in groups writing song parodies about neuroscience found that 72.5% reported that the music activity helped with memorizing the concept and that 84.9% felt that writing lyrics aided memory more than listening to other groups' songs (Alves et al., 2017). Students who wrote songs about thermodynamics noted that they "loved" the activity, and felt the process led them to think differently about the subject, as well as improving test scores (Bairaktarova, 2017). Graduate students who were asked to write poetry rather than essays about microeconomics reported that writing poetry, though more time-consuming, improved their understanding and retention of the concepts, while 75% agreed that the process enhanced their interest in the material (M.E. Davis, 2019).

These results parallel a U.S. study of pre-service teachers who wrote educational songs about science, finding that the process helped with engagement, motivation and memorisation, and enabled them to become "dynamic learners who construct their own knowledge" (Yoon & Kim, 2017, p. 243). Even when students are not involved in the process of songwriting, they enjoy using songs and multimodal presentations as a pedagogical tool in the classroom (Grossman et al., 2016; Hershner, 2018).

Another benefit of collaborative songwriting is that creativity and critical thinking lead to deeper understanding and increased knowledge and expertise (Vincent-Lancrin et al., 2019). It also provides a safe and constructive form of risk-taking, opening students to new experiences and increased confidence and empowerment (Rizzi et al., 2020). However, working in groups may have potential drawbacks, in that sometimes students' main focus may be socialisation with their friends, and the necessity for compromise to create a mutually agreed upon product may stifle individual creativity (Khatoon, 2020).

While collaborative songwriting is shown to have many educational benefits, the crowded curriculum may not allow time or opportunity for students to create an entire song in class time. However, students may still experience the creative process, constructing a "meaningful learning practice" (Muhonen, 2014, p. 197) by collaborating in pairs or small groups outside the classroom to create a new song, or to provide accompaniment backing tracks, add a new verse or rewrite lyrics in songs they have already learned.

Even without the creative element of songwriting, singing in class allows maximum participation so that every student in the class can rehearse the materials simultaneously (yet anonymously) in a non-threatening modality, in a short amount of time (Dolean, 2016; Tomczak & Lew, 2019). Singing in a group is shown to raise middle school students' life satisfaction levels, as well as social and communication skills (Yilmaz et al., 2018). Though some students may not have the necessary vocal skills for this endeavour, through scaffolded learning and appropriate interventions they can connect with the activity and materials to make them personally relevant (Ostraff, 2020). Songs in the classroom, such as the materials created for this artefact, also offer an opportunity to include music in general studies when there is little or no time for music classes in today's crowded curriculum.

These creative learning activities may impart benefits beyond mere memorisation and retention of subject content matter. An Australian report about youth employment reveals that demand for enterprise skills rose over the three-year period of 2012-2015, specifically in teamwork by 19%, presentation skills by 25%, creativity by 65%, and critical thinking by 158% (The Foundation for Young Australians, 2016, p. 7). In the labour market, jobs requiring greater creativity are better paid and yield greater rewards (Sparks, 2020). Creative thinking is considered to be essential for success in the 21st century (Henriksen et al., 2016; Jerald, 2009; Robinson, 2005) in a world that is changing at an exponential rate, requiring students to develop the competencies of critical thinking, evaluation, effective communication, problem-solving, analytical skills, innovation and creativity (Boudreault et al., 2013; Schleicher, 2010; Venckutė et al., 2020; Wagner, 2014).

With this emphasis on developing students' creativity, it is important to clarify the ubiquitous term "creativity" as it pertains to children in education. In a review of children's creativity Kupers et al. inquire:

> Is creativity an individual characteristic or ability, similar to the way in which many scholars view intelligence? Is it a characteristic of a product, like an original drawing or an elegant solution to a mathematical problem? Or is creativity a process of generating, trying out and evaluating novel ideas? (2019, p. 94)

Other related questions include how to measure and assess creativity in children and their classrooms, and whether it is innate or can be taught? If so, what role does the teacher play, and as importantly, how essential is the task or assignment in developing creativity? Research shows that setting constraints before the creative problem is presented, such as establishing guidelines for lyric subject matter, improves creativity and idea evaluation (Medeiros et al., 2018), and that "working within a given matrix is one of the most powerful stimulants for creativity" (Odam, 2000).

Studies also find that arts education can positively impact creativity and learning in the classroom (Caldwell & Vaughan, 2012; Catterall, 2009; Chapman, 2015; Dwyer, 2011; Psilos, 2002; Winsler et al., 2019). Arts education includes visual arts, drama, media arts, music and dance.

Song in children's lives

I have chosen to use song as a vehicle for learning not only because of my personal and professional experiences in music education, but also because music and song are universal elements in children's lives. Children sing constantly and spontaneously, alone or in groups, composing their own songs and singing games (Countryman et al., 2016). Song is a natural means of communication for young children, making it a logical medium for presenting learning materials.

From birth children explore using their voices in prelinguistic vocalisations, increasing their speech-like sounds from 65% of utterances at 0-2-month-olds to 95% for 16-20-month-olds (Jhang & Oller, 2017). Oller et al. found infants in their first year vocalise these speech and song precursors known as protophones four to five times a minute while awake, even when alone (2019), with boys producing 24% more protophones than girls (2020),

Young children are observed singing spontaneously, both when interacting socially or alone (Dean, 2020; S. M. Griffin, 2009), often with complex, sophisticated rhythms, changing tempo, mostly skip-type intervals, and a melodic range of up to an octave or more (G3-C5) (Countryman et al., 2016; Perdue & Campbell, 2020). They improvise vocally using mostly steady patterns of beat and half beat rhythms, with occasional syncopations and triplets, and even polyrhythms, where they sing one rhythm and clap another (Campbell, 2010). From the age of two children start to incorporate fragments of learned songs into their own self-generated singing (Mang, 2005).

Through migration and technology such as video and computer games, television, Internet, movies, music CDs, smartphones, streaming services, iTunes and YouTube, children can access music of many genres, styles, and cultures from a very young age (Lum & Marsh, 2018; Marsh, 2008). This music at home is usually selected by older siblings and parents, reflecting their more mature musical tastes (Sarrazin, 2016) and influencing younger children's musical preferences (S. M. Griffin, 2009; Verhaegen, 2018).

From this often-constant soundtrack, children appropriate elements of popular music and dance, then adapt and improvise new multi-modal games that incorporate often-complex kinesthetic movement with the music (Harrop-Allin, 2017). By incorporating musical materials from a variety of sources from beyond the classroom, they move beyond teacher-selected songs and activities to develop their own musical identities and preferences (Marsh, 2017) that are more spontaneous and less structured than classroom musical activities (S. M. Griffin, 2009). These preferences and engagement with music will change throughout their lives (Bonneville-Roussy et al., 2013; Brittin, 2014; Gruhn, 2021; Silvagni, 2018; Thomas, 2016). The songs in this project are designed to meet these preferred musical genres as well as students' changing vocal capabilities at the different grade levels.

Song is integral to children's play, which is central to children's learning (Niland, 2009) and is an opportunity for children to be innovative and creative by incorporating singing and movement (Sarrazin, 2016; Trehub, 2019). These children's play songs and singing games are very similar to their solo spontaneous musicking, acting as accompaniment to movement such as handclapping games, jumping and skipping. They are rhythmically and melodically complex, often incorporating syncopation, polyrhythms, chromaticism, movement, and unusual scales (Campbell, 2010; Perdue & Campbell, 2020). Children's songs are most frequently in duple metre to facilitate coordinated movement such as clapping or stamping on the first strong beat of each bar (Perdue & Campbell, 2020). These singing games and musical activities positively impact preschool children's speech development (Blaženka, 2019) and neural sound discrimination (Putkinen et al., 2013).

An observation of musical behaviours of children aged three to ten on New York subways found the majority of their spontaneous singing or 'musicking' is for self-entertainment, with a third of the observed behaviours intended to communicate with others (Custodero et al., 2016). Thibodeaux et al (2019) investigated how 4 - 8-year-olds used spontaneous speech, singing, and humming while performing a selective attention task, finding that 95% engaged in private speech, and nearly a third used private song or humming. 87% of the private song lyrics were relevant to the task. The authors suggest that private singing while problem solving can help with self-regulation (Thibodeaux et al., 2019).

Interestingly, ethnomusicologist Bruno Nettl did not find the same levels of sophistication in his research of children's music, writing:

> Children's game songs, lullabies, counting-out rhymes, and nursery rhymes use limited scales and rhythms and small melodic range, and they may consist of only one musical line repeated many times. Their simplicity and their similarity throughout the world suggest that they may constitute an archaic layer in the history of music. (2014)

Marsh (2018) notes that how children engage with music informally is equally important as their classroom music experience. Children are creative, continually innovating new musical and movement activities in their playground singing games (Marsh, 1995). Recognising children's extramural musical knowledge and skills and carefully scaffolding their learning can provide students with confidence, encouraging them to take risks and be creative and productive musically in the classroom as well as the playground (Marsh, 2018). Inviting children to sing their own songs in the classroom, then to write new, subject-specific lyrics using their melodies would acknowledge their abilities, empower them as creators, and provide a shorter time frame for creating new songs.

As well as creating their own music and songs, children are avid consumers of recorded music (Miranda, 2012; Rideout, 2015). In this age of digital access via platforms such as iTunes and YouTube, children are exposed to music from a wide range of cultures and styles (Lum & Marsh, 2018), though they tend to prefer music of their own culture over less familiar music styles or genres (Brittin, 2014). Even second and third graders are very aware of current pop culture (S. M. Griffin, 2009).

De Vries' study of the multiple roles of music in children's lives reports that they like to listen to music while engaging in a wide variety of activities (2010), often engaging in several forms of media at the same time, or media multitasking (Chassiakos et al., 2016). Children use music as a way to express their emotions and sense of identity (Ilari & Young, 2016; Marsh, 2018; Uhls et al., 2017), to self-regulate their emotions (Campbell et al., 2007; Schäfer et al, 2013; Uhlig et al., 2013), and to choose and connect with their peer groups (Miranda, 2012; Soley, 2019; Thomas, 2016) and cultures (Gluschankof, 2017; Wu & Welch, 2020). Music offers "powerful aural images by which they come to understand themselves symbolically and emotionally" (Campbell, 2000, p. 36).

One possible negative effect from listening to music is potential hearing impairment. Many studies have found that between 12% and 17% of school age children show noise-induced hearing loss due to listening to music on phones, earbuds or headphones, or in computer games (Harrison, 2008; Herrera et al., 2016; le Clercq et al., 2018; Widén et al., 2017). Children's toys can also be a source for high decibel levels (up to 129 decibels) which will negatively affect hearing (Levey et al., 2012). One study shows no link in younger children between exposure to recreational noise and hearing loss, perhaps because the majority listened to music for less than one hour a day, at medium volume (Swierniak et al., 2020). However, over time the incidence of children's tinnitus increases, which is linked to impaired hearing (Båsjö et al., 2016; Swierniak et al., 2020), as hearing loss from noise may manifest slowly over many years (Twardella et al., 2017). Indeed, hearing thresholds were significantly worse for middle and high school students who had used their personal listening devices for over five years (Portnuff, 2016).

Previous research has focused on the quantifiable benefits of using song in the classroom (Governor, 2011; Hayes, 2009; Henriksen & Mehta, 2016; Khauanpuck & Kaewdee, 2016; McFadden, 2013; Ogunsile & Ogunsile, 2016; Pindale, 2013; Scro, 2006) and the effect of rhyme, rhythm, and melody on learning and retention (Butler & Newman, 2008; Ciecierski & Bintz, 2012; Gfeller, 1982, 1983; Iwasaki et al., 2013; Pindale, 2013; Segal, 2014; Shakerian et al., 2016; Tang & Loyet, 2003; Wallace, 1994; Werner, 2018; Zhu et al., 2016). This exegesis references specific examples of such research into teaching general subjects through song, though testing the effect of using these particular songs is outside the scope of this project. Instead, this research addresses the current lack of investigation into the *process* of creating these materials by answering the two research questions.

Music in schools

The need for subject-specific song materials that can be incorporated into the classroom to improve learning outcomes and a guide for teachers to help develop confidence in writing their own educational songs is clear. Over the past three decades research has shown that generalist teachers at the elementary school level in general lack confidence in their abilities and skills to teach music (Biasutti, 2010; Digby, 2020; Joseph, 2019; Mills, 1989; Swain

& Bodkin-Allen, 2017). This sense of inadequacy is what this project attempts to address.

The reasons for this lack of confidence include teachers' insecurity regarding their own musical and vocal capabilities, lyric-writing, or music composition skills, as well as inadequate professional training, lack of support from teachers and administrators, and inadequate time, funding, and resources (Alter et al., 2009; Begić et al., 2017; Carlow et al., 2015; Cross, 2015; de Vries, 2011b, 2013; Digby, 2020; Duck, 1990; Gluschankof & Shahar, 2004; Hash, 2010; Heyning, 2011; Holden & Button, 2006; Incoporated Society of Musicians, 2019; Kulset & Halle, 2019; May & Robinson, 2015; McFadden, 2013; Pascoe, et al. 2005; Russell-Bowie, 2015; Shin, 2019; Sotiropoulou–Zormpala et al., 2015; Swain & Bodkin-Allen, 2017; van As & Excell, 2018; van Vuuren, 2018; Varis, 2012; Welch, 2020). Also, some teachers are concerned about their students' behaviour and noise levels in the classroom if song is incorporated into their lessons (Ahlem, 2015; Papachristou & Kononidou, 2019; Trinick, 2012; Wiggins & Wiggins, 2008).

Researchers in the U.K. found that with the decrease in numbers of school students studying music, there is a shrinking population of sufficiently skilled potential music teachers (Keene, 2020; Stunell, 2006; Welch, 2012). Unfortunately, students taught by teachers with inadequate expertise or training often develop a negative attitude towards music (Lepherd, 1995). Pike (2016) suggests that if teachers lack confidence in their own musical and practical skills, this will be perpetuated in their teaching and affect their students. Many music undergraduates choose other careers than teaching due to concerns over student behaviour and lack of interest, and fear that their piano skills are inadequate for the role (Hargreaves et al., 2004). Teachers tend to use their own formative experiences in music to form strategies of how and what to teach in their classrooms (Stakelum, 2008).

A cycle of negativity and disengagement towards music in the classroom adversely affects future primary and elementary teachers (Biasutti, 2010; Keene, 2020; Lowe, 2017; Mills, 1989). This is exacerbated by the demoralization of music teachers facing shortages in funding and skills training, as well as the devaluing of music as a subject (ISM, 2019), and of educators in general, facing a shift in teacher education towards an increasing focus on accountability and outcome-aligned assessment (Foran et al., 2020). It is not only teachers who are important in supporting and improving arts education. An Australian survey of arts specialist teachers found that school principals' attitudes towards the arts were highly influential in prioritizing resource and time allocation for arts education (Lorenza, 2021).

Trainee non-music specialist elementary teachers in England report that music is the subject they are least confident to teach (Hennessy, 2000; Mills, 1989). Many generalist teachers believe that strong musical talents and performing skills are necessary in order to be able to teach music, and so feel inadequate, particularly if they feel they failed at music lessons in their own childhood (Hennessy, 2000; Poultner & Cook, 2020), or cannot match the professional standards of performers so readily available to their students via technology (Welch, 2020). However, studies show that when teachers receive appropriate training, their confidence and educational outcomes improve (Barton, 2015; Chua, 2018; Häggström et al., 2020; Jeanneret, 1997; Powel & La Rocca, 2021; Welch et al., 2020).

Unfortunately, pre- and in-service arts education training for teachers is often inadequate (Mota, 2015; Stunell, 2006; Welch, 2020). In Australia, while the creative arts are mandated as part of the curriculum, there is insufficient pre-service teacher education, resources and professional development (Alter et al., 2009; De Vries, 2011a, 2013; Gibson & Anderson, 2008; Joseph, 2015). This is evidenced in a study of 66 primary teachers in NSW who reported taking few professional development courses in the arts (music 42%, visual art 47%, drama 62.1% or dance 65.2%), and that 6.1% received no pre-service education in the creative arts (Power & Klopper, 2011, pp. 9, 10). In a 2009 survey of Queensland beginning teachers, only 19% reported having adequate resources, budget and materials for arts education (Garvis & Pendergast, 2010).

An Australian music education national review found music education training was reduced from 110-120 hours over four years to 6-12 hours of general creative arts teacher training (Pascoe et al., 2005). In 2009 a Music Council of Australia report showed that music comprised just 1.51% of the average Australian primary teacher education (Hocking, 2009), while at the University of Melbourne preservice primary teachers received just 12 hours of music training in a two-year bachelor's degree (Jeanneret, 2006). Another Queensland study showed that rural early childhood educators express fewer positive views about the benefits of music in education than their urban counterparts, suggesting this may be due to insufficient resources and teacher education in rural schools, and advocating the provision of on-line music resources to benefit academic achievement (Barrett et al., 2019).

In New Zealand a study of nine schools found no teacher professional development in the arts, that teachers felt ill-prepared to teach the arts, and that "in numerous schools the arts have been marginalised to little more than that of decoration and marketing status" (Irwin, 2016, p. 18). Another New Zealand study of primary schools reports that arts education is relatively minimal, due in large part the crowded curriculum and lack of teacher training (Buck & Snook, 2016). In Greece, a report on arts teacher education identified the need for more arts courses and better qualified and experienced instructors, finding that only 9.95% of the arts education courses were aimed at developing teacher skills and readiness (Sotiropoulou–Zormpala et al., 2015). A Croatian study into primary education teacher training also highlighted the need for more practical training, particularly in singing and playing instruments to accompany singing, rather than the current emphasis on music theory (Begić et al., 2017).

Russell-Bowie found six key challenges for Australian pre-service and in-service elementary general teachers in teaching the arts. These are the lack of personal artistic experience, lack of prioritization of the arts, lack of time in the classroom, lack of preparation time, lack of resources, and lack of curricular knowledge (2012, p. 61). Vermeulen (2009) identified the need for arts lesson materials, including songs and backtracks on CD. Teachers are also faced with increasing administrative workloads, negatively impacting time available for lesson preparation and arts integration (K.-N. Kim, 2019; Walker et al., 2019).

Arts education in schools has decreased in many countries such as Australia, the U.K. and the U.S. due to the expanding emphasis in education on literacy, numeracy, and assessment (Barton et al., 2013; British Phonographic Industry, 2019; Caldwell & Vaughan, 2012). Budget cuts and a strong emphasis on standardised testing mean that many schools have reduced arts education programmes and now rely on general classroom teachers to teach music and singing (Benn, 2020; Bhachu, 2019; Biddulph & Wheeler, 2017; Fackler, 2016; Holden & Button, 2006; Jeanneret & DeGraffenreid, 2018; Jones-Lewis, 2015; Keene, 2020; Wiggins & Wiggins, 2008). For example, in some Australian states such as parts of New South Wales (Hocking, 2009) and Western Australia (Lowe et al., 2017) early childhood and primary teachers are expected to teach all areas of the arts curriculum, including music, dance, drama, media arts, and visual arts (A. Collins, 2016).

In England, state schools have seen a 21% decrease in music provision between 2014 and 2019 (BPI, 2019). English school budgets have dropped in real terms by 8% 2010-2019, while some schools now close one half day each week, further reducing available teaching hours for so-called non-essential subjects (Hay et al., 2020). Twenty per cent of English primary schools do not offer regular music classes, and only 44% of primary school music lessons are taught by a music specialist (BPI, 2019).

Scotland has no statutory primary music curriculum and has cut specialist teachers and instrumental music in some areas, instead relying on the Youth Music Initiative which privately funds school music activities (Bhachu, 2019). Even these community-school music partnerships often struggle to survive due to lack of funding, community support, inadequate facilities and insufficient professional training for teaching artists (Bhachu, 2019; Jones, 2019).

Research from Venezuela and Argentina (Frega & Limongi, 2019), Brazil (de Figueiredo, 2002), Finland (Ruismäki & Ruokonen, 2006), Zambia (Sianagowa, 2013), Portugal (Mota, 2015), and Italy (Biasutti, 2010; De Ciccio, 2019) provides examples of other countries which use generalist teachers to provide music lessons for younger students without providing adequate teacher training or funding. Different problems arise in China, where there are very few preschool teacher education music or arts courses and no standardised curriculum or teaching materials. Chinese lecturers for many pre-service music courses are highly qualified performing musicians with no experience of kindergarten education. This leads to difficulties for pre-service teachers when they attempt to learn conservatory style music and performance, or to find age-appropriate methods and materials for young students (Wang, 2020).

Even in countries which use specialist music teachers in elementary schools, they are often required to teach in several different schools because they teach each class only once a week. A Greek survey of primary music teachers found that half taught in three schools, and eleven per cent taught in four or five schools (Zbainos & Anastasopoulou, 2012, p. 56).

Educators who would like to collaborate with music teacher colleagues to develop materials are discouraged by the time factor and logistical demands involved (Brogla-Krupke, 2003; McFadden, 2013; O'Keefe et al., 2015). Responding to this acknowledged need, this artefact offers educators materials for immediate use in their classrooms, as well as a methodology for writing their own songs.

Educational songs

At present most teachers in the U.S. and Australia use curriculum-*linked* songs, which are often peripheral to the subject, rather than curriculum-*based* songs, which are tailored to the specific subject and grade level. Literature searches reveal a small number of dissertations and theses by educators who have produced and trialed original content-based songs.

In two U.S. studies, Kimmel (1998) tested attitude and retention for two middle school classes for his song with computer animation about cellular physiology, finding small gains in retention, but low enthusiasm for singing, especially from male students. Scro (2006) used original subject-based songs to teach middle school social studies, math and Spanish. Test scores improved significantly with the use of music (social studies: control group 60.48%, music group 80.29%; Spanish: control group 81.05%, music group 88.71%; mathematics (two short songs): control group 65.73%, 64.49%, music group 75.19%, 80.83%). The smaller improvement for the Spanish song is because the students did not like it, so did not engage with it to the same extent.

In Iceland Porvaldsdottir (2008) discussed why song benefits learning and presented her original teaching materials to teach English in first through third grade classes. However, she did not document the learning outcomes of using song with her classes. Draper (2015) wrote and produced a musical about Canadian history, which led to improvements in learning, student self-confidence, and social benefits.

Other dissertations (see page 25) describe the creative process of creating educational songs. However, the majority of these document projects that are intended for general performance, rather than a classroom environment. The students are involved only as listeners or observers, rather than as participants or collaborators. In this research I have taken a step further by creating materials which the students can perform, interact with, and potentially supplement with their own creative input by collaborating with their teacher or peers to write new lyrics.

Cashman (2014) describes the creative and collaborative process of funding and producing a short video with sixteen songs about endangered marine wildlife. However, this is targeted at a general population rather than at schools. Domencic (2014) wrote a musical about Galileo to be performed by a professional company visiting schools. As with some of my previous work (Debreceny, 2018) he incorporated appropriate musical styles, including 16th and 17th century Italian song, but again the students play a passive rather than participatory role. Sosenheimer (2015) constructed a guide for composers to create and produce touring operas for elementary schools using fairy tales or stories with moral or cultural themes, also with professional performers and the children in merely a spectator role.

Other research investigates using parody (Boothe & West, 2015) or piggyback (Schier & Eldridge, 2013) songs, or “songs-that-teach” (Shevock & Bates, 2019, p. 17) where new lyrics are added to well-known melodies, such as ‘Twinkle, Twinkle’, or ‘Row, Row, Row Your Boat’. Borrowing a melody is the quickest and most convenient method for teachers to generate a melody for their song. However, this can easily lead to confusion as to which set of lyrics to sing (Serafine et al., 1986). These parodies are often used for subjects requiring rote learning, such as literacy (J.A. Smith, 2000), English Language Arts (ELA) (D. Smith, 2017) mathematics (Hayes, 2009), and chemistry (Schier & Eldridge, 2013; Yee Pinn Tsin, 2015). All the lyrics and music in this project are my original creative work.

Whether using original or parody songs, integrating arts and creativity into the innovation agenda is recognised as essential for a successful, productive society (Madden et al., 2013; Robinson, 2005), and is emphasised in many national education policies (Department for Culture, Media and Sport, 2012; National Association of Schoolmasters Union of Women Teachers, 2017; Shaheen, 2010). For example, the Australian Council for Humanities, Arts and Social Sciences stated the importance of cross-disciplinary and cross-sector collaboration in education as vital to fulfil the need for a future innovative workforce (Haseman & Jaaniste, 2008). Arne Duncan as U.S. Secretary of Education noted the multiple benefits of arts education, adding it is a critical element of a world-class education, stimulates innovation and creativity, and that “creating by doing is a uniquely powerful way to learn” (2012).

Benefits of song in learning

There are many ways that song enhances learning. Research in Germany (Brunnhuber, 2017) and the U.S. (Mintz, 2014) shows that delivering information through multiple delivery modes leads to improved memory compared to a single presentation mode. Since 2007 new pedagogical models have attempted to incorporate the arts into the core curriculum to create STEAM (Science, Technology, Engineering, Arts and Mathematics) education, improving "student engagement, creativity, innovation, problem-solving skills, and other cognitive benefits, and…employability skills (e.g., teamwork, communication, adaptability) necessary for career and economic advancement" (Perignat & Katz-Buonincontro, 2019, p. 31). Integrated arts education in a transdisciplinary space (Liao, 2016) includes service connections, where one subject reinforces another subject's learning outcomes such as using song to learn (Estrada & May, 2019), and is shown to improve student motivation, participation and achievement (Cheng, 2015; Greene & Sawilowsky, 2018; Hershner, 2018; Wilson, 2016). STEAM education also helps students acquire expertise in the 21st-century skills of collaboration, problem-solving, critical thinking, and communication (Singh, 2021). Arts education positively affects students' wellbeing, fulfilling their needs for autonomy, competence, and connection (Clarke & McLellan, 2021).

Specifically, using song in the classroom has been shown to be a non-stressful medium for learning that can improve students' attitudes (Kihoro, 2016; Ruokonen & Ruismäki, 2015; Welch et al., 2014), motivation (Davis, 2017; Everett-Brown, 2017), and engagement (Geist & Geist, 2012; Veiga et al., 2015; Yoon & Kim, 2017). These positive results may be because singing provides a "stimulating learning platform that…provides a change from traditional classroom routines" (Boothe & West, 2015, p. 249) and a "friendly learning environment" (L.-L. Chuang, 2016, p. 26). These findings validate the use of educational song in the classroom.

Live vocal music in ten U.S. middle school classrooms in Georgia was found to be a strong positive influence on students' overall learning experience (Everett-Brown, 2017). Song as a learning tool improves retention at every age and academic level (Brown, 2012). Research in Canada shows that students who studied music achieved better results in all their other subjects (Cabanac et al., 2013), while Schellenberg found in multiple studies that music training (keyboard or Kodály singing) increased full-scale IQ (2004; 2006), as well as improving visuospatial abilities, listening and language abilities, academic performance (2015) and prosocial skills (2015).

Music education improves students' quality of school life, particularly a sense of achievement and opportunity, more so than other extended curriculum classes of sports or visual arts (Eerola & Eerola, 2014). Busse et al. (2018) found that incorporating song into lessons led to greater student concentration and discipline.

Song used in the classroom, such as the material created for this artefact, is effective for improving social cohesion (Welch et al., 2014; Wilson et al., 2011), social inclusion (Hallam, 2015; Welch et al, 2015), and to improve school attendance and discipline (Jones, 2019). Studies of preschoolers found that singing leads to increased prosocial feelings and behaviour, with greater benefits when singing is combined with movement (Beck, 2018; Kirschner & Tomasello, 2010). This may be because singing together reinforces a sense of belonging to the group, where "individual brains are coupled together in shared activity" (Benzon, 2001, p. 23), as singing is an essentially communal activity (Astor, 2021). Singing together even before understanding the language can lead to greater empathy and social inclusion for young children (Kulset, 2020), improving students' classroom experience.

Another positive outcome of using song in the classroom is that musical activity in school is shown to have significant benefits for students with learning difficulties, including improved communication skills, attention, focus, engagement, fine and gross motor coordination, and social interaction (Welch et al., 2015). Short-term memory recall is appreciably improved for learning disabled students using musical rehearsal of mnemonics (Gfeller, 1983). Music and speech training significantly increases autistic students' verbal production, with low functioning students improving more with music training than speech training (Lim, 2010). Teaching students with autism to sign to communicate is improved by using music (Buday, 1995). Music training also improves dyslexic students' phonological and reading abilities (Flaugnacco et al., 2015; Rolka & Silverman, 2015; L.C. Wang, 2017), with the improvement still evident after six weeks of no training (Habib et al., 2016).

Butler and Newman (2008) found that adding music and rhyme improved retention test scores for the jingle and poem group (control group 77.3%, music integration group 87.43%), but did not make any difference in spelling test scores (control 59.93%, music 60.38%). The study included a single student with learning disabilities studying three books using a Balanced Literacy programme that incorporated music with the story, which led to the student's word recognition and retention scores rising from 12% to 95%. In the United States, even students with learning disabilities are expected to make 'Adequate Yearly Progress' (AYP) in standardized testing, while students with Limited English Proficiency (LEP) are expected to make up 25% of school populations by 2025 (United States Department of Education, 2006). These two underserved populations are the focus of much of teachers' energies in the classroom, as they struggle to perform at the same level as the standard student body. Any teaching strategy and materials that can help improve engagement, learning and retention for these students will be valuable.

Another at-risk population study investigated the effect of an Australian art- and music-based day programme (Tutti Arts) with five young adults with intellectual disabilities, finding a positive effect on their social and emotional wellbeing (Darragh et al., 2015). A New Zealand study of music therapy at a special needs school also discovered improved student confidence, mood, and social interaction skills (Martin, 2015).

Though the benefits of singing are well-researched, not all children enjoy singing. A Japanese study of using songs and chants in elementary school reveals that children begin to lose interest in singing with their teachers in the third grade. This may be because as they age music as a school subject is seen as increasingly less important as it is not deemed essential for their academic success, and that they are using more complex cognitive learning strategies (Kimber & Apple, 2014).

Some students have negative perceptions of singing, particularly boys who may be embarrassed as their voices change, lack confidence in their own singing abilities (Warzecha, 2013) or feel that singing is a threat to their masculinity (Powell, 2014; Watson et al., 2019), so may refuse to sing in class in front of their peers. A U.S. study reveals that this change in boys' attitudes toward singing begins in the second grade, rising sharply between the fourth and fifth grade (Wyler, 2021). This does not mean that song with its many benefits cannot be utilised with these students. In such cases, the song can be performed as rap, as a "potential escape route from singing that saves masculine face" (Ashley, 2015, p. 122).

Even without using the element of melody, educational chant, rhymes, or raps improve learning outcomes, memorisation and retention (Bartelen, 2018; Chong, 2012; Ciecierski & Bintz, 2012; Kung, 2013; Murakami, 2017; Segal, 2014; Stephenson, 2016). A Californian study of children aged 2 to 4 compared memory for animal names from a storybook reading in either rhymed or prose versions, finding better results for the rhymed condition (Read et al., 2014). A Taiwanese inquiry into the results of teaching vocabulary using song, chant, or song and chant reveals that all groups significantly outperformed the control group, with the highest scores for the song and chant group, followed by song, then chant (Kuo et al., 2014). Even without rhyme or melody, a Queensland study of eighty-one 7- to 10-year-old children found that reading words and non-words aloud rather than silently improved word recognition, a result of the production effect which improves memory for the vocalised condition (Pritchard et al., 2020).

Illustrating this, Alex Kajitani is an award-winning teacher in the U.S., renowned for his innovative use of rap and hip-hop to teach and reinforce mathematical concepts. He noted that at one lunchtime "all the kids were singing this song I'd created for the math lesson…For the first time, by the end of the week, they understood how to add and subtract decimals, and their test scores were better" (Henriksen & Mehta, 2016, p. 83).

These findings are relevant to this project in that they illustrate that learning is enhanced even without the element of melody. Teachers who may be intimidated by creating melodies and harmonies for their teaching materials can know that spoken chant, with its strong elements of rhythm and rhyme, will be almost as valuable a pedagogic tool in their classroom as song.

The act of creating educational songs as outlined in the creative artefact is powerful. Bintz (2010) teaches his education students to write new lyrics about science using familiar melodies for their classes. One of his graduate students noted, "I have seen firsthand how students remember knowledge if it is presented to them in the form of a catchy tune", and "I also learned that singing and songwriting have unlimited potential for teaching content area material, especially material that teachers find challenging to teach, like science" (Bintz, 2010, p. 686). Ciercierski and Bintz (2012) also investigated their student teachers' success with writing content-based chants and songs in a variety of subject areas. The teachers reported the experience to be enjoyable and rewarding, and that personalizing the curriculum broadened and deepened their thinking about the subject, as well as improving their song writing skills (Batchelor & Bintz, 2012).

Similarly, Veiga requires his mining students to collaborate in groups to create a parody song about environmental issues, after using his own parodies to reinforce concepts and themes in his lectures. Students noted that "the [professor's] songs are catchy and make it easy to remember", "songs stick in memory more effectively than studying", and that songs encouraged attendance (Xavier et al., 2009, p. 8). Veiga's (2007) students reported that they spent more time researching the parody topic than they would have studied for a quiz, that music enhanced their learning (93%) and should continue to be used in the course (91%). While these examples are at the tertiary level, it is reasonable to expect similar results with younger students who are encouraged to become songwriters and lyricists.

Though song composition is a valuable pedagogic tool, not every teacher has the confidence, time or resources to utilise it with their class. However, songs in the classroom, such as those found in the project's creative artefact, enhance learning outcomes. For educators wondering if song can benefit their students' learning, the following research shows that innovative pedagogies using songs or music videos have been successfully used in a wide variety of subjects.

Governor's (2011) investigation of six U.S. middle school science teachers found that using content-rich songs in the classroom improved engagement and attention, helped build vocabulary and acted as mnemonic devices, and that 56 of 57 students enjoyed using song to learn. Similarly, Hardiman et al. (2019) observed that in four U.S. urban fifth grade classrooms science songs significantly improved content memory, especially for poor readers.

Khauanpuck and Kaewdee's (2016) study of two Bangkok seventh grade science classes using song also produced notably higher scores and improved student attitudes and learning. Crowther et al. (2015) in the U.S. studied the use of short songs about physiology, finding that 60 – 67% of students found the songs helpful or very helpful. Using song to teach personal identity information (parents' (i) names, (ii) address and (iii) phone numbers) to Indonesian kindergartners led to significant improvements in memory ((i) 36% to 84%, (ii) 24% to 80%, and (iii) 44% to 76%) (Ginting, 2019).

At the college level Yee Pinn Tsin (2015) at Monash University, Australia found that teaching using parody songs about science set to popular tunes lowered students' stress levels and improved student understanding, retention, attendance, and punctuality. Similar improvements in memory from using parody science songs were noted by Yeoh (2014, 2015a, 2015b) in Malaysia, thought to be the result of the musical mnemonics facilitating the consolidation of memory processes, converting short term memory into long term memory. Cecchini and Walsh (2018) used a country music video to teach about celiac disease to Canadian pathology students, finding that those who watched the video scored higher both immediately (music 88%, non-music 76%) and two weeks later (music 73%, non-music 71%), while those who watched the video at home scored highest after two weeks (83%).

Baker (2011) investigated six history teachers in Alabama who used music as a teaching strategy, finding noteworthy improvements in student engagement, attention and test scores. Binkeiwicz (2006) and Burroughs and Hare (2008) note that songs enhance learning and that historical songs are valuable primary sources, presenting literal voices from the past to provide context and social commentary to history classes (White, 2005).

Using song and video to teach cardiopulmonary resuscitation skills to Spanish high schoolers significantly enhanced effectiveness and retention over a period of eight months (Fonseca Del Pozo et al., 2016). Similarly, S.G. Jones (1998) reports that parody songs have been used by the Mount Sinai Medical Center in Florida to successfully teach CPR to parents of newborns and adult classes. A Nigerian study of 136 adolescents into the use of song to teach nutrition found a significant improvement in knowledge, attitude, and healthy eating practices (Ogunsile & Ogundele, 2016).

Winter et al. (2009) report that 94% of U.S. students remembered the parody songs that were played during food safety education classes, with 53 – 78% retaining the main message in the lyrics. Some interesting findings in this report include the students' preference for different music styles - rap, and rhythm and blues. This led to their lack of engagement with some of the songs in the study that used the styles of rock, pop, country, and disco. Retention of material from the songs was highest in the group which already had knowledge of the subject (food service supervisors: 90% - 96%), while students with no prior knowledge scored considerably lower (55% - 78%), suggesting that prior knowledge is a factor in memory. Teachers requested that songs be written to incorporate the materials the students would be tested on, as they felt that the time spent on learning songs was detrimental to the goal of passing tests. The researchers also noted that using each song's main concept as a title improved retention. McCurdy et al. (2008) used the same songs in a study of 17 high school classes, finding that teachers and students reported increased enjoyment of the classes with music as well as significantly improved test scores, though this may be attributable to smaller class sizes or more experienced teachers.

Educational song is also used to promote public health messages to more general audiences. In Kelantan, Malaysia songs are used to raise public awareness about preventing the spread of HIV and dengue fever to a wide audience in supermarkets, public transportation and taxis, health facilities and government agencies (Bahri et al., 2016). In Nigeria a popular music video teaches about handwashing to prevent disease (Neji, 2016), while a South African song lists the risks and signs of malaria for pre-school children (Anderson et al., 2018). In Uganda primary students retained important health information from listening to music videos by celebrities (Macnab & Mukisa, 2019), and in Indonesia, a children's song has been created to teach about handwashing to prevent the spread of Covid-19 (Tyasrinestu, 2021).

Music videos and student karaoke videos improved students' attitudes towards their fisheries studies in the U.S., though learning and retention were not examined (Grossman et al., 2016). Crowther et al. (2016) found that a majority of music videos (13 of 15) about science led to statistically significant improvements in knowledge and comprehension in a study of over 1,000 U.S. students. While a music video about fossils was not as effective in enhancing learning in the short term, it improved test scores 28 days later, and students were more likely to share and replay the music version than the non-music video. Crowther et al. (2015) also found that teaching math concepts at the college level through short jingles made the material more accessible, and that a majority of students found them helpful.

A study in Zimbabwe found using songs to teach subtraction to second graders improved test scores, attention and retention as students regarded songs as fun and so were unaware they were learning (Shanangurai, 2017). A Kenyan study found that using song to teach over 3,000 pre-school children increased their listening and oral skills, verbal memory, reading fluency, and vocabulary (Wairimu, 2015). A smaller study in Pakistan found that using songs and poems to teach six lessons in second grade science led to improved content knowledge, motivation, enjoyment of classes, and retention by students, while also boosting teachers' confidence, knowledge, skills and attitude (Virani, 2015).

There is also a large body of research that documents the benefits of using songs to learn language (Ashtiani & Zafarghandi, 2015; Çevikbas et al., 2018; Džanić & Pejić, 2016; Farrah, 2016; González, 2015; Jolly, 2011; Papachristou & Kanonidou, 2019; Pourkalhor & Ravakoli, 2017; Schon et al., 2008; Tomczak & Lew, 2019), particularly for verbatim word recall (Edmonston, 2015; Ludke & Ferreira, 2013), even after a four week (Shaffer, 2004) or six month (Good et al., 2015) delay. Using song in the foreign language classroom is found to be motivating for students, as seen in a student's comment "I enjoyed the classes because it didn't feel like the teacher was teaching and the students were learning; rather it felt more like everybody had a lot of fun" (Dolean, 2016, p. 647). Song is shown to be helpful in teaching language to immigrant children and refugees by improving social inclusion and engagement (Busse et al., 2018; Crawford, 2016; Playsted, 2018). Singing improves students' learning and retention of vocabulary (Çevikbas et al., 2018; Fadhli, 2017; Gasma et al., 2017; Papachristou & Kanonidou, 2019), motivation (Džanić & Pejić, 2016; Ludke, 2018), connected speech, and pronunciation (Ashtiani, & Zafarghandi 2015; Nadera, 2015; Žáková, 2010).

Language is learned through the modes of listening, speaking, reading and writing (Sevik, 2012). The skills of listening and speaking or singing are fundamental, and do not require the more advanced elements of reading and writing. Therefore, song with its primary emphasis on listening is an appropriate medium for young students' introduction to another language (Sevik, 2011). A German study of 3–4-year-olds learning English vocabulary found the singing group scored highest (38.4%) ahead of the recitation group (30%) and the control group (8.8%), noting that the recitation group tended to add high and low intonations to make it more song-like and interesting (Lim-Kemper, 2014).

Music and song are vehicles for communicating culture as well as language. Many diaspora minority families use songs or rhymes in their mother tongue to preserve their language, heritage, and culture (Avanesians, 2015; Walker, 2014; Wu & Welch, 2020). In Finland, teaching songs, dances and games from other countries encourages primary school students' understanding and acceptance of other cultures (Ruismäki & Ruokonen, 2006). Traditional and foreign songs are used in Taiwan to teach citizenship and values (Ho, 2019), while ethnic Mulao folk songs teach culture and principles in China (Wei, 2020), and folk songs instill patriotism in Uzbek school children (Ibodovich, 2021).

Music acts as a framework, facilitating encoding and retrieval (Wallace, 1994), transforming two-dimensional text through melody and rhythm into three-dimensional information (Morris, 2000). This may be one reason that many studies report that music students outperform non-music students academically in standardized tests and learning outcomes (CollegeBoard, 2012; Črnčec et al., 2006; dos Santos-Luiz et al., 2015; Guhn et al., 2019; Holochwost et al., 2017; Jones-Lewis, 2015; Kelly, 2012; Nazario, 2018; Ruppert, 2006; Uyan, 2018; van As & Excell, 2018; Wetter et al., 2009; Winsler et al., 2019). Another potential rationale linking music education to higher test scores is that music training boosts phonological awareness, which is directly related to improved literacy skills (Baleghizadeh & Dargahi, 2010; Bryant et al. 1990, 2008; Fernandez-Fein & Baker, 1997; Gordon et al., 2015; Harper, 2011; Hurwitz et al., 1975; Lems, 2021).

A Finnish study followed students in 26 Helsinki kindergartens who participated in music or dance playschool or regular day care for 30 45-minute classes for two years. Those attending music playschool significantly improved their phoneme processing and vocabulary skills over students in dance classes or no classes, with a direct correlation between intensity of the intervention and rate of improvement in linguistic skills (Linnavalli et al., 2018).

Classroom-based singing activities improved first graders' reading achievement in Queensland (McMahon, 1979) and reading outcomes and phonological working memory in Welch et al.'s (2020) two-term study of 6-year-olds in disadvantaged schools in London.

Biggs et al. (2008) investigated the use of Carry-A-Tune software to help struggling U.S. middle school readers. Twenty-four 7th or 8th grade students used the individualized software for thirty minutes, three times a week, for nine weeks, with immediate feedback from the programme. They typically sang two songs each session, increasing in difficulty through the course. While the control group did not experience gains, the students using CAT improved their reading scores significantly, making a seven-month gain over the nine weeks, or a 1.37 grade level gain (Biggs et al., 2008, p. 208).

Darrow et al. (2009) investigated five U.S. studies which used music to enhance reading education of 460 second graders. Songs and music were used in the reading classroom two or three times a week for six to nine weeks, usually replacing the standard reading curriculum. In four of the five groups, the experimental musical group outscored the control group, though not significantly. However, all the studies reported student and teacher enthusiasm for music as a pedagogical tool.

Iwasaki et al. (2013) studied the use of songs to accelerate progress in reading at the first-grade level in the U.S. By learning one new song every week accompanied by a lyric sheet and reading and rehearsing the songs daily, students' reading skills improved more than average results.

In contrast to these results, some research shows no significant positive results for using music and song in the classroom, such as Klimek's (2017) study of kindergarten and second grade classes. Albaladejo et al. (2018) tested vocabulary acquisition using story, story and song, or song presentations to Spanish two- and three- year-olds, finding that the story condition was most successful and song the least effective. A German study reports little effect on kindergartner's mathematical or grammar skills from increased exposure to music for kindergarten students (Hart et al, 2017). Leguizamon's (2010) study of the effects of Kodály choral music instruction with U.S. first graders found that while reading fluency increased with the experimental group, overall reading achievement was not significantly impacted.

Calvert (1998) found a prose presentation was more successful than song for U.S. preschoolers remembering their phone number. Similarly, a study by Hayes et al. (1982) of U.S. preschoolers revealed that while they preferred stories in rhyming verse (75%) to prose form (44%), their short-term memory of the story elements was higher for the prose (78%) than verse condition (54%). Winter's (2010) study of song in her Minnesota ESL classroom noted that while students enjoyed the songs, singing them before and after class, vocabulary learning outcomes were not statistically better than traditional language instruction. In Japan Kanel (1997) reported that text and song presentations produced similar learning outcomes, but that students felt that listening to songs was beneficial and wanted song incorporated in their classroom.

Three large reviews of arts education programmes in mostly elementary schools did not find enough convincing evidence that demonstrated a causal link between arts education and improved academic outcomes, though this may be in part due to widespread flawed study design, small sample sizes, difficulty in replication, and conflicts of interest (Sala & Gobet, 2017; See & Kokotsaki, 2015; Winner & Cooper, 2000). The positive results could also be attributed to other differences between students, such as socioeconomic status, prior academic achievement, use of time, attitudes toward school, or parental income, education and involvement (Elpus, 2013; Winsler et al., 2019).

Another potential reason for lower-than-expected learning outcomes from using song in the elementary classroom is that students do not always comprehend the meaning of what they are singing, though understanding does improve in middle and high school students (Greenfield et al., 1987). A

Taiwanese study reveals that while students enjoyed web-based learning through song, there was “little to no relationship between listening repetition, song understandability, and perceived learning and actual learning outcomes” (Beasley & Chuang, 2008, p. 11). Yeoh (2014) notes that while mnemonics help stimulate recall, they do not facilitate comprehension.

Calvert (1993) found that listening to a song version of the American Constitution improved memorisation, with better results linked to the number of exposures. However, she later observed that comprehension and retention were poorer in a sung than spoken presentation, suggesting that the song format may distract children from processing the material (1998). She suggests that while singing can preserve a verbatim memory over a long period of time, it can be a superficial learning tool unless linked to deeper understanding of the content (1998). Interestingly, research shows that children sing more accurately using lyrics rather than a neutral sound such as the syllable “loo”, suggesting that words help to organise their melodic memory (Hanna, 1999; Jacobi-Karna, 1996).

Over several decades of using song to teach I have observed a number of benefits beyond the obvious improvement in retention of subject material. Singing together creates an informal, nonthreatening learning environment which reduces student anxiety and increases motivation (Millington, 2011). Song in the classroom creates a sense of community and connection which improves social cohesion and cooperation (Ehrlin, 2016; Gul, 2018; Kirschner & Tomasello, 2010), and offers an enriching learning experience for all students rather than only a select few in a chorus (Roberts, 2019). Song is an accessible learning medium, enhancing students’ acquisition of knowledge through repetition, group participation, and easily memorised materials (Ibrahim, 2018; Tomczak & Lew, 2019).

As we see, the literature is well-served with prior research documenting the outcomes of using educational song materials. However, it also reveals the contradictory nature of the data, where though the majority of studies show that song improves learning outcomes for a variety of reasons, a smaller body of research questions the efficacy of song in the classroom. I compared these studies to my own personal experience of writing and teaching educational songs, which has been almost uniformly positive.

Seeing the dichotomy in the literature and my experience between positive and ineffectual results of using song in the classroom led me to pose the question “what are the potential factors that contribute to the difference in educational outcomes in using song in the classroom as shown in the current literature?” I hypothesized that the most probable explanations are

- whether students find the materials relevant and appealing,
- how the songs are presented and utilised in the classroom, and
- the number of times the songs are heard and/or performed in class.

By providing creative examples and guidelines to teachers (and potentially their collaborative classes), the song writing process becomes relevant in several ways. Firstly, the teacher and students are able to write about the subject that they are currently teaching or studying, providing relevance. Secondly, when a song is created expressly for a class, the students will appreciate the personal effort the teacher has made for them. Additionally, such novel arts integration activities are shown to engage and motivate students. In response to the second suggested explanation, suggested activities for several of the songs is presented, as well as approaches and ideas in the teachers’ guide which can be adapted and applied to any song. Lastly, repetition is a key element in memory and retention (Calvert, 1993; Chen, 1990; English, 2014), though the number of repetitions will obviously depend on available class time.

The Nature and Purpose of the Creative Artefact

This research project endeavours to facilitate the use of educational songs by offering teachers an understanding of the creative process of writing curricular musical materials that are appropriate for their subject and connect with their students. It presents songwriting exemplars, interwoven with supporting materials from the relevant literature.

The song materials that comprise the artefact are grouped in three levels: grades 1 & 2, grades 3 & 4 and grades 5 & 6, covering a variety of subjects. These subjects and resources are selected from a review of elementary and middle school learning standards from the United States, as well as supplementary materials from Australian, Canadian and U.K. curricula and educational websites, as listed in the Appendix (see page 409).

Chapter 3 - Theoretical Framework & Research Methodology

This third chapter presents and discusses the theoretical framework and methodologies utilised in the research. There is very little previous research available in my specific area of praxis, so I decided to start by investigating the *process* of my research, which I could then link to an appropriate theoretical framework. A theoretical framework is a loosely structured approach or set of guidelines which allows for flexibility and creativity, while methodology is the study of the system of methods, tools and techniques selected to solve a problem and the underlying logic behind those methods. The theoretical framework is practice-led research, based on Wallas's (1926/2014) creative process model.

Theoretical Framework

I perceived that I work simultaneously on two distinctly different planes: the assembling of quantitative factual 'scientific' or 'academic' curriculum materials and content, and the qualitative 'artistic' practice of creative writing and composition. My research takes place at the intersection of these two areas: the integration of facts and imagination in a "symbiotic, interconnected practice" (Osvath & Newport, 2020), each informing and influencing the other to generate the artefact, which is "an archive of synthesized research" (Modolo, 2019, p. 10). This fusion takes place within the domain of qualitative research, specifically practice research.

Practice research is defined by Candy and Edmonds as "an original investigation undertaken in order to gain new knowledge, partly by means of practice and the outcomes of that practice" (2018, p. 63). Practice is at the core of such research, which investigates how to improve practice, and "informs theory building within research to gain new insights, knowledge or understanding" (Niedderer & Roworth-Stokes, 2007, p. 10). Creative practice not only generates an artefact, but also focuses on how the creative process is transformative, leading to new works (Candy & Edmonds, 2018). It explores the knowledge required to create an artefact (Nimkulrat, 2007), potentially leading to individual evolution and development (Zhang, 2021).

This practice-informed research employs an updated version of Wallas's (1926/2014) foundational model of the creative process as a theoretical framework. This theory provided the principal concepts and terminology for my research, allowed me to make predictions about my praxis, and to determine the relevance of data and what materials should be collected, analysed, and interpreted. Interestingly, the model acts not only as the theoretical framework, but also as a creative practice method in my praxis.

Wallas's creative process model can be viewed as a problem-solving sequential process in multiple phases (Barbot & Webster, 2018). Wallas's (1926/2014) four stages of the process are preparation, incubation, illumination and verification. This is based on Poincare's work in 1913 where he defined the creative process as a sequential progress starting with conscious thought, moving through unconscious work, leading to inspiration (Truman, 2011). This creative process model is analogous to research by Sadowski and Connolly (1999), and, with slight variations, López-González (2012), and in the arena of music composition Bennett (1976), Andrews (2004), and Hannan (2004).

These stages alternate between conscious, deliberate work and unconscious mental activity. The first stage of preparation is the conscious identification, definition and analysis of the problem or task, and the collection of information and relevant resources. Incubation is the phase of unconscious or partially unconscious mental exploration and activity, while illumination is the 'aha' moment of insight, the solution to the problem. Verification is the conscious evaluation and refinement of the idea, relating it to existing knowledge, and the expression of the insight (Amabile, 2019; Gruszka & Tang, 2017; Hines et al., 2019; Ritter & Dijksterhuis, 2014; Sadler-Smith, 2015).

Cropley and Cropley (2010) replace Wallas's incubation phase with the "generation" phase, where a number of possible solutions are generated to be tested in the later verification phase. Wierzbicki and Nakamori (2005) term this phase “gestation”, where the brain has time to forget the problem in order to allow the subconscious mind to work. This unconscious or partially unconscious mental activity and exploration (Gruszka & Tang, 2017) is when the problem or task is set aside, allowing deeper connections to be made (Hines et al., 2019). Webster (2002) describes it as “working through”, noting that this stage uses the most creative time in the process.

The creative process phases are not always linear, usually cycling between phases in an iterative process termed “recursion” (Runco, 2014; Wierzbicki & Nakamori, 2005) which can occur between all stages of the creative process (Chung et al., 2009; Popova, 2013; Runco, 2014; Wierzbicki & Nakamori, 2005). The process can also commence partway through or appear to omit a stage when knowledge and skills acquired previously are used as the resources for the generation phase, seemingly eliminating the preparation phase (Cropley & Cropley, 2010; Lavranos et al., 2020).

In this research project the illumination phase, where the possible creative solution(s) and insights rise to conscious awareness (Gruszka & Tang, 2017), is incorporated into Webster’s (2002) “working through” phase, which includes revising, editing and introducing new ideas. Processing a problem over an extended time allows deeper neural connections and more diverse solutions to occur through multiple unconscious and random combinations of ideas (Hines et al., 2019) in “stimulus-independent thought” (Travis, 2021, p. 161) and off-task, non-conscious processing periods (Gallate et al., 2012).

The final stage of verification includes the publication of the artefact as a product, the tangible essential outcome of any creative research (Rhodes, 1961; Webster, 2002). It also includes the examination of the product against current knowledge (Amabile, 2019), and the evaluation, refinement and further development of the creative idea (Gruszka & Tang, 2017).

My previous experience in writing poetry, performing and composing music and teaching provides the basic competence and skills in creating the artefact. A major change from my past work is the new element of recursive reflexivity that illuminates the evolution of each artefact and my practice over time. This has generated improved skills and increased understanding of creativity and my personal praxis.

Another difference between my previous composition and this project is the age group for which I am writing. Most of my prior work has been written for middle school students, with a correspondingly greater depth of information, number of required facts and musical complexity. I have realised that writing for younger students requires a very intense focus and higher level of distillation of material.

I now see my work as a synthesis of practices, where the creative process is reiterated with different input (curriculum) to produce new original work (songs). Though I am always writing for children, each song is targeted at one of three different age groups, with distinct parameters and expectations.

I have observed and documented further changes in my practice and process as I revise and refine my creative methods through repeated reflective writing and journaling, seen in the exegesis Praxis section. This type of reflective self-study is often engaged by teacher educators as part of their professional development and to enhance understanding of educational practices and processes (Cole & Knowles, 1998). It can expand the knowledge base of educational pedagogy while also detailing and validating their own professional proficiency (Vanassche & Kelchtermans, 2015).

Arts based research offers a new methodology to expand knowledge in experiential and inventive ways (Pentassuglia & Boylan, 2017). Art research can address questions that are pertinent not only in the creative context but also in the real world (of classroom teaching), documenting processes and outcomes not only for the academic community but potentially to a wider audience (Achugwo, 2020; Barbour, 2011). In this case, there are two possible new outcomes for teachers: first, the song materials which can be used by non-music teachers in the general classroom, and second, the acquisition of songcrafting skills for non-musicians.

Rather than being merely the object of investigation, art practice is not only the outcome or research, but also the subject matter, method, and context (Borgdorff, 2012), where the process and substance are inseparable (Klein, 2010). Here, the investigation of the creative process becomes part of the creative outcome in the form of an exploration and documentation of my praxis and the song materials.

As shown in this exegesis, art research can provide the opportunity for the researcher to explore their own creativity, leading to new understandings and transformation (Clarke & Bautista, 2017). An individual's lived experiences can explicate understanding across branches of knowledge that may contribute to new insights and solutions to practice-based issues (Lewis & Throne, 2021), as in this case, to provide a methodology for creating educational songs on any subject. Music is a multi-sensory vehicle which can be used as a tool for scientists or researchers to communicate with other disparate communities (Gershon & Ben-Horin, 2014). While this exegesis is focused primarily on elementary school teachers, the resources and methodologies are also relevant for other educators at the secondary and tertiary level, and potentially anyone who wishes to create songs with a purpose.

Noury and Paquin define research-creation as "doing research *through/within* creative practice, rather than alongside, around or for it" (2020, p. 13), while Borgdorff (2012) suggests that creative practice as research is research *in* and *through* the arts, as valuable as research *about* the arts. He writes that "embedded in artistic and academic contexts, artistic research seeks to convey and communicate content that is enclosed in aesthetic experiences, enacted in creative practices, and embodied in artistic products" (2012, p. 144). Borgdorff also states that from a methodological standpoint, the creative process shapes the directions in which new insights, perceptions, and outcomes are formed (2012). Achugwo writes that:

> The making of an artefact is pivotal for practice-based researchers. The insights from making, reflecting and evaluating may be fed back directly into the artefact itself. For practice-led researchers, the understanding from the research leads to the evolution of new practices in a given field or organisation. (2020, p. 4)

The term Creative Process-based Research methodology is used by Penn-Crawford (2020), who describes it as a consisting of three poles: the creator, the product, and the “creative process voice”, that uses a distinctive language that may be different from everyday prose. As cited in Scott-Alexander, she defines the creative voice as “an experience of the internal/external creative process of the creator” (2020a, p. 113). Scott-Alexander (2020b) adds that the research material consists of the interplay and reciprocity of the three poles, noting it is a fluid style of writing, similar to streams converging or the weaving of threads into cloth. This aligns with the concept of synthesis in my praxis, for example the constant recursion and revision of songs, moving between the creator/composer and the product/song using incubation and illumination, explicated in the creative voice.

Goldson writes that Creative Practice as Research, or CPR, can “contribute just as much ‘new knowledge’ as the more traditional approaches to research, at least in arts and social sciences, which involves publishing in monographs, journal articles and edited collections” (2020, pp. 226-227). We now inhabit a “multimodal, multimedial world, where knowledge is created, debated, disseminated, and accessed digitally” (Paré, 2019, p. 80), where students are immersed in media, and digital production and creativity are already an integral part of their lives (Goldson, 2020).

There are two approaches which use creative practice to develop knowledge. They differ in the role of the creative output, or artefact. In practice-*led* research the creative process is more important than the artefact, and leads to new understandings about the practice, while in practice-*based* research the artefact is the basis of the addition to knowledge (Candy & Edmonds, 2018; Skains, 2018).

This practice-led project answers my first research question (what are the creative processes involved in writing developmentally appropriate educational songs for elementary and middle school students in the United States?) by investigating the *process* of creating educational songs and describing the method in detail. It provides educators with a template for writing their own subject-specific songs or collaborating with their classes to create song materials for learning.

The project responds to my second research question (how can I best describe the educational songwriting process so that other educators can utilise the knowledge and skills?) by offering an experiential investigation of the writing and composition process. This is linked to a literature review both in chapter form and embedded in the narrative, supporting my personal creative choices and artistic and musical decisions over time. The descriptions in commentary form of how my understanding of my praxis, or "intertwined theory and practice" (Armstrong, 2020, p. 2) demonstrate how both my research process and songcrafting practice have evolved.

Methodologies

Here I describe the two methodologies utilised in the exegesis. The difference between methodology and method is important. Methodology is the rationale for the approach used in the research, and the perspective from which it is analysed, while methods are the specific research tools utilised to solve the research problem. I then discuss the relationship between exegesis and artefact, the diversity of research structures in compositional doctorates, and the woven or braided approach which combines several perspectives.

The first methodology is the commentary model, which presents a written first-person description of the research process, providing context and an explanation of the research and creative practice (Fletcher & Mann, 2004; Hamilton, 2011; Milech & Schilo, 2004). This method "tends to have practice at its core, providing close readings of artefacts, with reflexive accounts and thick description" (Morrison, 2017, p. 123). It includes the use of field and archival data, including personal journals, drafts and revisions of lyrics and songs, and workbooks. This is illustrated in the song exemplars and the final presentation of the artefact creation process.

The exegesis also incorporates elements of the "annotated portfolio approach" (Hall, 2020, p. 210), a design research model originated by Gaver and Bowers (2012), though substituting scores for visuals. Annotations are brief blocks of text linked to an image as explanation and validation, as well as providing context (Hall, 2020).

A collection of annotations becomes a portfolio which index and demonstrate the specific context of the artefact and connect it to wider research areas, as well as a chronological explanation of the evolution of the exploration, work, and reflexive processes during the project (Srivastava & Culén, 2017). This commentary or portfolio documents Schön's "pattern of tacit knowing-in-action" (1995, p. 30), chronicling the embedded knowledge found in competent practice, and "bring[ing] together individual artifacts as a systematic body of work" (Gaver & Bowers, 2012, p. 46). This "archive of synthesized research" (Modolo, 2019, p. 6) is where "experiential knowledge becomes explicit" (Mäkelä & Nimkulrat, 2018, p. 14). The exegesis's annotated artefacts documenting the stages of song development are also similar to design prototypes which designers use to reflect, frame, filter, refine and progress iteratively (Lim & Stolterman, 2008; Srivastava & Culén, 2017).

The use of thick descriptions (Geertz, 2004) where "researchers immerse themselves in, and report on, particulars before moving toward…theories" (Tracy, 2019, p. 24) accompanied by detailed examples is designed to generate knowledge about the creative process and practice (Riis & Groth, 2020). This exemplifies the hermeneutic circle, where knowledge is seen as a continuous process of engagement, interaction and reflection in practical activity (Kezar, 2000; Lähdesmäki et al., 2010). The exegesis becomes a component of the artefact, rather than a mere appendage (Williams, 2016), where the practice is situated in the inquiry (Yee, 2010). It presents an example of creative enquiry, or "experiential, aesthetic, and practice-based knowledge construction" (Younie & Swinglehurst, 2019, p. 447).

A recent survey of 102 composition doctoral projects in the U.K. (Leedham & Scheuregger, 2020) presents a variety of approaches, probably arising from the ongoing argument about whether composition is research, and if so, do composers need to provide a text element as part of their research? A Queensland study also found wide diversity in music doctorates' methodologies as the programme evolved over time (Draper & Harrison, 2011). Armstrong (2020) notes that the view of music composition as research in academia has changed from being equivalent to research to being required to conform to traditional scientific research criteria, where initial questions lead to new insights through specific methodologies.

Bridges and Schendan write "the expectations laid onto the arts to function in a research-like way, may have more to do with the instrumental requirements generated by their incorporation into the bureaucratic nightmare that is contemporary higher education than an authentic reflection of the real dynamic of artistic expression" (2020, p. 19). Gaver and Bowers state that while research theory offers structure and guidance to researchers, it fails to capture and express the multidimensional and unique nature of design (2012). If we substitute 'creative practice' for 'design', this becomes relevant to my project.

In conforming to the academic requirements of a doctorate, I felt concerned that my creativity may be influenced in a negative manner. Would the constant detailed analysis and referencing "kill the muse" (Weston & Byron, 2015, p. 71) and stifle my creativity? Would I unconsciously conform to the conventional children's songwriting styles that I had researched so carefully, or would I retain true originality? Would song creation become a boring routine, rather than a challenge? I decided to work on the exegesis from two separate perspectives or roles of 'academic' scholar and 'creative' artist, as can be seen in the different intertwined 'voices' in the praxis commentary.

This dual approach is aligned with Krauth and Nash's (2019) suggestion that the creative and exegetical components can be linked more closely by being woven or braided together, and that the exegesis does not necessarily have to be written in academic prose. Leedham and Scheuregger's (2020) research model proposes either a technical commentary, an artistic structure, or reflexive interpretation, or a combination of these, similar to Yee's "pick and mix" approach (2010, p. 16). Nottingham (2020) recommends using critical reflection to personalise and professionalise practice in order to demonstrate knowledge in the artefact, as seen in the following commentary and annotations.

Chapter 4 - Praxis

This fourth chapter presents two different perspectives of my praxis, or "intertwined theory and practice" (Armstrong, 2020, p. 2), documenting and interpreting the creative process involved in developing songs for learning. The first defines the process or method of songwriting in general terms using exemplars from songs created for this project and supported by relevant data and information which provide an embedded literature review. These materials were essential to my evolution as a composer of children's songs, specifically in gaining a deeper understanding of children's cognitive and neurological development, increasing memory and cognitive capacities, and the impact of music training to improve spatial-temporal reasoning and retention.

The second perspective provides specific examples of six of the artefact songs. These annotated exemplars present an overview of the construction and elements of each song. Though I have been writing educational songs for decades, I continue to refine and improve my work practice through reflexivity and ongoing self-critique, in response to my first research question ("What are the creative processes involved in writing developmentally appropriate educational songs for elementary and middle school students in the United States?"). Clarke and Parsons note that "research engages [graduate students] in a process of personal growth" (2013, p. 36) where self-identity can be transformed. These reflexive comments document creative and musical decisions to provide a parallel, more personal perspective on my praxis interwoven into the contextualising theoretical data.

The structure of the first section follows Wallas's (1926/2014) model of creativity, which he defined as the process of preparation, incubation, illumination, and verification. It includes the additional phase of 'recursion' (Runco, 2014; Wierzbicki & Nakamori, 2005) or 'working through' (Webster, 2002) combined into Cropley and Cropley's 'generation' phase (2010), as detailed in the Methodology chapter.

Preparation

Preparation defines the problem, analyses the task, and collects information required to solve the issue. This involves the selection of the song subject, grade level, and collation of relevant curricular materials from a variety of sources (see Appendix). This ensures that the songs will be appropriate for a widespread population of educators and students.

In selecting a curriculum on which to base the songs, I was faced with a dilemma. I live and teach in the United States, but my doctoral programme is based in Australia, where I intend to return to live and work. I have worked with a wide variety of educational communities and curricula as music teacher and composer in residence, including Waldorf/Steiner, Montessori, public and private schools and a Charlotte Mason programme. I therefore chose to utilise learning standards primarily from the United States, with additional resources from Australia, the United Kingdom, and Canada.

These are all easily accessible online and English language based. Australia and the U.K. use national and state curriculum guidelines, Canada has adopted provincial guidelines, while in the U.S. each state and school district determine their own curriculum. There are currently 13,584 U.S. public school districts (National Center for Education Statistics, 2018), so there is an abundance of available material. Fortunately, some U.S. states issue learning standards used by all school districts, and there is considerable duplication between states. However, there is also significant variation in depth, content, and adherence to the federal Common Core guidelines (Achieve, 2014). In Waldorf/Steiner education each classroom teacher designs their own curriculum within general sequence and subject guidelines.

The first task in this project was to create a master list of possible song subjects in the areas of science and history by researching national and state learning standards and guidelines (Australian Curriculum, Assessment and Reporting Authority, 2018; British Columbia Ministry of Education, 2016;

California Department of Education, 1998; National Ccenter for History in the Schools, 2014a; NCSS, 2014; New Jersey Department of Education, 2020; National Research Council, 1996; New York State Education Department, 1998; Ontario Ministry of Education, 2018; Pinellas County Schools, 2012; Seneca Valley School District, 2018; Texas Education Agency, 2017; Tennessee Social Studies Standards, 2018; Utah Education Network, 2018; Utah State Office of Education, 2010; Youngstown City School District, 2016) and Waldorf/Steiner education precepts (Rudolph Steiner School, 2018; Steiner Waldorf Schools Fellowship, 2018; Waldorf School of Lexinton, 2016). These overview curricula are supplemented by further research into each specific subject and grade level (see Appendix).

After identifying and defining the problem, the preparation phase then gathers relevant information and materials. The parallel songcrafting process begins with the following sequence of activities:

- Select subject and grade level.
- Collect curricular information, essential vocabulary, concepts.
- Rank information/facts/terms in order of importance and relevance.
- Collate 'word banks' of rhymes for important words.

Once the song topic is selected (defining the problem), I research the subject online to collate materials from a variety of sources (collecting information). These include national curricula (see pages 53-54), state and school district education department standards of learning, and reputable educational resources such as National Geographic, the National Aeronautics and Space Administration (NASA), the National Center for Atmospheric Research (NCAR), the United States Geological Survey (USGS), the Academy of Sciences, the Smithsonian Institution, and encyclopedias such as Encyclopedia Britannica and Britannica Kids. By utilising educational websites which are targeted to elementary and middle school students and their teachers, I am able to access suitable age-specific concepts, materials and vocabulary. Obviously, this step may be unnecessary for teachers who can use their lesson plans and teaching materials as resources for essential vocabulary and information.

My practice is to transcribe all the relevant curricular information into a large notebook by hand. By amalgamating all the relevant materials into one location the commonalities become obvious. Facts, concepts, or terms which occur in a majority of sources become the core essential information and vocabulary to be included in the song.

I use this method of handwriting the primary data because I have found that it improves my work process by saving time, enhancing my focus and memory, and making the information more readily accessible. If I print off copies of websites, I accumulate masses of paper which are difficult to organise and that include irrelevant data. By handwriting my notes, I am able to edit and select the most relevant facts, vocabulary, and information in one place where they are easily available. The book format allows me to make connections between different sources and materials in one accessible location, as well as to input annotations and visual prompts for ranking the importance of facts.

Research proves that the physical act of handwriting improves focus on the written material and enhances retention of the subject matter. Multiple studies show that handwriting words rather than typing them results in better recall and memory (Frangou, 2016; Mangen et al., 2015; Shibata & Omura, 2018; Smoker et al., 2009). Handwriting is shown to be beneficial for “attention sustenance, working memory activation, better transcription of thought-to-script, and overall quality of text production” (Karavanidou, 2017, p. 154), as well as improved concentration and retention (Llach, 2009; Lund, 2016; Pichette et al., 2012). Research indicates that writing or drawing activates the brain’s parietal and central regions, which are important for encoding new information and memory, and stimulates larger brain networks than typing (Askvik et al., 2020; King, 2015; van der Meer & van der Weel, 2017). Handwriting’s added kinesthetic information may also lead to improved memory and retention (Mangen et al., 2015), which is essential when dealing with the multiplicity of facts and concepts used as resources for crafting lyrics over an extended period of time, sometimes weeks or months. Writing notes also creates a “robust external memory storage: your notebook” (Roessingh, 2020).

For these songs, I ranked the curricular information in order of relevance and importance (analysing the information). Depending on the intended grade level, the number of essential facts to be incorporated will vary. Developmentally appropriate songs for younger students are generally short, between six and twelve lines, containing fewer facts, while songs for older students may be longer to include much more information. For instance, the Basic Water Cycle song for grades 1 and 2 has six lines (one of which repeats the previous line) and introduces 4 essential terms (hydrosphere equation, evaporation, condensation, precipitation), while the extended, more in-depth version for grades 5 and 6 has 14 lines and 13 essential terms (evaporation, condensation, precipitation, hydrologic cycle, runoff, infiltration, deep percolation, plant uptake, transpiration, sublimation, deposition, transportation, surface flow).

In the artefact songs, lyric length varies considerably, from six to twenty-two lines. These differences in complexity and length are related to children’s cognitive development and evolving capabilities. Understanding these is essential to writing age- and developmentally- appropriate teaching materials.

My praxis has been informed by Piaget’s theory of cognitive development. This describes children’s mental maturation as a sequence of four periods, each with several substages, denoted by quantitatively different systems of thinking or mental organisation becoming progressively more complex (Piaget, 1964; Simatwa, 2010). These periods are the sensory-motor intelligence stage, approximately 1 – 24 months, which is pre-verbal; the pre-operational representation or intuitive stage (ages 2 to 7 years), with the emergence of language skills, symbols and representation; the concrete operations stage (ages 7 – 11) which relies on operations rather than verbal hypotheses, where the child develops a conceptual framework to understand their environment and evolves from egocentric to socialized speech; and the period of formal or hypothetic-deductive operations (ages 11-15), where the child can construct new operations, deal with abstract concepts, and use logical and rational thinking (Flavell, 1963; Piaget, 1964; Simatwa, 2010).

Piaget's work remains very influential in understanding children's changing capacities and abilities, though later research has developed new, multifaceted understandings of cognitive development. These include the concept that his age-related progressions can be explained by the development of executive functions (Barrouillet, 2015), and that external influences are more important than Piaget believed, as is the acquisition of domain, context, and task specific skills or insights (Case et al., 1996).

In order to create developmentally appropriate learning materials, it is important to recognise the crucial role that age plays in learning, as students' cognitive abilities and competences change over time (Bhamare, 2011; Komur et al., 2005; Nguyen, 2021; Ozturk, 2007; Ricci, 2000; Salli-Copur, 2010). After researching children's different levels of cognitive and memory capabilities, I have attempted to conform to these developing capacities by writing differently for each grade level.

As noted above, songs for younger students will usually be short, both to make them easier to learn and remember and because there is less required information in the learning standards and essential knowledge guidelines. They use simple vocabulary for the lyrics, a small vocal range and simple, mostly stepwise and skip melodic shapes. Songs for older, more capable students are generally longer in order to incorporate more in-depth information and vocabulary. They utilise more complex melodic contours, sophisticated vocabulary, syncopated rhythms, and a wider vocal range.

Learning is dependent on the structural plasticity of the brain, which is strongest in early childhood (Gruhn, 2005). Children start to develop right-brain activities, such as musical intelligence, creativity, and artistic expression from the age of four (Harris, 2009). Pre-adolescent school children further develop their cognitive abilities as the prefrontal cortex, which is the location of most cognitive functions, matures (Gruhn, 2021).

As children develop their working memory capacity triples between the ages of 4 and 14 (Gathercole, 1999). This increases not only short-term retention of information, but also the ability to implement stimulus-response tasks or rules (van 't Wout et al., 2019). As children's brains evolve, their basic operations and information processing speed increase in speed and efficiency (Schneider & Ornstein, 2018), needing less space for processing which results in more available storage space for information (Case et al., 1982) and, presumably, increased memory for longer songs. Children's episodic and working memory develop rapidly from the age of six to seventeen years, positively affecting learning, due to the development of neural mechanisms and metacognitive operations (Ghetti & Bunge, 2012; van 't Wout et al., 2019).

Music is a multimodal activity (Wan et al., 2010) which can also play a crucial role in children's neurological development by stimulating development of the brain's connectivity (Mongelli et al., 2017). Music utilises three of the four modalities the brain uses to process information: auditory, kinesthetic, and tactual (eliciting emotion), and if presented as lyrics or music, visual (Brown & Brown, 2020). Music training is found to enhance white matter integrity in the corpus callosum which connects the two hemispheres of the brain, especially when the training begins before the age of seven (Penhune, 2020). Processing musical information of pitch and rhythm occurs both simultaneously and sequentially, which may lead to similar highly developed types of processing in other areas of learning (Collins, 2011).

A Canadian study of pre-school children using interactive training in music or art on computers for twenty days found the music group improved verbal intelligence scores and executive function, which is linked to brain plasticity (Moreno et al., 2011). A group of four- to six-year-olds in Texas enrolled in a thirty-week music programme exhibited significant gains in spatial-temporal reasoning abilities (Bilhartz et al., 1999), as did U.S. kindergarteners given music instruction who scored 48% higher on spatial-temporal skills than students who did not receive music training (Rauscher, 1999). Several other studies also show improved spatial-temporal skills results (Hurwitz et al., 1975; Rauscher & Zupan, 2000; Schellenberg, 2015).

These positive results are contradicted by other research. A U.S. study of kindergarten students who received two half-hour weekly sessions of Kodály (singing) or computer training found no significant difference in their spatial-temporal abilities compared to the control group after seven months (Hanson, 2003). Another U.S. study of preschoolers who received keyboard, computer or singing training showed no benefit from singing, though spatial-temporal reasoning was significantly improved for the keyboard cohort (Rauscher et al., 1997). This lack of improvement may be linked to the length of the music intervention, as shown in a 15-month study in Boston which showed no improvement in non-musical domains (Hyde et al., 2009), while a three-year study in Boston found music lessons led to improved vocabulary and nonverbal reasoning skills (Forgeard et al., 2008).

Singing and music training obviously impact children’s cognitive development, involving the “integration of auditory and sensor motor processes” (Wan, et al. 2010, p. 287). The neural networks that serve musical behaviours are widely distributed through the brain (Hodges, 2007), utilising more of the brain while learning than when only reading or only listening, again enhancing retention (Pallesen et al., 2010).

It is important to ensure that the curricular materials are at an appropriate level, as learning tasks that are too difficult will lead to student frustration and ineffective learning, while tasks that are too simple lead to boredom and disengagement (Tomlinson & McTighe, 2006). Therefore, as well as developmentally suitable musical elements, each song’s vocabulary must be appropriate for the age and grade level of the singers, while fulfilling curricular requirements.

To ensure this, I use materials created by educators for each specific grade level. For example, when collating information for the Solid, Liquid and Gas song for grades 3 and 4, I used several state standards for learning. As an exemplar of my synthesized approach (see p. 42), integrating quantitative learning standards with qualitative artistic practice, I include three examples of U.S. state learning guidelines and materials, which provided the source terms and concepts for the lyrics. These included:

- the Mississippi College and Career-Readiness Standards for Science:

GRADE THREE: Physical Science

P.3.5 Organization of Matter and Chemical Interactions

Conceptual Understanding: Matter is made up of particles that are too small to be seen. Even though the particles are very small, the movement and spacing of these particles determine the basic properties of matter. Matter exists in several different states and is classified based on observable and measurable properties. Matter can be changed from one state to another when heat (i.e., thermal energy) is added or removed.

P.3.5 Students will demonstrate an understanding of the physical properties of matter to explain why matter can change states between a solid, liquid, or gas dependent upon the addition or removal of heat. (MDE, 2018)

- Arlington Public Schools, VA second grade science curriculum document:

Science Curriculum Unit Planner	**Grade**: 2 **Strand**: Matter **SOL**: 2.3 The student will investigate and understand basic properties of solids, liquids, and gases. Key concepts include a) identification of distinguishing characteristics of solids, liquids, and gases; b) measurement of the mass and volume of solids and liquids; and c) changes in phases of matter with the addition or removal of energy. **Time**: 3 weeks
1. Desired Results	
Enduring Understandings (BIG Ideas)	

Solids, liquids, and gasses make up our environment and have specific properties.

Essential Questions

- What in your world is matter?
- How can matter be measured?
- How can matter be changed?
- What are the physical properties of matter?
- What are the characteristics of solids, liquids and gases?
- How can we measure the mass and volume of solids and liquids?

Understanding the Standard

- All substances are made of matter.
- Matter is anything that has mass and takes up space.
- Solids have a defined shape and volume.
- Liquids have a definite volume and take the shape of the container.
- Gases will completely fill any closed container (take the shape of its container) and assume the volume of its container. (e.g., Helium gas put into a balloon takes the shape of the balloon because the balloon defines its shape.)
- Mass is a measure of the amount of matter.
- Weight is the measure of the gravitational pull on an object.
- Volume is the measure of the amount of space occupied by matter.
- Matter most commonly occurs in three phases: solids, liquids, and gases.
- Matter can change from one phase to another.
- When matter changes from one phase to another, these changes are referred to as physical changes.
- Changes from solid to liquid to gas require the addition of energy.

Essential Knowledge, Skills and Processes

Students will:

- Classify materials as to whether they are liquids, solids, or gases.
- Describe and identify examples of condensation, evaporation, melting, and freezing of water.
- Measure the mass of solids and the volume of liquids in metric and standard English units.
- Examine and describe the transformation of matter from one phase to another, i.e., solid water (ice) to liquid (water) to gas (water vapor).
- Conduct an investigation to observe the condensation of water.
- Design and conduct an investigation to determine basic factors that affect the evaporation of water.
- Identify the phases of water and the uses of water in its various phases in the home and at school.

Science Vocabulary

observe, classify, communicate, predict, experiment, hypothesis, define, mass, volume, matter, evaporation, condensation, melting, precipitation, freezing, changing phase, solid, liquid, gas, properties, water, ice, steam (APSVA, 2013c)

- The Science Standards of Learning, Enhanced scope and sequence, Grade 2, from the Virginia Department of Education:

Science Enhanced Scope and Sequence – Grade 2

Organizing Topic — Investigating Solids, Liquids, and Gases **Related Standards of Learning**

2.3 The student will investigate and understand basic properties of solids, liquids, and gases. Key concepts include

1. a) mass and volume; and
2. b) processes involved with changes in matter from one state to another (condensation, evaporation, melting, and freezing).

Essential Understandings, Knowledge, and Skills

The students should be able to

- classify materials as to whether they are liquids, solids, or gases
- measure the mass of solids and the volume of liquids in metric and standard English units
- design an investigation to determine basic factors that affect the evaporation of water
- examine and describe the transformation of matter from one state to another, i.e., solid water (ice) to liquid (water) to gas (steam)
- conduct an investigation to observe the condensation of water
- describe and identify example of condensation, evaporation, melting, and freezing of water
- identify the uses of water in the home and at school. (Stevens, 2005)

I also used educational websites for lower grade students on the subject (Brent International School, Subic, 2012; Guzman, 2015; LAZEL, 2020) (see Appendix). By employing these sources, I ensured that the lyrics include the specific U.S. learning standards content and vocabulary required for this grade level. The first verse is repeated as the final verse to reinforce the most important information.
From this list of vocabulary and important terms I created a word bank, which is an inventory of words to provide potential rhymes for rhyming couplets. These rhyming couplets were then organised sequentially to become verses.

Solid, Liquid, and Gas Gd. 3/4

Everything around us we touch and see
Is made of matter, which can be
In a solid, a liquid, or a gas state,
Depending on its particles' movement rate.

A solid keeps its size and shape, a case
Of particles closely packed and fixed in place.
A liquid is a fluid, its molecules maintain a
Constant volume, in the shape of its container.

A gas shapes itself through kinetic energy
To fill its container in its entirety.
Matter’s physical state changes when we add or subtract
Energy – a temperature or pressure impact.

Add heat, a liquid turns to gas, that’s evaporation.
Cool a gas to liquid is condensation.
Heating solids melts them to liquid states,
While freezing a liquid a solid creates.

Yes, everything around us we touch and see
Is made of matter, which can be
In a solid, a liquid, or a gas state,
Depending on its particles’ movement rate.

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Rhyme is the use of similar sounding words usually placed at the ends of lines of poetry or song lyrics. Couplets are pairs of lines in a songtext or lyric which rhyme. They can rhyme in different patterns, with the most common rhyme scheme being AABB (Mayer et al., 2008).

I use rhyme in the songs because it has been proven to improve retention and recall (Chuang, 2016; Knott & Thaut, 2018; Read et al., 2014; Tillmann & Dowling, 2007), perhaps because using rhyme restricts potential word choices and can cue memory (Rubin, 1995). A strong rhythmic structure can also aid recall of spoken material by providing phonological priming (Ee, 2015; Kuppen & Bourke, 2017) and is easier to reproduce than an irregularly metred phrase (Obermeier et al., 2013). Failoni writes that “many people often remember rhyme, rhythm or melody better than ordinary speech” (1993, p. 98).

Song and rhyme may positively affect children’s capacity and memory, as shown by the fact that most 5-year-olds are capable of working consciously with just two pieces of information at once yet can sing from memory the alphabet song which contains 26 items of unrelated information (Wolfe, 2001). Singing songs enables even very young children to memorise words and lesson content (Adu & Frimpong, 2018; Werner, 2018). Memory for words is higher in singing than storytelling (Wilson et al., 2011). Also, song may appeal to young children because of its novelty value, particularly as a change in classroom activity, leading to greater engagement (Chemi, 2020).

Song also implements the production effect where speaking words enhances memory over silently reading text, as observed in an Australian study of 7- to 10-year-old children where the read-aloud group scored 87%, while the silent-read group scored 70% (Pritchard et al., 2020). Testing pupil dilation when listening to melodies performed either on the piano or as a vocalise (sung to la, la) found larger dilations for vocal timbre than instrumental and for familiar over novel melodies, indicating greater arousal, attention, and engagement for known vocal music (Weiss et al., 2016).

Incorporating gestures or movement with speech also aids retention (Choi & Kim, 2015; Cook & Fenn, 2017), which in one study of eight-year-olds persisted over six months (Andrä et al., 2020). Gestures are “elaborated encoding” (Porter, 2016, p. 236) providing a “supplemental dimension to learning” (Cherdieu et al., 2017, p. 3). They facilitate memory consolidation both when observed and performed (Cook et al., 2010; Halvorson et al., 2019).

Effective gestures are iconic or meaningful, based on the action or image correlating to the word(s) (Kartalkanat & Göksun, 2020; Overoye & Storm, 2019; So et al., 2012). They should be paired with individual words and be consistent throughout the song (Werner, 2018). Educators can incorporate gestures with the songs they use in the classroom to further improve attention and retention (Choi & Kim, 2015). An example of this is seen in the supplementary activity suggested for the song The Basic Water Cycle. The students can augment the important vocabulary terms in a physical representation of the cycle: circulation – both hands move in a big circle; evaporation - wiggle their fingers as their hands rise up; condensation – make fists and bring their hands together as dense ‘clouds’; and precipitation – wiggle fingers as hands move downwards as rain or snow.

Mnemonics, which are “memory strategies that organise to-be-learned information in ways that enable encoding and facilitate later retrieval” (Lummis et al., 2017, p. 141), frequently contain two organising elements: metre, or repetitive rhythmic patterns, and rhymes at the end of lines (Bower & Bolton, 1969), both key elements of children's song. Preschoolers greatly prefer verse to prose stories, though in one U.S. study their short-term retention was better for the prose version, while adults' retention was higher for the verse condition (Hayes et al., 1982). Young children use rhyme in their own poetry, as shown in 606 poems by 78 two- to six-year-olds in London, of which 42% used rhyme and 26% used alliteration (Dowker, 1989). Rhyme is not only a human phenomenon. A study of 548 songs of humpback whales found rhyme-like repeated patterns occurring in strongly rhythmical contexts, most frequently in the longest songs, hypothetically as mnemonic devices (Guinee & Payne, 1988).

I use a much-annotated rhyming dictionary (Whitfield, 1981) to assist in compiling the word banks with rhyming words that are relevant to the topic. Occasionally a rhyming word can prompt new or unexpected connections with the subject. However, rhyming dictionaries should not be relied upon for all rhymes, especially as they do not include word combinations which can produce polysyllabic rhymes (Hammerstein, 1985). This compilation process is time-consuming and laborious. As renowned songwriter Stephen Sondheim notes, lyric writing is "an occupation consisting chiefly of tedious list-making and frustration" (2010, p. 5).

Obviously, the essential vocabulary words do not have to be placed at the end of a line but listing their rhymes can trigger the mental process of linking words and concepts into phrases or couplets. Some subjects include basic facts in brief phrases that students are expected to memorise. These 'fact phrases' can also be incorporated into the lyrics to aid memorisation and retention. For instance, the chorus of Metamorphic, Igneous and Sedimentary Rock repeats the three classifications of rock four times during the song, while The Basic Water Cycle repeats the cycle of "evaporation, condensation, precipitation" as the final two lines. This is termed repetitive priming, which leads to listeners' increased processing fluency (Nunes et al., 2015).

Memory is the encoding, storing, and retrieving of information, and is a crucial component of learning (Johnson et al., 2020). A U.K. study of 4- to 11-year-olds using multiple memory tasks suggests that all components of working memory are established by the age of four (Alloway et al., 2006). Longitudinal studies show that the speed of cognitive processing increases considerably during childhood and less rapidly in late childhood and adolescence (Kail & Ferrer, 2007). Children's total brain volume reaches 95% by the age of six, peaking for girls at 10.5 and boys at 14.5 years of age, while white and grey matter increase in volume at varying rates during childhood and adolescence (Giedd et al., 2014).

As children mature, they develop complex networks of connections or synapses in the brain, which become permanent through repeated use. The brain develops in stages, with different optimal ages for development, specifically birth to 4 to 5 years for visual and auditory development, birth to 10 years for language development, and birth to 12 years for physical, motor, emotional and social development (Brotherson, 2005, pp. 5-6). Memory develops alongside language in preschoolers and improves during school years as students are able to process and organise information more rapidly via their neural connections. By the age of 7 children develop conscious strategies for remembering, aided by school expectations (Davies, 2010) and training (Schneider & Ornstein, 2018).

When educators incorporate subject-specific song in their classrooms, such as the songs created for this project or their own original songs, they are utilising an innovative pedagogy which enhances learning and memorisation (Calvert & Tart, 1993; Hayes, 2009; Knott & Thaut, 2018; Lummis et al., 2017). This is important because many school systems assess students' comprehension and knowledge and evaluate the effectiveness of educators and institutions through mandated standardised testing (Özturgut, 2011; ProCon, 2016). While not educationally ideal, these tests require the recall and retrieval of facts and information, which involves memorisation.

Research shows that children's memory can be substantially affected by encoding information strategies such as organisation, elaboration, and rehearsal (Gathercole, 1999; Schneider & Ornstein, 2018). One study found that multiple short sessions of learning are more effective than one lengthy session, a process called 'distributed practice' (Baddeley & Longman, 1978). This correlates to singing in the classroom on a regular basis, such as a warmup song at the beginning of each lesson.

Corroborating the positive effect song has on memory, further research in Hong Kong found that music training improves verbal memory but not visual memory in 6- to 15-year-old boys, potentially a result of neuroanatomical modifications, where the left planum temporal is enlarged through music training (Ho et al., 2003). In France, Ferreri et al. (2015; 2015; 2016) reported that using music, even as background sound, improves episodic encoding and recall of information by providing an enriched context for learning.

Neuroimaging shows that processing language and music utilises the same cerebral network (Schön et al., 2010), and that listening to music activates widespread neural networks throughout the brain (Alluri et al., 2011; Geethanjali et al., 2018; Gordon et al., 2018). Exposure to music also activates a network of reward processing mesolimbic structures including the nucleus accumbens and releases the "pleasure" neurotransmitters dopamine and serotonin (Mavridis, 2015). All of these activated neural connections and positive outcomes of using music support the use of song in the classroom for learning.

I worked to ensure that the rhyming couplets or songtext lines in the artefact songs were of similar length, with the same number of beats. Kuppen and Bourke note that "sung or spoken rhyming text provides a strong rhythmic structure" (2017, p. 182) which can facilitate word recognition and phonological priming. These will combine into stanzas or verses, the most common structure being four lines long. I usually limit songs to a maximum of four verses without chorus, or three verses with chorus, depending on the age and abilities of the students.

Rhyme

Through constant reflection my creative process has become more fluent, as my writing skills improved and expanded through investigating not just my praxis, but the ways that children learn at different ages, and how rhyme and song can affect learning. In order to write successful rhymes that enhance learning and retention (Adu & Frimpong, 2018; Read et al., 2014), lyricists and writers need to be familiar with the different types and uses of rhyme.

Researching the different categories of rhyme has led to the conscious incorporation of a greater variety of rhyme types in my lyric-writing process from my previous work, in particular the increased use of internal and crossed rhymes. These rhyme types as defined by Finch and Varnes (2002), Knoop et al (2019), Pape (2012), Strachan and Terry (2001), and Brooke (1976) are presented below, with examples from the artefact songs.

- Perfect rhyme pairs two syllables that are phonologically identical.

  e.g. The compass is a circle, like a clock face,
  Showing four main directions, guides to each new place.
  [Compass]

  e.g. A stream has well-defined banks and a current we can see.
  A river flows to a lake, ocean, or sea. [Bodies of Water]

- Masculine rhymes are accented on the final syllable of the line.

  e.g. Formed from a nebula of dust and gas, its gravitational force
  Pulls its eight planets on their orbit course. [The Solar System]

  e.g. Drawn on a flat surface, a map is a chart,
  A bird's eye view of our world, drawn like art. [Map Legends]

- Feminine rhymes are accented on the penultimate syllable of the line.

  e.g. Why can't polar bears and turtles live together?
  They've adapted to diff'rent climates and weather. [Biomes 1]

  e.g. A map is a diagram representation
  Of the physical features of a location. [Map Legends]

- Triple rhymes are accented on the third to last syllable of the line.

  e.g. What is a polygon? Let's clarify.
  It's a closed plane figure, bounded by [Polygons]

e.g. A food chain is the transfer of energy
From the Sun to plants to animals. Here's a summary. [Food Chains]

- Imperfect rhyme, also termed half, slant or near rhyme is the use of any of the following:
    - Assonance, where the words use the same vowel sounds followed by a different consonant. It is also called vowel rhyme.

      e.g., In the aquatic biome salty water is "marine".
      Freshwater's found in ponds, lakes, wetlands, river, or stream. [Biomes 2]

      e.g., They grow a hundred times in size, from minute to large.
      Some have patterns or coloured skin as camouflage. [Butterfly Life Cycle]
    - Consonance, where the same consonants are used with different vowel sounds, e.g., pitter / patter. I do not use this rhyme type in my lyrics, as I don't feel it is a genuine rhyme.
    - Alliteration, where the words begin with the same consonant sounds. Alliteration has been found to increase attentional engagement, especially for related words (Egan, 2020). This particular example also exhibits
    - sibilance, or the use of sibilants in close proximity, not necessarily only at the beginnings of words.

      e.g., Our solar system is a tiny part of the Milky Way galaxy.
      The Sun is at the centre, the closest, brightest star we see. [The Solar System]
- Eye rhymes are pairs of words which use the same spelling, but are pronounced differently, such as rough / through / cough / though / bough. It is used in poetry, where rhymes are visual, rather than aural. Many are the result of changes in pronunciation over time (Rickert, 1978). I do not use this type of visual-only rhyme in my lyrics.

- Identical rhymes are when the same word is used twice. I used it in the song Triangles due to a lack of suitable rhyming words for “angle”, and in the Days and Months song to reinforce learning of the weekday names.

  e.g. The days are Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday,
  Yes, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.

- Polysyllabic rhyme uses two or more similar sounding syllables.

  e.g. In between these cardinal directions
  Marked by degrees are four sections. [Compass]

  e.g. Two lines that pass through the same point are called intersecting,
  While parallel lines move side by side, never connecting.
  [Basic Geometry]

- Polysyllabic rhymes sometimes use multiple words, which is also termed composite or mosaic rhyme (Kislan, 1995).

  e.g. Deserts are the driest biome. They are a
  Cold zone like Antarctica, or hot like the Sahara. [Biomes 2]

  e.g. A liquid is a fluid, its molecules maintain a
  Constant volume, in the shape of its container.
  [Solid, Liquid, and Gas]

- Chain rhyme is when stanzas are linked by using the same rhymes. Two songs, Civilisations – Eight Great Features and The Basic Water Cycle, take this to the extreme, where every line ends with the same rhyme: -ation. These two songs were among the easiest to write lyrics for, as their key terms all rhymed. The challenge was then to incorporate other rhymes within the lines, such as the internal rhymes in the first two lines of the first example (eight / great, see / history).

  There are eight features great of civilisations,
  We can see through history these common foundations.
  Arts and architecture, social classes, job specialisation,
  Writing, complex religion, public works like roads and irrigation,

Organised central government, cities: all indications
Of successful advanced civilisations.
[Civilisations – Eight Great Features]

The basic water cycle starts with evaporation
Which cools so rain and snow clouds form: condensation.
Then water falls to the earth: precipitation.
Our hydrosphere equation – water's constant circulation:
Evaporation, condensation, precipitation,
Evaporation, condensation, precipitation. [The Basic Water Cycle]

- Enclosing rhyme is ABBA, which I do not use in my song rhymes, as I think it is more difficult for young singers to remember.
- Alternate rhyme uses the pattern ABAB, as shown in Triangles (AABCBC)

Three-sided polygons are called triangles,
Classified by their sides, or their angles.
An equilateral triangle has three equal sides,
An isosceles only has two,
While a scalene triangle has no equal sides,
But wait, we're not through.

  - Internal rhymes are placed within the line (interior), or inside and at the end (leonine) (Young, 2017), and are effective and common (Fraser, 2017). As former U.S. Poet Laureate Billy Collins said, "In the best poetry, the rhymes, you might say, abandoned their little positions at the ends of the lines and invaded the body of the poem. They went inside the poem and became a more organic part of its soundscape" (2016).

e.g. Though climate change can rearrange each biome's location.
[Biomes 2]

e.g. Their lives completed, then repeated, as the females lay eggs, then die. [Butterfly Life Cycle]

e.g. Water flowing, like wind blowing, can transform topography,
And human acts have huge impacts on our world community.
[Bodies of Water]

- Crossed rhyme is where a word in the middle of a line rhymes with a word in a similar location in the following line.

  e.g. In between <u>these</u> cardinal directions
  Marked by de<u>grees</u> are four more sections. [Compass]

  e.g. The continents <u>ride</u> on the tectonic plates below,
  They slowly <u>slide</u> and col<u>lide</u>, move, and grow.
  [Continents & Oceans]

- Envelope is where the identical (or near-identical) line or stanza begins and ends the poem or stanza. Examples of this include the use of the same verse to start and finish the song Solid, Liquid, Gas, and a rhyming couplet which serves as the introduction and chorus for Metamorphic, Igneous & Sedimentary Rock.

  e.g. There are three types of rock in Earth's geology:
  Metamorphic, igneous, and sedimentary.

By researching the numerous types of rhyme, I gained new tools to improve my rhyming skills. Understanding the possibilities inherent in different types of rhyme led to my writing more complex and multiple rhymes in a more conscious and deliberate praxis, particularly internal rhymes.

From these word banks and couplets lyrics are developed for each song. Lyrics are the words of a song (Bhutia, 2017; "Lyric," 2021), or poetry set to music. In song composition lyrics are frequently more subtle and expressive than prose, often playing with language using metaphor, allegory, personification or humour (Low, 2016). However, in writing curriculum-based lyrics, the content is highly constrained as it is determined by the subject. Constructing 'poetry' from 'facts' is a challenge, or as Veale describes it, "linguistic creativity is a marriage of form and content in which each works together to convey our meanings with concision [and] resonance" (2013, p. 152), or "chemistry with words and ideas" (2013, p. 154).

Research shows that rhyme and song are valuable tools for learning for young children. Children can retain more information if it is presented in song or rhyme (Gfeller, 1983; Ortis, 2008). Songs and rhymes are frequently used in second language classrooms, where they not only facilitate memory, but also introduce fun to the classroom (AlAfar, 2016; Ara, 2009; Džanić & Pejić, 2016; Ortiz et al., 2016), potentially boosting student motivation (Azizi, 2016; Mejzini, 2016). In advertising, sung jingles are found to improve retention more than instrumental presentations, or voice overs accompanied by either sound effects or music (Alexomanolaki et al., 2007).

Song or rhyming chant allow young students to learn sounds or phrases even before comprehension, as shown in a three-year German study of eight- to ten-year-old students exposed to multimodal presentations of text in song and chant. Students learned unfamiliar words phonologically with movement and sound effects through repeated, student-initiated rehearsal leading to memorisation and improved fluent reproduction of phrases (Kaminski, 2019). In general, song lyrics are learned more quickly than words, and melody improves retention even if the words' meaning is not understood (Lee & Lin, 2015). This research further supports the value of using song in the classroom to improve learning and retention. Educators can use songs such as those written for this project or write their own to take advantage of these benefits.

Incubation & Illumination

The gestation and revision phases of my praxis align with the second and third stages of Wallas's four-stage model of the creative process of incubation and illumination, or Cropley and Cropley's (2010) generation phase.

- Generate rhyming pairs, couplets, and chains.
- Combine couplets into verses and chorus.
- Write rhythm and melody.
- Add harmony.
- Revise and improve.

It is during this generation phase that two qualitatively distinct ways of thinking emerge. Divergent thought is imaginative, exploring musical possibilities, and alternates with convergent thinking, which is more analytical and discriminating (Webster, 2002).

Crafting lyrics is a process which exemplifies the recursive generation phase of creativity. The word bank prepared in the preparation stage is used to write rhyming couplets, which are then sequenced into verses. This process is mediated by the default-mode network in the brain, which is involved in memory, semantic integration and divergent thinking, where multiple solutions to a problem are created (Kleinmintz, 2019, p. 131). Illustrating the generation phase is an exemplar of songwriting from early in this project, titled Metamorphic, Igneous & Sedimentary Rock, written for grade 5/6.

Exemplar: Metamorphic, Igneous & Sedimentary Rock

In my curriculum overview I found that the three types of rock are taught at different grade levels in different locations: in the U.S.: grade 2, Utah and Texas; grade 4, Utah, Florida, New Jersey; grade 5, Texas; grade 6, Ohio, Texas; and in Australia, year/grade 8. I decided to write for grade 5/6, to challenge myself to include more facts than the smaller vocabulary and fewer facts required at lower grades. I collected materials from the U.S. learning standards (California Academy of Sciences, 2014; Graham, 2015; North Carolina Department of Public Iinstruction, 2011), the Australian Curriculum, Assessment and Reporting Authority (ACARA, 2018), National Geographic (2016), and two age-appropriate classroom online resources, the New World Encyclopedia (NWE, 2019), and the Annenberg Foundation (AL, 2016). From these sources I collected essential facts and vocabulary, then created rhyme lists for important terms as seen below.

Word Bank:
Sedimentary – key, elementary, rudimentary, geology, geography, discovery, extraordinary
Metamorphic – thick, fabric, volcanic
Formed – stormed, warmed, informed, transformed
Classified – guide, slide, glide, ride, wide, beside, inside, identified, modified, liquefied

Earth – birth, worth

Find – lined, defined, grind, combined

Change – range, strange, exchange, arrange

Crust – thrust, dust, just, must, adjust, combust

From this I started writing couplets.

> Earth's crust is made of solid rocks and minerals
> Rocks are solid, mineral materials.
>
> There are three types of rock we must know,
> That form the crust of our Earth – here we go.
>
> Rocks are classified
> How they are formed is our guide.
>
> When magma or lava cools and hardens, we find
> Igneous rocks (they're volcanic) defined.
>
> We learn about rocks in geology –
> Solid mineral materials, there are three
> Main types that are classified.
> How they are formed is our guide.

Over time and multiple rewritings, these were refined and improved:

> There are three types of rocks in Earth's geology
> Metamorphic, igneous, and sedimentary.
> Metamorphic rock is transformed by intense heat
> Or pressure from magma or lava, it's neat.

I realised that today's students probably don't say "neat", so I rewrote the couplet by changing the previous line to end with a different word that would be easier to rhyme. As another example of the evolution of my creative practice I have come to realise that placing the important terms which may be challenging to rhyme such as "metamorphic rock" in the middle of the line creates more opportunities for easier or better end-of-line rhymes.

> Under Earth's surface metamorphic rock is formed
> By intense heat or pressure, it's transformed.

This couplet was edited and combined with another couplet:

> Tectonic plates collide and grow mountain ranges.
> Rocks caught in between them undergo great changes.
> Their mineral composition and texture are transformed
> By great heat and pressure metamorphic rock is formed.

and

> Sand, shells, pebbles, particles and sediment press
> And cement together in layers, a long process.
> Formed where water is, or used to be,
> These soft rocks are sedimentary.

Like the majority of songs in the artefact, the song's metre or musical time signature is common time or 4 4, with four quarter note beats in each bar. This conforms with the fact that the preponderance of children's songs are in duple (or quadruple) metre (Burling, 1966; Campbell, 1989; Gonzalez, 2016). This finding may be because young children frequently use song as an accompaniment to movement and games such as handclapping, hopping, skipping, or jumping rope where duple metre facilitates coordinated movement such as clapping on the first strong beat of each bar (Perdue & Campbell, 2020). The key is E flat major, and the melodic range is a major ninth, from B flat 3 to C5, and uses both stepwise/scale and triadic movement.

The harmony for this song is determined by the melodic structure. The chorus opens with the outline of the tonic chord (B flat 3, E flat 4, G4, B flat 4), which is accompanied by the E flat major chord. The harmonic progressions are standard:

Verse:	I, vi, IV, V / ii^7, V
	I, vi, IV, V / ii^7, V^7, I
Chorus:	I, IV, V / vi, ii^7, V^7, I

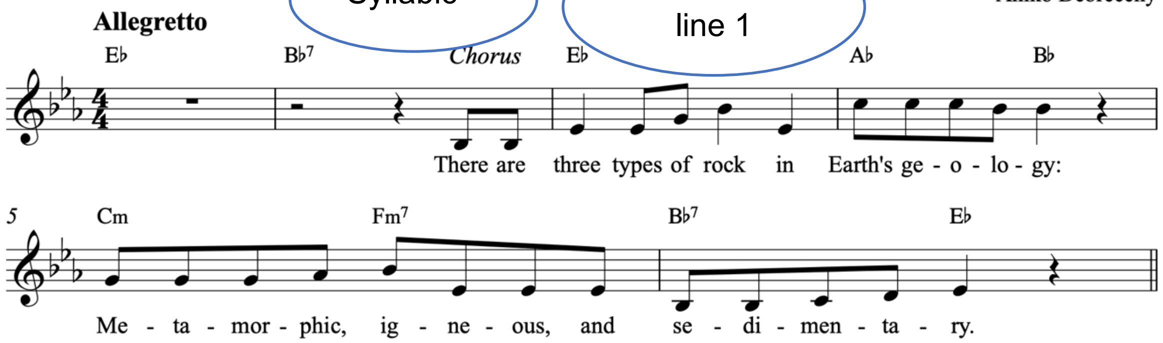
This annotated version shows the rhyme elements incorporated in the song:

Metamorphic, Igneous & Sedimentary Rock

Syllabic

Anacrusis
line 1

Aniko Debreceny

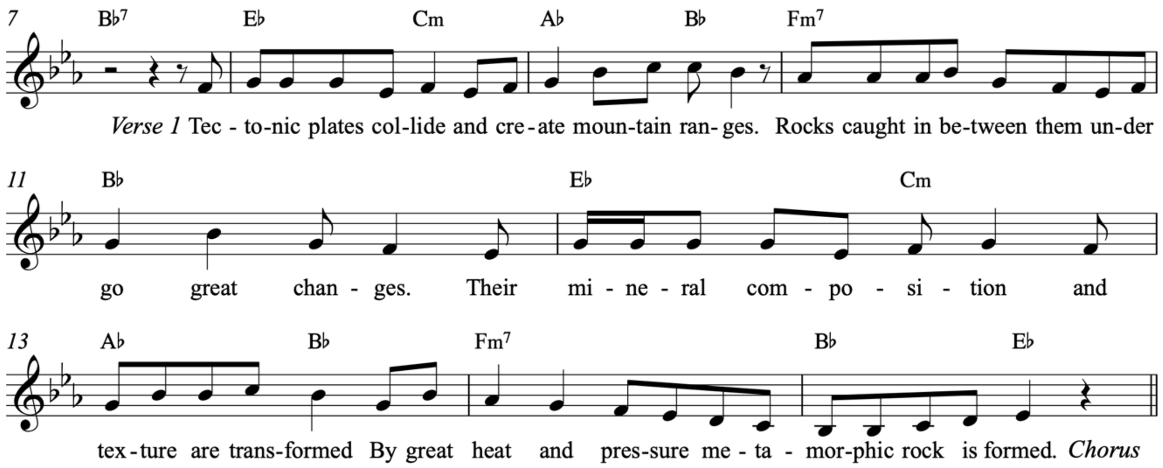


Masculine
Rhyme

Envelope – the same lines are
used at the beginning and end

Anacrusis
lines 1, 3, & 4

Feminine rhymes
lines 1 & 2



Inner rhymes
lines 1 & 2

Alliteration
line 3

Masculine rhyme
lines 3 & 4

Anacrusis
lines 1 & 4

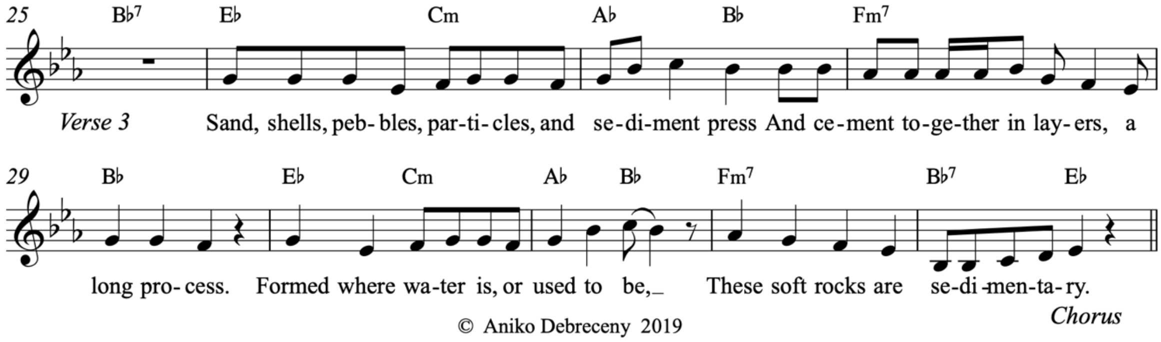
Masculine rhymes
all lines

Melisma
lines 1 & 2

Alliteration
line 2

Masculine rhymes
all lines

Anacrusis
line 2



In this case, the final version of the song took six months to accomplish in the recursion cycle of incubation, illumination and revision. The "illumination" couplet (see page 89) became the introduction and chorus, encapsulating the essential information in two lines. I revised the harmony to include less predictable modulations, changing the bass line and harmony to incorporate scale patterns: ascending (A flat – B flat - c minor) in the chorus and descending (E flat – D flat - c minor – B flat) in the verse. I added syncopation to the final verse for greater rhythmic interest, using the same rhythmic motive at the end of the first and second lines.

Here is the annotated version 2 of Metamorphic, Igneous & Sedimentary Rock.

Annotation Key:	
Rhyme	Blue
Melody	Green
Harmony	Red
Rhythm	Orange

Major tonality

Largest melodic interval major 6th

Melodic range major 9th B♭3-C5

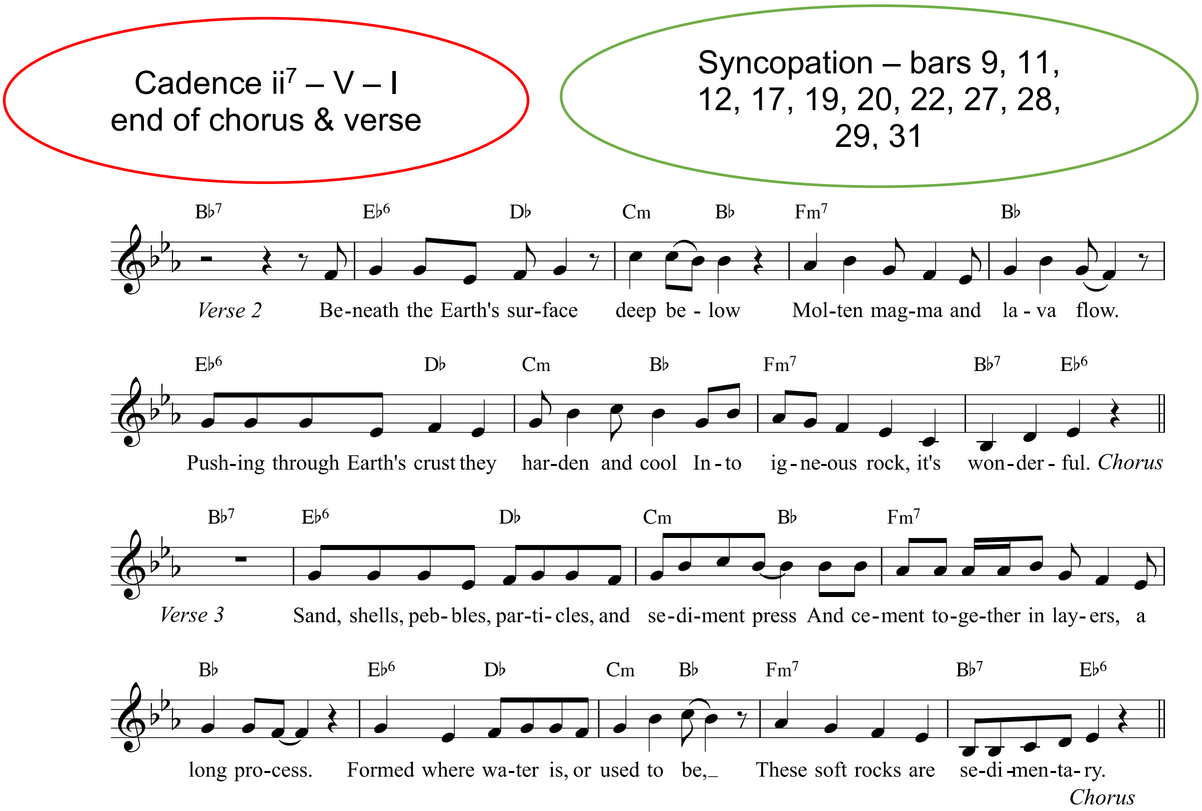
Added note harmonies 13 of 24 chords

Metamorphic, Igneous & Sedimentary Rock version 2

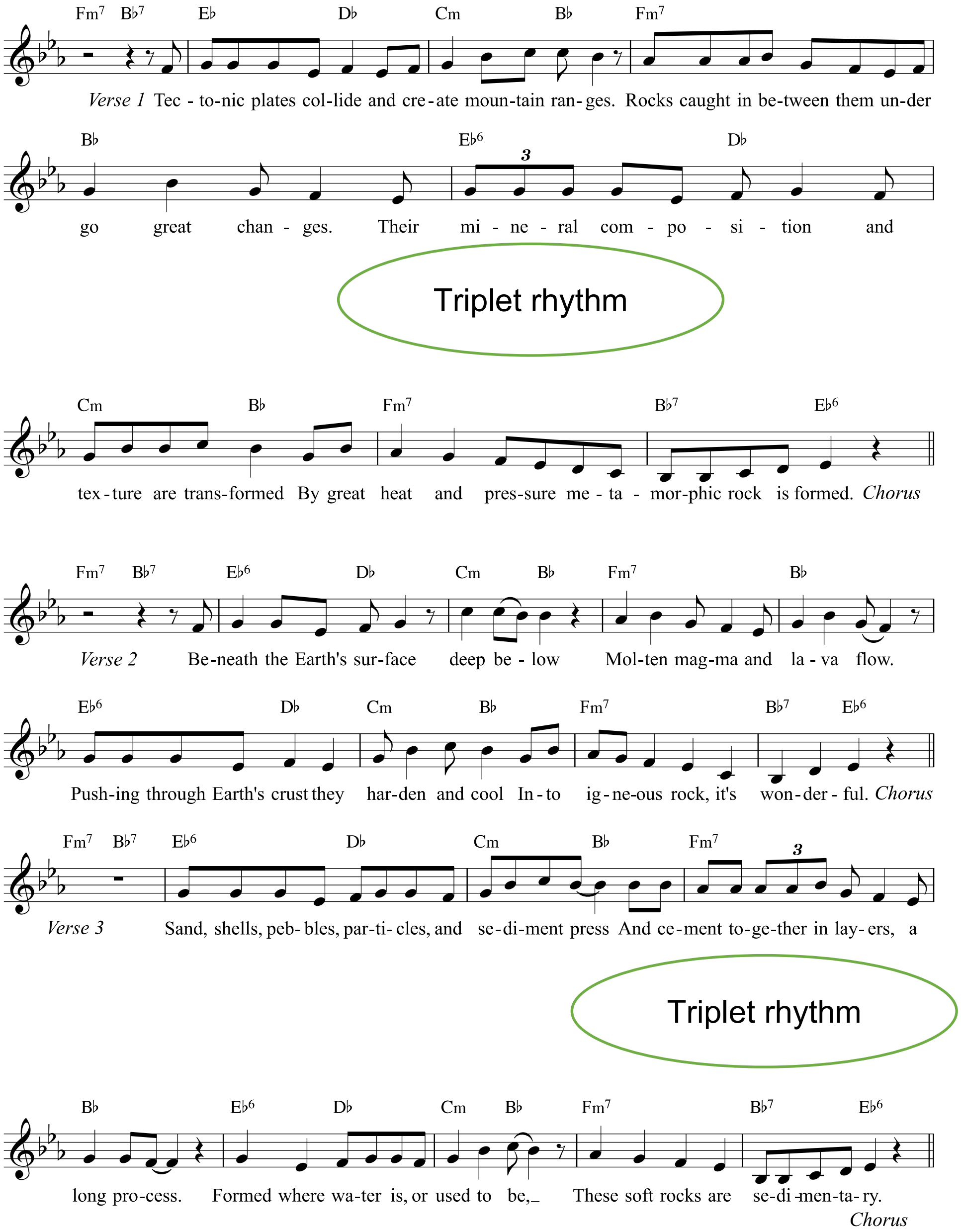
Aniko Debreceny

Anacrusis - bars 2, 7, 11, 14, 17, 23, 29

Accented passing notes bars 5, 8, 10



I later revised the lyric rhythms to be less hurried, altering the two sixteenth note + eighth note rhythms to equal length triplets (for vs. 1 “mineral”, vs. 3 “together in”). The even triplet rhythm is slightly slower and therefore easier to enunciate for young singers.



Some of this song’s vocabulary may be considered too advanced for young students. However, it is included as essential information in the learning standards, and so the students will be expected to know the terms. In my experience, children are capable of absorbing incredible amounts of information, especially when it is (a) relevant to their learning experience and (b) presented in an appealing medium. While not guaranteeing comprehension of the material (Beasley & Chuang, 2008; Calvert, 1993, 2008), particularly for younger students (Greenfield et al., 1987), song as a vehicle for learning is shown to improve retention (Butler & Newman, 2008; Gfeller, 1983; Ortis, 2008; Wolfe, 2001).

This enhanced retention can be long-term. Students in Panama who learned their middle school curriculum through songs (Zarate & Pérez, 2016) and Japanese students who were taught patriotic songs during the second world war (Manabe, 2012) still remember the songs over five decades later.

The chorus contains the most important information. Repetition improves memorisation and retention (Beasley & Chuang, 2008; English & Visser, 2014; Fisch, 2014; Iwasaki et al., 2013; Legg, 2009; Nunes et al., 2015; Pindale, 2013; Rockell, 2015; Tomczak & Lew, 2019; Wallace, 1994), especially for young students (Millington, 2011; Vidovic, 2016). Repeating the most important information in the chorus multiple times reinforces recall (Fisch, 2014), though too many repetitions may lead to a negative effect (Nunes et al., 2015).

The repeated active retrieval of information such as listening to and singing of songs on a regular basis also aids memorisation and promotes learning (Johnson et al., 2020; Karpicke & Blunt, 2011; Karpicke, 2012), by strengthening neuron networks linked with the information (Crowther et al., 2013). Cook notes that “the very act of repetition also allows greater time for processing and creates a generally more secure and relaxed (because it is more predictable) atmosphere which may aid receptivity” (2000, p. 30).

While working on the lyrics, the word/musical rhythms become obvious. The rhythm conforms to normal speech patterns, though I frequently employ syncopation for rhythmic interest. As when writing poetry, the lyricist must place important syllables on a strong beat in a bar (unless an unexpected, syncopated effect is intended). For instance, the simple sentence “The cat sat on the mat” should have the “strong” beats/emphases on “cat” and “mat”, rather than “The” and “the”. In musical terms, this would require an upbeat to each bar, so that the emphasis falls on the second and sixth syllables of the example sentence. This anticipatory syllable(s) or note(s) is known as “anacrusis” in both music and poetry (Strachan & Terry, 2001).

Syncopation is where the accent is unexpectedly placed on a weak or off-beat rather than a strong beat, creating metrical or rhythmic tension. Though it may be considered too sophisticated or difficult for young singers, I feel justified in using syncopation in children's songs because they frequently use it in their own songs (Campbell, 1989; Perdue & Campbell, 2020). Also, a moderate level of syncopation is shown to lead to a significant increase in "groove" ratings, which is where the listener wants to move while listening to music, evidencing greater listener enjoyment (Sioros et al., 2014). Repeated syncopation can cause an increase in heart rate (Verhaegen, 2018).

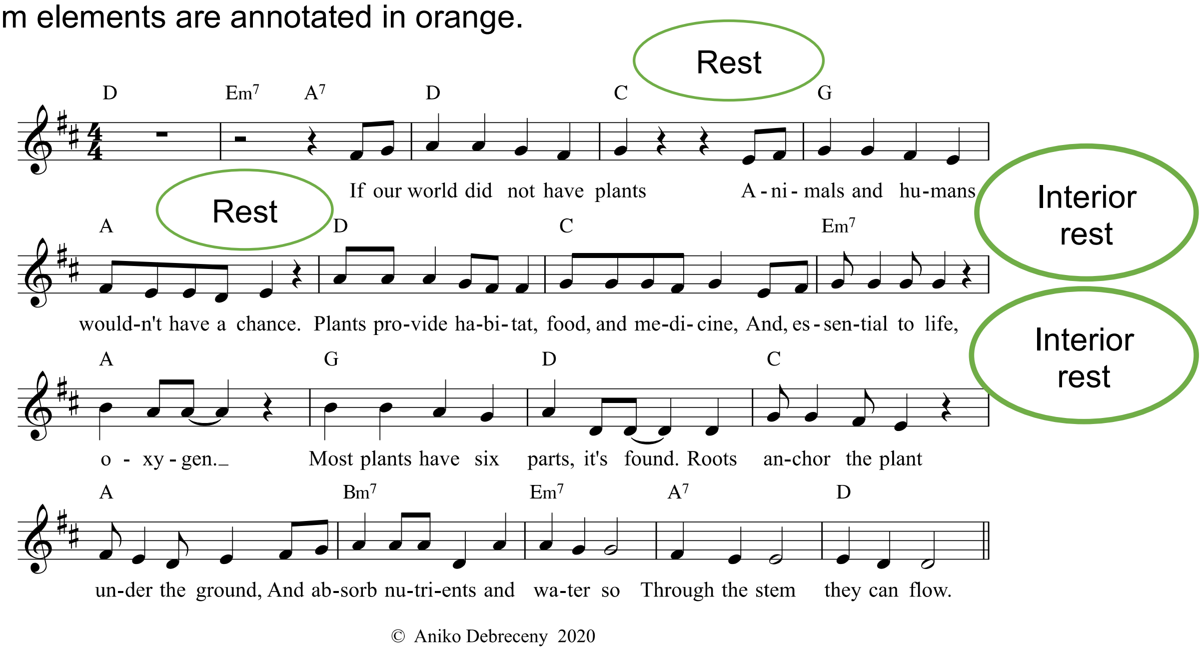
In this song, I use anacrusis/upbeats in the first and second verses and the chorus, so that the strongest syllable of primary words coincide with the strong first beat of a bar. In the chorus, two weaker, upbeat notes are used for the text "there are", with the strong, downbeat note for the important word "three". Verse 1 places the strong second syllable of "tectonic" on the downbeat, with "collide" on the strong third beat, and "create" on the strong downbeat of the next bar. The next line of lyrics starts on the downbeat for the strong syllable emphasis on "rocks", while the following line begins on an upbeat into the strong first syllable of "mineral".

In this example, all the notes are either quarter or eighth notes, except for one two sixteenth-note pattern which is necessary to compress the lyric syllables for "mineral composition". Like most children's songs, it is syllabic as in normal speech, where each syllable is sung on one note, rather than melismatic, where one syllable will be sung over several notes (Wassink, 2011). This is notated using a curved line called a slur, as seen below.

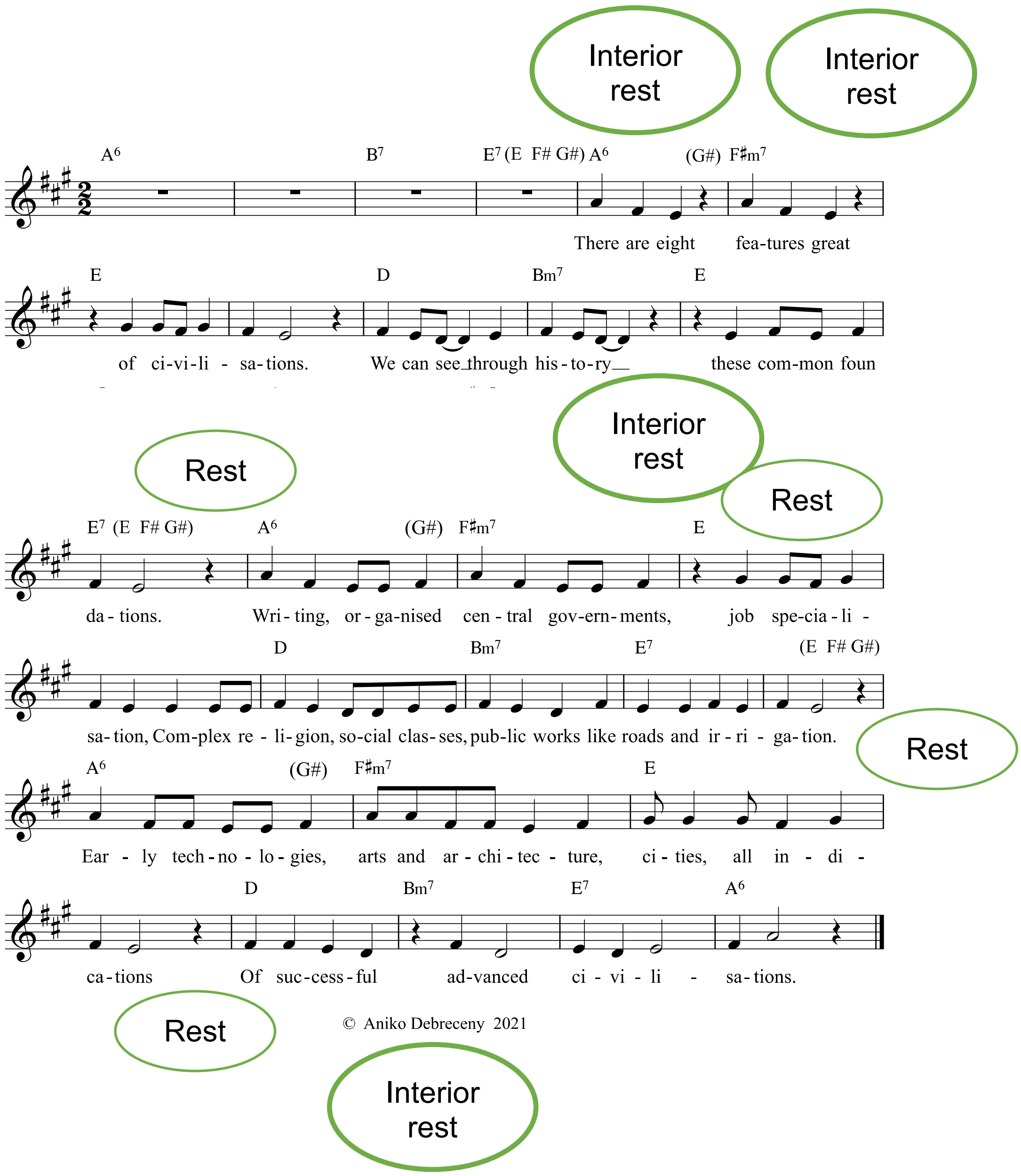
I very rarely use melismas in my songs as research shows that more words are correctly recognised in syllabic (84%) than melismatic (77%) settings and that matching word or syllable stress with musical stress (strong beat) also improves intelligibility (Johnson et al., 2014).

I include rests or spaces in the music, when possible, for the singers to take a comfortable breath between phrases. This is common practice in nursery rhymes in many cultures, with frequent rests at the end of the second and fourth lines of a four-line stanza (Burling, 1966). Rests allow young singers with a small lung capacity to be able to sing an entire lyric line in one breath. Gonzalez's (2016) analysis of 21 popular nursery rhymes found that 57% used two-bar phrases, and 29% used four-bar phrases, while Lum and Campbell's (2007) study of elementary school children's play songs showed frequent uneven phrases, usually the length of a single breath.

Another example of rests which can be used for breaths can be found in Parts of a Plant, written for grades 1 and 2. Rests are written at the end of the first, second, and fourth lines, and interior rests in the fourth and sixth lines. Rhythm elements are annotated in orange.

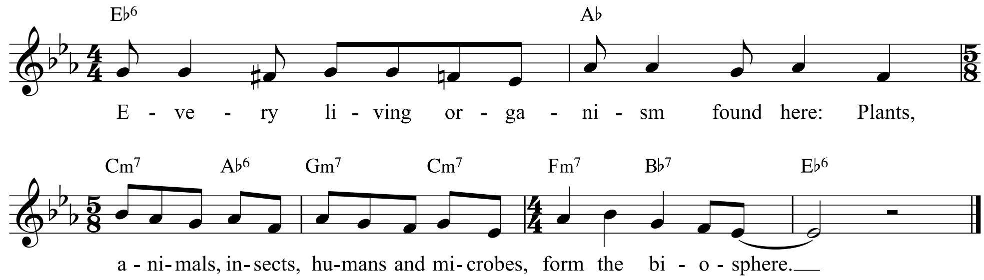


Of course, including rests is determined by the number of syllables in each line of lyrics, as can be seen in the second example, Civilisations – Eight Great Features (grades 5 & 6). The first two lyric lines have fewer syllables, so can include internal rests, as in the third, fifth, and sixth lines.



The lines of the lyrics contain the same number of beats, as a regular metrical pattern is more easily remembered and reproduced than an irregular pattern (Essens & Povel, 1985). Children from the age of three are able to perform and improvise rhythms using a steady beat and metre, adding more complex patterns as they grow older (Reinhardt, 1990). Traditionally, children's songs are structurally repetitive, with simple rhythms (Bebout & Belke, 2017). Children appear to enjoy this repetitious and predictable structure, without finding it tedious, using it in their own songs as they grow older (Cook, 2000).

To create more interesting lyric rhythms, the composer can change the number or value of beats in the bar for variety of word and beat emphasis, and bar length. This can also be useful when the number of essential word syllables is greater than in the matching couplet line or verse. An example of this can be found in Earth Systems, where the usual simple quadruple time signature (4 4) changes to 5 8 for two bars.



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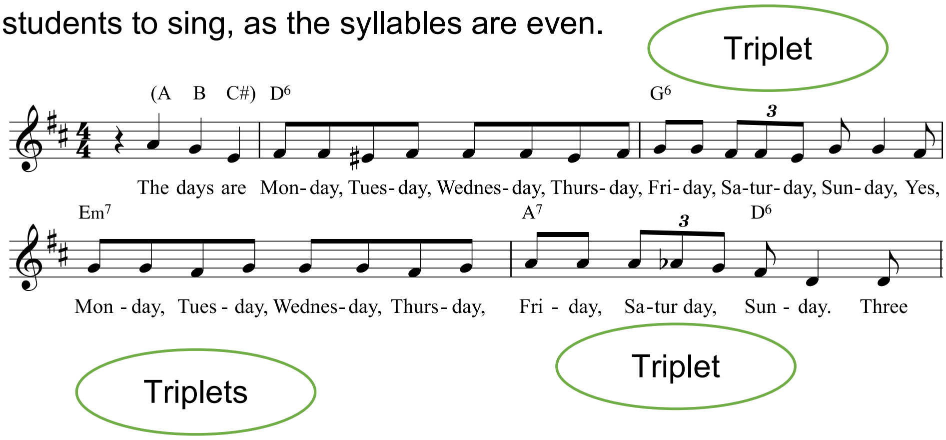
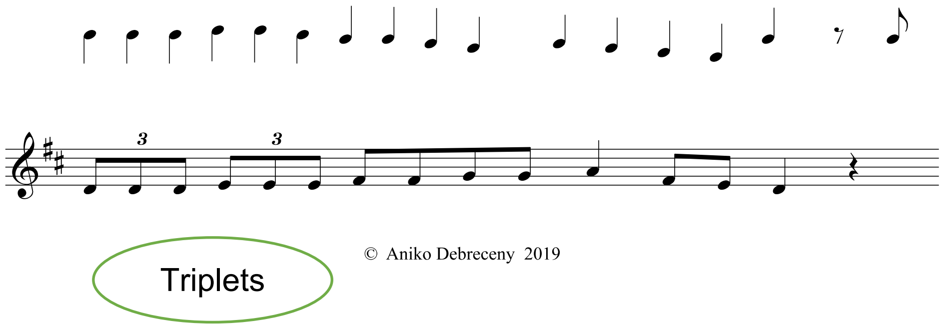
Another example of this is Days & Months, where I use triplet eighth notes to facilitate enunciation in common quadruple metre, or 4 4. This makes the rhythm sound as though I have briefly changed the time signature to compound quadruple, or 12 8, but makes the lyrics much easier for grade 1 and 2 students to sing, as the syllables are even.





Nursery rhymes and children's songs in many cultures and languages follow a common pattern of four-line verses, each containing four regular strong stresses or beats (Burling, 1966; Cook, 2000). The lines are usually approximately three seconds in length (Cook, 2000). Indeed, this four-beat, four-line verse structure is found in poetry since medieval times, traditional and popular songs, and advertising jingles (Attridge, 2014). The majority of my songs are structured similarly to conform to children's typical musical lexicon, such as their preference for repeated melodic patterns and rhythms in songs (Campbell, 1989).

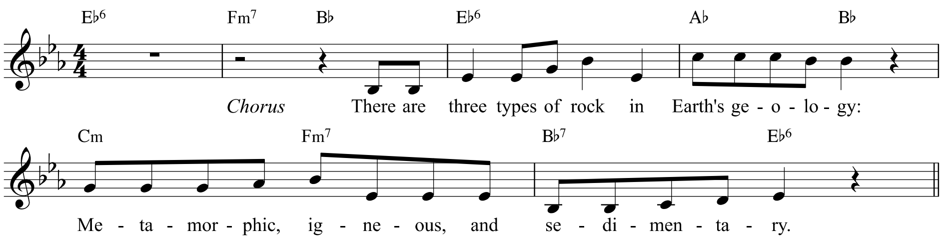
Most educational children's songs are short, in major keys, with a small melodic range, and use simple rhythms and typical speech patterns, and mostly conjunct (stepwise) melodic shapes (Legg, 2009; Marsh, 2008). Using simple and symmetrical melodies which are easy to sing also improves learning and recall (Ferreri & Verga, 2016; Maloy, 2016; Wallace, 1994). In addition, repetitive melodies and consistent rhythm patterns are effective to enhance assimilation and retention (Gfeller, 1983). Familiar melodies benefit learning better than unfamiliar melodies, or a spoken modality (Serafine et al., 1986; Tamminen et al., 2015).

Most of my teaching song melodies are based loosely on the AABA or ABAC melodic structures, with the repetition or similar melodic contours adding familiarity to make them easy to learn and remember. The contrasting line(s) provides melodic and harmonic variety for interest.

If writing songs, understanding the importance of allowing adequate time for the incubation or gestation (Wierzbicki & Nakamori, 2005) phase of the creative process is essential for educators and their students. This is the result of the unconscious mind making connections between experience and prior knowledge to form new associations and solutions (Carpenter, 2019), usually over an extended period of time (Csikszentmihalyi & Sawyer, 2014; Perkins, 2009; Poincaré, 1914). Without providing sufficient time and opportunity for incubation, illumination is less likely to occur.

As my praxis has developed during this project, I have incorporated new strategies to encourage the incubation phase in my creative work. I have consciously put songs to one side and started working on another in its preparation phase, then returned to the first song after a period varying from a few days to a month. Another new stratagem was to read over all my preparation materials before sleeping to stimulate problem-solving neural activity while asleep in the incubation phase. I learned to carry a small notebook and pencil everywhere in case a rhyme, rhythm or melodic fragment would emerge unexpectedly in the illumination phase.

An example of the “illumination” phase of Wallas’s (1926/2014) theory of creativity is my personal experience when walking while thinking about the Metamorphic, Igneous and Sedimentary Rock song, described above. That incubation phase produced the following couplet, complete with melody. I sang it all the way home, so as not to forget it.



I frequently find rhymes or couplets ‘arrive’ or come into my mind when I am walking. Though this may seem to be a sudden inspiration, it is the outcome of extended thought and processing. It has been shown that the physical movement or the slight disengagement of mental concentration is the “x” factor in allowing new connections to be made in the brain. Aristotle lectured while walking, thus founding the Peripatetic school (Balas, 2018), while Nietzsche wrote in his ‘Epigrams and Arrows’, “Only thoughts reached by walking have value” (1889, p. 10). Walking increases creativity and creative divergent thinking scores compared to sitting (Keinänen, 2016; Oppezzo & Schwartz, 2014), providing an opportunity for the incubation and gestation phase of creativity (Abraham et al., 2019; Nelson, 2013).

Cognitive psychology classifies two systems of reasoning, the rational or rule based, which utilises conscious activity, and the experiential or associative system, which is non-conscious or de-focused activity (Aldous, 2007). These two processing systems are thought to function in parallel and interact with each other (Epstein, 1994). Recent research using neuroimaging technology shows that sudden creative insights involve three regions of the brain, the temporal, occipital and parietal, while deliberate and analytical conscious creativity involves the prefrontal cortex (Carpenter, 2019). While creativity’s rapid ‘aha’ moment of illumination or inspiration is initiated in the brain’s right hemisphere, an extensive network across both hemispheres is then activated in the slower process of elaboration (Carafoli, 2017).

Csikszentmihalyi and Sawyer note that there is actually a “life span” for the “moment of insight…one short flash in a complex, time-consuming…process” (2014, p. 73), or as Perkins writes, “Mental leaps depend on extended unconscious thinking” (2009, p. 50). This elongated processing time may allow for enhanced spreading activation, where recall of one piece of information triggers a series of recalled information segments leading to more diverse solutions (Hines et al., 2019).

A U.S. study of hikers showed that they improved their creative problem-solving skills by 50%, though the study did not test which factor may have contributed most – the walking or immersion in nature (Atchley et al., 2012). However, Oppezzo and Schwarz’s (2014) U.S. study found that walking significantly improved divergent creative thinking in 81% of participants whether it occurred indoors or outside. A Norwegian study of nine academics who use walking-for-thinking as an integral part of their professional lives reports that walking at participants' optimal individual speed leads to enhanced memory, concentration, and creative problem-solving (Keinänen, 2016).

The improvement in cognitive thinking while walking may be explained by the increase in blood flow caused by physical effort, which affects the brain. However, visual movement also affects divergent creativity positively, as shown in a study where participants were found to be more creative in a virtual environment which provided a perception of movement, such as a train which is moving (Fleury et al., 2020).

Understanding that walking can facilitate the incubation phase of creativity led to my walking at least once a day, and often twice when time permitted, with correspondingly more frequent moments of illumination leading to solutions of creative problems. Though walking is the most frequent activity which stimulated illumination in my praxis, I also experienced it during other activities, such as dishwashing, showering, and upon waking.

Research corroborates my personal outcomes of enhanced creativity through activity. Divergent thinking or creative idea generation is shown to improve after performing low cognitive demand repetitive or mindless activities, during "spontaneous task-independent mind wandering" (Gable et al., 2019, p. 396), relaxing (Heilman, 2016), or dancing (Steinberg et al., 1997). An Australian study investigated 1,114 respondents' experiences with insight or illumination, finding that 88% had experienced the phenomenon in a variety of locations and activities, which included showering and travelling. They suggest that there may be a link between the soothing sound of a train, bus or shower that reduces the level of aural stimulation, providing a state more conducive to creative thought (Ovington et al., 2015).

A study of 96 9–12-year-old students in Spain found that a 45-minute aerobic games class significantly improved creativity in all areas except graphic originality, titles and details over students who did not exercise (Román et al., 2018). Sixty U.S. college students were tested for creative potential after moderate aerobic exercise, finding significant improvement not only immediately, but also that exercise had a residual effect on creativity over a two-hour period (Blanchette et al., 2005). A review of 20 studies reports that 90% found that embodied movement significantly enhanced creativity (Frith et al., 2019).

A meta-analysis of 177 studies found the benefits were greatest for creativity when subjects were involved in an undemanding task during the incubation period, rather than a demanding task or no task (Sio & Ormerod, 2009). This "task-unrelated or stimulus-independent thinking" (Travis, 2021, p. 161) allows the brain to generate solutions to problems, experienced as illumination as either an 'aha' moment of spontaneous breakthrough, or an unexpectedly rapid solution upon returning to the creative task (Gilhooly, 2016). This unconscious yet active processing is different to the fresh-look approach, where one walks away from and forgets the problem for a time before returning to work (Gilhooly et al., 2012), also termed selective forgetting (Sio & Ormerod, 2009).

On the other hand, a study into creative problem solving found no difference between an easy stimulus-response task, a more complex stimulus-response task and a mindfulness exercise during an incubation period, which may be explained by its brevity of only twelve minutes (Rummel et al., 2020). Research which compared the results after incubation periods of ten and twenty minutes discovered significant gains in performance for the longer time (Fulgosi & Guilford, 1968). The esteemed mathematician Henri Poincaré described his moments of "sudden illumination, [as] obvious indications of a long course of previous unconscious work" (1914, p. 55), and suggested that iterative conscious work unlocks the unconscious solution to a problem. Taking a break produces more solutions than continuous work (Ellwood et al., 2009), with significantly greater creativity when participants are aware that they will resume the task after the incubation period (Gallate et al., 2012).

Sleep is also found to facilitate creativity (Nelson, 2013; Ritter & Dijksterhuis, 2014; Wierzbicki & Nakamori, 2005). Testing creative insight after 8 hours of sleep or wakefulness found that almost 60% of the subjects who slept generated a solution after waking, compared to 23% of the non-sleepers (Wagner et al., 2004). REM sleep optimizes the brain towards the ideal neurophysiological state for creative processing, forming associative networks and integrating unassociated information. This can either be remembered upon waking from a dream where the new product appeared, or by the priming of the brain for later reactivation of critical associations (Cai et al., 2009; Stickgold, 2019).

In my own praxis I have found that 'priming' my brain by reading over material I am working on before sleeping can help produce 'illumination' insights the following day. By combining this process with walking in the early morning, I now am utilising two methods of improving my creative processing.

Verification

The fourth phase of creativity is verification, which is the conscious articulation of the insight (Amabile, 2019). This stage includes checking, developing and refining (Aldous, 2007), elaboration and evaluation (Sadowski & Connolly, 1999) and modification (S. Liu et al., 2016). Creativity often cycles between the incubation or generation phase and evaluation (Kleinmintz et al., 2019). This stage leads to realisation, production and publication (Botella et al., 2018; Heilman, 2016). Verification is represented in the graphic and symbolic presentations of musical sound, as documented in my workbooks, song exemplars, and the creative artefact. To make these accessible to a wide audience, I employ standard musical notation, as explained below.

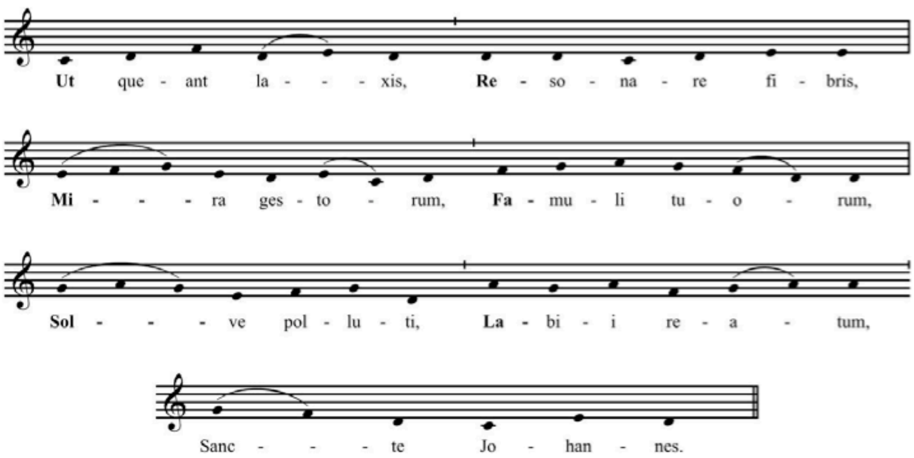
Using the same notebooks for the collated curricular materials and the compositions keeps all elements of each song in one location for easy background referencing. I prefer to write melodies and rhythms with pen and paper, rather than the now common practice of composing directly into a music publishing software programme. I find it easier to compare different versions of the same song visually literally side by side, and I can notate the words and music more rapidly by hand. By lightly crossing out rather than erasing or deleting, I am able to see and compare all versions of a developing musical or poetic train of thought simultaneously.

Notation

Music notation is “graphic signs…to represent sound visually” (Rankin, 2018, p. 9), and has been used for centuries as a means of organising choral and instrumental musical performances. Since the earliest known examples of notated melody cuneiform tablet fragments from around 1250-1200 BC (West, 1994) music notation has gradually evolved, allowing vocal music to disengage from the oral tradition, so that it could be “learned without hearing it…memorized more easily, and…transported to and learned in distant cities” (Strayer, 2013, p. 5), in modern classrooms or online. Without a commonly accepted notation system, written music would be far less accessible to a wide audience. Students and composers would not have a common language to share their work. This standardised musical vocabulary enables universal dissemination and performance.

I notate pitch using ‘solfa’, which evolved from the work of Benedictine monk Guido of Arezzo, a very influential music pedagogue and theorist in the Middle Ages (Reisenweaver, 2012). Solmization is the “substitution of any syllables for letter names or scale-step names” (More, 1985, p. 9), or “the use of syllables in association with pitches as a mnemonic device for indicating melodic intervals” (Sultanova & Bariseri, 2012, p. 2395). This system enabled singers to link notes to an established pattern of intervals. The names of the solfa scale are based on the first syllable of each new phrase in the hymn to St. John *Ut queant laxis*, where each new phrase begins one note higher than the previous one.

Ut queant laxis



(Reisenweaver, 2012, p. 45)

This chant may be a very early example of educational song, as Guido is thought to have rearranged an earlier melody or composed this hymn as an instructional tool for teaching young choristers (Robertson, 2012), as there are no prior examples of this melody for the hymn (Harbinson, 1971; Palisca & Pesce, 2001). Over time music expanded from the medieval hexachord (six note) range. The seventh degree of the scale *ti* was added around 1600 (More, 1985), and *do* was substituted for *ut* to facilitate pronunciation (Reisenweaver, 2012).

A single letter denotes each pitch, conforming to the Hungarian composer and educator Zoltán Kodály's solfa notation where d = *do*, r = *re*, m = *mi*, f = *fa*, s = *so*, l = *la*, t = *ti*, and d' = high *do*. A high dash written after a note shows that it is to be sung an octave above do (e.g., r' = high *re*), and correspondingly a low dash written after a note shows it will be sung below do (e.g., so, = low *so*). In music theory, the solfa names correspond to the notes of the major scale as *do* = tonic, *re* = supertonic, *mi* = mediant, *fa* = subdominant, *so* = dominant, *la* = submediant, and *ti* = leading tone.

Solfa has advantages in that it uses a single syllable for each note, including raised or lowered notes (e.g., a raised "fa" becomes "fi", or a lowered "mi" becomes "maw" or "me") and is quick and simple to write. All the solfa names end in a vowel, making them easy to sing. Also, by using solfa, numbers can be reserved for counting beats or rhythms.

Solfa note names

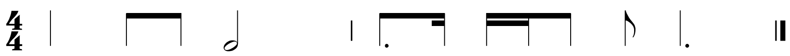
Having studied the Kodály method in Australia and Hungary, I use “movable-*do*” or “Relative Solfa” (Chiel, 1996) rather than fixed-*do* solfa. In fixed-*do* solfa *do* is always the pitch C, while in relative or movable-*do* solfa, *do* is the first note of the major scale no matter what the key. Each solfa syllable corresponds to a scale degree rather than a specific pitch (Frey-Clark, 2017; Sultanova & Bariseri, 2012). Kodály became aware of solfa through the teaching and texts of John Curwen, an English music educator who appropriated and expanded on the work of Sarah Glover (Bennett, 1984; Stevens, 2003). Curwen’s most important contribution was the introduction of chromatic syllables to accommodate all twelve half steps of the octave scale (More, 1985).

Using natural speech patterns and emphases, the rhythm is written using stick notation (Green, 2010; Houlahan & Tacka, 2008). This was also developed by Kodály as a quick notation method using only note stems (or sticks), dots, and flags (Houlahan & Tacka, 2008; Stevens, 2010). Note heads are not included, except for half and whole notes. As with early music notation (Jacobson, 2017; Johnson, 2000; Landels, 2002), it does not use the musical stave, but instead uses symbols written above the words of the lyrics. I find it a simple and rapid notation system, which does not require specialised five-lined manuscript paper but can be jotted down anywhere when inspiration strikes.

Some of my musical ideas have been written on the back of envelopes or grocery receipts.

Traditional rhythm notation

Stick figure rhythm notation



These two notation methods are quick and uncomplicated to write. By using non-pitch-specific notation, the key can remain undetermined until the melodic range is decided. The melodic range will dictate the potential key(s) which conform to the appropriate singers' vocal range. For example, if the melodic range is s, (low so) to la (high la), children's lowest comfortable singing note is A3 (A below middle C). Therefore, the key can be either D major (A3 – B4), E flat major (B flat3 – C5), or E major (B3 – C#5). The final phase of my notation process adds the harmonies using chord names, e.g., D, em, G, A^7 (D = D major, em = e minor, G = G major, A^7 = A dominant 7^{th}).

Melody

As part of the gestation and incubation phase of the process, once the lyrics are written, the next step is to compose the melody. Melody is the succession of single musical notes or pitches combined with rhythm. So that my melodies would conform with children's preferred musical lexicon and vocabulary, I researched both songs written by children and the traditional children's repertoire. Campbell's (1989 p. 19) study of 18 songs by children in kindergarten, first and second grade in the U.S. found that four were unpitched chants, one used two pitches, two used three pitches, four used four pitches, two used five pitches, and three used six pitches. 55% used the range of a fifth or less, and none exceeded an octave in range. All were in duple metre, with one in 6 8 or compound duple. To correspond to these elements, the melodic range for the grade 1 & 2 songs varies between a perfect fifth and a major ninth, and all are in duple or quadruple metre.

Gonzalez's (2016) analysis of twenty-one popular European nursery rhymes found that the majority of melodic intervals were unisons (34%) or major seconds (a single step) (32%), and that 65% of the songs utilised only two intervals. The same study found that perfect fifth intervals occurred very rarely (2.1%), perfect fourths sometimes (8.2%), while the perfect octave was not used at all. Matching these findings, most of the artefact songs for the younger classes use primarily stepwise and skip intervals.

In songs, the rhythm is determined by the speech patterns and rhythms of the lyrics, and influences the metre, or number of beats in each measure or bar. Gonzalez's study of nursery rhymes found that only 10% were in triple meter (3 4), with the rest using two or four important rhythmic beats in the bar (simple quadruple = 42%, simple duple = 19%, and compound duple = 29%) (2016, p. 16). A study of 30 Brazilian children's songs found only one in triple metre, with the majority (97%) in simple duple or quadruple time (Green, 2010), while two songbooks from the children's educational television show Sesame Street also use predominantly two or four beats in the bar (93%) (Moss & Raposo, 1992; Raposo & Moss, 1971). Children's songs, while conforming to differing cultures' language speech patterns and rhythms, are characterised by regular rhythms and slower speeds (Hannon et al., 2016).

Prosody is the study of both rhythm or the placement of stresses, and the number of emphasised syllables in a line of poetry (Adamson, 2019). When analysing or scanning a line of English poetry or lyrics, there are commonly four stressed beats, each of which usually is grouped with one or two unstressed syllables. These units are called feet, and there are six types: [- = unstressed syllable, / = stressed syllable]

- *iamb - /*
- *anapest - - /*

- *trochee / -*
- *dactyl / - -*
- *spondee / /*
- *pyrrhic - -*

The most common foot is the *iamb*, with an unstressed syllable preceding a stressed syllable. In music, this corresponds to the poetic anacrusis, the upbeat or note(s) before a bar line or strong beat. This upbeat rhythm is found throughout my songs, in order to extend the number of notes to match syllable counts within a restricted number of beats or bars and to conform with natural speech patterns and stresses.

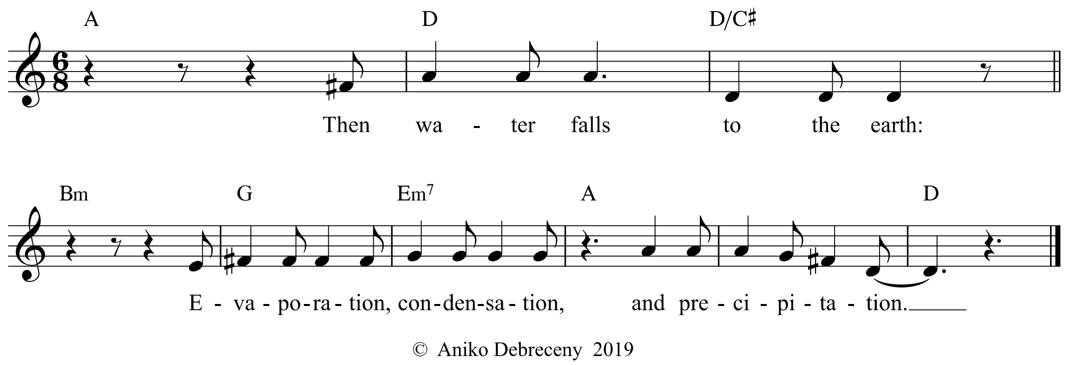
The most common poetic verse line structures or length are four beats, or *tetrameter*, and five beats, or *pentameter* (Attridge, 1995). The prevalent underlying rhythm in English popular verse is tetrameter, with four strong beats to each line. This pattern is also found in verse written in Sanskrit, Greek, classical and medieval Latin, French, German, Yoruba, and some North American Indian languages (Attridge, 2014, p. 81). Using four lines of four beats is very common in children's verse (Bill, 1990), with its distinctive swinging rhythm and unifying effect, facilitated further by the use of rhymes (Attridge, 2014).

The most common form of both European folk song and primitive music is strophic, where the tune is repeated with different lyrics (Nettl, 1972). The "strophe" or verse can be two to eight lines in length, but is most commonly four lines (Burling, 1966; Cook, 2000; Nettl, 2014). Wallace's (1994) research found that recall is best for song lyrics which use a repeated melody, rather than different melodies for each verse, or only a single verse.

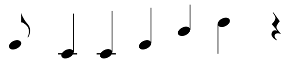
All of the songs in the artefact are strophic, though one song, Biomes 2, uses two different melodies in contrasting tonalities (AABAA). Seven songs include a two-line introduction. The majority of the artefact songs (21) use four-line stanzas.

Within the common structure of four-line verses, there are opportunities for creativity and imagination. One of these is wordpainting, which is a device where the melodic contour depicts the meaning of the lyric. Word-painting is described in Grove Music Online as “the use of musical gesture(s) in a work with an actual or implied text to reflect, often pictorially, the literal or figurative meaning of a word or phrase” (Carter, 2020). Zbikowski defines it as “a compositional device that aims to represent in music specific images summoned by the text of a vocal work” (2002, p. 17). Word or text painting has been used since the Renaissance (Grout & Palisca, 1988) by composers of both secular and religious vocal works (Zbikowski, 2018) as a means of emphasizing the text using “musical parameters (melody, harmony, and their inherent attributes such as contour, texture, mode, modulation, text repetition, diatonicism, chromaticism, tessitura, and cadence types)” (Draper, 2012, p. 3).

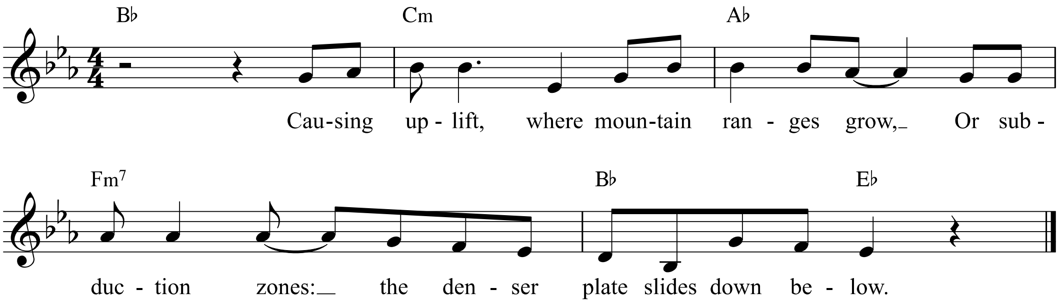
The Basic Water Cycle (grades 1 & 2) incorporates this melodic device first in the line “Then water falls to the earth”, with a falling perfect fifth between “falls” and “to the earth”. I also use a downward, falling melodic motive for the term “precipitation”, as the term is defined as “water that falls from the clouds toward the ground, especially as rain or snow” (Cambridge Dictionary, 2020).



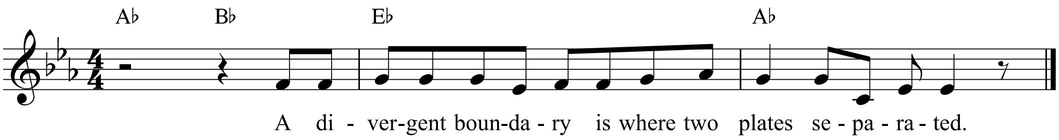
Tectonic Plate Boundaries (grades 5 & 6) provides three examples of word painting. I use stepwise or conjunct movement to convey closeness for the line “convergent comes together”, and a triadic arc upwards for “divergent separates”.



The phrases “causing uplift” and “where mountains grow” are written with ascending melodic phrases, the mountains spanning a perfect fifth, greater than the minor third of “causing uplift”, while the line “the denser plate slides down below” uses two descending melodic contours.

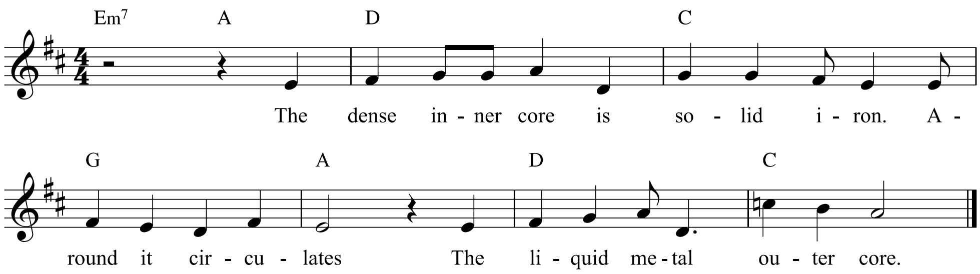


Finally, the word “separated” uses a falling perfect fifth then ascending minor third to indicate the sense of separation.

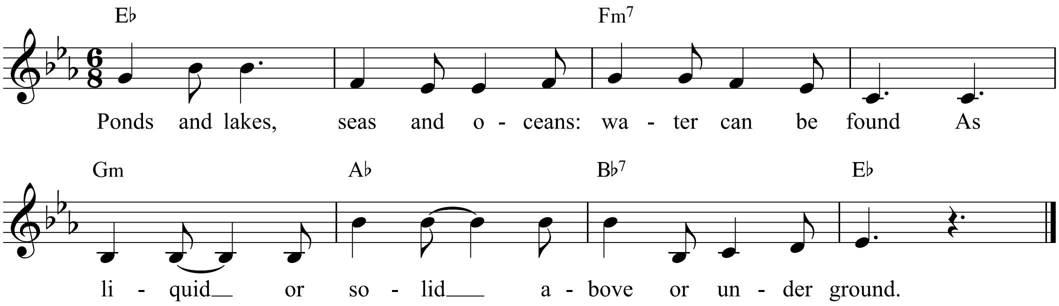


In The Tectonic Tango (grades 5 & 6) a triplet quarter note rhythm conveys the sense of slowing down for “very slow rates”, as the notes in the rhythmic pattern are longer than the standard eighth note, and so sound broader and slower.

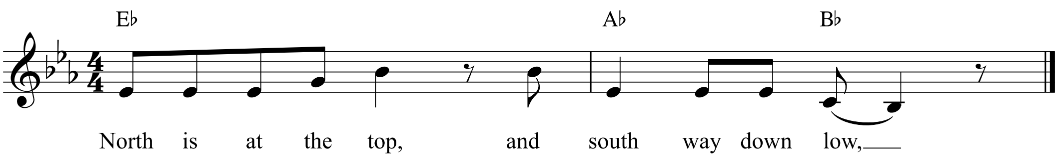
In Earth Structure (grades 5 & 6) the melody moves by step around one note in the line “around it circulates”, then ascends a minor seventh on the term “outer core” to portray the distance involved.



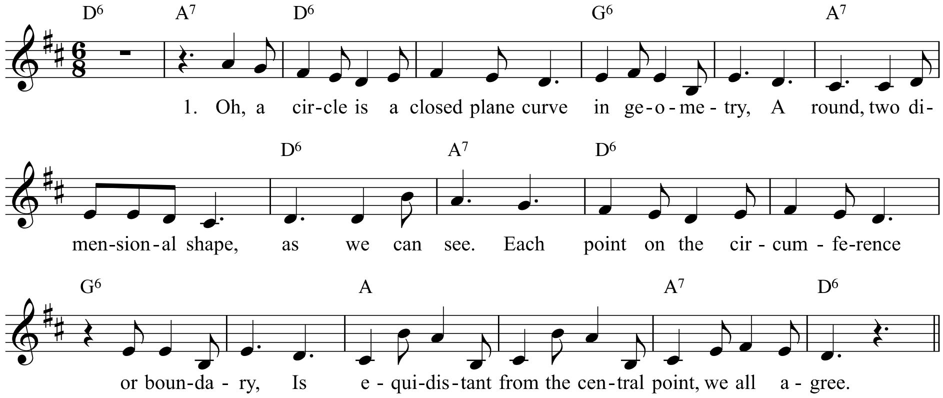
In Bodies of Water (grades 3 & 4) the word “above” is written on the highest note of the melody, while the phrase “underground” starts on the lowest note and ascends in steps to the tonic.



In Compass (grades 1 & 2) the phrase “north is at the top” ascends in a triad, while “and south way down low” falls a perfect fifth onto the word “south” and descends on “way down low” to the octave below the note used for “top”. These musical “gestures” can be paired with physical gestures of pointing in the correct position for each compass direction, as gesture is shown to improve retention (Andrä et al., 2020; Choi & Kim, 2015; Halvorson et al., 2019).



As well as wordpainting, melodic contour or phrase shape is important in writing melodies. As noted earlier, most children’s song melodies use predominantly stepwise or conjunct motion (Gonzalez, 2016) which is easy to sing (Ewer, 2014) or skip intervals of a third (Campbell, 1989), and rarely an interval of more than a fifth (Savage et al., 2015). Some of the earlier versions of songs in the project used wide intervals to be more interesting, but I realised that this was not developmentally appropriate and simplified the melodic lines to make them easier for untrained teachers and their students to learn and sing. An example of this change is seen in the third and fourth versions of the song Circles. The third version included four minor seventh intervals in the last line of the verse.



These wide intervals, while catchy and interesting, would be potentially too challenging for the target audience of grade 3 and 4 students. The final version altered that phrase to stepwise movement which moved in a circular shape around the final note in another example of wordpainting. By making the melody easier to sing, I hoped that the students would be able to concentrate more on the lyrics and educational content.

The tempo or speed of a song is determined in large part by the number of syllables in each line of lyrics. If a line has multiple syllables to insert into a certain number of beats, they may have to be sung (or spoken) very rapidly, using fast musical note values. This can lead to difficulties with correct pronunciation and enunciation for untrained singers and children. Songs with

’dense’ lyrics should be sung at a more moderate pace so that the lyrics can be sung with clarity. In my lyric-writing, I try to avoid such ‘tongue-twister’ phrases.

All of the songs created for this project are fast in tempo, to appeal to the normal tempo preferences of children. The ‘upbeat’ tempos are intended to engage the students and create a sense of arousal and energy in performance.

Research shows that the tempo or playing speed of music activates the brain differently, and that faster tempi raise beta brain wave amplitudes, increasing physiological activation or arousal (Hurless et al., 2013). Children of all ages prefer the fastest music tempo offered, while adults prefer an intermediate tempo (Baruch et al., 2004). Several studies by LeBlanc et al. (1983, 2000) found that fifth and sixth graders from Brazil, China, Italy, South Africa and the United States prefer faster music, with each tempo increase gaining significantly greater preference ratings. They also observed that the strength of the beat significantly affected music preferences, with stronger rhythmic beats more popular. Even infants are found to prefer play-songs that are fast rather than slow (Conrad et al., 2011), though in one Canadian study students in kindergarten and first and second grade did not report the same preference (Montgomery, 1996).

Every individual has a preferred music tempo, which peaks just above 120 beats per minute, and appears to be linked to their preferred locomotion and motor cortex beta frequency (Bauer et al., 2015). Most adults prefer a musical tempo from 70 to 100 beats per minute, followed by beat rates 1.5 and 2 times faster (e.g., 70 bpm, 105 bpm, and 140 bpm), and that preferred tempo speeds up if the heart rate increases (Iwanaga, 1995). Listening to music can affect physiological responses, increasing heart rate up to 136 beats per minute (bpm), and respiration up to 200 bpm (Færøvik, 2017). Music influences brainstem responses such as pulse, blood pressure, body temperature, respiration and muscle tension (Chanda & Levitin, 2013, p. 185), and heightens arousal, which can influence cognitive skills (Husain et al., 2002). To take advantage of children's preferred tempo and heightened physical responses, the artefact songs have speeds (tempo) of 80 to 160 beats per minute.

Vocal Range

When writing melodies, the key is determined by the melodic range of each song, which should correspond to a comfortable singing range for the intended singers. This vocal range is "the total span of the child's capacity to produce phonated sounds" (Wassum, 1979, p. 214). Understanding the typical vocal range for each grade level is crucial to composing songs that lie within a comfortable range without vocal strain for the students. When researching this area, I discovered conflicting data.

Many texts state that at the beginning of their school experience young singers have a limited vocal range of five or six notes (Choksy, 1999; Guerrini, 2004), and suggest that D major is the optimal key for their voices, using D4 – B4 (Johnson, 2012; Kim, 2000). However, further research has found that children have a much wider vocal range. Over time as they mature physically this expands to more than an octave, from A3 (the A below middle C) to E5 or F5 (Guerrini, 2004), or G3 – G5 in 6th grade (Phillips, 1992).

A study found that over half of the students at all grade levels could sing an octave or more, while those who could sing two octaves or more rose from 9.7% in first grade to 52.2% in the sixth grade (Wassum, 1979). A U.K. investigation of 320 children aged 4 to 11 determined that their vocal ranges extended from E flat 3 to D5 (Sergeant, 2009). Research shows that in the third and fourth year of school, both genders expanded their vocal range by three half tones from 23 to 26 half tones, though the girls' mean voice range was one whole step higher than the boys' (Pieper et al., 2020). Several studies show no significant gender difference in vocal range (Pieper et al., 2020; Pribuisiene et al., 2011; Sergeant, 2009; Wassum, 1979), while one study found girls had a wider vocal range than boys (Welch, 1979).

A U.S. study comparing children's and pre-service teachers' preferred comfortable singing ranges for a well-known song found they used almost identical ranges (two octaves plus one half step), though the children sang two notes higher (G3 – G#4) than the adult females (E3 – F5) (Moore, 1991). An early study found that children as young as four may be able to reproduce the same number of notes as the average adult, though not necessarily with accuracy, and that a year of singing classes led to an average expansion of vocal range of over 30% (Jersild & Bienstock, 1934). Gudmundsdottir and Trehab similarly suggest that toddlers use a smaller vocal range for singing songs with lyrics than for their vocal play, which is similar to adults' pitch ranges (2018).

A review of research in the 1970s found that children's comfortable vocal range or tessitura is actually lower than most published children's music of the period (Welch, 1979), which did not change appreciably in the next three decades (Leighton & Lamont, 2006). Children who had difficulty singing in tune were able to sing more accurately when the melody was transposed down a sixth (Welch, 1986). This is supported by a small study of Chinese seven-year-olds that found 87% spoke in the pitch range of A3 to E4, and 75% had a comfortable singing range of almost an octave, A#3 – A4 (Lu et al., 2017). Children six and older use a lower tessitura which more closely resembles their natural speech range than younger children (Sarrazin, 2016). A Swedish study of 218 elementary school music educators found they teach songs with vocal ranges that descend below C4, even transposing well-known songs to fit the lower spoken pitch range (Johnson, 2021).

Rutkowski (2018) posits that children use three vocal registers: low (chest), middle, and upper (head), noting that the lowest register is used for normal speech. Her research found that younger children up to age seven have a limited low range of A3 – C4, which expands upwards to C5 as they mature. The middle range is usually D4 – A4, while the upper register is A4 – F5 or higher.

Berger et al. (2019) surveyed the speaking range of 2,626 6–17- year-olds in Germany, finding that the mean fundamental frequency lowered in both sexes. The frequency for girls lowered about 1.4 half tones from 223.3 to 205.8 Hz (A3 – G#3) in a steady decline over time. Boys' voices lowered 13.5 half tones from 223.3 to 102.3 Hz (A3 – G#2), with a particularly rapid rate of change at age 13.5. Singing activity did not influence the children's conversational voice range. The reason for the greater change in boys is that during puberty their larynx and vocal folds increase in size and length to more than twice that of girls (Howard et al., 2019), while the gain in length and mass of the vocal folds accounts for the drop in pitch between stages 3 and 4 of the male voice change (Williams et al., 2021).

Composers must be aware of this changing vocal range for boys to accommodate their new tessitura as they mature physically. Fortunately, most of the songs in this project are intended for singers between the ages of 5 and 12, so it is only the students in grades 5 and 6 who might be affected. I tried to use vocal ranges for these songs that the boys could manage in their new, alto/tenor voice range of G3 – G4, which usually starts in grade 7 (Looney, 2015). They also have the option to sing in falsetto, as many boys are able to continue to sing using their treble range as well as their deepening tenor or baritone range.

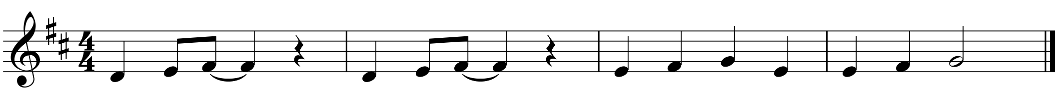
Moore (1991) found that all singers, children and adults, tend to sing in the lower part of their vocal range. In contrast, when children sing to their younger siblings, they use a higher pitch and different vocal quality (Trehub et al., 1994). Different linguistic communities tend to use different pitch profiles (range and variation), as evidenced by the fact that Germans and English speak at a lower pitch, using a smaller pitch range, with less variation than other Europeans. Bi-lingual speakers use different pitch profiles for each language, so that Japanese is spoken at a higher pitch than English (Andreeva et al., 2014). Children who speak a tonal language such as Cantonese, where pitch is used as well as intonation to denote meaning, are found to sing with greater pitch accuracy (Chen-Hafteck, 1999).

Though this information is initially confusing, I realised that it confirms my decades of personal experience with young singers, where I have found that they prefer to sing in a lower tessitura than the traditional D4-B4 range and can sing at least an octave even at the age of five. I have successfully taught very complex songs to young students, with a wide vocal range and large intervals.

My long teaching career gives me an advantage over educators who may be inexperienced singers or lacking in musical self-confidence. I therefore adhered to common practice to make singing and teaching the artefact songs easier for teachers who may wish to utilise them. Accordingly, the songs' melodic ranges conform to the normal vocal range for each age-group: a perfect 5th to a major 9th for the grade 1 & 2 songs, a major 6th to perfect octave for grades 3 & 4, and the wider range of perfect 5th to major 10th for grades 5 & 6. The anomaly in this case is the song Compass for grades 1 and 2 which intentionally uses a melodic range of a major 9th, B flat 3 to C5, in order to depict the distance between north and south.

In crafting two songs about Biomes for grades 1 / 2 and 5 / 6, I wrote both versions of the song in the same key, D major, and used a similar melodic motive as the opening to create a link between them (see Biomes examples 1b/d & 2/a below).

Biomes 1b example d

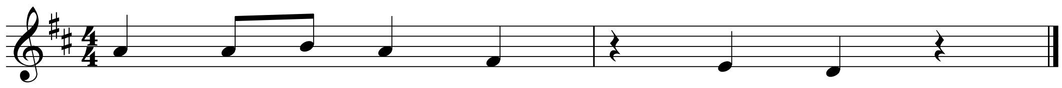


Biomes 2 version 3 example a

The end of each verse is also similar to provide a sense of familiarity, using a descending pattern (see examples Biomes 1b/e & 2/b below). Gonzalez's

(2016) analysis of nursery rhymes found that 66% of them used a descending phrase to conclude.

Biomes 1b example e



Biomes 2 version 2 example b

The most common melodic form or structure in U.S. popular song is AABA, which is based on the A section, usually 8 bars long, repeated with different lyrics as the second line. The third line (B) provides melodic contrast, followed by the A section repeated with new words as the fourth and final line (von Appen & Frei-Hauenschild, 2015).

I find that I most frequently use the form AABC or A1A2B1B2 for my song melodies. This enables me to create harmonies which will lead to the final tonic chord in the last line, rather than the dominant, as is usual at the end of the first line. Closing a melodic line with the tonic chord creates an aural sense of completion, arriving back on the “home key” or tonic harmony, which provides a sense of harmonic stability. Within a song, one or more lines will probably end using the dominant chord, which provides an aural sense of inquiry, or tension. This leads the ear forward into the next line of the song and harmony. Music is often written as a series of question-and-answer phrases, with the dominant harmony producing the “question” and the tonic harmony the stable “answer”. These two chords (and keys) in opposition create tension, where the tonic chord establishes stability and the dominant instability (Morrison, 2009), and have been used to provide dramatic effect since the Classical period (Harutunian, 1990).

As previously noted, most of my lyric lines are four bars long, to allow students to sing them in one breath. A study of 304 music recordings from nine geographic areas show that in general songs are made up of phrases shorter than nine seconds (Savage et al., 2015). Shorter musical phrases suit young children's small breath capacity (Atoh, 2016).

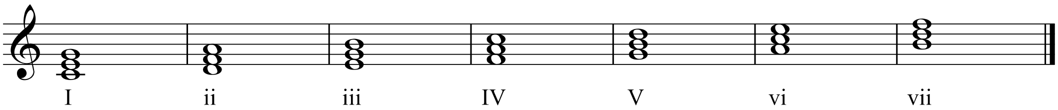
I very rarely use "quotes" from other music or composers but found myself writing a few bars reminiscent of the theme from the television show M*A*S*H in the third line of the 'A' verse theme in Biomes 2 because the lyrics used that particular rhythm. I used two bars of melody and rhythm, then altered the following two bars for variety by changing the melodic shape and transposing it up a third. The prolific U.S. popular songwriter Irving Berlin spoke of the impossibility of writing even eight bars of truly original music, saying that a composer's "work is to connect the old phrases in a new way, so that they will sound like a new tune" (Hamm, 1997, p. 10), while Ball notes that most popular song melodies are "amalgams and mutations of others [the composer has] heard" (2010, p. 93). When I am composing, I do not listen to music which can influence my writing. To appeal to the target student audience, I try to incorporate elements of the common musical vocabulary from their preferred genres of familiar, contemporary musical styles (de Vries, 2010; Scro, 2006; Winter et al., 2009).

Harmony

The final step in composing a song is writing harmony. Harmony is the interaction of a melodic line and chords (Aldwell et al., 2018), or how "chords relate and are organized through time" (Martineau, 2008, p. 50). It consists of vertical and horizontal dimensions (Tramo et al., 2001). Melody (horizontal) is "successive pitch structure" while harmony (vertical) is "simultaneous pitch structure" (Trainor & Trehub, 1994, p. 125). The primary musical impulse is melody, which generates the harmony with which it interacts and is inextricably linked (Toch, 1977).

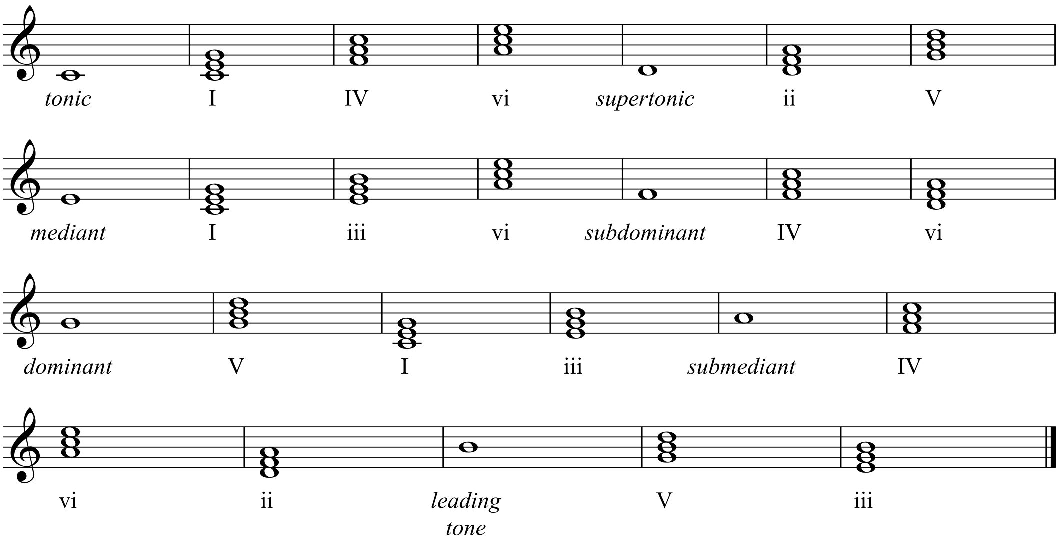
In adding harmony to a melody, the composer tries to avoid dissonance, unless it is appropriate to the lyric text. Therefore, one must be aware of which chords will be consonant with each melodic note. Chords are built on each note of the diatonic scale and are notated according to common convention using Roman numerals, where upper-case indicates major and lower-case minor tonalities. Arabic numbers denote added notes or extensions to chords (e.g., C^6 = C E G A) (Temperley & de Clercq, 2013).

Scale degree chords, C major



Melody implies harmony as only certain harmonies will sound consonant with each melodic pitch. Each degree of the scale can be matched with several different chords to create an agreeable, congruent sound. Obviously, melodic notes can also be harmonised with chords that are not based on the diatonic scale, which leads to more interesting harmonies and chord progressions.

Consonant harmonies for scale degrees, C major



As well as creating vertical harmony, chords that sound well with each note of the melody, the composer must construct horizontal harmony, or a series of chords which establishes a tonality (Schoenberg & Stein, 1969). The harmonic syntax of Western Classical tonal music presents repetitive chord progressions, generating listener expectations (Moreno, 2017), with greater acceptance of out-of-key chords in blues or rock music than in classical music (Hughes, 2011). Many of the harmonic progressions in popular Western music, based on classical traditions, have remained stable for over fifty years (Serra et al., 2012).

These standard chord progressions customarily use combinations of I, IV and V, with an occasional ii. However, in the songs created for the artefact I intentionally incorporated less commonly used chords to provide unexpected harmonies in an attempt to be more interesting. These include:

- II (The Water Cycle 2)
- iii (Plant Life Cycle; The Basic Water Cycle; Bodies of Water; Quadrilaterals; Birds; Metamorphic, Igneous & Sedimentary Rock; Earth Systems; Biomes 2)
- III (The Solar System; Biomes 2)
- raised V (Clocks: B major harmony in E flat major)
- vi (Days & Months; Map Legends; Primary & Secondary Colours; Continents & Oceans; Basic Geometry; Birds; Metamorphic, Igneous & Sedimentary Rock; Photosynthesis; Civilisations – Eight Great Features; The Nitrogen Cycle; Tectonic Plate Boundaries)
- VI (Solid, Liquid, & Gas; Food Chains)
- flattened VII (Primary & Secondary Colours; Parts of a Plant; Polygons; Metamorphic, Igneous & Sedimentary Rock; The Water Cycle 2; Civilisations – Eight Great Features; Earth Structures) and
- chromaticism (Triangles: B flat major, B major, C major).

Of these chords, II, III, VI and VII in major keys are unexpectedly major instead of the harmonically correct minor tonality, providing harmonic unpredictability. The flattened VII chord is not part of the diatonic scale, so adds harmonic appeal.

I also used harmonies based on scale movement in the bass line, such as the chord progressions in Compass. The introduction uses E flat major, f minor, g minor, A flat major, B flat major (an ascending scale of five notes), and in the verse E flat major, B flat major / D in bass, c minor, B flat major, A flat major, g minor, f minor, B flat major (a descending scale of seven notes). In

Metamorphic, Igneous & Sedimentary Rock the verse bass line and harmony descend in a scale (E flat major, D flat major, C major, B flat major), providing contrary motion to the ascending melody line.

I realised after analysing all the songs in the project that I have developed my own “standard” chord progressions which I use frequently, in particular the first phrase of I, vi, IV, V which is found in seven of the songs (21%). This can also be harmonised as I, IV, IV, V, but I prefer the minor tonality of chord vi for harmonic variety and colour.

The other harmonic “signature” of the artefact songs is the use of added notes in chords, predominantly added 6ths and 7ths, e.g. I^6, ii^7, V^7. This provides a thicker texture in the accompaniment chords and a little harmonic ambiguity. For instance, in C major, the I^6 chord consists of C, E, G, A. The A adds the potential for an A minor chord (A, C, E) to be heard in the harmony layered onto the major tonality of C, E, G. All 33 songs (100%) use at least one added note chord in the harmony. Indeed, in Food Chains 88% of the harmony chords use added notes, Polygons 89%, Days & Months and Circles 92%, and Photosynthesis 100%.

Some of the artefact songs use standard chord progressions as used in many children’s songs, such as Biomes 1 (chorus: I, IV, V, I, I, IV, V^7, I), Butterfly Life Cycle (I, IV, V, ii^7, I, IV, V, ii^7, A^7, I), Map Features (I, IV, V, I, IV, V, I), Circles (I, IV, V, I, V, V, IV, V, I), Phases of the Moon (I, ii^7, V^7, I, IV, V, V^7, I), and the Tectonic Tango (I, ii, V, I, V, I, ii, IV, V, I).

The three most commonly used chords (I, IV, and V) include all the notes of the diatonic scale, and so can be used to harmonise any diatonic melody. The three chords are also the only major tonality chords, as ii, iii, and vi are minor, and vii is diminished. An analysis of the 200 most popular rock songs found that the most frequently used scale degrees in both melody and harmony were 1 (I), followed by 5 (V) (Temperley, 2013 & de Clercq). A survey of 180 Beatles’ popular song harmonies found that 76% were major, 20% were minor, with only 4% using diminished or other chords, while 244 jazz standards used 54% major chords, 33% minor chords, and 6% diminished chords (Mauch et al., 2007). Using a limited number of chords also makes performance easier, especially for guitar (Rahn, 1986), which may be helpful for instrumentally inexperienced teachers in the classroom.

Chords can be ordered depending on their tonal function, with the three most important being tonic (I), dominant (V), and predominant (ii or IV) (Rohrmeier, 2011). Moreno's (2017) study of 254 phrases from J.S. Bach's four-part chorales which are frequently used as standard tonal harmony texts found that the tonic and dominant chords were most common, comprising 57.12%, and that the tonic – dominant (I – V) and dominant – tonic (V – I) progressions provide the most common harmonic goals to complete phrases. Used at the ends of phrases as cadences, they evoke different degrees of closure, tension and release (Smit et al., 2020). In most Western music the dominant chord (V) (based on the fifth note of the scale) is used to produce tension, resolving at the next tonic chord (I) which is based on the first note of the scale (Trainor & Trehub, 1994). Common harmonic progressions use the tonic – dominant (I-V) progression to end an intermediate phrase as it sounds unresolved, with the dominant – tonic (V-I) cadence providing a stronger sense of closure and resolution to end the final phrase.

The composer's challenge is to incorporate enough variation into the well-established musical lexicon to be interesting but also conform to the listener's unconscious expectations in order to appeal to students' musical preferences. These change over time as adolescents' brains develop (Bonneville-Roussy et al., 2013), with younger children being more open to different musical styles than teenagers, who have evolved definite preferences for particular types of music, in particular, fast popular songs (Miranda, 2012; Silvagni, 2018; Thomas, 2016). A study which rated 100 randomly selected songs found that non-musicians rated familiar songs and artists higher than more unfamiliar examples (Lundy et al., 2019).

This musical familiarity results from the amount of music and media students consume outside of the classroom. The omnipresence and influence of

Western popular music on young people's song is seen in a South Korean report on contemporary compositions for children's song festivals which shows the introduction of quadruple metre, fast tempo, a vocal range of A3 – D5, an average length of twenty-four bars, and rhythmic syncopation superseding traditional Korean musical elements (Y.-Y. Kim, 2013). In the project songs I have incorporated most of these elements in order to write in a style which is familiar and therefore appealing to students. Adding non-standard harmonies, rhythmic complexities and melodic features such as accented passing notes and wordpainting is an attempt to provide enough contrast to make the songs interesting while still conforming to the students' preferred musical genres.

Listening to popular contemporary music may be a means of establishing young people's personal and social identities (Brittin, 2014), bonding socially with their peer group (Boer, 2009), or to positively affect self-regulation and emotions (Boer et al., 2012; Bragazzi et al., 2015). Adolescents' musical preferences change over time according to age, social environment, or mood, and can be placed in two categories: fulfilling individual emotional needs and fulfilling social needs or bonding with their peers (Thomas, 2016). As using popular music in the music classroom is shown to improve student attitudes, enjoyment, and motivation (Özdemir & Çiftçibasi, 2017), it makes sense to take advantage of student musical preferences to improve the chance of young students liking a song enough to sing it.

One of the most common sequences in classical and popular music and jazz is I - ii - V - I (Terefenko, 2009). Adding the seventh to the dominant chord as a V^7 – I cadence strengthens the effect of closure (Smit et al., 2020). Indeed, chord ii can be analysed as the dominant (V) of the dominant (V), so the progression can be heard as two cadences: V – I in the dominant key, and V – I in the tonic key (Piston, 1966), thereby potentially doubling the closure effect. Three chord schemas in popular music are usually uneven in the length of the chords, with the last (or sometimes first) chord twice the length of the other two, to conform to the common quadruple metre (Doll, 2017).

In writing songs for children, the composer faces the dilemma of whether or not to write in the commonly used popular style, using major keys, upbeat tempo, and simple melodic shapes and harmonies. The other option is to be more subversive, using non-standard harmonies, dissonance, chromatism, minor tonalities, syncopation, and more challenging melodic intervals and patterns. As seen in the research noted below and my personal experience, even very young children are capable of singing complex and unpredictable melodies and are not disconcerted by occasional unexpected harmonies from outside the norm.

In my reflections I have realised that this research into harmonisations, both standard and innovative, has emboldened me to write more interesting chord progressions as noted above, knowing that while students prefer chord patterns common to their preferred musical styles, they are also accepting of harmonic variation. As noted above, I have moved beyond the familiar I – IV – V – I harmonic progressions of many children's songs, while still incorporating the universal structure which ends the second line with chord V, and provides a strong sense of closure at the end of verse and chorus with some version of V – I.

The vast majority of children's songs are in major keys. An analysis of children's songs from the educational television show Sesame Street (Moss & Raposo, 1992; Raposo & Moss, 1971) found that 85 of 89 songs were major, as were 83 of 84 traditional children's songs and nursery rhymes (Hooper, 1997; *World's greatest children's songs*, 2003). An analysis of thirty Brazilian children's songs reveals that 29 were major, with one in the Aeolian mode (Green, 2010), and a study of 21 European nursery rhymes notes that they are all major (Gonzalez, 2016). Therefore, I use major tonalities for the preponderance of the teaching songs to correlate with children's common musical vocabulary and their preferred musical genres (de Vries, 2010; Winter et al., 2009). Of thirty-three songs in this project, only two are in minor keys (The Solar System and Solid Liquid and Gas), and two alternate between major and minor (Biomes 2 and The Tectonic Tango).

In order to write songs suitable for the target age group, I realised that deciding on which key to use is not only a matter of the vocal range of the song. Since the late seventeenth century composers and scholars have proposed that different keys provide differing emotional resonances (Cook & Hayashi, 2008; Ward, 2019). Some studies have tested this theory that each key possesses a distinctive character and affects listeners' emotions and found no correlation (Powell & Dibben, 2005; Rigg, 1940). However, other studies have found links between tonality, tempo, and emotional response, showing that major and faster tempo pieces are perceived as happier than minor and slower music (Crowder, 1984; Ramos et al., 2011; Straehley & Loebach, 2014; Webster & Weir, 2005). Listening to high-arousing or joyful (major) music enhances attentional processing, increasing activity in the fronto-parietal network of the brain (Fernandez et al., 2019).

This neural response appears to be a learned association, as 3- and 4-year-olds did not select the happy-major and minor-sad responses, while 7- and 8-year-olds made the connection (Gregory et al., 1996). 6- and 7-year-old children with no musical training from France, Australia, and Canada show "implicit knowledge of basic harmonic functions" in Western music, perhaps through regular exposure (Schellenberg et al., 2005, p. 561). Newborn infants respond differently to minor, major and dissonant chords, as well as being sensitive to pitch, length, and location (Virtala et al., 2013). Children develop awareness of key membership (which pitches belong in a key) as young as three years of age, adding sensitivity to harmony at age 5 – 6 (Corrigall & Trainor, 2009) through musical enculturation, or exposure to a culture's music (Corrigall & Trainor, 2010).

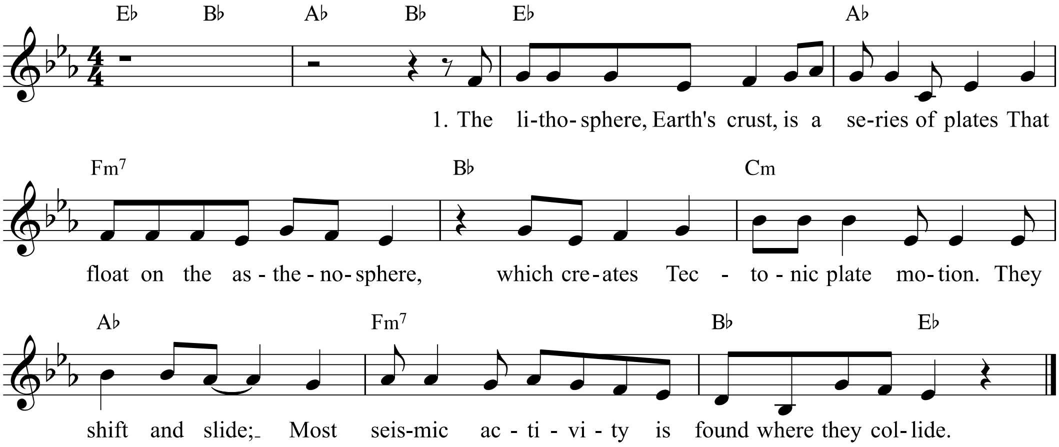
Finnish research shows that when children aged 6-15 were asked to add harmony to a melody, 6- and 7-year-olds showed an implicit understanding of tonal harmony, and that "tonal stability and implicit knowledge of harmony seem to develop during children's school years" (Paananen, 2009, p. 156). A longer exposure to standard harmonies may instill harmonic expectations in students (Paananen, 2009). Another Canadian study showed implicit knowledge of key membership at the age of five and of implied harmony at the age of seven, showing clear developmental advancement over time (Trainor & Trehub, 1994).

This data about tonality and harmony had an obvious impact on my praxis. I realised that I needed to write melodies and harmonies that conformed (at least partially) to the students' musical expectations and preferences. I attempted to write songs which were somewhat predictable, conforming to the parameters of traditional children's songs, so the singers would feel comfortable with the musical style.

Interestingly, a study of more than 400 musicians and non-musicians from 42 countries found that slightly dissonant (minor ninth, major ninth and minor seventh) chords played in isolation were preferred to consonant chords (Lahdelma & Eerola, 2016). Temperley and de Clercq's rock music study found that while the most common tonality was major (49%), then minor (23%), there was a large number of songs which used major harmonies with a minor melody (20.5%), and that the minor seventh melodic interval was more common than the major seventh (2013).

These research findings allow me to feel more confident about composing using either dissonances or contrasting major and minor harmonies and melodies, even for very young students. I frequently use accented passing notes, where a note that is not part of the harmony chord is played or sung on a strong beat, creating a brief sense of dissonance which then resolves.

Examples of dissonance are evidenced in Tectonic Plate Boundaries (grades 5 & 6) (see page 119). As in Lahdelma and Eerola's (2016) study which found a preference for slightly dissonant harmonies, a B flat begins bar 8 against the harmony of A flat major, sounding like a major second or ninth, while the B flats in bar 7 add the minor 9th to the harmony-chord of c minor. Other dissonances in this example are the G's in bar 4 and 6, and the B flats in bar 7. These notes provide more complex harmonies: G's in bar 4 add the major 7th of the harmony-chord A flat major, while in bar 6 they add the 6th to the harmony-chord B flat major. Though the melody is written in E flat major, three of the eight melodic bars utilise minor harmonies.



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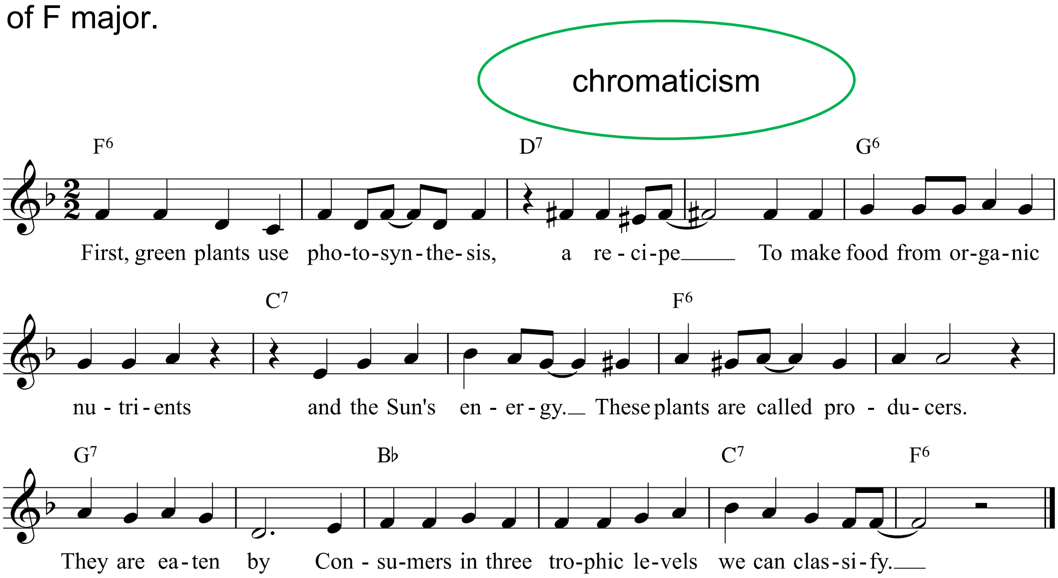
I also include some chromaticism in my melodies, where a note is raised or lowered by a half step. For example, in Food Chains (grades 3 & 4) the melody line moves up a half step in sequence, adding an unexpected D major harmony to F major. The chord built on D in F major in “correct” standard harmony would be d minor. An E# and two G#s make the melody more interesting as they are not part of the standard diatonic scale vocabulary in the key of F major.



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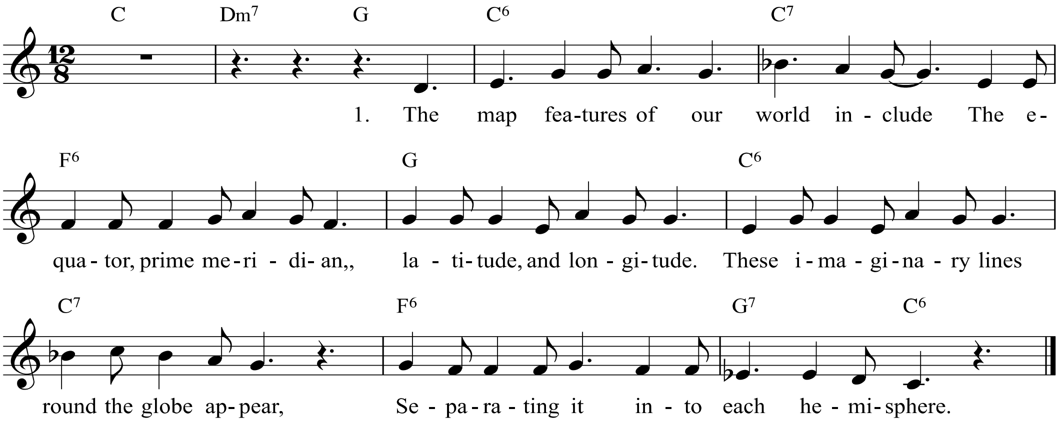
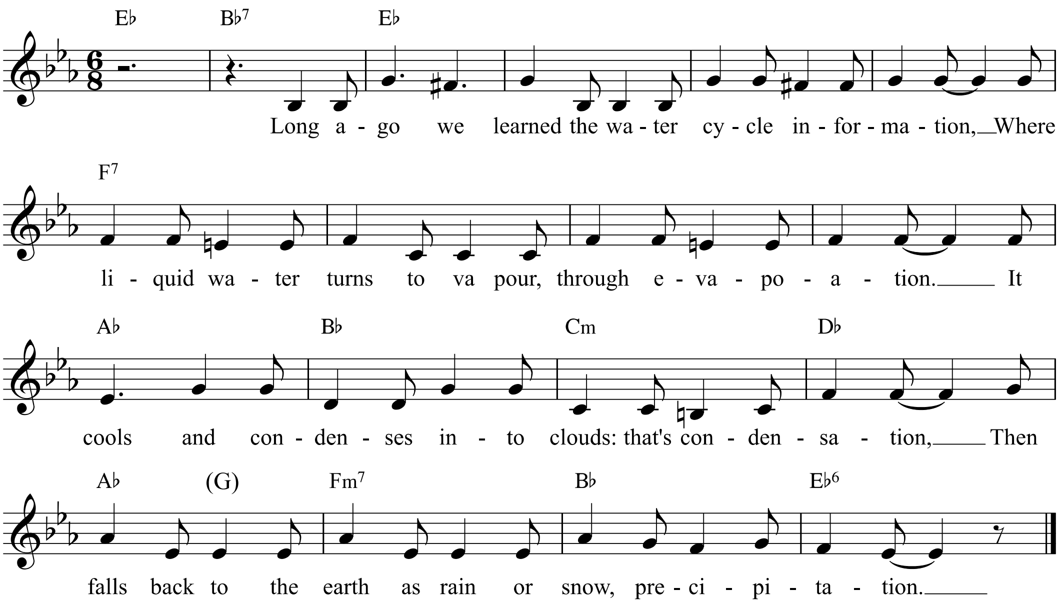
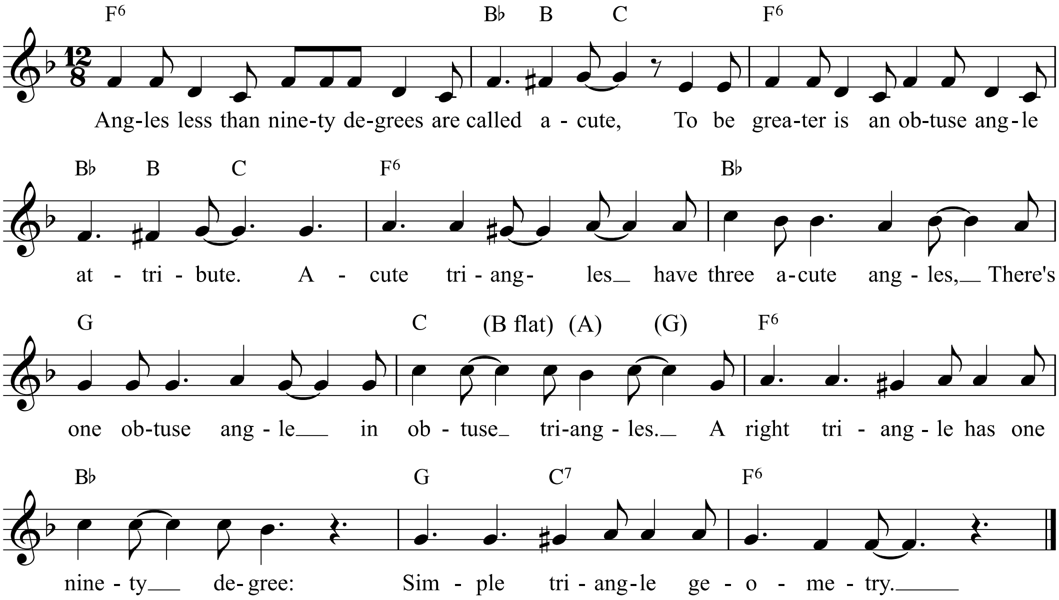
In Map Features (grades 3 & 4) I use B flats and E flat in C major, which do not belong to the diatonic scale. The G’s in the penultimate bar and E flat in the final bar are dissonant accented passing notes, to express the lyric "separating".



The Water Cycle 2 (grades 5 & 6) incorporates chromaticism, using F#s, E and B naturals in the key of E flat major. The D flat harmonisation is not part of the standard harmony for E flat major. Also, the use of F major instead of f minor in bars 7-10 is unexpected, in an attempt to enhance student engagement through unpredictability.



Triangles (grades 3 & 4) also uses chromaticism, synchronising the chromatically ascending melody (F, F#, G) with harmony (B flat major, B major, C major). Accented passing notes occur on the first beats of bars 6, 10, and 12, creating harmonic tension through dissonance before resolving on the following note, to make the song more interesting. G#s are used to provide a ‘jazzy’, upbeat style. However, the chromatic melody notes are not as challenging as they may appear, as they are part of repeated melodic patterns (F#: bars 2 & 4; G#: bars 5, 9), and the majority of the melody uses repeated notes, stepwise or skip intervals, which are easy to sing for this grade level.



The Nitrogen Cycle was written for grades 5 or 6 as part of a series of songs about science subjects which are part of the U.S. curriculum. This illustrates the stages of the notation process, using the first verse as an example.

Phase I: Lyrics – verse 1

This first verse uses masculine rhyme in lines 1 and 2 (“biology” / “it’s key”), and polysyllabic rhyme in lines 3 and 4 (“biochemistry. A” / “bacteria”). Interior internal rhymes are found in lines 3 (“plants and animals” “can’t use it until”) and “cycle of diff’rent states, compounds, gas and nitrates”).

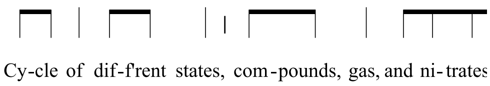
> Nitrogen is essential to all life in biology,
> A component of proteins, nucleic acids, and chlorophyll – it’s key.
> But plants and animals can’t use it until it’s converted by biochemistry, A Cycle of diff’rent states, compounds, gas, and nitrates, by interacting with bacteria.

Phase II: Rhythm

The rhythm is notated to conform to normal speech patterns as is common in most educational songs for children (Legg, 2009; Marsh, 2008). The strongest syllables are placed at the beginning of bars, in the widespread 16-beat structure of four lines each with four strong beats found in poetry in many cultures (Attridge, 2014) and children's own songwriting (Cook, 2000):

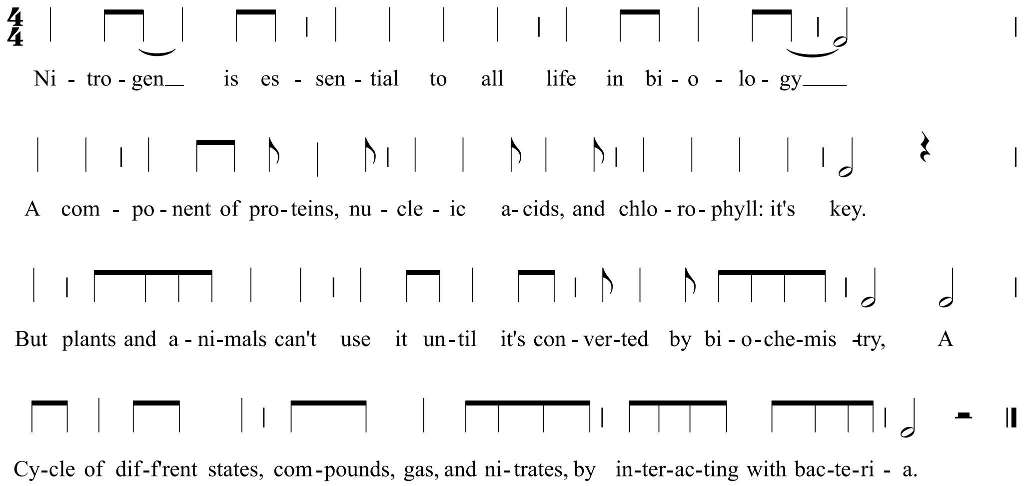
> Nitrogen is essential to all life in biology,
> A component of proteins, nucleic acids, and chlorophyll – it's key.
> But plants and animals can't use it until it's converted by biochemistry, a
> Cycle of diff'rent states, compounds, gas, and nitrates, by interacting
> with bacteria.

Syncopations provide rhythmic interest, while the interior internal rhyme in the last line uses the same rhythm pattern (a rhythmic rhyme?) for both rhymes:



The time signature is 4 4, or four quarter note beats in each bar, as is most common for children's songs and singing games (Gonzalez, 2016; Green, 2010). The rest at the end of the second line frequently occurs in children's nursery rhymes and songs (Burling, 1966), and enables a larger breath before the densely packed syllables of the third line. The tempo is 144 beats per minute, with the smallest note value being eighth notes, conforming to children's preference for fast tempi (Baruch et al., 2004; Conrad et al., 2011; LeBlanc et al., 2000).

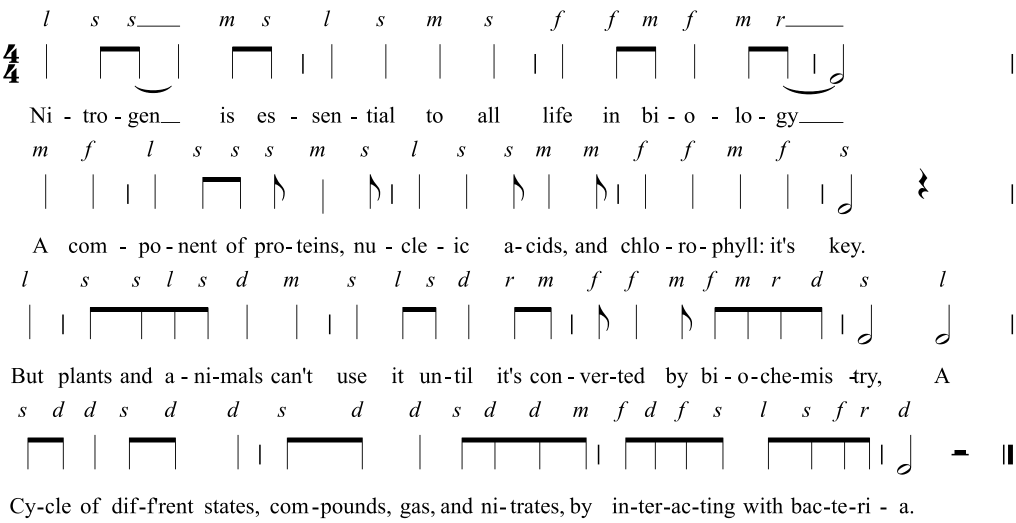
The following example is notated in stick notation (Green, 2010; Houlahan, 2008).



Phase III: Melody

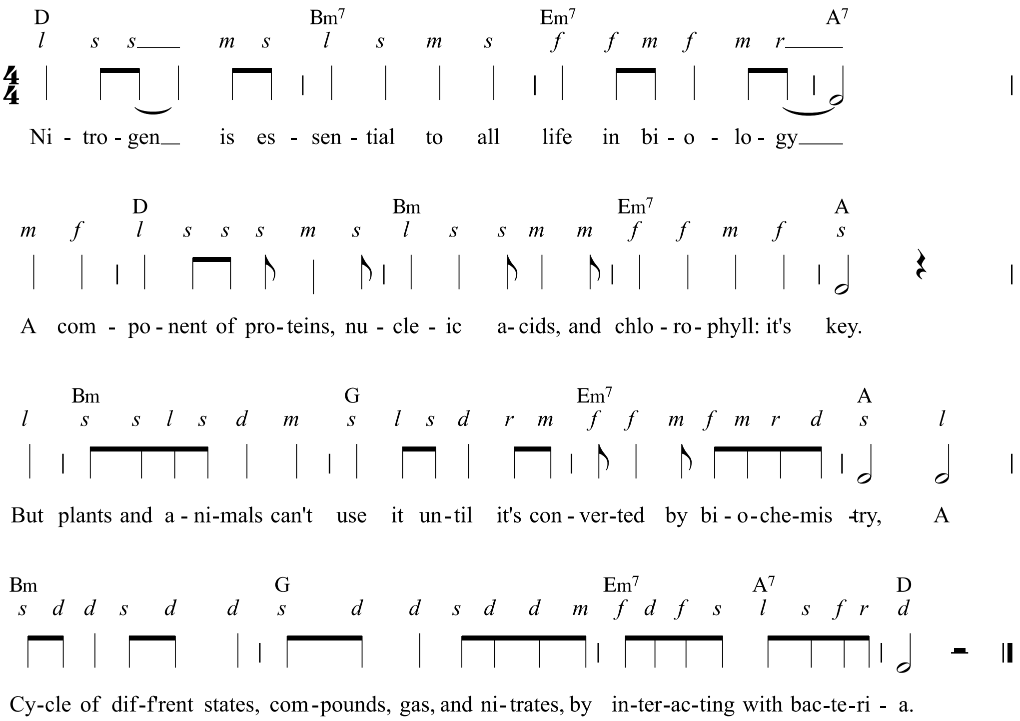
The melody has a range of a major 6th, D4 – B4, which is within the comfortable singing range for this age group of C4 – C5 (J. Kim, 2000; Phillips, 1992). Accented passing notes create dissonances on the first beats of bars 1, 5, 9, 10, 13 and 14, and the third beat of bar 15 creating sonic tension which then resolves on the next beat. Melodic movement is mostly stepwise, with the largest melodic interval a perfect fifth, both ascending and descending (D4 – A4), which is well within the capabilities of singers at this grade level. It is notated using Kodály's movable do solfa (Frey-Clark, 2017).

Repetition of a melodic shape adds familiarity which benefits learning and memory (Gfeller, 1983; Wallace, 1994) and is a feature of children's own songs (Campbell, 2010), so the main melodic contours are repeated. The melody is primarily based on the notes of the harmonic chords and uses only a few passing notes, e.g., bar 1 / D major 6 (D, F#, A, B) uses the melody notes B, A, A, F#, A, as does bar 2 / b minor 7 (B, D, F#, A). Bars 9 and 13 use b minor^7 (B, D, F#, A) harmony pitches as melody – A, B, A, D, F#, and the third and fourth beats of bar 15 use an accented passing note B then A, G, E in the melody, a descending version of the accompanying dominant 7th chord A major 7 (A, C#, E, G). This example is presented using stick (rhythm) and solfa (pitch) notation.



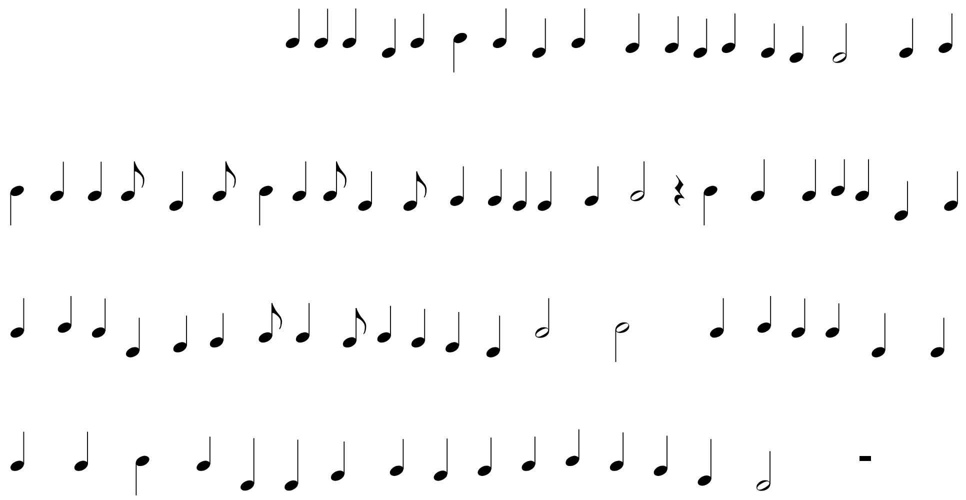
Phase IV: Harmony

The harmony for this song uses a majority of added-note chords (76%). The repeated melodic ideas are accompanied by differing harmonies. For example, the repeated melodic phrase in bars 1-3 and 5 -7 switches the G major in bar 3 for e minor tonality in bar 7. The accompaniment uses one chord per bar except for two chords in bar 15 which propel the harmonic movement towards the final tonic chord, with a ii^7, V^7, I^6 chord sequence, one of the most commonly used closing harmonic progressions (Terefenko, 2009). The following example is presented using stick and solfa notation, with chord note names.



Phase V: Musical notation

The following example is presented using Sibelius music publishing software, as a lead sheet.



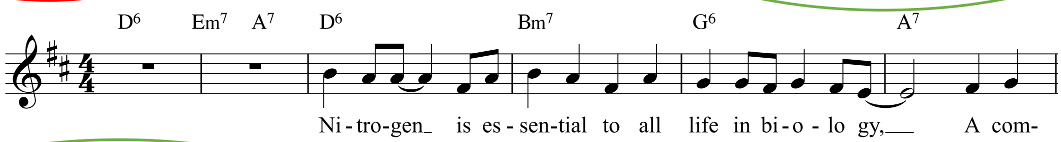
Last, a final annotated example of the song’s first verse.

Annotation Key:	
Rhyme	Blue
Melody	Green
Harmony	Red
Rhythm	Orange

Major tonality

Triadic phrases

Accented passing notes bars 3, 7, 12, 16, 17



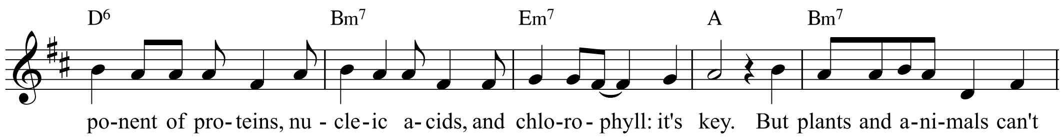
Syncopation – bars 3, 5, 7, 8, 9, 13

Assonance and alliteration line 2 – component of proteins

Masculine rhyme lines 1 & 2

Anacrusis - bars 6, 10, 14

Cadence ii7 – V bars 9-10



Repetition of melodic shape, falling perfect 5th, bars 11, 12, 15, 16

Inclusion of minor tonality harmonies, 8 of 20

Unexpected minor tonality bars 11, 15

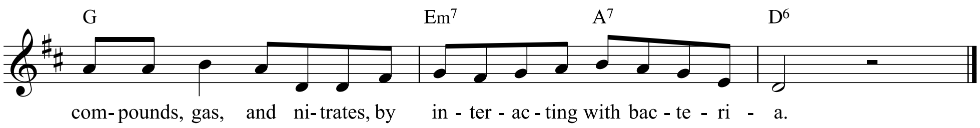
Mostly stepwise melodic movement

Composite rhyme lines 3 & 4

Largest melodic interval perfect 5th

Added note harmonies
16 of 20 chords

Interior internal
rhyme line 4



Melodic range
major 6th D4 – B4

Common closing
harmonic progression
ii7 – V7 - I

Descending final
phrase

Songwriting exemplars

Exemplar 1: Clocks Grade 2

Clocks is written for the Grade 2 level, to teach how to read analogue clocks.

Learning Standards:

- Students be able to tell the time.
- Students should know and use vocabulary such as o'clock, am/pm, morning, afternoon, noon & midnight.
- Students should know the number of minutes in an hour, and the number of hours in a day.
- Students should know that there are two twelve-hour cycles in a day.

Curricular resources:

U.S. curriculum (CDE, 2015; Maryland Public Schools, 2015; Maryland State Department of Education, 2015; North Carolina Department of Public Instruction, 2017)
U.K. curriculum (Department for Education, 2021)
Australian curriculum (ACARA, 2010)

Word Bank:
Minute – in it, begin it
Day – delay, relay, display, array, portray, say, stay, way, halfway, stay
Night – light, bright, daylight, midnight, write, right
Late – date, rate, great, wait, locate, allocate, educate, calculate, state
Round – found, around
Moon – noon, soon
Face – case, place, space, pace, chase

The opening line of lyrics came to mind as I was walking, as an example of illumination following gestation:

An analogue clock has two hands in it,
The short one is the hour; the long is the minute.

I clarified the location of the clock hands by adding “face” to “clock” and removed extraneous syllables from the second line to make it easier to sing:

> An analogue clock face has two hands in it.
> The short shows the hour; the long the minute.

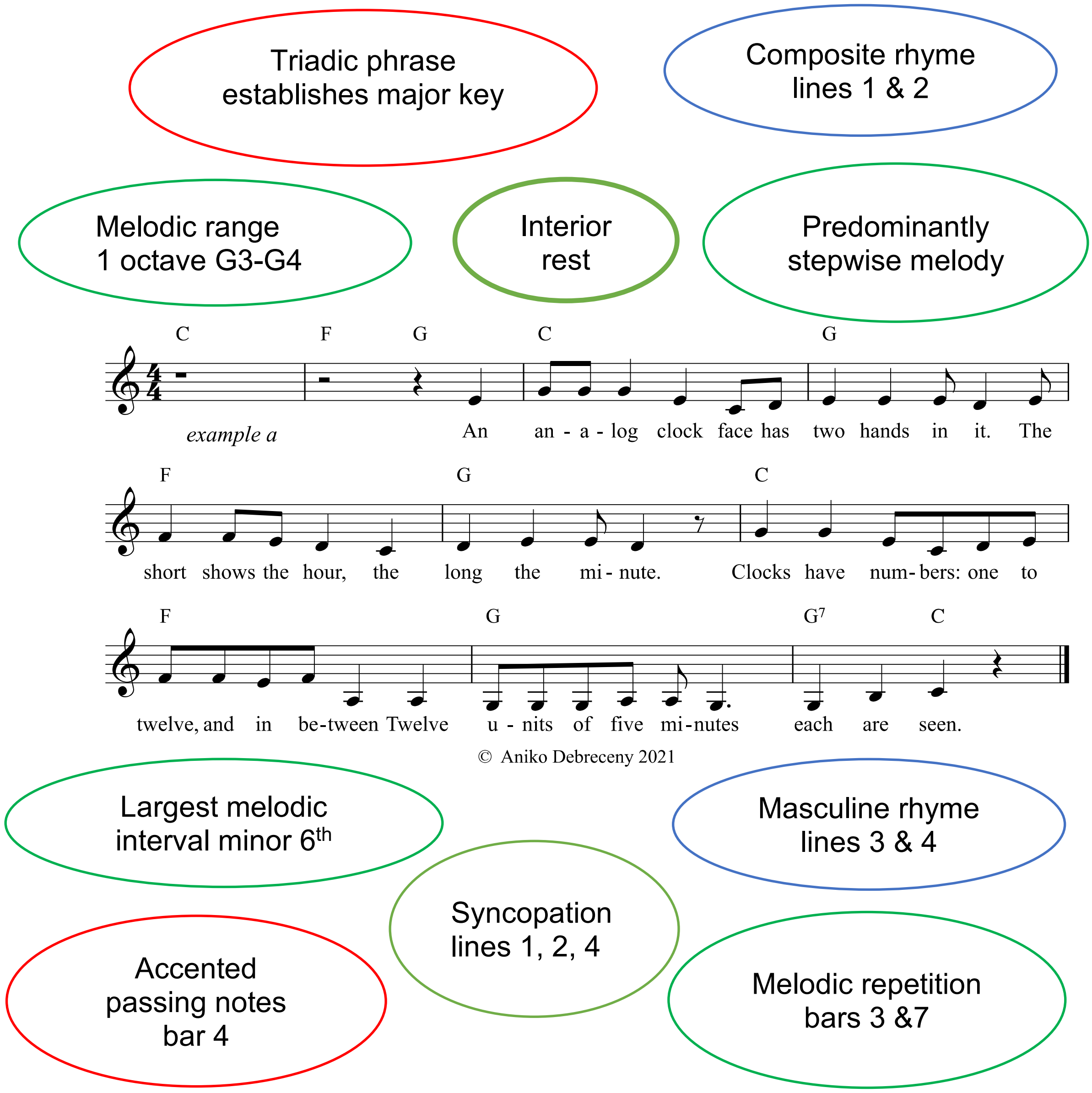
Clocks

> An analogue clock face has two hands in it.
> The short shows the hour; the long the minute.
> The numbers one to twelve are seen,
> Each with five minutes in between.
>
> So, each hour has sixty minutes on display.
> There are two twelve-hour cycles in ev’ry day.
> Time passes: midnight, morning, noon, afternoon, then night: it’s great,
> A.M. is early, P.M. is late.

While some songs in this project were written quickly, using the illumination phase of the creative process to produce a single melody, I decided to write several versions of Clocks to analyse and assess the elements which I felt would be most successful for five- and six-year-olds. The following four examples use different melodic ranges and contours, tonality, intervallic movement, dissonance, and harmonies. They present contrasting musical styles, varying levels of difficulty of performance, and different melodic and harmonic features. They provide more examples of incorporating knowledge of which musical elements are most age appropriate acquired from the literature review with the illumination, incubation and verification stages of creativity in my practice, through constant recursive reflection.

Colour-coded annotations describe the musical elements for each version.

Annotation Key:	
Rhyme	Blue
Melody	Green
Harmony	Red
Rhythm	Orange



The first melody in C major uses repetition of the first melodic motive, the falling major tonic triad, which enables learning and memory (Gfeller, 1983; Wallace, 1994), as does melodic symmetry (Ferreri & Verga, 2016). A rest at the end of the second line of lyrics allows a breath to be taken (Burling, 1966). The melody is mostly conjunct and uses normal speech rhythms as in most children's educational songs (Legg, 2009; Marsh, 2008).

Though second graders are capable of singing the melodic range of a full octave, and singing low G3 (Jersild, 1934; Sergeant & Welch, 2009), I decided to rewrite the melody using a smaller melodic range to fit the recommended parameters from the children's song literature (Campbell, 1989; J. Kim, 2000; Lu et al., 2017; Pieper et al., 2020). Also, the falling minor sixth interval may have been challenging for inexperienced singers.

The second version in the key of a minor introduces the changed lyrics in the third and fourth lines of the first verse, from the initial version:

> Clocks have numbers, one to twelve, and in between
> Twelve units of five minutes each are seen.

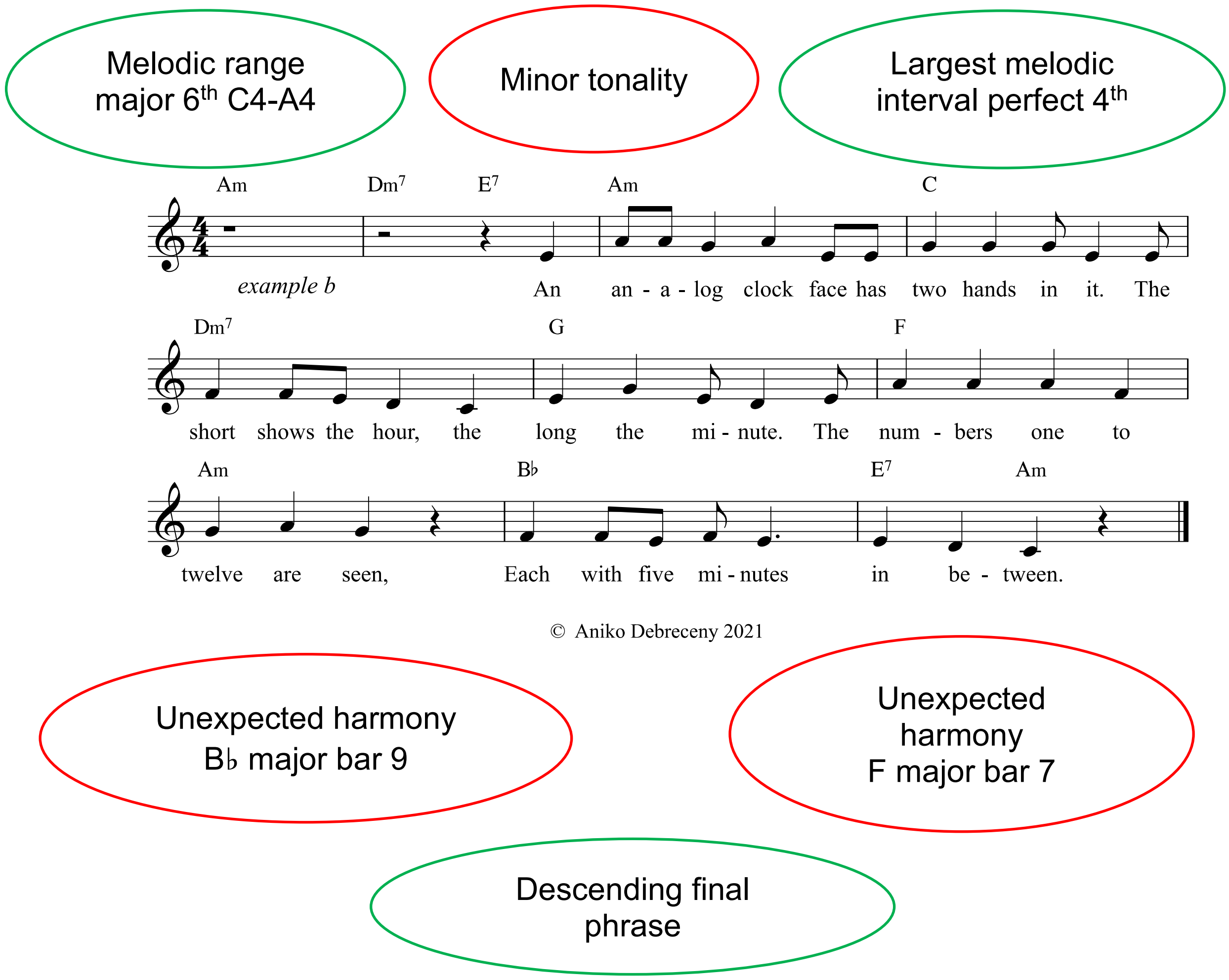
To

> The numbers one to twelve are seen,
> Each with five minutes in between.

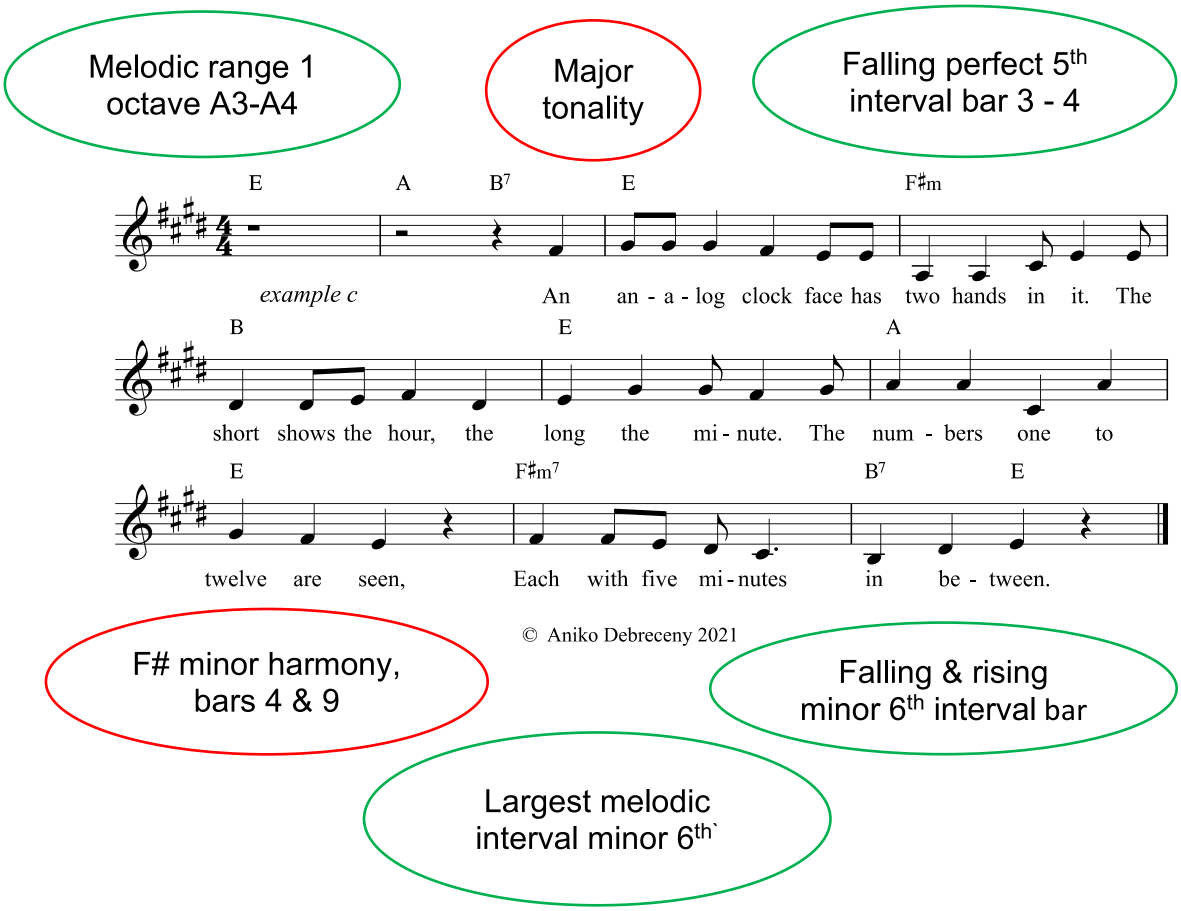
This revised version has fewer syllables, making it easier to sing. Repeating the term "clocks" from the first line was redundant, so I deleted it from line 3. This deletion also provided the opportunity to insert a rest at the end of the third line, to facilitate taking a breath.

I changed the tonality from major to minor to provide harmonic variety within the artefact. I incorporated melodic elements of the first melody (see bars 5 & 6), but with different harmonies and a smaller melodic range of a major 6^{th}, C4 – A4.

The harmonisation incorporates two non-standard harmonies. First, the use of the G major chord in bar 6 acts as an aural cue that the chord in that midpoint location is part of a modulation to the relative major, where G major is the dominant (V). The aural expectation is to hear C major in the following bar, but instead, I use F major. The second is the use of B flat major in bar 9. A more customary chord sequence would be ii-V-I, or b minor - E major - a minor. Introducing an unrelated harmony creates interest and tension and conforms to research which discovered that slightly dissonant chords are preferred over consonant chords (Lahdelma & Eerola, 2016), and that a fifth of rock songs use major harmonies with minor melodies (Temperley & de Clercq, 2013). This is another example of using the theory from my literature search in practice, then using reflection and time to revise and rewrite in the generation and verification stages of creativity.



The third version is in E major, with a melodic range of one octave, A3 – A4, with wider melodic intervals of a descending perfect 5th and descending and ascending minor 6th, with the rest of the melody using easy-to-sing repeated notes, step and skip intervals.

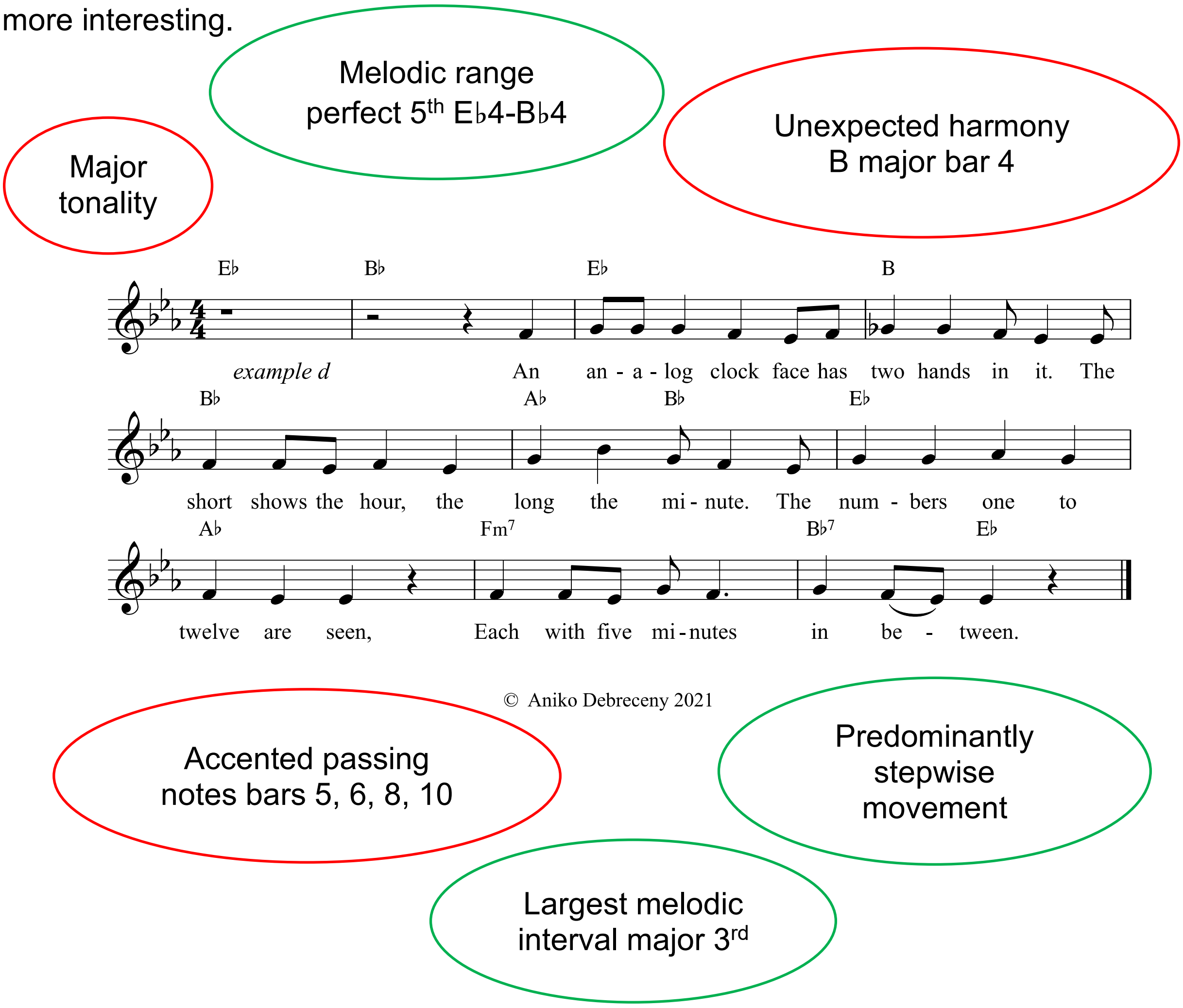


Based on the literature on melodic shape in songs for young children being mostly stepwise (Gonzalez, 2016; Nettl, 2014), I decided to retain this more angular melody with its wider melodic intervals for a different song for older or more advanced singers. I also decided to reduce the melodic range from a perfect octave to conform to general practice for this age group.

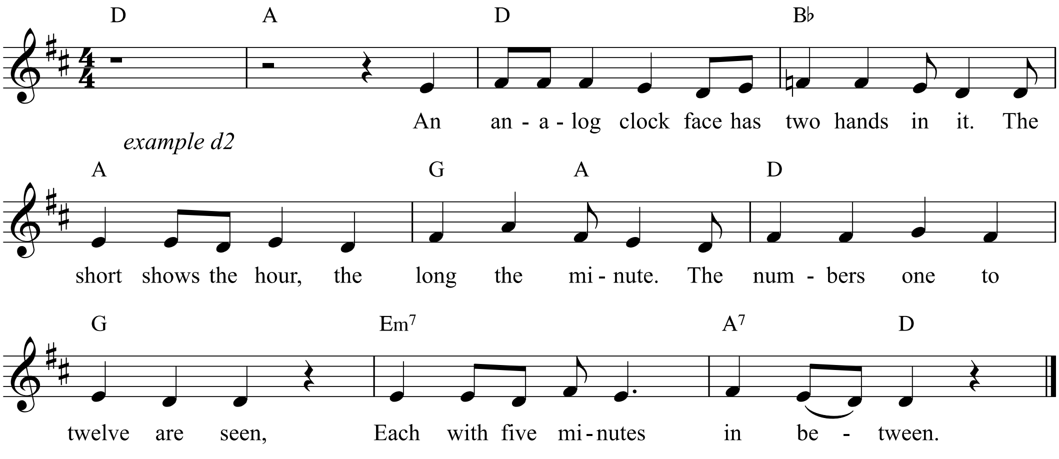
The fourth and final version is in E flat major, as relief from the preponderance of D major tonality in the songs in this artefact. D major is a key which lends itself to accompaniment by guitar, as the chords of D major (I), G major (IV) and A major (V) are relatively easy to finger and play for the teacher who may not be a trained performer. Therefore, I have made frequent use of it for the songs in this artefact. However, if students were singing a number of the songs in sequence, such as for a concert, the lack of key variety might be tiresome to the audience and singers. Using a capo with guitar can easily change key to E flat, E or F major.

The melodic range is a perfect fifth, again with principally stepwise melodic movement. The largest melodic interval is a major third, making it easier to sing for younger singers. Harmonic interest is provided by the unexpected B major harmony in bar 4, and the f minor 7th chord in the penultimate bar. The verse concludes with the common chord progression of ii-V-I, using 7ths on chords ii and V to strengthen the closing harmonic structure (Smit et al., 2020).

The use of chromaticism with the flattened third/G flat in bar 4 provides harmonic ambiguity, utilising a chord (B major) which does not belong to the tonic key of E flat major. Accented passing notes (which are not part of the harmonic chord) in bars 6, 8 and 10 produce dissonances which then resolve on the following notes. These features add unpredictability to make the song more interesting.



The song would be easy to for teachers or students to play on guitar in D major, with a capo over one fret. A copy of the song in D major is included in the creative artefact, as seen here.



example d2

A composer can potentially continue to write new melodies and harmonies for the same lyrics for a lifetime. The Romantic composer Johannes Brahms told his students that “it is rare that a piece, once it has been completed, becomes better through revision; usually it gets worse” (Jenner, 1990, p. 200). So, one must draw the line somewhere, and be somewhat satisfied with the (current) final version, all the while knowing that further revision and recursion may occur. Many of the songs in this project have evolved over time with multiple revisions of both lyrics and music leading to up to six distinctly different versions of a song.

As a composer one is usually writing to a deadline. This predetermined time frame for generating a certain number of songs curtails the revision process. In this project I have appreciated the luxury of being able to revise songs up to a year after they were first composed. In doing so, I find that I have become less emotionally connected to these songs, as my ego is no longer invested when I analyse their quality from a fresh, distanced perspective. The research information I have absorbed and the songs I have created in the interim have also affected my praxis, prompting changes in my composition process. I am able to be more knowledgeable, clearsighted and dispassionate in deciding on revisions or even complete rewrites.

In the final version of the song, I decided to add an introduction and coda to be more appealing and add a new element to the performance. Children regard song in the classroom as a fun activity (Dolean, 2016; Shanangurai, 2017), and in my experience, enjoy using their speaking voices as well as singing. The whispered “tick tock” sounds use onomatopoeia to emulate mechanical clocks, which many children may not have heard due to the ubiquity of digital clocks and watches. I included the words “Time told on a clock” to establish the function of clocks.

I also utilised the well-known pitches of the chimes of Big Ben, the famous clock in London next to Parliament House, as a familiar melody is preferred by students (Lundy et al., 2019; Weiss et al., 2016) and improves their learning and recall (Gfeller, 1982; Tamminen et al., 2015). If the school has a set of chimes or bells, students can play the “chimes” of Big Ben, while the “tick tock” sound can be produced on wood blocks or other student-generated instruments.

Clocks

Aniko Debreceny

Exemplar 2 – Phases of the Moon - Grades 3 / 4

Phases of the Moon is usually taught at the third or fourth grade level in the U.S. The song exemplifies the intermediate level of songcrafting in this project.

Basic Facts:

- The moon does not emit light but reflects light from the sun.
- The portion of the moon that we can see from Earth is called the moon's phase.
- The moon takes one month (29.53 days) to orbit the Earth.
- Depending on how much of the moon is lit by sunlight, it appears to be different shapes.
- A waxing moon appears to be getting bigger, while a waning moon gets smaller.
- Moon phases: new, crescent, quarter, gibbous, full.
- The north and south hemispheres view the moon oppositely.
- A satellite is a celestial body that orbits a planet.

Curricular resources:

U.S. curriculum (GenerationGenius, 2020b; Nelson, 2020a; Timberlake & Belloni, 2015)
U.K. curriculum (Barrow, 2013b)
National Geographic (NatGeoKids, 2020a)
Educational websites (Carr, 2017; Education.com, 2020a, 2020b; T. Smith, 2017)

Word Bank:

Moon – tune, soon
Phases – gazes, blazes, ways/is, stargazers, amazes
Hemisphere – here, clear, near, appear, reappear, disappear
(Sun)light – night, bright, sight, right, satellite
Days – phase, gaze
Reflected – detected, affected

Reflection – direction, connection
New – blue, clue, grew, knew, true, through, view
Sun – done, none, spun, run, begun
Grow – know, show, glow, flow, slow, so, ago, below, shadow
Growing – glowing, going, showing
Faces – places, chases, space/is, races, paces
Aligned – find, defined
Create – great, state, rotate, illustrate, demonstrate, elucidate

The first version of this song was written over four days, with most of the couplets written in a single day. This may be a result of immersing myself in the curricular information, or the well-stocked word bank which led to successful rhyme pairs. Another potential reason for the rapidity of creating this song is that I wrote it after more than a year of focused songcrafting. During that period my praxis developed and improved, potentially leading to faster and more efficient performance of creative tasks, where previous knowledge or skills can affect the incubation or generation phase (Cropley & Cropley, 2010).

The first version was in d minor, with five verses. As is most common in children's songs, I use four-line stanzas, each with four strong beats (Burling, 1966; Cook, 2000).

> The Moon is Earth's only natural satellite
> (A celestial body orbiting a planet), what a sight!
> The Moon rotates at about the same as its orbit pace,
> So, on Earth we always see the same "near" side, or face.
>
> The Moon does not emit light, but reflects the Sun's rays
> As it orbits the Earth in twenty-nine point five three days.
> Depending on how the Sun, the Earth and Moon are aligned
> Different phases of the Moon are defined.
>
> When the Moon moves between the Earth and sun, it is 'new',
> As its position hides its sunlit side from our view.
> If less than half the Moon's surface can be spied,

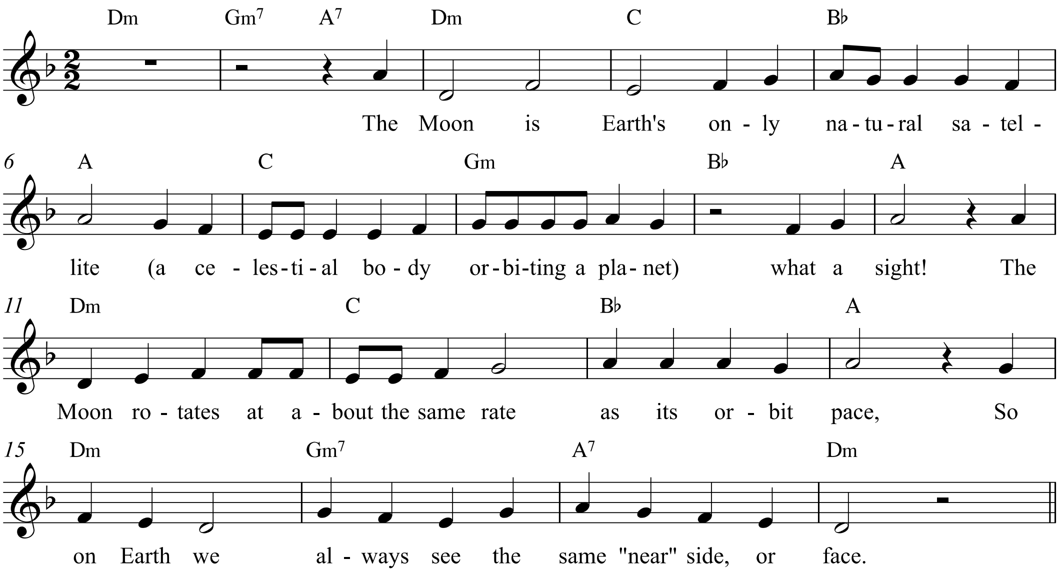
As a ‘crescent’ moon it is classified.

When the Sun, Earth and Moon form a ninety degree
Angle, it’s a ‘quarter’ moon, half its surface we see.
A ‘gibbous’ moon shows more than half its surface as light,
While a ‘full’ moon shows the entire surface, very bright.

A ‘waning’ moon shrinks, while a ‘waxing’ moon grows.
In fact, it’s just how much of the dust and rock Moon’s sunlit side shows.
These lunar phases repeat through the year,
Seem upside down and backwards in the Southern Hemisphere.

Phases of the Moon
version 1

Aniko Debreceny



I almost immediately decided to rewrite the song. Five verses may be too long for this grade level to remember easily, so I abbreviated it to four verses, omitting extraneous lyric lines. I realised that I could list the five phases of the moon, rather than repetitively describing the relative positions of the Sun, Moon, and Earth, and that knowing that the Moon is made mostly of rock and dust was not an essential fact for a song in the U.S. learning standards for this grade level.

Referring to the data on rhyme, I worked to incorporate different types of rhyme, not only at the end of lines. Most of the couplets use masculine rhyme, with composite rhyme in the fourth verse with “sliver” / “give a”. Internal rhymes are found in verse 2, line 1:

The Moon rotates at the same rate as its orbit glide

And verse 2, line 2:

So, on Earth we always see the same ‘near’ side.

The rhythm is very straightforward and simple to sing for this intermediate grade level, as syncopation is used only once at the end of the first line. The harmony is mostly predictable, except for an unexpected chromaticism in the first bar of the melodic first and third phrases (E#) and the use of the minor harmony ii^7 in bars 5 and 6 for harmonic variety. I used added note chords for the majority of the piece, which adds a richer texture to the accompaniment.

Phases of the Moon

Gd. 3/4

The Moon is Earth’s only natural satellite
(A celestial body orbiting a planet) seen by day and night.
The Moon does not emit light, but reflects the Sun’s rays
As it orbits the Earth in 29.53 days.

The Moon rotates at the same rate as its orbit glide,
So, on Earth we always see the same ‘near’ side.
A waning moon appears to shrink, a waxing moon grows.
In fact, it’s just how much of the Moon’s sunlit side shows.

Depending how the Sun, Earth and Moon are aligned
Different phases of the Moon are defined.
New, crescent, quarter, gibbous, and full appear,
Seen upside down and backwards in the Southern Hemisphere.

The new moon is dark; a crescent moon a silver sliver.
A quarter moon shows half its face. A gibbous moon will give a
Larger surface to reflect the Sun’s light.
A full moon shows its entire face, very bright.

The second melody also was created quickly, first in compound duple / 6 8 metre, then in alla breve / 2 2. It is in the key of D major, to facilitate guitar accompaniment. The melodic range is a perfect octave, B3 – B4, within the comfortable tessitura or vocal range for eight- and nine-year olds (Berger et al., 2019; Lu et al., 2017). The melody is mostly stepwise, as is common for children's songs (Gonzalez, 2016), though many children's play-songs use skip, or the interval of a third, rather than step melodic shapes (Countryman et al., 2016), as seen in bars 2-3, 7-8 and 11-12.

I include rests for breaths after each lyric line (except verse 1, line 3, and verse 4, line 2). The melody descends in the final phrase, as is common in a majority of children's nursery rhymes (Gonzalez, 2016).

Keeping in mind the musical and singing capabilities of third and fourth graders, I consciously incorporated musical elements that provide more of a challenge than the simpler melodies of the first and second grade songs. The song is 72 bars in length, but the beat is notated in half notes, so it is equivalent to a 36-bar song in 4 4 metre.

While the melodic movement is mainly stepwise or conjunct, I also include the minor 6th interval, B3 – G4, both descending and ascending, which singers of this age should be comfortable with singing. The large interval is made easier to sing by descending G4 – B3, then immediately returning to the previous pitch G4, which is still in the singers' immediate pitch memory.

Writing for these older students, I decided to use more complex and sophisticated harmonies so that they would not feel the song was too simple and 'babyish'. The use of chromaticism (E# instead of E natural) in the first bar of the melody's first and third phrases creates ambiguity in the harmony, as it varies the tonic chord (I) from major to minor for one beat. An unexpected minor harmony occurs in bars 5 and 6 (ii^7). The majority of harmony chords incorporate an added note, e.g., D^6, A^7, Em^7, providing a thicker, fuller texture to the accompaniment.

Adding notes to the usual three note or triad harmony chords “enhances the structure of the chords [and] adds a kinetic force that energizes harmonic progressions” (Terefenko, 2017). A 1997-2011 study found that certain chords evoked similar emotions in over 2,100 children on four continents, specifically that the added sixth chord produced a sense of warmth or happiness (Willimek & Willimek, 2017). I frequently use added sixth chords in my songs, which provides a ‘jazzier’ style.

The final full version:

Phases of the Moon

Aniko Debreceny


(A B C#) D6 Em7
De - pen-ding how the Sun, Earth and Moon are a - ligned
A7 D
Dif - fe - rent pha - ses of the Moon are de - fined.
D6 G6
New, cres - cent, quar - ter, gib - bous, and full ap - pear, Seen
A A7 D6 A7
up - side down and back-ward in the Sou-thern He - mi - sphere.
(A B C#) D6 Em7
The new moon is dark; a cres-cent moon a sil - ver sli - ver. The
A7 D
quar - ter moon shows half its face. A gib - bous moon will give a
D6 G6
Lar - ger sur - face to re - flect the Sun's light. A
A A7 D6
full moon shows its en - tire sur - face, ve - ry bright.

Exemplars 3 & 4: The Water Cycle 1 & 2 – Grades 1 / 2 & 5 / 6

The Water Cycle material is presented in both early and late elementary curricula in the U.S. These exemplars demonstrate the differences between the curricular requirements and musical capabilities of younger and older students. The two songs provide an example of spiral curriculum, where a subject is revisited repeatedly in a logical sequence of increasing levels of depth and difficulty (Smith, 2002), and the new learning is directly linked to previous learning phases, reinforcing earlier concepts (Jaime et al., 2016).

Basic Facts:

- The basic water cycle flows from evaporation – condensation – precipitation.
- The water cycle is also termed the hydrosphere equation.
- The cycle is actually far more complicated, adding transportation, runoff, infiltration & percolation, groundwater, plant uptake, transpiration, deposition.

Curricular resources:

U.S. curriculum (Cey, 2017; Seneca Valley School District, 2018; Utah State Office of Education, 2010)

Canadian curriculum (British Columbia) (BCME, 2016)

Encyclopedia (Augustyn, 2018)

NASA (2019)

National Geographic Society (2019)

National Oceanic and Atmospheric Administration (NOAA) (2019)

Word Bank:

Evaporation – condensation, precipitation, rotation, hydration, migration, equation, explanation, mutation, application, liquidation, irrigation, revelation, percolation, circulation, formulation, information, transformation, operation, transpiration, illustration, transportation, sublimation, infiltration

Complicated – educated, fascinated, illustrated, elucidated, elaborated

Uptake – make

Land – spanned, understand
Ground – found, round, underground

Writing the lower grade song lyrics went quickly, as there are so few essential facts required at this level. Rhyming was made easy by using all the important terms which end with “-ation” at the end of each line (evaporation, condensation, precipitation).

> The water cycle starts with water evaporation,
> Next rain and snow clouds form – condensation.
> Then water falls to the earth – precipitation.
> The basic water cycle – the hydrosphere equation.

I then added the step of cooling for condensation, and the concept of the water cycle being the constant circulation of water through different phases. I first replaced ‘equation’ with ‘transformation’ as it more closely rhymes with the other lines:

> Our hydrosphere equation – water’s constant transformation.

but realised that ‘circulation’ was a more accurate term.

To emphasize the most important information in the song I repeated the three steps of the water cycle twice in the final two lines, using the same melody to make it easier to learn and remember, but with one altered harmonic chord for sonic variety (em^7 – A major – D major; G major – A major – D major). Repetition, as in singing the final line which states the most essential information twice, provides constant reinforcement of the subject or skill (Harden, 1999; Jaime et al., 2016). It is essential for encoding information into long-term memory, thereby enhancing learning and recall (Pindale, 2013; Trinick et al., 2016).

The Basic Water Cycle — Gd. 1/2

> The basic water cycle starts with evaporation
> Which cools so rain and snow clouds form: condensation.
> Then water falls to the earth: precipitation.
> Our hydrosphere equation – water’s constant circulation:

Evaporation, condensation, precipitation,
Evaporation, condensation, precipitation.

In creating the melody, I used D major, with a vocal range of a minor 6th, from C#4 to A4, which is appropriate for this age group (Jersild, 1934; J. Kim, 2000; Lu et al., 2017; Sergeant & Welch, 2009). I employed a compound duple time signature (6 8), which uses a mostly long – short 'bouncy' rhythm, or iambic tetrameter, which is the most popular prosodic pattern in many languages (Attridge, 2014) and children's verse (Bill, 1990).

Every line of the Basic Water Cycle begins with an unaccented upbeat note, or anacrusis, so that the stronger downbeat note will coincide with the important syllable e.g., line 2: "Which <u>cools</u>", line 3: "Then <u>wa</u>ter falls", line 4: "Our <u>hy</u>drosphere", lines 5 & 6: "E<u>va</u>poration". In the first line, there are three upbeat notes so that the first strong downbeat matches the first syllable of "<u>wa</u>ter". Every line of both versions of the Water Cycle has eight strong beats, in iambic meter.

The decision to use compound duple metre (6 8) allows for more than two syllables to be sung per beat. Compound duple metre consists of two strong beats in each bar or measure of music, where the beats are subdivided into three even eighth notes rather than the standard two eighth notes found in simple duple metre. It allows an extra syllable to be sung smoothly in each beat if required, rather than adding sixteenth notes. These are twice as fast as eighth notes and can be difficult to sing rapidly, especially for younger singers. This was useful in the second Water Cycle song, enabling more syllables to be used in each line, e.g., "Transportation's the movement of water in the atmosphere to and fro" could be sung in 8 beats of 6 8 metre, but would take 10 or 12 beats in 2 4 or 4 4 metre, depending on how the word stresses are placed.

As previously noted on page 98, The Basic Water Cycle incorporates wordpainting, where the melodic shape depicts the meaning of the lyric, first in the line ‘Then water falls to the earth’, with a falling perfect fifth between ‘falls’ and ‘to the earth’. I also used an ascending phrase for the terms “evaporation, condensation” to depict the upwards movement involved in ‘evaporation’ followed by a descending melodic motive for the term ‘precipitation’.

These lyrics can be accompanied by gesture, which improves memory and retention (Cook & Fenn, 2017; Halvorson et al., 2019; So, 2012; Werner, 2018), e.g., point up for ‘north’, down for ‘south’, left for ‘west’ and right for ‘east’. For a group performance, the class can separate into four groups. As each term is sung each group points in “their” direction: the standing “north” group points up with hands over their heads, the lower “south” group kneeling in front of them points down to the ground, the “west” group points to the left and the “east” group to the right (ensuring that the correct directions are from the audience’s perspective, not the students’) to make a starburst / compass rose effect.

Rests are included to allow for breaths for young singers with smaller lung capacity. The long notes at the ends of phrases can be cut short in order to take extra breaths if necessary.

In an example of recursion in the incubation or generation phase of creativity, the first version of the Basic Water Cycle was revised after several months, making small alterations in rhythm, melody, and harmony. These changes made the song easier to sing with more stepwise melodic movement and more interesting harmonies. The bass line in bars 16 – 20 changed from E – B – G – E – G to E – F# - G – A – B, a stepwise ascending motive as counterpoint to the melody. The anticipatory syncopation at the end of the second line on “condensation” was removed to match the following accent on the rhymes of “precipitation” and “circulation”. I also added another two bars of introduction to firmly establish the tonality and starting note of the melody.

Here is the annotated version of the final version of Basic Water Cycle.

Annotation Key:

Rhyme	Blue
Melody	Green
Harmony	Red
Rhythm	Orange

Major tonality

Feminine rhymes lines 1 - 6

Repetitive melodic shape bars 4/5, 6/7

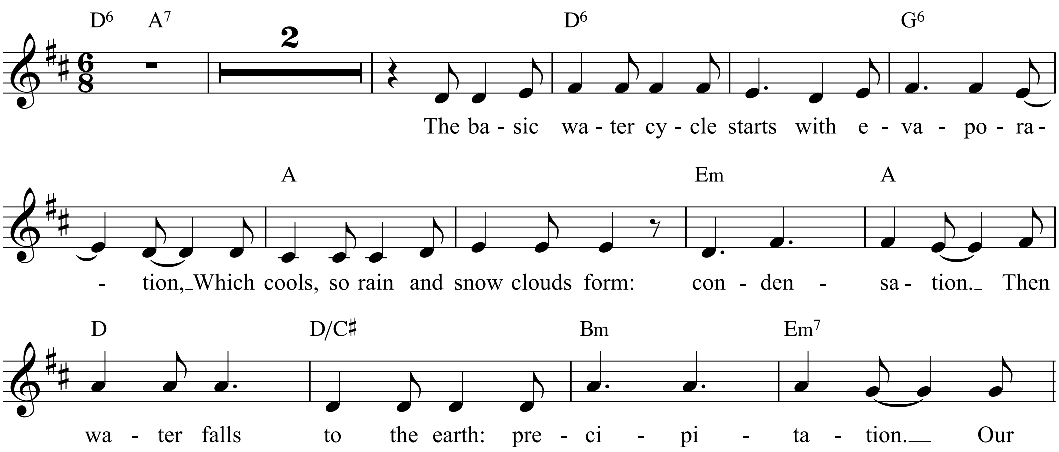
Wordpainting line 3

The Basic Water Cycle version 2

Alliteration line 1

Aniko Debreceny

Moderato



Minor tonality harmonies bars 11, 15, 16, 17, 20, 22, 27

Accented passing notes bars 7, 11, 12, 15, 16, 19, 21, 28, 29

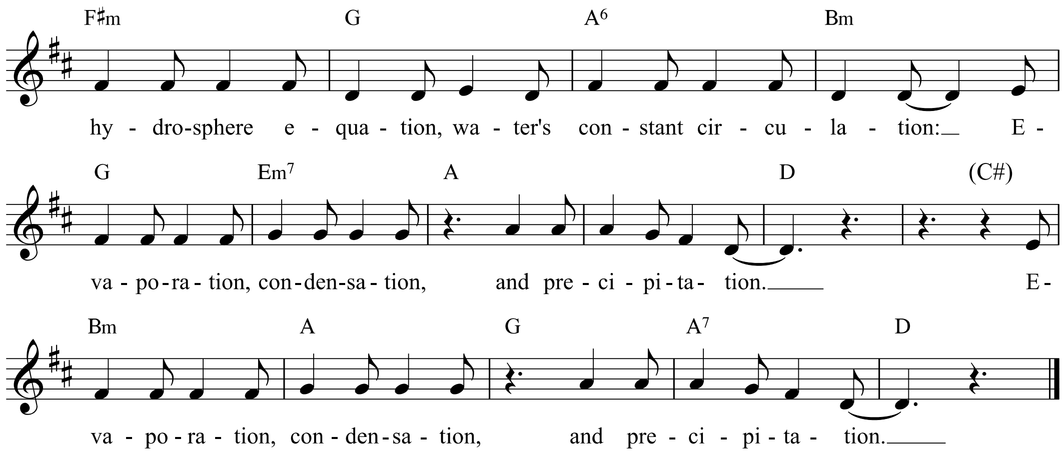
Largest melodic interval perfect 5th

Melodic range minor 6th C#4 – B4

Syncopation – bars 7, 8, 12, 16, 20, 24, 30

Mostly stepwise melodic movement

Anacrusis - bars 4, 8, 12, 17, 20, 26



Rests for breath
bars 10, 23, 25, 26, 29

Common closing
harmonic progression
ii7 – V7 – I, bars 22-25

Added note harmonies -
8 of 24 chords

Repetition of
important information
line 5 & 6

Descending final phrase

The second Water Cycle song for grade 5 or 6 needed to include more curricular information, so is longer. Expanded from one to three verses, it has an introduction which paraphrases the Basic Water Cycle song, and leads into the next section with an invitation to learn more, also introducing the term “hydrologic cycle”:

> But wait, there’s so much more
> About the hydrologic cycle to explore.

The following two verses contain further essential terms and their definitions (percolation, plant uptake, transpiration, sublimation, deposition, transformation, transportation and surface flow), with 13 terms defined in 14 lines. I changed the chain “-ation” rhyme scheme by using “transportation” at the beginning of the line in order to rhyme “to and fro” with “surface flow”. I used different melodies for the introduction and the two verses in order to separate the older, more basic information from the new extended material.

The Water Cycle 2 Gd. 5/6

Long ago we learned the water cycle information
Where liquid water turns to vapour through evaporation.
It cools and condenses into clouds – that’s condensation,
Then falls back to the earth as rain or snow – precipitation.
But wait: there’s so much more
About the hydrologic cycle to explore.

Precipitation can become runoff, or evaporation,
Or move into the soil through infiltration and deep percolation.
Plant roots absorb groundwater (plant uptake), then evaporation
From plants into the atmosphere is termed transpiration.

The direct conversion of solid ice or snow to vapour is sublimation,
Deposition’s when vapour becomes solid, the reverse transformation.
Transportation’s the movement of water in the atmosphere to and fro;
Rivers, lakes, and streams drain to the ocean: surface flow.

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Chain rhyme is where stanzas are linked by using the same rhyme, as in this case with the repeated use of words ending in “-ation”, which are also polysyllabic rhymes. The second Water Cycle song also uses wordpainting, as in the introduction, where the phrase “falls back to the earth as rain” contains two descending perfect fourth intervals on “falls back” and “earth as rain”. In the first verse “plant uptake” is sung on a rising scale, and in verse 2 “streams drain” is sung on a descending perfect fifth.

The vocal range is a perfect octave, B flat 3 to B flat 4, two notes greater than the version for younger singers. The largest melodic interval is a major 6th, one tone greater than the earlier song. The melodic shape in the verses is angular rather than stepwise, with changing intervals which are somewhat challenging to sing, appropriate for this older age group. There are fewer rests within the verses, as the more physically mature students will have a larger breath capacity. By utilising compound duple (6 8) metre, the multi-syllabic terms can be accommodated in one beat as triplet rhythms.

Several revisions allowed for altered melodic notes and harmony, and simpler rhythms with fewer syllables per bar. The third verse line “Deposition’s when water vapour becomes solid, the reverse transformation” was changed to omit “water”, reasoning that the word was both unnecessary and rhythmically awkward. The bass line and harmony in bars 11 – 14 was altered from A flat – A flat – B flat – B flat to A flat – B flat - C minor – D flat, creating an ascending scale motive as counterpoint against the melody. I removed some accented passing notes in the melody, in order not to have too many dissonances. In the second verse I moved the second line a beat earlier in the anacrusis to create the trochee foot (long short) rhythm rather than rapid triplets which may be more difficult to sing quickly.

Major tonality

Largest melodic interval major 6th

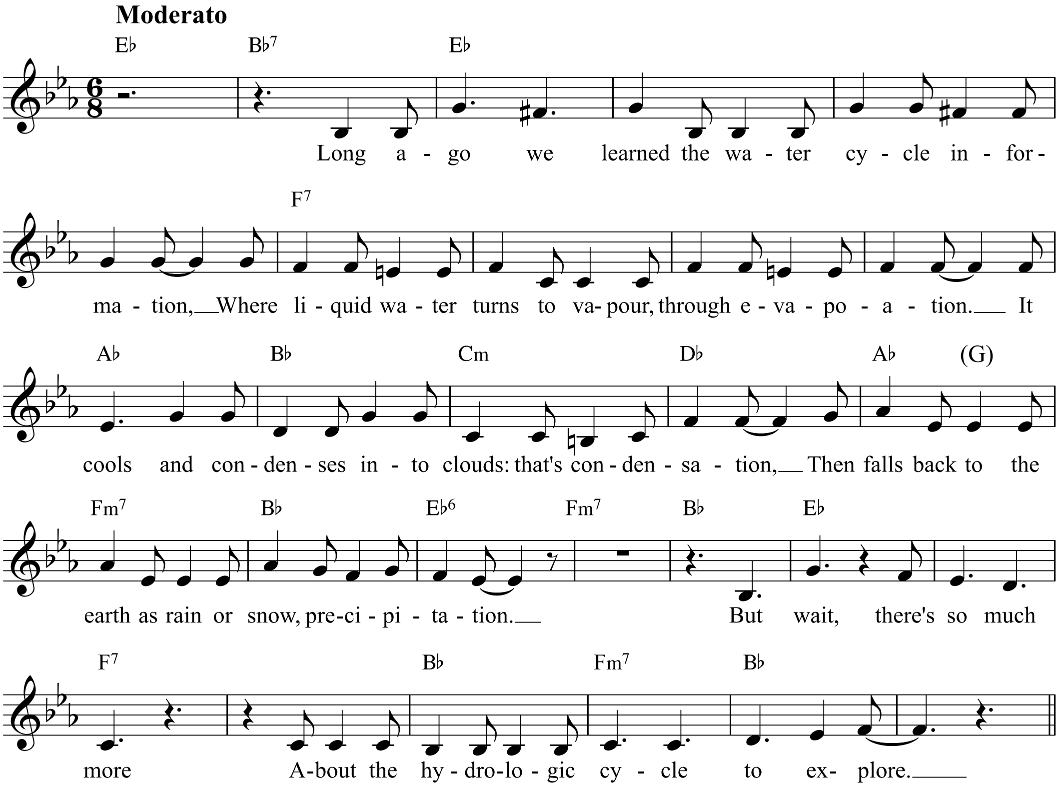
Unexpected harmonies F major bar 7, D♭ major bar 14

Melodic range perfect octave B♭3-B♭4

Polysyllabic rhymes lines 1 - 4

The Water Cycle 2 version 2

Aniko Debreceny



Syncopation – bars 6, 10, 14, 18, 27

Accented passing notes bars 17, 18

Anacrusis - bars 2, 6, 10, 14, 20, 24

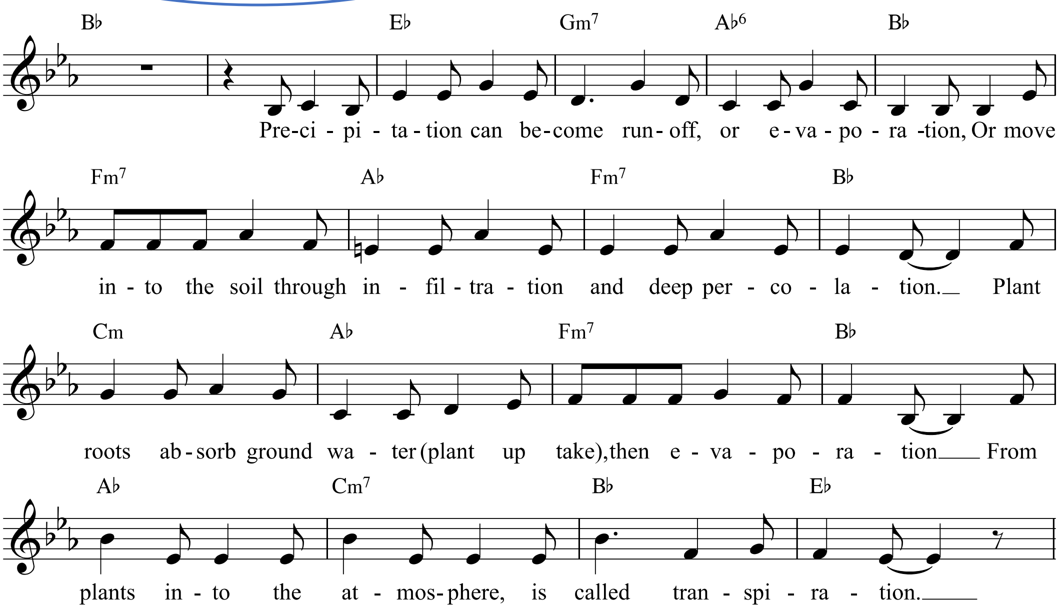
Cadence ii7 – V - I bars 16-18

Masculine rhyme lines 5 & 6

Chromaticism bars 3, 5, 7, 9, 13, 36

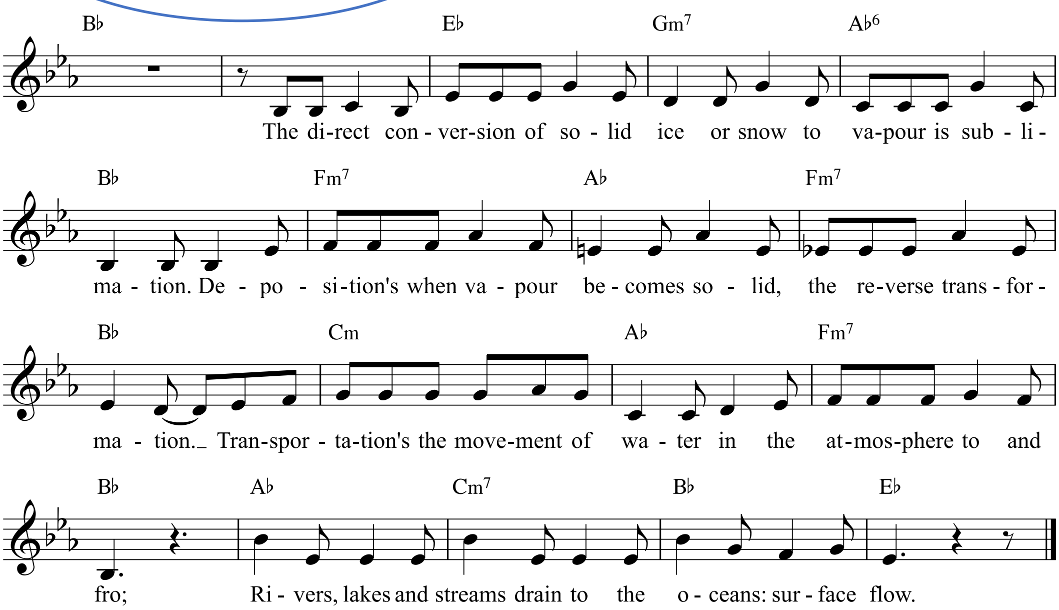
Anacrusis
bars 30, 34, 38, 42

Syncopation
bars 38, 42, 46



Wordpainting
“plant uptake”
ascending

Added note harmonies -
13 of 35 chords



Here is the final version, without annotations.

The Water Cycle 2

Aniko Debreceny


A♭ Cm7 B♭ E♭
plants in - to the at - mos- phere, is called tran - spi - ra - tion.
B♭ E♭ Gm7 A♭6
The di-rect con - ver-sion of so - lid ice or snow to va-pour is sub - li -
B♭ Fm7 A♭ Fm7
ma - tion. De - po - si-tion's when va - pour be - comes so - lid, the re-verse trans - for -
B♭ Cm A♭ Fm7
ma - tion. Tran-spor - ta-tion's the move-ment of wa - ter in the at-mos-phere to and
B♭ A♭ Cm7 B♭ E♭
fro; Ri- vers, lakes and streams drain to the o- ceans: sur-face flow.

Exemplars 5 & 6 – Biomes 1 & 2 - Grades 1 / 2 & 5 / 6

As part of a sequence of science songs about geography using U.S. learning standards, I elected to write a song about biomes. Like the water cycle, this subject is presented several times in the U.S. elementary curriculum, so I created two songs for different grade levels: a simple basic song for grades 1 & 2, and another with greater detail as required at the middle school level for grade 5 & 6.

Curricular resources:

U.S. curriculum materials (Elementary School Science, 2017; Technical Solutions, Inc., 2020)

U.K. curriculum material (Mountbatten Primary School, 2020; Old Town Primary School, 2020; Scoffham & Owens, 2017)

Australia curriculum materials (FUSE, 2020; Sydenham & Thomas, 2018)

Encyclopedias (Augustyn, 2020; BritannicaKids, 2020a)

NASA (Anderson, n.d.)

National Geographic (2011)

Online texts (biologyonline, n.d.; Dotson, 2019; Elemntary School Science, 2017; Fries-Gaither, 2009; Moeller, 2013; National Center for Ecological Analysis and Synthesis, 2004)

<u>Basic Facts</u>:

A biome is

- a large naturally occurring community of flora & fauna occupying a major habitat, e.g., forest or tundra.
- a major ecological community of organisms adapted to a particular climatic or environmental condition on a large geographical area in which they occur.
- a complex biotic community characterised by distinctive plants and animal species and maintained under the climatic conditions of the region.

- a large group of ecosystems together, with similar climate, flora and fauna, soil type and weather.
- a community of plants and animals living together in a particular climate.
- regions of the world with similar climate, weather, temperature, animals and plants, terrestrial and aquatic.
- Five main biome regions: Forest, Grassland, Desert, Tundra, Aquatic (freshwater, saltwater/marine).
- Other biomes: Savanna, Taiga / coniferous / boreal / deciduous forests, Tropical Rainforest, Alpine, Chaparral, Coral reef, Wetland, Estuary.

Word Bank:

Adaptation – foundation, creation, formation, station, complication, explanation, variation, location, designation

Aquatic – biotic, exotic

Biome – home

Cold – told, behold

Community – geography, biology, sea, see, key, canopy, tree, agree, boundary, summary, elementary, intricacy, complexity, ecology, category, opportunity, unity, variety, biogeography

Covered - discovered

Defined – find, kind

Environmental – continental, fundamental

Equator – locate a, locator, greater

Know - go, know, grow, below

Knew – too, drew, grew, true, view

Life zone – known, shown, unknown

Marine – been, scene, seen, piscine, between

Organised – categorised, comprised, realised, advised, revised, specialised, visualised

Separated – located, created, complicated, formulated, generated, illustrated, affiliated, enumerated, elaborated

Wetland – spanned, wonderland, understand

Obviously, the early grade level song would be simpler both in melodic and rhythmic complexity, containing less detailed information, and shorter in length. I first decided that I would link the two songs by placing the most essential information in the chorus and first verse, which would then comprise the lower grade level song. When students encountered the second version of the song in a later grade, they would already know an important part of the song and the core information.

Biomes 1a – version 1 Gd. 1/2

A biome is a complex ecological community
In a large geographic area or region where we see
Distinctive plants and animals with similar adaptations
To their climate, weather, and soil type, with variations.

There are five basic biomes, each with subcategories:
The aquatic, tundra, forest, grassland, and desert communities.
Each is uniquely adapted to its climate and situation,
Though climate change can rearrange each biome's location.

I quickly realised that these words were too advanced for students at this level. My constant challenge as a lyricist is to incorporate the essential terms and concepts using vocabulary that is suitable for the target grade level. Over several weeks in the gestation phase of creativity I wrote multiple progressively simpler, more age-appropriate rhyming couplets e.g.

Plants and animals live together
In places with the same climate and weather.

In each community the plants and creatures
Have adapted to its features.

In our world we can see
Large plant and animal communities.

Hot or cold, wet or dry,
We can classify:

Our world of oceans and continents is
Full of big differences.

Animals and plants live where they will thrive
In large communities – biomes – there are five.

From ice caps to equator, sea to mountain ranges,
There are so many changes.

In our world there are so many plants and creatures
Living in habitats that share the same features.

Our world has many different places,
Hot or cold, wet or dry spaces.

Revision led to version 2's original first verse.

Plants and animals, animals and plants
Live in places with the best chance
To survive, to thrive and grow,
From ocean to desert, rainforest to snow.

I liked the sound of the first line, but the repetition was redundant, so I altered it to "In our world, animals and plants". I also liked the internal rhyme of "survive" and "thrive". Then I realised that in a short song, I needed to include only the most essential information about the biomes. I should not use ocean, rainforest or snow, in case the students remembered those as the major biomes instead of the more accurate aquatic, forest, tundra, grassland and desert terminology.

From a line "Polar bears and monkeys don't live in the same place", which I intended to rhyme with "space", came the question,

Why can't polar bears and monkeys live together?

which then rhymed with the answer:

They've adapted to different climates and weather.

I substituted ‘turtles’ for ‘monkeys’, hoping the students would find the concept of mismatched species funny, and to hold their attention. I also enjoy the multiple ‘t’ sounds of “can’t turtles live together”, a form of alliteration.

Placing that pair of lines into the chorus offers the opportunity for students to insert their own incongruous species pairing. In notes for teachers on this song, I suggest a class activity to create lists of two- and three-syllable animals or plants that can be inserted into the second and third choruses, enhancing student engagement and participation.

I also suggest the chorus can be sung by two different groups in the class, which can alternate. The questions [Q] can be sung by either part of the class or the teacher, while the answers [A] are sung by the rest of the students or the entire class [All].

I realised that most of the first verse was redundant because the information was repeated in the other verses and chorus. To follow the popular mantra KISS, which I have adapted to “Keep It Simple, Short”, I abbreviated the first verse to two lines. Song or chant offers an opportunity to make “the length short while the content remains rich and complex” (L.-L. Chuang, 2016, p. 26). Crowther et al. (2015) use song as an information summary, finding that college physiology students strongly prefer very short jingles to long educational songs. Students using songs to learn science prefer them to be “short and sweet and to the point” (Governor, 2011, p. 174). Tony Award winning composer William Finn described writing songs for children’s television as “[With kids,] you make a statement and then you get out—with a little elegance and a few tricks. You can’t overstay your visit. Kids will get bored” (NYCC, 2015).

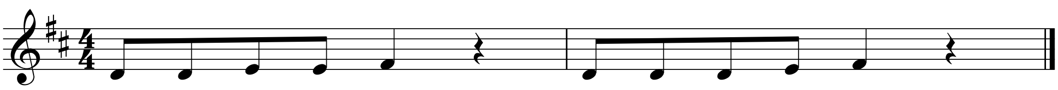
The original melody used a triad/chord pattern for the first two bars, which I altered to a scale/stepwise pattern to be easier to sing (see Biomes 1b examples a & b, below). The lyric rhythms follow normal speech patterns, though I added a few syncopations for interest (see example b, below).

Biomes 1b example a

Biomes 1b example b

For the repeated four eighth note patterns I changed from a pattern of two notes on the lower pitch followed by two notes on the next pitch above to a more interesting pattern of three notes on the lower pitch and one on the higher pitch (see Biomes 1b example c, below).

Biomes 1b example c



The melodic intervals again are primarily stepwise, with the largest interval being a descending perfect 5th (A4-D4), appropriate for this age level (Gonzalez, 2016). Each syllable of the lyrics is sung on one note (syllabic), rather than extending over several notes (melismatic), which improves word recognition (Johnson, 2014).

Biomes 1
version 1

Aniko Debreceny

In this first version I merely listed the five major biomes but decided to expand with a single line about each biome in the later version. I intended to provide an overview of the topic which could prove useful as a prompt for further information in later studies. I tried to keep the lyrics as simplistic as possible, without going into too much detail. For example, for the forest biome I did not have space to add the subcategories of tropical/rain, coniferous and deciduous. I decided the most important facts the students need to know are that forests can be warm (tropical) or cold (taiga/boreal), and that they all have trees, which have green leaves or needles. For deserts, I felt the most important facts were that this is the driest of the biomes, which can be hot or cold, not necessarily sandy and hot, but also cold and icy, such as in Antarctica.

I used the term “communities” in both the chorus and a verse, because it is so common in definitions of biomes. The other essential concept is that species have adapted to their specific biome’s characteristics, climate, and weather, so that also is included in the repeated chorus. This repetition reinforces learning and retention (English & Visser, 2014; Fisch, 2014), particularly for young students (Millington, 2011; Vidovic, 2016).

I would have included in the chorus that “They’ve each adapted to different climates and weather”, but there were not enough notes rhythmically available in the bar to do so. I could have used a pickup note in the previous bar but wanted to leave space for the young singers to take a breath. The vocal range is one octave, B3 – B4, which is a comfortable range for five- and six-year-olds (Jersild, 1934; Lu et al., 2017; Sergeant & Welch, 2009).

Biomes 1b Gd. 1/2

In our world we can see
Plants and animals, a huge variety.

Chorus Oh, [Q] Why can’t polar bears and turtles live together?
[A] They’ve adapted to different climates and weather.
[All] These regions or communities are their homes.
[Q] What do we call them? [All] Biomes.

Aquatic is water, fresh or salt – ‘marine’.
Forests can be cold or hot, with trees so green.
The tundra’s very dry and cold, no trees can grow.
Deserts are the driest, with sand or rock or snow.

Chorus Oh, [Q] Why can’t __________ and __________ live together?
A] They’ve adapted to different climates and weather.
[All] These regions or communities are their homes.
[Q] What do we call them? [All] Biomes.

Grasslands are mostly open plain.
These five basic biomes each contain

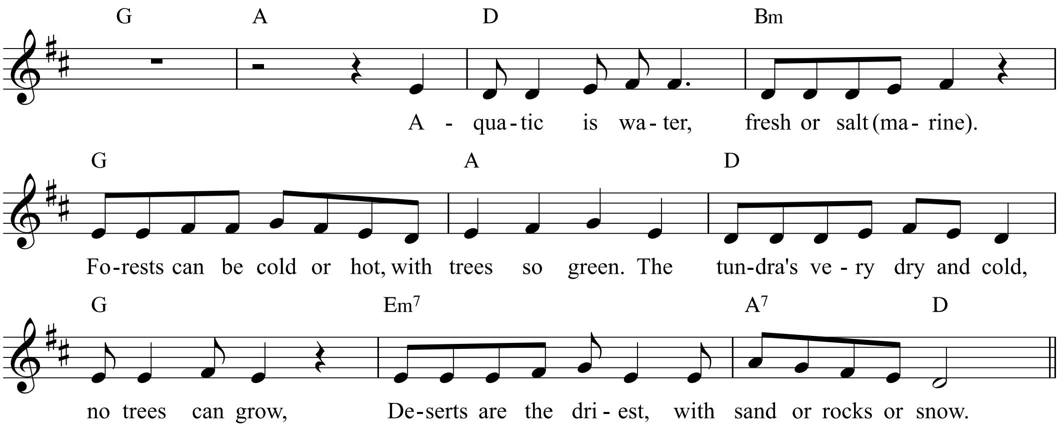
Similar climate, weather, plants, and species
In their biome communities.

Chorus Oh, [Q] Why can't __________ and __________ live together?
[A] They've adapted to different climates and weather.
[All] These regions or communities are their homes.
[Q] What do we call them? [All] Biomes.
Yes, what do we call them? Biomes.

Next, the annotated version of Biomes 1.

Interior rests
bars 3, 4, 8, 12, 14

Descending final phrase



Masculine rhymes
lines 1 & 2, 3 & 4

Syncopation
bars 3, 8, 9

Interior rests
bars 4, 8

Melodic repetition
bars 3 & 4, 5 & 6

Common closing
harmonic progression
ii7 – V7 - I

Anacrusis
bars 2, 6

Masculine rhymes
lines 1 & 2, 3 & 4

Syncopation
bars 1, 8, 11, 13

Alliteration
line 2

Envelope rhyme
Chorus at beginning and end

Repetition of
concept/term:
communities

Interior rests
bars 6, 11, 15, 17, 19

Next is the final version.

Biomes 1

Aniko Debreceny

Biomes 1b - version 2

Writing a biomes song to incorporate U.S. grade 5 & 6 learning standards was a major challenge, as there is an enormous amount of curricular information which students are expected to learn and retain. I had collated a large amount of material about the major biomes, which facilitated writing lyrics for the more advanced grade level. By noting which facts were included in a preponderance of the learning standards and educational websites, I was able to determine the core essential information. Though it meant that the song would be very long, with seven verses, I rationalized that it would be taught over a period of several weeks in the classroom. Over a month I worked on distilling the information as much as possible.

For instance, an early version included:

> The five basic biomes are aquatic and
> Forest, desert, tundra, and grassland.
> These can be divided into more categories a-plenty:
> Some scientists think there are up to twenty!

I decided that the “and” and “grassland” rhyme was weak, and that contemporary students would laugh at “a-plenty”. Knowing there are more biome subcategories could be written differently:

> There are five basic biomes, each with subcategories:
> The aquatic, tundra, forest, grassland, and desert communities.

The first verse started as:

> A biome is a complex community
> Of similar ecosystems, where we see
> Distinctive plants and animals living together
> And similar climates, soil types, and weather.

which then, emphasizing the importance of adaptation, became:

> A biome is a complex ecological community
> In a large geographic area of region where we see
> Distinctive plants and animals, with similar adaptations
> To their climate, weather, and soil type, with variations.

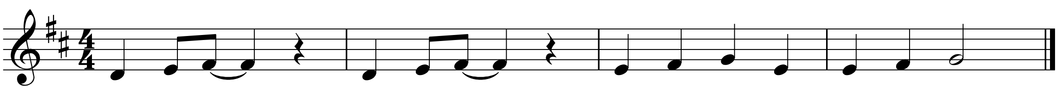
I contemplated writing a short song about each major biome, then decided that it would be too confusing to have a different melody for each topic, or verse. Wallace’s (1994) early research into song’s effect on learning and recall found that when comparing recall of three verses of spoken text with a repeated melody or different melodies, the repeated melody was most successful, while the three different melodies were least effective for retention. However, I thought that the older students would be able to learn two different melodies and would prefer that to singing the same melody seven times in a row.

I decided to use a contrasting melody and tonality in two verses to provide interest and variety. The verses about the tundra and desert which have the driest and most extreme conditions use the key of B minor, to contrast with the D major tonality for the other verses.

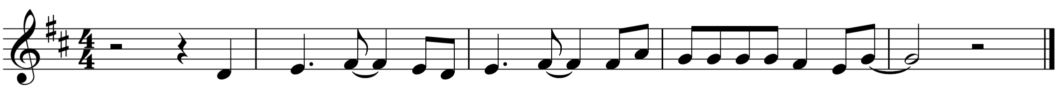
The melodic range is the same as for the Biomes 1 song, one octave (B3-B4). However, the melodic intervals include larger intervals with both ascending (D4-A4) and descending (F#4-B3) perfect 5ths, while the lyric rhythms are frequently syncopated to make them more interesting to learn and sing.

I wrote both versions of the song in the same key, D major, and used a similar melodic motive as the opening to create a musical link between them (see Biomes 1b example 1b/d & Biomes 2 3/a below).

Biomes 1b example d

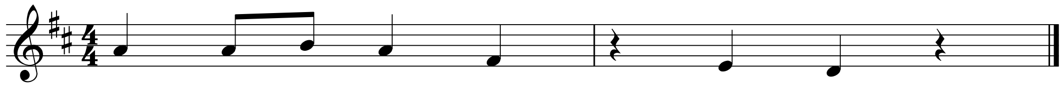


Biomes 2 version 3 example a

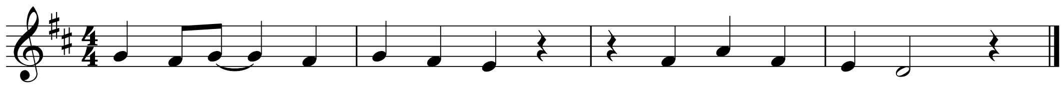


The end of each verse is also similar to give a sense of familiarity, using a descending pattern (see examples Biomes 1b/e, 2/b & Biomes 2/b, c below).

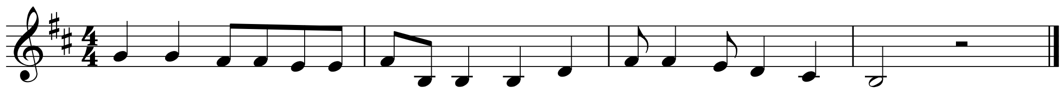
Biomes 1b example e



Biomes 2 version 2 example b



Biomes 2 version 2 example c



I added internal rhyming where I could, e.g.

Though climate change can rearrange each biome's location.

and also incorporated a multiple word rhyme:

Deserts are the driest biome. They are a
Cold zone like Antarctica, or hot like the Sahara.

Biomes 2 Gd. 5/6

A biome is a complex ecological community
In a large geographic area or region where we see
Distinctive plants and animals with similar adaptations
To their climate, weather, and soil type, with variations.

There are five basic biomes, each with subcategories:
The aquatic, tundra, forest, grassland, and desert communities.
Each is uniquely adapted to its climate and situation,
Though climate change can rearrange each biome's location.

Coldest is the tundra, it's very dry, so
With the frozen permafrost layer, no trees will grow,
Just mosses, lichens, small shrubs and short grasses thrive there
With insects, caribou, migrating birds, and polar bears.

The forest biome includes the rainforests with dense canopies,
And half the world's plant and animal species.
The taiga in cold regions grows conifers, like pines, spruce, firs,

And temperate, deciduous forests – all oxygen producers.

Grasslands, and warm savannas, are mostly open plain.
They don't have many trees because of fires, and not enough rain.
The animals are mostly herbivores here,
Giraffes, gazelles, birds, lions, bison, antelopes, and deer.

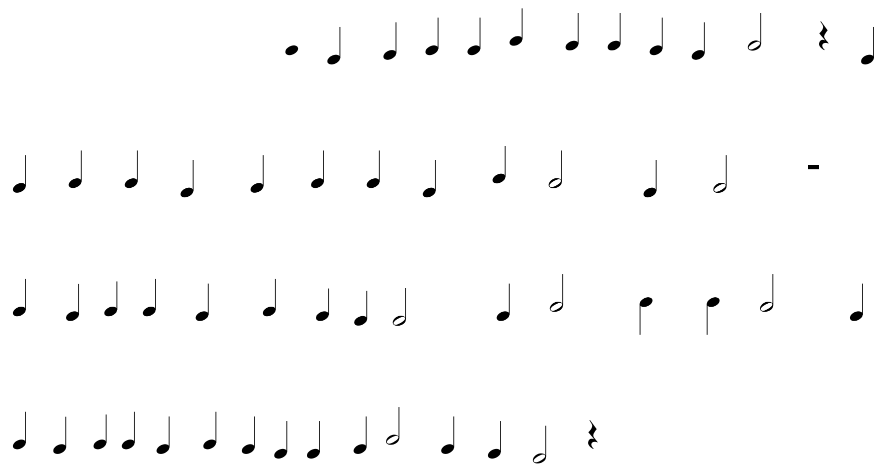
Deserts are the driest biome. They are a
Cold zone like Antarctica, or hot like the Sahara.
To beat the heat some animals and owls burrow deep
Or are nocturnal, spending the hot daytime asleep.

In the aquatic biome saltwater is 'marine';
Freshwater's found in ponds, lakes, wetlands, river, or stream.
Seventy per cent of Earth's surface is covered
By oceans, where so much is yet to be discovered.

Biomes 2
version 3

Aniko Debreceny


C Bm F♯ Bm Em7
in-sects, ca-ri-bou, mi-gra-to-ry birds, seals, lem-mings, and po-lar bears.
A D6 F♯m7 G6 A
4. The fo-rest bi-ome in-cludes the rain-fo-rest with dense ca-no pies, And
D6 Bm7 G6 A Em7 A
half the world's plant and a-ni-mal spe-cies. The tai-ga in cold re-gions grows
Bm7 F♯m7 Em7 A G
co-ni-fers, pines,spruce, firs, And tem-per-ate de-ci-du-ous fo-rests, all o-xy-gen pro-
D6 Em7 A D6 F♯m7 G6
du-cers. 5. Grass-lands and warm sa-van-nas are most-ly o-pen plain.
A D6 Bm7 G A
They don't have ma-ny trees, be-cause of fires, and not e-nough rain. The
Em7 A Bm7 F♯m7 Em7 A
a-ni-mals are most-ly her-bi-vores here, Gi-raffes, ga-zelles, birds, li-ons, bi-son,
G D Em7 F♯ Bm
an-te-lope, and deer. 6. De-serts
A G F♯ C Bm
are the dri-est bi-ome. They are a Cold zone like An-tarc-ti-ca, or



In another example of the iterative recursion process (Webster, 2002; Wierzbicki & Nakamori, 2005), I kept returning to the song, debating on whether to abbreviate it. Remembering that research shows that shorter songs are preferred by students (Crowther et al., 2015; Governor, 2011), I decided to abbreviate it by eliminating two lines from each biome description. I combined the two most extreme biomes, tundra and desert, for the middle verse, retaining the minor melody for harmonic interest. Though I was aiming for brevity, I repeated the most essential information from the first verse in a fifth verse, altering the final line from “To their climate, weather, and soil type, with variations” (vs. 1) to the equally important fact “Though climate change can rearrange each biome’s locations” (vs. 5), which had been omitted when condensing the lyrics.

I changed the sequence of the biomes in the first verse to align with the new order of descriptions in the verses. Though I do not like the vowel rhyme, or assonance of ‘marine’ and ‘stream’ for the aquatic biome couplet, I could not find a better rhyme pair which still included the important information of salt oceans and freshwater bodies of water. There were no available syllables to add ‘sea’ to the aquatic biome definition.

Biomes 2

Gd. 5/6

A biome is a complex ecological community
In a large geographic area or region where we see
Distinctive plants and animals with similar adaptations
To their climate, weather, and soil type, with variations.

There are five basic biomes, each with subcategories:
The aquatic, tundra, forest, grassland, and desert communities.
The aquatic biome is water: salt oceans, they're called "marine",
Or fresh in lakes, ponds, wetlands, river, or stream.

Coldest is the tundra, it's very dry, so
With the frozen permafrost layer, no trees will grow.
Deserts are the driest biome. They are a
Cold zone like Antarctica, or hot like the Sahara.

Grasslands, and warm savannas, are mostly open plain.
They don't have many trees because of fires, and little rain.
The forest biome: the taiga, temperate, and rainforest, each plant and tree
Stores carbon, and produces oxygen, with great biodiversity.

A biome is a complex ecological community
In a large geographic area or region where we see
Distinctive plants and animals with similar adaptations
Though climate change can rearrange each biome's locations.

Next are the annotated fourth versions of the first and third verses, showing the different keys (D major and b minor), melodies and harmonies, followed by the final (fifth) version.

Melodic range

major 6th D4 – B4

Anacrusis
bars 2, 6, 10, 14

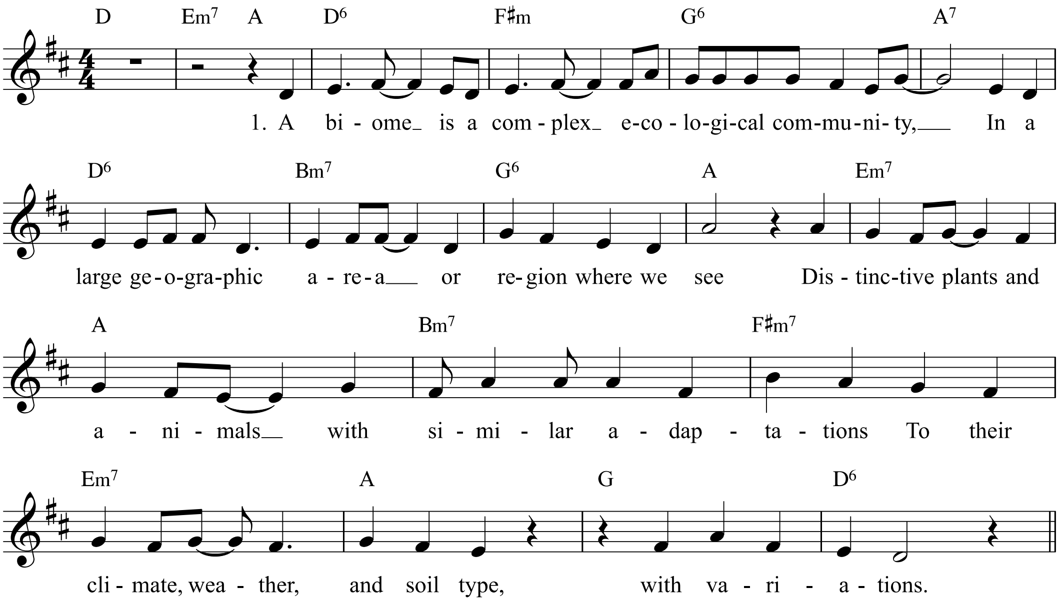
Alliteration
line 1

Rests for breath
bars 10, 16, 17

Major
tonality

Biomes 2
version 4

Aniko Debreceny



Syncopation – bars 3, 4, 5, 7, 8, 11, 12, 13, 15

Largest melodic
interval perfect 5th

Masculine rhyme
lines 1 & 2

Accented passing notes
bars 3, 4, 6, 7, 8, 13, 15, 17, 18

Added note harmonies
12 of 19 chords

Polysyllabic rhyme
lines 3 & 4

Repetitive melodic shape bars 2-4, 6-8, 11-12, 15-16

Mostly stepwise
melodic movement

Descending final phrase

Melodic range minor 7th B3-A4

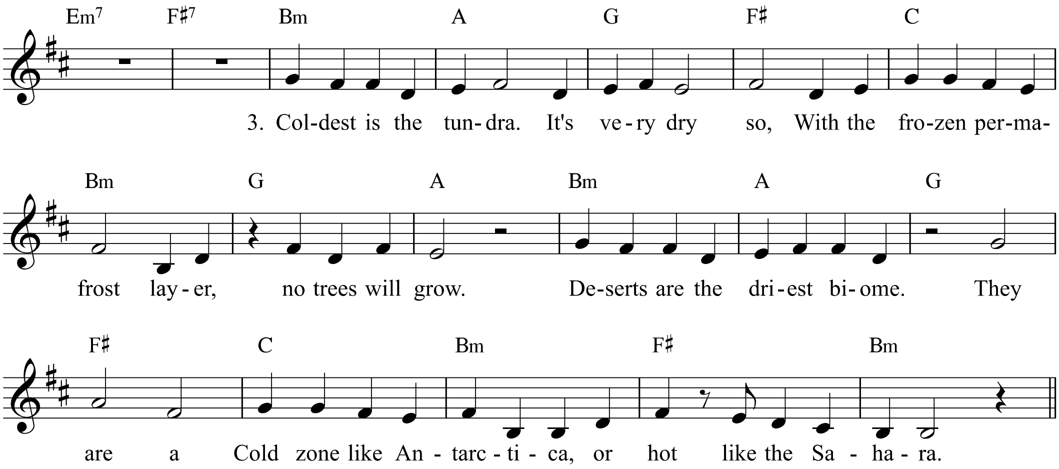
Minor tonality

Predominantly stepwise movement

Anacrusis bar 6

Largest melodic interval perfect 5th

Accented passing notes bars 3, 5, 9, 11



Unexpected harmony C major bars 7, 15

Masculine rhyme lines 1 & 2

Longer note values – sounds slower

Rests for breath Bars 9, 19, 13, 17

Composite rhyme lines 3 & 4

Repetitive melodic shape bars 3-4, 11-12

Descending final phrase

No syncopation

Biomes 2

Aniko Debreceny


Bm F♯ Bm Em7 A7 D6
tarc - ti - ca, or hot like the Sa - ha - ra. 4. Grass - lands and
F♯m7 G6 A7 D6 Bm7
warm sa-van-nas are most-ly o-pen plain. They don't have many trees, be-cause of
G6 A Em7
fires, and lit - tle rain. The fo - rest bi - ome; from
A Bm7 F♯m7
tro - pi - cal to cold, each plant and tree Stores
Em7 A G D Em7
car-bon, and pro-du-ces ox - y - gen, in great bi - o - di-ver - si - ty.
A7 D6 F♯m G6 A7
5. Yes, a bi - ome is a com - plex e-co - lo-gi-cal com-mu-ni-ty, In a
D6 Bm7 G6 A
large ge - o - gra-phic a - re - a or re - gion where we see Dis -
Em7 A Bm7 F♯m7
tinc - tive plants and a - ni - mals with si - mi - lar a - dap - ta - tions, Though
Em7 A G D Em7 A7 D6
cli-mate change can re - ar-range each bi-ome's lo - ca-tions.

These six exemplars model the adoption and articulation of Wallas's model of creativity in my praxis. Each of the songs in the creative artefact was developed over time utilising the four stages of preparation, incubation, illumination and verification, as described above. To this core structure or process, I have added Cropley and Cropley's (2010) "generation" phase, where a variety of possible answers are produced to be tested in the verification stage (e.g., four deliberately different versions of the song "Clocks"). I also learned to deliberately put the creative task aside to allow for unconscious neural activity, which is termed "gestation" by Wierzbicki and Nakamori (2005), or "working through" by Webster (2002).

Chapter 5 – Reflections & Conclusion

Reflections

This research project has transformed my praxis over time in several significant ways. The first and most obvious change is the amount of research and referencing for each song. My first classroom songs were written for two Waldorf schools in the U.S. Steiner education follows a general curriculum outline but allows teachers to create their own specific curriculum and materials (RSS, 2018). Therefore, there were no specific texts, detailed learning goals or standards framework for me to conform to, and I was encouraged to write poetic lyrics to capture the students' imaginations as well as impart information. For instance, a 1995 song about flight incorporated all the facts in the verses, with a more fanciful chorus, which became a favourite of the classes.

> Fly, soar in the sun,
> Escape from gravity.
> Race with the clouds, touch the light of the moon,
> Dance like sky-dolphins, fly free.

© Aniko Debreceny 1995

Now I am writing to satisfy specific detailed expectations across a variety of U.S. federal and state learning standards. Citing the provenances of the curricular material I have utilised fulfills academic referencing expectations, while assuring that the songs will be recognised as suitable for a variety of educational venues.

Ideally an effective song would incorporate content in an engaging musical vocabulary to appeal to students, without being too obviously didactic. In several previous commissions I was able to tailor the music styles to the students' preferences, as I was their music teacher. Obviously, I am now writing for a more general audience and using age-appropriate melodies rather than writing for specific performers. I am also far more aware of including as many facts as possible in the lyrics, condensing information rather than being poetic.

A second major difference in this artefact from my previous commissions and composition projects is the subject matter of the songs, which are about science and geometry. My previous songs have been predominantly about history and biography. They include ‘teaching operas’ about the Renaissance, explorers and inventors, ancient civilisations, African American history, the American Civil War, Homer’s Odyssey, and blindness, as well as songs about Aesop fables, geography, and physics. I wanted to challenge myself to write within a strictly constrained subject area, rather than more personal, interpretive history or biography content. This would take me beyond my comfort zone and extend my professional skills, as I attempted to write appealing and developmentally appropriate songs about scientific subjects which most students find tedious.

Another change has been the vocal range used for the songs. As noted earlier, in my preliminary research I found that the usual suggested vocal range for young voices is from D4 to A4 or B4 (Choksy, 1999; Greenberg, 1979; J. Kim, 2000). However, my further research found that children have a wider vocal range (Guerrini, 2004; Phillips, 1992), which expands as they mature (Liduma, 2010; Pieper et al., 2020; Wassum, 1979) and lowers to resemble their speaking voice range more closely (Berger et al., 2019; Sarrazin, 2016). Welch’s (1979; 1986) research found that children’s comfortable singing range or tessitura is lower than the commonly accepted D4 – A4 range, with a lowest note of A3 or A#3 and a range of an octave (Lu et al., 2017). This new information empowered me to use a lower vocal range in some of the songs, which conforms to my personal teaching experience.

Continuing research into the use of song for learning has shown me that brevity is best. The artefact’s early songs exhibit the approach of writing to include as many facts as possible within the confines of two or three verses and a chorus. However, research reveals that shorter songs, or jingles, are strongly preferred by students at both the college (Crowther et al., 2015) and middle school levels (Governor, 2011), and indeed can act as summaries or prompts of classroom content and information. This new understanding has led to revisions of several songs to further distill the information and lyrics to improve learning and retention.

Yet this also leads to the question of the ideal song length, which of course will differ for children as they mature. Ongoing questions include should song lyrics include as much curricular information as is feasible in twelve lines, or use key facts to act as a trigger for memory? Should the lyricist/composer write a chorus as summary, with the verses expanding on the essential material in the chorus? Is writing a song that appeals to students so that they will sing it more important than including as many facts as possible?

I have developed a new understanding of creativity, both in general and specifically in my own work. While my work practice conforms to Wallas's (1926/2014) theory of creativity, I now realise the crucial importance of recursion (Runco, 2014), which is the repetitive cycle of revision, editing and rewriting from different perspectives. This process can occur at any stage and return to any phase of the process (Wierzbicki & Nakamori, 2005). My work now includes regular and deliberate iterations of incubation and review, rather than my previous somewhat haphazard approach to improving a song and reliance on the illumination stage of creativity. I also realise the value of incorporating past techniques or models to produce better quality new results (Katz, 2016). Creativity is a practice, not a miracle, and relies heavily on proper preparation and efficient management of time and resources.

I have also learned to use time as a means of distancing myself from my original creative work by putting songs aside for several weeks or even months. I am then able to assess them from a more analytical, impersonal perspective, taking on a new role as impartial critic as well as composer. This was not possible in previous composition projects where I was commissioned to write songs in a much shorter time frame.

Another creative skill I have adopted is to prepare for the incubation – illumination process by consciously thinking or reading about what I want to work on. Usually, I do this at night so that my brain may use REM sleep and unconscious processing to reach new insights or solutions to my creative block or problem. This often leads to solutions or new lyrics on my early morning walks by combining two incubation processes, sleep and movement.

In this research project reflective journaling recorded my evolving praxis. These linked entries detail the spiral of newly constructed theoretical and material knowledge (Kealy-Morris, 2016) which is built on previous entries (Jarvis & Baloyi, 2020). This is a form of creative enquiry, which seeks to understand and engage imaginatively with one's experience (Younie & Swinglehurst, 2019). This constant review and appraisal of my professional practice to ensure its effectiveness is part of action research (McNiff, 1996), and has become an integral feature of my work process.

Beyond the evolution of my praxis, I have found this research transformational. The changes in my creative practice have been paralleled by an increase in self-awareness on several levels. I am now far more likely to listen to and trust my inner creative "voice" (illumination) in areas beyond composition. I am less emotionally invested in my work, which allows me to be more analytical and ruthless in revising and editing. I am also incorporating my newly acquired knowledge of neural development and learning strategies in my teaching.

Conclusion

This research project was intended to investigate the creative process involved in writing developmentally appropriate educational songs for elementary and middle school students, using U.S. learning standards. It has identified and attempted to fill the gap in current knowledge of research into the *process* of song composition for children rather than the more commonly studied *outcomes* of using song to teach. It bridged that knowledge gap in an exegesis and creative artefact presenting both a narrative description of the creative process with annotated exemplars and a methodology for creating educational songs, bringing new insights to this field of study. It potentially empowers teachers to incorporate creativity and integrate the arts into their classrooms by using song as a valid opportunity to present learning materials in an engaging and innovative medium.

This area of study is important because educational performance is in decline in the United States (Pál et al., 2019) and Australia (Echazarra & Schwabe, 2019), while arts education has been largely sidelined in favour of literacy, numeracy, and STEM subjects (Caldwell & Vaughan, 2012). However, significant research demonstrates that arts integrated education can improve learning outcomes (Chapman, 2015) as well as student engagement and motivation (Sener & Erkan, 2019; Yoon & Kim, 2017) and subject retention (Hardiman et al., 2014, 2019; Park & Shin, 2016). Song is shown to be effective as a transdisciplinary pedagogical approach (Ciecierski & Bintz, 2012; Everett-Brown, 2017).

The significance of the research is found in the general lack of teacher confidence (Biasutti, 2010; Digby, 2020; Hennessy, 2000; Power & Klopper, 2011) and training (Alter & Hays, 2009; De Vries, 2011a; Hocking, 2009) in using song in the classroom, as well as the scarcity of arts-integrated song materials (Garvis & Pendergast, 2010; Vermeulen, 2009) which are age-appropriate and subject-specific. Though arts integration has been shown to enhance learning (R. A. Baker, 2011; Chapman, 2015; Jones-Lewis, 2015), there is currently a shortage of pedagogical materials and professional training for teachers to generate their own songs for or with their classes (De Vries, 2011a; Power & Klopper, 2011).

Central to this research was the investigation of the creative process involved in writing subject-based lyrics and music which are age appropriate for students in grades 1 – 6. By examining and defining the creative process, the first aim of this study was to explore and understand the sequence of creative activity involved, and the second was to craft two artefacts: a series of songs generated using this sequence which could be used by teachers, and a song-crafting methodology for educators and potentially their students.

The following research questions were posed in accordance with these two aims:

- What are the creative processes involved in writing developmentally appropriate educational songs for elementary and middle school students using United States learning standards?
- How can I best describe the educational songwriting process so that other educators can utilise the knowledge and skills either alone or in collaboration with their students?

To answer these questions, this project used a theoretical framework which is a creative practice-informed version of Wallas's (1926/2014) foundational model of the creative process. These four stages of preparation, incubation, illumination and verification parallel the actual composition praxis described in detail in the exegesis as a narrative, providing a model for educators to follow in their own praxis. This framework is augmented by use of the annotated portfolio approach (Hall, 2020), where visual annotations in the music exemplars present brief descriptions of the rhyme, rhythmic, melodic and harmonic elements. The research findings are presented in the exegesis in the form of annotated exemplars of both the separate stages of the songwriting process and six songs written for grades 1 - 6, based on U.S. learning standards.

The thirty-three songs were written over a period of two years in parallel with the exegesis, each mutually informing the other. While other researchers have used a smaller number of songs to assess the efficacy of using song to learn, my focus was on producing a variety of songs which teachers could use in the classroom. They are presented in the order in which they were completed, within each grade division. However, this does not mean that the first songs in each level were written first. Almost all the songs underwent multiple revisions and improvements as my skills and understanding of my creative process increased. Each song has its own history, documented in my workbooks and journals, as shown in the abridged exemplars in Chapter 4.

To answer the first research question, “what are the creative processes involved in writing developmentally appropriate educational songs for elementary and middle school students using United States learning standards?” the creative processes involved in songcrafting were investigated through the writer’s personal experience as documented in a series of written reflections, personal journal entries, workbooks and multiple annotated song drafts and revisions. These data documented the evolution of praxis and of understanding the inter-relationships between active and nonconscious processing which alternate over time to lead to creative breakthroughs and solutions to problems.

Contextualising research is embedded or interwoven within the exegesis narrative to provide supporting information for each concept and area of research. To show the relevance of the study, data is presented on the current state of arts education globally, the widespread lack of teacher confidence and training, the effects of using song to learn, the central position of music in children’s lives, and the main elements of song which include rhyme, melody, harmony and notation.

To support the significance of this research an extensive review of related data demonstrated that song improves student engagement (Geist et al., 2012; Sullivan, 2016; Yoon & Kim, 2017), motivation (Everett-Brown, 2017; Özdemir & Çiftçibasi, 2017; Sener & Erkan, 2019), retention (Brown, 2012; Butler & Newman, 2008; Hardiman et al., 2014) and learning outcomes (G. Baker, 2011; Hardiman et al., 2019; Khauanpuck, 2016), and that students with a wide range of cognitive abilities (Flaugnacco et al., 2015; Gfeller, 1983; L.-C. Wang, 2017) benefit from using song to learn. Song is also shown to be effective in teaching language (Ashtiani & Zafarghandi, 2015; Çevikbas et al., 2018; Kung, 2013; Schon et al., 2008; Tomczak & Lew, 2019). The research also described the changes in childhood development which determine the appropriate different lyric and musical levels of difficulty, as well as vocal range, length, and melodic or rhythmic sophistication most suitable for each grade level.

The second research question “how can I best describe the educational songwriting process so that other educators can utilise the knowledge and skills either alone or in collaboration with their students?” was answered by two analyses of educational song-crafting. The first is the detailed presentation of the creative process in the exegesis with annotated exemplars and the second is the teachers’ guide, which summarises the songwriting techniques.

The artefact contributes to existing knowledge by presenting thirty-three original songs written about science, math and history for elementary and middle school students using U.S. learning standards as lyrics and lead sheets for teachers to use in their classrooms. It is accompanied by the teachers’ guide to creating subject- and grade- specific songs either on their own, or in collaboration with their students. While the song materials can be utilised immediately in the classroom, the guide provides a methodology for educators to use to create their own materials tailored specifically for their classes and can potentially lead to valuable creative collaborative work with their students.

This research project expands existing knowledge in the discipline of arts integrated education in two areas. The teachers’ guide presents a potential solution to the problem of teachers’ lack of confidence in using or creating music in their classrooms. The guide could be used either in teacher training or later professional development, or as an online resource for in-service educators. The song collection provides song materials to fill the gap found in the current lack of teaching resources (de Vries, 2013; Garvis & Pendergast, 2010; Vermeulen, 2009).

There are several limitations of this study that could be addressed in future research. First, the study did not test the learning outcomes of using the specific songs created for the artefact, instead relying on previous research reporting the multiple benefits of using educational song. Rather than duplicating others’ research, I identified the gaps in knowledge which are the need for subject-specific teaching materials, and an accessible method for teachers to create their own chants, raps, and songs.

Second, the study did not work with teachers. Working in isolation may have prevented me from benefiting from others' experience and suggestions. Future studies could cooperate with educators to either use the teachers' guide for writing their own songs, or to collaborate to create specific songs and lyrics for their subjects.

A third limitation was the lack of previous research studies in this specific field of study. Most of the existing research data was based on testing the effects of using music to teach and learn, rather than the process of creating song materials. Also, the majority of the studies used popular songs, rather than original songs.

Future research in this area could include an investigation of how teachers utilise the songs as pedagogical materials, then testing the educational outcomes. Further study could observe how teachers use the songcrafting guide in their classrooms either alone or collaboratively with their students and assess the results. Teacher feedback through interviews and questionnaires could lead to further improved multiple versions of the guide, focused on the specific requirements of pre-service and in-service teachers at different grade levels.

Additional research might examine whether pre-service teachers find the methodology useful in their practice teaching and if it increases their confidence to incorporate music in their classrooms. The compositional questions posed on page 187 could be researched to discover whether more appealing songs are more memorable, and if so, which elements are most appealing to different age groups.

A long-term research project might study the use of educational songs in the classroom over a period of years, potentially in a school-wide programme. This could begin at the first grade, adding a grade each year, and would offer the potential of using spiral learning, such as in this project's 'Water Cycle' and 'Biomes' song pairs.

This practice-led project contributes to knowledge in the area of transdisciplinary education by presenting a narrative perspective on the area of arts integrated pedagogy, specifically the creative process of writing educational song for the elementary school classroom based on U.S. learning standards. The outlined method for song-crafting in the teachers' guide presents educators with an opportunity to develop confidence and agency in using or creating educational songs in their classrooms to present information in an engaging and innovative medium specifically tailored to their students.

Artefact: Lyrics & Music

Grades 1 & 2

The Solar System
The Basic Water Cycle
Map Legends
Compass
Days & Months
Primary & Secondary Colours
Continents & Oceans
Parts of a Plant
Biomes 1
Plant Life Cycle
Butterfly Life Cycle
Solid, Liquid & Gas
Clocks

Grades 3 & 4

Map Features
Bodies of Water
Basic Geometry
Triangles
Polygons
Circles
Quadrilaterals
Phases of the Moon
Food Chains
Birds

Grades 5 & 6

Metamorphic, Igneous, and Sedimentary Rock
The Water Cycle 2
Civilisations – Eight Great Features
Photosynthesis 2
Earth Structure
Earth Systems
The Tectonic Tango
The Nitrogen Cycle
Tectonic Plate Boundaries
Biomes 2

The attached sound files are not intended to be used in the classroom, but to provide simple examples of the song materials.

The Solar System

Gd. 1/2

Our solar system is a tiny part of the Milky Way galaxy.
The Sun is at the centre, the closest, brightest star we see.
Formed from a nebula of dust and gas, its gravitational force
Pulls its eight planets on their orbit course.

Closest to the Sun is Mercury,
Next Venus, Earth, Mars, and Jupiter we see.
Then Saturn, Uranus, and last Neptune,
As well as comets, asteroids, three dwarf planets, and the satellite moons.
Each planet turns on its axis, each rotations is one “day”.
A year’s a revolution round the Sun, a long, long way.

https://soundcloud.com/user-58744603/the-solar-system

The Solar System

Aniko Debreceny

The Basic Water Cycle

Gd. 1/2

The basic water cycle starts with evaporation
Which cools so rain and snow clouds form: condensation.
Then water falls to the earth: precipitation.
Our hydrosphere equation – water's constant circulation:
Evaporation, condensation, precipitation,
Evaporation, condensation, precipitation.

- Use movement or gestures to further enhance memory and retention (Cook, 2017; Halvorson, 2019; So, 2012; Werner, 2018), e.g. hand movements: circulation (both hands move in a big circle), evaporation (wiggle fingers as hands rise up), condensation (make fists and bring them together as 'clouds') and precipitation (wiggle fingers as hands move downwards as rain or snow). The teacher can also make the gestures out of order for the students to identify the stages of the water cycle or ask them to make the gestures when the terms are spoken or sung.

https://soundcloud.com/user-58744603/the-basic-water-cycle

The Basic Water Cycle

Aniko Debreceny

Map Legends

Gd. 1/2

A map is a diagram representation
Of the physical features of a location.
Drawn on a flat surface, a map is a chart,
A bird’s eye view of our world, drawn like art.

To unlock a map’s symbols, use the legend or key,
The scale is the ratio of distance, map to reality.
The compass rose points to the cardinal directions:
North, East, South, West, our world in sections.

https://soundcloud.com/user-58744603/map-legends

Map Legends

Aniko Debreceny

Compass

Gd. 1/2

How do we know
How to get where we want to go?
The points of a compass help us see
Directions, our geography.

1. The compass is a circle, like a clock face,
Showing four main directions, guides to each new place.
North is at the top, and south way down low,
West is left and east is right, as we know.

2. In between these cardinal directions
Marked by degrees are four more sections:
Northeast, southeast, southwest, and northwest,
Help explorers, navigators on their quest.
North is at the top, and south way down low,
West is left and east is right, as we know.

3. The sun rises in the east, creating daylight,
Then it sets in the west, bringing the dark night.
Yes, North is at the top, and south way down low,
West is left and east is right, as we know.

- Add gestures for directions to improve memory and retention (Cook, 2017; Halvorson, 2019; So, 2012; Werner, 2018), e.g. point up for 'north', down for 'south', left for 'west' and right for 'east'.
- For a group performance, separate the class into four groups. As each term is sung each group points in "their" direction: the standing "north" group points up with hands over their heads, the lower "south" group kneeling in front of them points down to the ground, the "west" group to the left and the "east" group to the right (make sure that the correct directions are from the audience's perspective, not the students') to make a starburst / compass rose effect.

https://soundcloud.com/user-58744603/compass

Compass

Aniko Debreceny

Compass. p. 2


E♭ A♭ B♭ E♭ (D) Cm B♭ E♭
North is at the top, and south way down low,__ West is left and east is right, as we_ know.
Fm7 B♭7 Fm7 B♭7 E♭ B♭/D Cm7 B♭
3. The sun ri - ses in the east, cre - a - ting day - light.
A♭7 Gm Fm7 B♭ (B♭ C D)
Then it sets in the west,__ bring - ing the dark night. Yes,
E♭ A♭ B♭
North is at the top, and south way down low,__
E♭ (D) Cm B♭ B♭7 E♭
West is left and east is right, as we know.

Days & Months

Gd. 1/2

There are seven days in a week, and twelve months in a year.
To learn their names in order, just listen here.

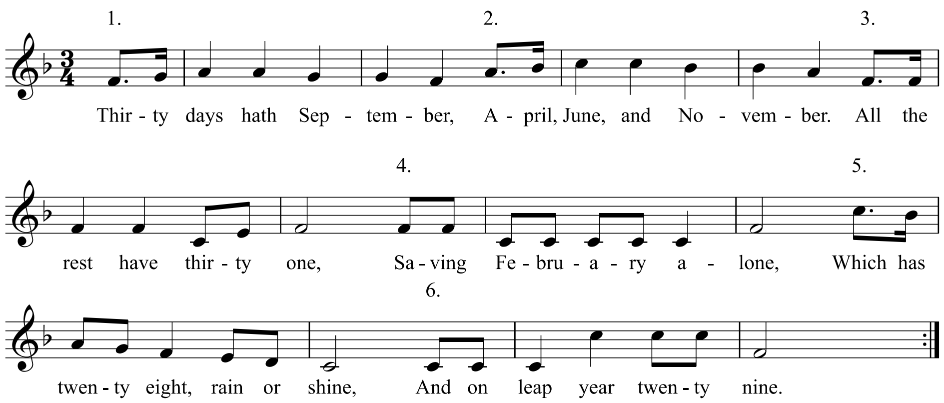
The days are Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday,
Yes, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.
Three hundred and sixty-five days make a year, three years out of four.
The fourth is a "leap year" where February adds one day more.

The months are January, February, March, April, May, June, July, August, September,
Next is October, then November, the last month is December.
Twenty-eight to thirty-one days in each month appear.
Fifty-two weeks and one day make one year.

- Additional material:

This popular round presents the number of days in each month dates back to the Renaissance and is based on early poetic versions from c. 1425 and c.1555. It can be sung in either 6 or 3 parts, depending on the singers' choral abilities. Note the word-painting in the ascending octave interval on "leap year".

Thirty Days Hath September



https://soundcloud.com/user-58744603/days-months

Days & Months

Aniko Debreceny

Primary & Secondary Colours

Gd. 1/2

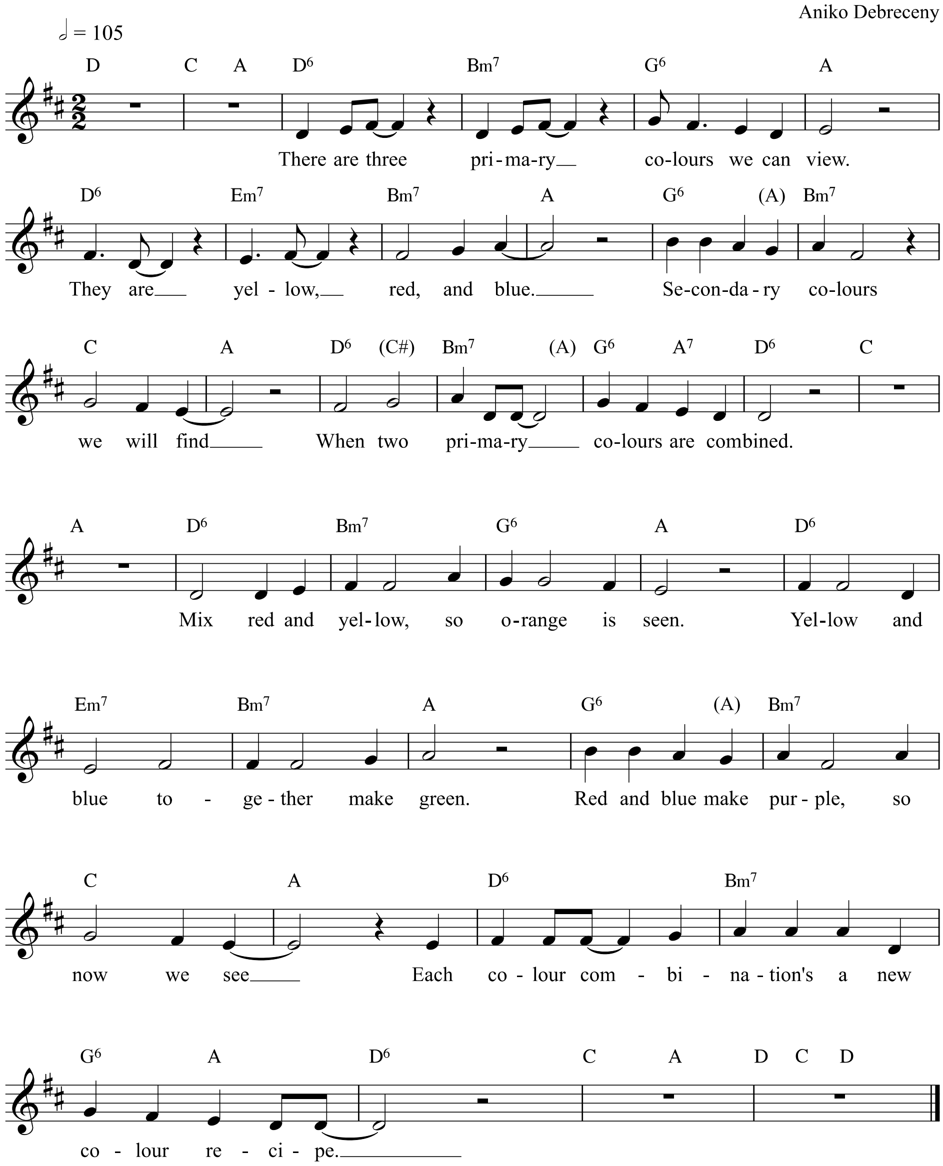
There are three primary colours we can view.
They are yellow, red, and blue.
Secondary colours we will find
When two primary colours are combined.

Mix red and yellow so orange is seen.
Yellow and blue together make green.
Red and blue make purple, so now we see
Each colour combination’s a new colour recipe.

https://soundcloud.com/user-58744603/primary-secondary-colours

Primary & Secondary Colours

Aniko Debreceny



Continents & Oceans

Gd. 1/2

There are seven huge landmasses we call continents,
Surrounded by seas and oceans immense.
Seas are by land mostly surrounded,
Oceans by latitudes or continents bounded.

Two hundred fifty million years ago was the start
With Pangaea, a single landmass, which broke apart.
The continents ride on the tectonic plates below,
They slowly slide and collide, move, and grow.

From largest to smallest, the continents are
Asia, Africa, North America,
South America, Antarctica,
Europe, and Australia.

One vast global ocean is divided geographically
Into five huge ocean basins, as we see.
From smallest to largest, our mnemonic key:
Arctic, Southern, Indian, Atlantic, Pacific – they spell ASIA-P.

https://soundcloud.com/user-58744603/continents-oceans

Continents & Oceans

Aniko Debreceny

Parts of a Plant

Gd. 1/2

If our world did not have plants,
Animals and humans wouldn't have a chance.
Plants provide habitat, food, and medicine,
And – essential to life – oxygen.
Most plants have six parts, it's found.
Roots anchor the plant under the ground,
And absorb nutrients and water so
Through the stem they can flow.

Yes, the stem's above ground, it transports
Water, sugar, nutrients and starches, and supports
The upper part of the plant where leaves collect
Sunlight, and make food, the photosynthesis effect.
Flowers attract pollinating insects.
Fruits are fleshy, they hold and protect
Seeds, which contain the embryo:
The materials so a new plant can grow.

https://soundcloud.com/user-58744603/parts-of-a-plant

Parts of a Plant

Aniko Debreceny

Biomes 1 Gd. 1/2

In our world we can see
Plants and animals, a huge variety.

Chorus Oh, why can't polar bears and turtles live together?
They've adapted to diff'rent climates and weather.
These regions or communities are their home.
What do we call them? Biomes.

Aquatic is water, fresh or salt – 'marine'.
Forests can be cold or hot, with trees so green.
The tundra's very dry and cold, no trees can grow,
Deserts are the driest, with sand or rock or snow. *Chorus*

Grasslands are mostly open plain.
These five basic biomes each contain
Similar climate, weather, plants, and species
In their biome communities. *Chorus*

Class activities:

- Divide the class into either two sections or teacher and class to sing Q and A.
  e.g. [A] Oh, why can't polar bears and turtles live together?
  [B] They've adapted to diff'rent climates and weather.
  [A & B] These regions or communities are their home.
  [A] What do we call them? [B] Biomes.
- In the two singing groups, divide the lines in half, e.g.
  [A] Aquatic is water, [B] fresh or salt – marine,
  [B] Forest can be cold or hot. [B] with trees so green etc.
  Alternate which group sings first.
- Make lists of other animals / plants with two and three syllables to replace polar bears and turtles in the second and third choruses.
- Give out lyric sheets with missing words for students to fill in. Omitting the rhyme word at the end of a line makes it easier for students to work out the missing word from the rhyme word sound.

https://soundcloud.com/user-58744603/biomes-1

Biomes 1

Aniko Debreceny


D D G
cli-mates and wea-ther. These re-gions or com-mu-ni-ties are their homes.
A A7 D G A (A B C#)
What do we call them? Bi - omes.
D Bm G A
Grass-lands are most-ly o-pen plain. These five ba-sic bi-omes each con-tain
D G Em7
Si-mi-lar cli-mate, wea-ther, plants, and spe-cies, In their bi-ome com-
A7 A7 (A B C#) D
mu - ni - ties. Oh, Why can't and
G A D
live to-ge-ther? They've a-dap-ted to diff-'rent cli-mates and wea-ther. These
D G A
re-gions or com-mu-ni-ties are their homes. What do we call them?
A7 Bm A A7 D
Bi - omes. Yes, What do we call them? Bi - omes.

Plant Life Cycle

Gd.1/2

All living organisms change and grow
In a series of orderly stages we know
As plant and animal life cycles, diversely completed:
Birth, growth, reproduction, death – repeated.

A seed begins the plant life cycle with the right combination
Of moisture, air, sunlight, and temperature for germination.
A sprout, then seedling grows with leaves that will be
Used by photosynthesis for plant food and energy.

Mature plants grow leaves with pollen; its transportation
By wind, bees, bats, or butterflies results in pollination.
Fertilisation produces fruit and seeds, thick-skinned,
Dispersed to start the cycle anew by animals and wind.

All living organisms change and grow
In a series of orderly stages we know
As plant and animal life cycles, diversely completed:
Birth, growth, reproduction, death – repeated.
Birth, growth, reproduction, death – repeated.

https://soundcloud.com/user-58744603/plant-life-cycle

Plant Life Cycle

Aniko Debreceny

Butterfly Life Cycle

Gd.1/2

The butterfly life cycle has four stages of transformation –
Egg, larva, pupa, adult – that repeats each generation.
The larva is a caterpillar, the pupa a chrysalis,
In this example of complete metamorphosis.

The tiny eggs are laid on leaves, in different shapes they're found:
Smooth or wrinkled, bumpy, oval, cylindrical, or round.
From each egg a larva hatches, they eat and eat for energy.
They split and moult their skins as they grow so rapidly.

They grow a hundred times in size, from minute to large.
Some have patterns or coloured skin as camouflage.
The third stage is the pupa: a protective, hard shell forms
Around the butterfly inside as it transforms.

The adult butterflies emerge with soft, wet wings, so they wait,
Then pump blood through their now-dry wings, so they can fly and mate.
Their lives completed, then repeated, as the females lay eggs, then die.
Egg, larva, pupa, adult, the life cycle of a butterfly.

https://soundcloud.com/user-58744603/butterfly-life-cycle

Butterfly Life Cycle

Aniko Debreceny


Em7 A7 D G
3. They grow a hun-dred times in size, from mi - nute to large.
A Em7 A
Some have pat-terns or co - loured skin as ca - mou - flage. The
D G
third stage is the pu - pa; a pro - tec - tive, hard shell forms A -
A Em7 A7 D
round the but - ter - fly in - side as it trans - forms.
Em7 A7 D G
4. The a - dult but - ter - flies e-merge with soft, wet wings so they wait, Then
A Em7 A
pump blood through their now - dry wings so they can fly and mate. Their lives com -
D G
ple - ted, then re - pea - ted, as the fe - males lay eggs, then die. Egg,
A G Em7 A7 D A7 D
lar - va, pu - pa, a - dult, the life cy - cle of a but - ter - fly.

Solid, Liquid, and Gas

Gd.1/2

Everything around us we touch and see
Is made of matter, which can be
In a solid, a liquid, or a gas state,
Depending on its particles' movement rate.

A solid keeps its size and shape, a case
Of particles closely packed and fixed in place.
A liquid is a fluid, its molecules maintain a
Constant volume, in the shape of its container.

A gas shapes itself through kinetic energy
To fill its container in its entirety.
Matter's physical state changes when we add or subtract
Energy – a temperature or pressure impact.

Add heat, a liquid turns to gas, that's evaporation.
Cool a gas to liquid is condensation.
Heating solids melts them to liquid states,
While freezing a liquid a solid creates.

Yes, everything around us we touch and see
Is made of matter, which can be
In a solid, a liquid, or a gas state,
Depending on its particles' movement rate.

https://soundcloud.com/user-58744603/solid-liquid-gas

Solid, Liquid, & Gas

Aniko Debreceny

Clocks

Gd. 2

Time – tick tock tick tock tick tock
Time – told by a clock
Tick tock tick tock tick tock

An analog clock face has two hands in it.
The short shows the hour; the long the minute.
The numbers one to twelve are seen,
Each with five minutes in between.

So, each hour has sixty minutes on display.
There are two twelve-hour cycles in ev'ry day.
Time passes: midnight, morning, noon, afternoon, then night: it's great,
A.M. is early, P.M. is late.

Time – tick tock tick tock tick tock
Time – tick tock tick tock tick tock tick tock Time

- Two versions are presented in lead sheet form. The second is in the key of D major, which is a much easier key to play guitar chords than E flat major. The teacher can play the chords as shown in the D major version, using a *capo* on the first fret of the guitar to raise the pitch one half step to E flat major.
- If the school owns chimes or bells, students can perform the notes of the Big Ben chimes.
- The tick tock sound can be produced by a wood block (a double wood block will produce two different pitches) or a student-generated percussion instrument.

https://soundcloud.com/user-58744603/clocks

Clocks

Aniko Debreceny

Clocks

in D major

Aniko Debreceny

Map Features

Gd. 3/4

The map features of our earth include
The equator, prime meridian, latitude, and longitude.
These imaginary lines round the world appear,
Separating it into each hemisphere.

North and south by the equator are separated.
To split East and West the prime meridian was created.
East and west, sideways, run lines of latitude,
North and south, top to bottom, show longitude.

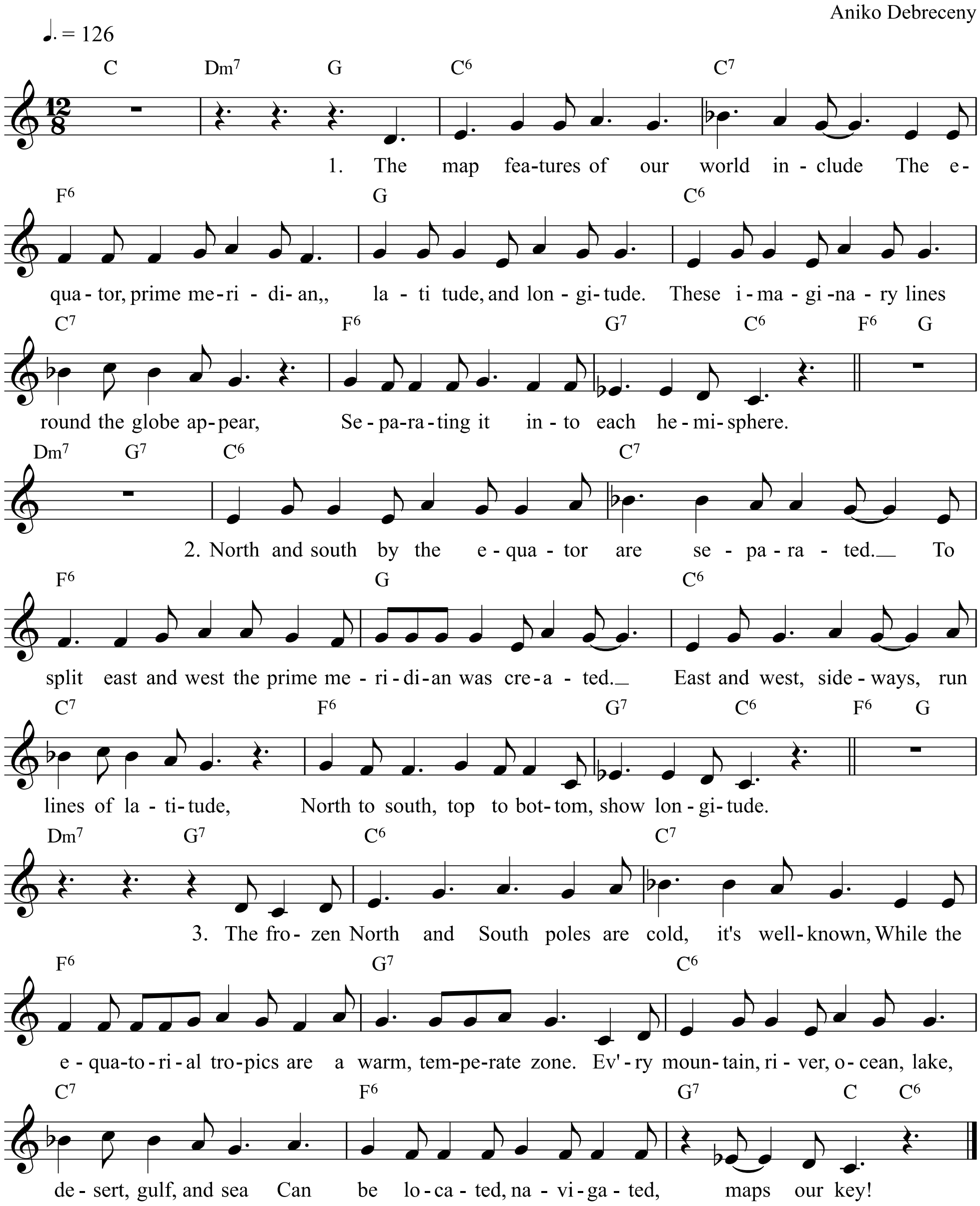
The tropics at the equator are a warm paradise,
While the north and south poles are covered in ice.
Mountains, rivers, lakes, and seas, deserts, gulfs and more
Are found on earth's maps, to help us explore.

- Add gestures for directions to improve memory and retention (Cook, 2017; Halvorson, 2019; So, 2012; Werner, 2018), e.g. make a flat east-west circle with their index finger at waist height for “equator”; then a north-south circle in front for “prime meridian”; spread fingers widely and move hands apart at chest height for “latitude”; spread fingers widely and move hands from above head to below waist for “longitude”.

https://soundcloud.com/user-58744603/map-features

Map Features

Aniko Debreceny



Bodies of Water

Gd. 3/4

Water is everywhere, as streams and rivers flow,
As rain and fog, mist in the air, or glaciers, ice, and snow.
Ponds and lakes, seas and oceans: water can be found
As liquid or solid, above or underground.

A stream has well-defined banks and a current we can see.
A river flows to a lake, ocean, or sea.
Tributaries are streams or rivers, a river their destination.
Canals are manmade, for transport or irrigation.

Water covers three-quarters of Earth's surface, but only three
Percent is fresh; the rest is salty ocean or sea.
Oceans surround continents; land surrounds the seas.
Small ponds and larger lakes are still, freshwater bodies.

Water flowing, like wind blowing, can transform topography
And human acts have huge impacts on our world community.
Rivers throughout history have nurtured civilisation,
Providing water for food and crops, energy, and transportation.

https://soundcloud.com/user-58744603/bodies-of-water

Bodies of Water

Aniko Debreceny


E♭6 A♭6
3. Wa - ter co - vers three quar - ters of Earth's sur - face, but on - ly three Per -
B♭7 E♭6
cent is fresh: the rest is sal - ty o - cean__ or sea.
E♭6 Fm7
O - ceans sur - round con - ti - nents, land sur-rounds the seas. Small ponds and
Gm A♭ B♭7 E♭6 Fm7
lar - ger lakes are still, fresh wa - ter bo - dies.__
B♭7 E♭6 A♭6
4. Wa - ter flow- ing, like wind blow - ing, can trans-form to - po - gra - phy, And
B♭7 E♭6
hu - man acts have huge im - pacts, on our world com - mu - ni - ty.
E♭6 Fm7
Ri - vers through - out his - to - ry have nur - tured ci - vi - lis - sa - tion,__ Pro -
Gm A♭ B♭7 E♭6
vi - ding wa - ter for food and crops, en - er - gy, and trans - por - ta - tion.__

Basic Geometry Gd. 3/4

We've measured our world using geometry
Since Euclid, back in 300 B.C.E.
In two or three dimensions we draw, build, and calculate
Area and volume. Yes, geometry is great!

A point has no height, length, or width; it's an exact location
Which is drawn as a dot, a simple notation.
A plane is two dimensional, flat, like a tabletop.
A line is a collection of points that never stop.

A line segment has two end points, it's part of a line. However,
A ray starts from one point and extends forever.
Two rays share an endpoint an angle to create
Measured in degrees: acute, obtuse, right, or straight.

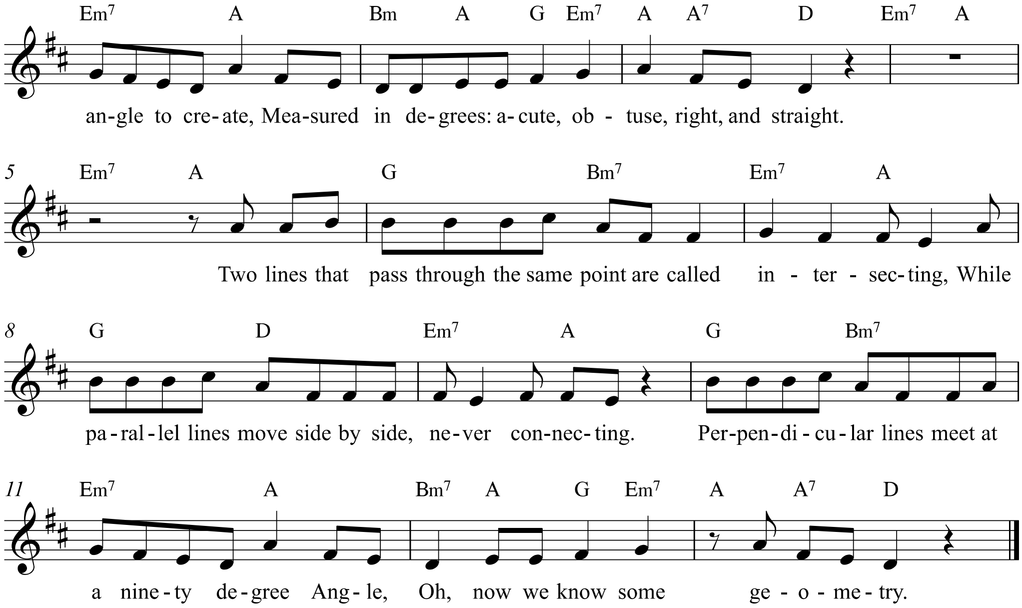
Two lines that pass through the same point are called intersecting,
While parallel lines move side by side, never connecting.
Perpendicular lines intersect at a ninety degree
Angle. Oh, now we know some geometry.

https://soundcloud.com/user-58744603/basic-geometry

Basic Geometry

Aniko Debreceny

Basic Geometry. page 2



Triangles

Gd. 3/4

Three-sided polygons are called triangles,
Classified by their sides, or their angles.
An equilateral triangle has three equal sides,
An isosceles only has two,
While a scalene triangle has no equal sides,
But wait, we’re not through.

An angle less than ninety degrees is called acute;
To be greater is an obtuse angle attribute.
Acute triangles have three acute angles.
A right triangle has one ninety degree.
An obtuse triangle has one obtuse angle:
Simple triangle geometry.

https://soundcloud.com/user-58744603/triangles

Triangles

Aniko Debreceny

Polygons

Gd. 3/4

What is a polygon? Let’s clarify.
It’s a closed plane figure, bounded by
Three or more line segments, and, we should mention,
Polygons are drawn in two dimensions.

Polygons are classified
According to their angles and sides.
They are regular if their sides and angles are the same,
All the rest – “irregular” is their name.

We name them for the number of their sides we draw:
A triangle has three, a quadrilateral has four.
Pentagons have five, hexagons have six (it’s great),
Heptagons have seven, octagons have eight.

https://soundcloud.com/user-58744603/polygons

Polygons

Aniko Debreceny

Circles

Gd. 3/4

Oh, a circle is a closed plane curve in geometry
A round two-dimensional shape, as we can see.
Each point on the circumference or boundary
Is equidistant from the centre point, we all agree.

This distance is the radius, the diameter a line through
The circle's centre point: the radius times two.
The Greek mathematician Archimedes declared
That to find a circle's area is π r squared.

Two types of lines connect with the circumference, let's review.
A tangent touches just one point, a secant touches two.
A chord is a line segment, an inner connection
Inside the circle, where an arc is a curved section.

https://soundcloud.com/user-58744603/circles

Circles

Aniko Debreceny

Quadrilaterals

Gd. 3/4

A quadrilateral is a polygon with four straight sides.
To learn the different quadrilaterals, here is an easy guide.
But first of all, let's remember corners are 'vertices',
And 'congruent' means sides have the same length, in geometry.

Four right angles are found in rectangles, these vertices they share
With a shape with four congruent sides called the square.
A rhombus has four congruent sides, but the angles are not the same,
While two pairs of congruent sides but no parallels, a kite is its name.

A parallelogram has parallel sides – two pair.
It can also be a kite, rhombus, or square.
A trapezoid/trapezium has just two parallel sides; it's the sixth design
Of four-sided figures that are all quadrilaterals we can now define.

https://soundcloud.com/user-58744603/quadrilaterals

Quadrilaterals

Aniko Debreceny

Phases of the Moon

Gd. 3/4

The Moon is Earth’s only natural satellite
(A celestial body orbiting a planet) seen by day and night.
The Moon does not emit light, but reflects the Sun’s rays
As it orbits the Earth in 29.53 days.

The Moon rotates at the same rate as its orbit glide,
So on Earth we always see the same ‘near’ side.
A waning moon appears to shrink, a waxing moon grows.
In fact, it’s just how much of the Moon’s sunlit side shows.

Depending how the Sun, Earth and Moon are aligned
Different phases of the Moon are defined.
New, crescent, quarter, gibbous, and full appear,
Seen upside down and backwards in the Southern Hemisphere.

The new moon is dark; a crescent moon a silver sliver.
A quarter moon shows half its face. A gibbous moon will give a
Larger surface to reflect the Sun’s light.
A full moon shows its entire face, very bright.

https://soundcloud.com/user-58744603/phases-of-the-moon

Phases of the Moon

Aniko Debreceny

Phases of the Moon. page 2

Food Chains

Gd. 3/4

A food chain is the transfer of energy
From the Sun to plants to animals. Here's a summary.
First green plants use photosynthesis, a recipe
To make food from organic nutrients and the Sun's energy.
These plants are called producers. They are eaten by
Consumers in three trophic levels we can classify.

Herbivores eat only plants, carnivores only meat.
Both plants and animals omnivores will eat.
Decomposers like bacteria and fungi break down
Organic wastes to nutrients: biomass cycling roun'.
Predators kill their prey, by that energy they're fed,
While scavengers eat food that is already dead.

Last, let's explain groups of food chains form food webs, they show
The Sun to producer, to consumer, decomposer: the food chain's energy flow.

https://soundcloud.com/user-58744603/food-chains

Food Chains

Aniko Debreceny


F6 D7
po - sers like bac - te - ri - a and fun - gi break down Or -
G6 C7
ga - nic wastes to nu - tri - ents: bi - o - mass cy - cling round.
F6 G7
Pre - da - tors kill their prey, by that en - er - gy they're fed, While
B♭ C7 F6
sca - ven - gers eat food that is al - rea - dy dead.
G7 C7 (C D E) F6 D7
Last, let's ex - plain groups of food chains form food webs, they
G A B♭
show The Sun to pro - du - cer, to con - su - mer, de - com -
Gm7 C7 F6
po - ser, the food chain's en - er - gy flow.

Birds

Gd. 3/4

You've probably heard a singing bird or seen them in the sky.
Look again, there are more than ten thousand species to classify.

Birds all have feathers, a beak or bill, two wings, two legs.
They're warm-blooded vertebrates that lay hard-shelled eggs.
Depending where they live, birds have many adaptations.
To find the needed food to breed, some make long migrations.

Most birds have hollow bones that make them light,
But not all are capable of flight.
Descended from dinosaurs, birds rule the air,
So many different sizes, colours, shapes and songs: they're ev'rywhere.

https://soundcloud.com/user-58744603/birds

Birds

Aniko Debreceny

Metamorphic, Igneous & Sedimentary Rock Gd. 5/6

There are three type of rock in Earth's geology:
Metamorphic, igneous, and sedimentary.

1. Tectonic plates collide and create mountain ranges.
   Rocks caught in between them undergo great changes.
   Their mineral compositions and texture are transformed
   By great heat and pressure metamorphic rock is formed.
   There are three type of rock in Earth's geology
   Metamorphic, igneous, and sedimentary.

2. Beneath the Earth's surface, deep below,
   Molten magma and lava flow.
   Pushing through Earth's crust they harden and cool
   Into igneous rock, it's wonderful.
   There are three types of rock in Earth's geology
   Metamorphic, igneous, and sedimentary.

3. Sand, shells, pebbles, particles, and sediment press
   And cement together in layers, a long process.
   Formed where water is, or used to be
   These soft rocks are sedimentary.
   There are three type of rock in Earth's geology
   Metamorphic, igneous, and sedimentary.

https://soundcloud.com/user-58744603/metamorphic-igneous-and-sedimentary-rock

Metamorphic, Igneous & Sedimentary Rock

The Water Cycle 2

Gd. 5/6

Long ago we learned the water cycle information
Where liquid water turns to vapour through evaporation.
It cools and condenses into clouds – that's condensation,
Then falls back to the earth as rain or snow – precipitation.
But wait: there's so much more
About the hydrologic cycle to explore.

Precipitation can become runoff, or evaporation,
Or move into the soil through infiltration and deep percolation.
Plant roots absorb groundwater (plant uptake), then evaporation
From plants into the atmosphere is termed transpiration.

The direct conversion of solid ice or snow to vapour is sublimation,
Deposition's when vapour becomes solid, the reverse transformation.
Transportation's the movement of water in the atmosphere to and fro;
Rivers, lakes, and streams drain to the ocean: surface flow.

https://soundcloud.com/user-58744603/the-water-cycle-2

The Water Cycle 2

Aniko Debreceny

The Water Cycle 2. page 2

Civilisations – Eight Great Features

Gd. 5/6

There are eight features great of civilisations,
We can see through history these common foundations.

Arts and architecture, social classes, job specialisation,
Writing, complex religions, public works like roads and irrigation,
Organised central government, cities: all indications
Of successful advanced civilisations.

https://soundcloud.com/user-58744603/civilisations-eight-great-features

Civilisations - Eight Great Features

Aniko Debreceny

Photosynthesis

Gd. 5/6

The most important biological process is
The transfer of light energy to plants: photosynthesis.

Two reactants, water and carbon dioxide,
Are transformed by sunlight energy. They divide
Into two products – oxygen and glucose, the foundation
Of most food webs: the reverse is cell respiration.

Leaves have tiny cells, chloroplasts, that are filled
With a green pigment chemical called chlorophyll.
This absorbs or traps sunlight energy
Which splits the water molecules – great chemistry!

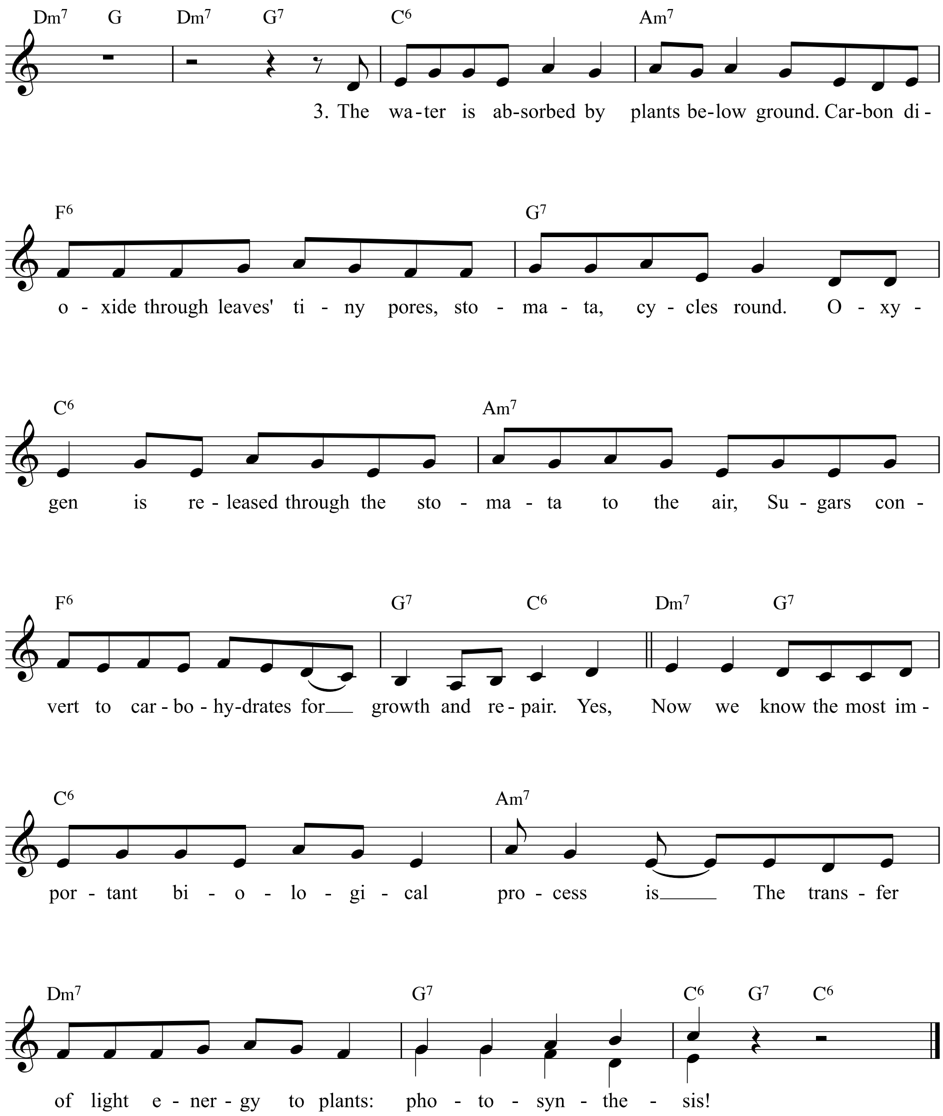
The water is absorbed by plants below ground,
Carbon dioxide through leaves' tiny pores (stomata) cycles round.
Oxygen is released through the stomata to the air.
The sugars convert to carbohydrates for growth or repair.

Yes, now we know
The most important biological process is
The transfer of light energy to plants: photosynthesis.

https://soundcloud.com/user-58744603/photosynthesis

Photosynthesis

Aniko Debreceny


Dm7 G Dm7 G7 C6 Am7
3. The wa-ter is ab-sorbed by plants be-low ground. Car-bon di -
F6 G7
o - xide through leaves' ti - ny pores, sto - ma - ta, cy - cles round. O - xy -
C6 Am7
gen is re - leased through the sto - ma - ta to the air, Su - gars con -
F6 G7 C6 Dm7 G7
vert to car - bo - hy-drates for growth and re - pair. Yes, Now we know the most im -
C6 Am7
por - tant bi - o - lo - gi - cal pro - cess is The trans - fer
Dm7 G7 C6 G7 C6
of light e - ner - gy to plants: pho - to - syn - the - sis!

Earth Structure
Gd. 5/6

The structure of the Earth has four main layers – let's explore
The crust, the mantle, and the outer and the inner core.
The visual model for Earth's structure is a hardboiled egg, that's right.
The crust's the brittle shell, the two cores the yolk, the mantle is the white.

The crust is the Earth's surface, a rocky "skin",
From rift zones spread the ocean bed, the oceanic crust – it's thin.
The continental crust is thicker and less dense. It can be
Billions of years old. It's mostly granite, as we see.

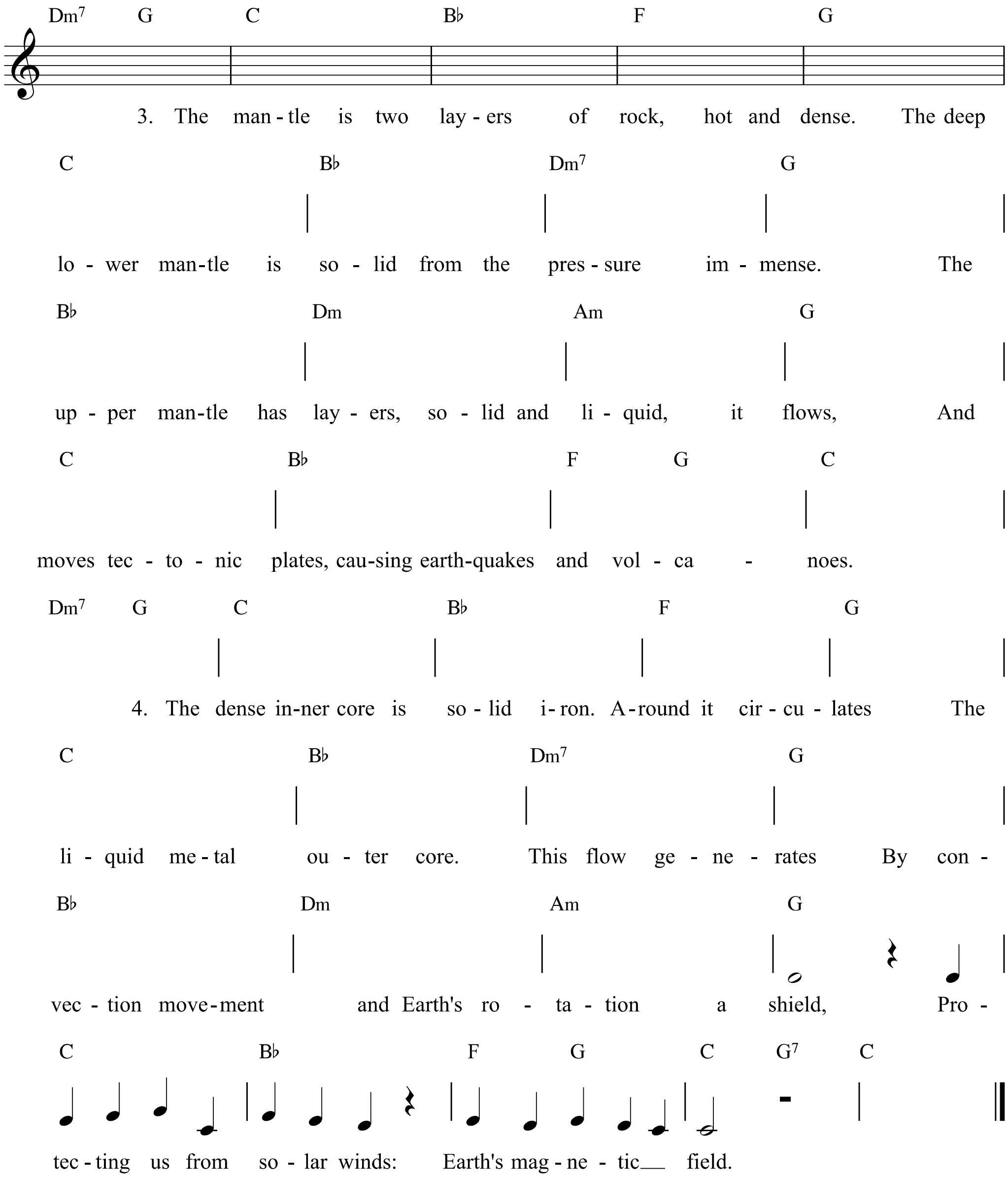
The mantle is two layers of rock, hot and dense.
The deep lower mantle is solid from the pressure immense.
The upper mantle has layers, solid and viscous, it flows
And moves tectonic plates, causing earthquakes and volcanoes.

The dense inner core is solid iron. Around it circulates
The liquid metal outer core. This flow generates
By convection movement and Earth's rotation a shield
Protecting us from solar winds – Earth's magnetic field.

https://soundcloud.com/user-58744603/earth-structure

Earth Structure

Aniko Debreceny


Dm7 G C B♭ F G
3. The man-tle is two lay-ers of rock, hot and dense. The deep
C B♭ Dm7 G
lo-wer man-tle is so-lid from the pres-sure im-mense. The
B♭ Dm Am G
up-per man-tle has lay-ers, so-lid and li-quid, it flows, And
C B♭ F G C
moves tec-to-nic plates, cau-sing earth-quakes and vol-ca-noes.
Dm7 G C B♭ F G
4. The dense in-ner core is so-lid i-ron. A-round it cir-cu-lates The
C B♭ Dm7 G
li-quid me-tal ou-ter core. This flow ge-ne-rates By con-
B♭ Dm Am G
vec-tion move-ment and Earth's ro-ta-tion a shield, Pro-
C B♭ F G C G7 C
tec-ting us from so-lar winds: Earth's mag-ne-tic field.

Earth Systems

Gd. 5/6

Earth systems, let's list 'em, they interact together
And flow to change our environment, land, climate, and weather.

Crust, mantle, and core form the geosphere;
The envelope of gas around the Earth, our atmosphere.
All Earth's liquid water is the hydrosphere,
And frozen water the cryosphere.
Ev'ry living organism found here:
Plants, animals, insects, humans, and microbes form the biosphere.

Earth systems, let's list 'em, they interact together
And flow to change our environment, land, climate, and weather.

https://soundcloud.com/user-58744603/earth-systems

Earth Systems

Aniko Debreceny

The Tectonic Tango

Gd. 5/6

Earth's outer mantle and crust form the lithosphere.
Below it is the hot and viscous asthenosphere.
This brittle shell of rock's a jigsaw of tectonic plates,
Sliding and colliding at very slow rates.

The asthenosphere is heated by the Earth's core (convection)
Which drives the floating plates in a new direction.
There are three main types of boundary movement: they collide,
Separate, or strike-slip slide.

Convergent boundaries are where two plates collide.
The lighter continental plates move on an upward ride.
Dense oceanic plates are forced below (that's called subduction)
Where they melt into magma – their destruction.

Divergent boundaries force the plates apart, a motion
That creates rift zones on land or ridges in the ocean.
These are filled with molten magma from below,
A new ocean floor and crust from hot lava flow.

Transform faults slide by in opposite directions,
A horizontal grind along the edge of two plate sections.
The crust is broken, but not destroyed or created,
When this friction energy's released, and earthquakes generated.

https://soundcloud.com/user-58744603/the-tectonic-tango

The Tectonic Tango

Aniko Debreceny


B♭ E♭ B♭ E♭6
lighter con-ti-nen tal plates move on an up-ward ride. Dense o-ce-a-nic plates are forced be-
Fm6 A♭ B♭ E♭
low (that's called sub-duc-tion) Where they melt in-to mag ma their de struc-tion.
A♭ G Cm Fm7
Di-ver-gent boun-da-ries force the plates a-part, a mo-tion That cre-
G Cm Fm7
ates rift zones on land, or rid-ges in the o-cean. These are filled with mol-ten mag-ma
Cm G Cm G Cm
from be-low:_ A new o-cean floor and crust from hot la-va flow.
Fm7 B♭ E♭6 Fm6 B♭
Trans-form faults slide by in op-po-site di-rec-tions, A ho-ri-zon-tal grind a-long the
E♭ B♭ E♭6 Fm6
edge of two plate sec-tions. The crust is bro-ken, but not de-stroyed or cre-a-ted, When this
A♭ B♭7 E♭6 A♭ B♭7 E♭6
fric-tion e-ner-gy's re-leased, and earth-quakes ge-ne-ra-ted.

The Nitrogen Cycle

Gd. 5/6

Nitrogen is essential to all life in biology,
A component of proteins, nucleic acids, and chlorophyll – it's key.
But plants and animals can't use it until it's converted by biochemistry, a
Cycle of diff'rent states, compounds, gas, and nitrates, by interacting with bacteria.

It's the most abundant element (seventy-eight per cent) in the atmosphere,
But the gas is inert, it must be converted so living forms can use it, it's clear.
First, it's deposited into the soil through precipitation.
Where bacteria separate its atoms into ammonia – that's called 'fixation'.

But ammonia is toxic to plants, so bacteria start oxidation,
Converting it to compounds, nitrites then nitrates – 'nitrification'.
Primary producers (plants) have many uses for these, they're the foundation
Of plant proteins, they're absorbed through the plant roots – 'assimilation'.

'Ammonification' is when dead organic matter is changed to ammonia again
By decomposers, bacteria or fungi, also releasing nitrogen.
In wet soil bacteria use this to gain oxygen – 'denitrification'.
This process releases nitrogen gas, the last stage of this transformation.

https://soundcloud.com/user-58744603/the-nitrogen-cycle

The Nitrogen Cycle

Aniko Debreceny


ver-ting it to com-pounds, ni-trites then ni-trates, "ni-tri-fi-ca-tion". Pri-ma-ry pro-du-cers,
(plants) have ma-ny us-es for these com-pounds, they're the foun-da-tion Of
plant pro-teins, they're ab-sorbed through the plant roots "as-si-mi-la-tion".
4. "Am-mo-ni-fi-ca-tion" is when dead or-ga-nic mat-ter is changed to am-mo-ni-a a-
gain, By de-com-po-sers, bac-te-ri-a or fun-gi, al-so re-lea-sing ni-tro-
gen. In wet soil, bac-te-ri-a use this to gain ox-y-gen: "de-ni-tri-fi-ca-tion". This
pro-cess re-lea-ses ni-tro-gen gas, the last stage of this trans-for-ma-tion.

Tectonic Plate Boundaries Gd. 5/6

The lithosphere, Earth's crust, is a series of plates
That float on the asthenosphere, which creates
Tectonic plate motion. They shift and slide;
Most seismic activity is found where they collide.
    Convergent comes together, divergent separates,
    Transform slides beside: Earth's tectonic plates.

Rocks and fossils show these movements, so we see
When two plates collide, it's a convergent boundary
Causing uplift, where mountain ranges grow,
Or subduction zones: the denser plate slides down below.
    Convergent comes together, divergent separates,
    Transform slides beside: Earth's tectonic plates.

A divergent boundary is where two plates separated,
So new sea floors, rifts and ridges are created.
When two plates slide past each other the earth grinds and shakes.
These transform boundaries cause faults and earthquakes.
    Convergent comes together, divergent separates,
    Transform slides beside: Earth's tectonic plates.

https://soundcloud.com/user-58744603/tectonic-plate-boundaries

Tectonic Plate Boundaries

Aniko Debreceny


G A7 D6 G
3. A di - ver-gent boun-da - ry is where two plates se - pa - ra - ted, So
Em7 A Bm
rifts and rid ges, new sea floors and o ceans are cre - a - ted. When two plates slide past each o - ther
G Em7 A7 D6
the earth grinds and shakes. These trans - form boun-da - ries cause faults and earth - quakes.
G A7 D6 G (F#)
Con - ver-gent comes to - ge - ther, di - ver-gent se - pa - rates,
Em7 A A7 D6
Trans-form slides be - side: mo - ving tec - to - nic plates.

Biomes 2

Gd. 5/6

A biome is a complex ecological community
In a large geographic area or region where we see
Distinctive plants and animals with similar adaptations
To their climate, weather, and soil type, with variations.

There are five basic biomes, each with subcategories:
The aquatic, tundra, forest, grassland, and desert communities.
The aquatic biome is water: salt oceans, they're called "marine",
Or fresh in lakes, ponds, wetlands, river, or stream.

Coldest is the tundra, it's very dry, so
With the frozen permafrost layer, no trees will grow.
Deserts are the driest biome. They are a
Cold zone like Antarctica, or hot like the Sahara.

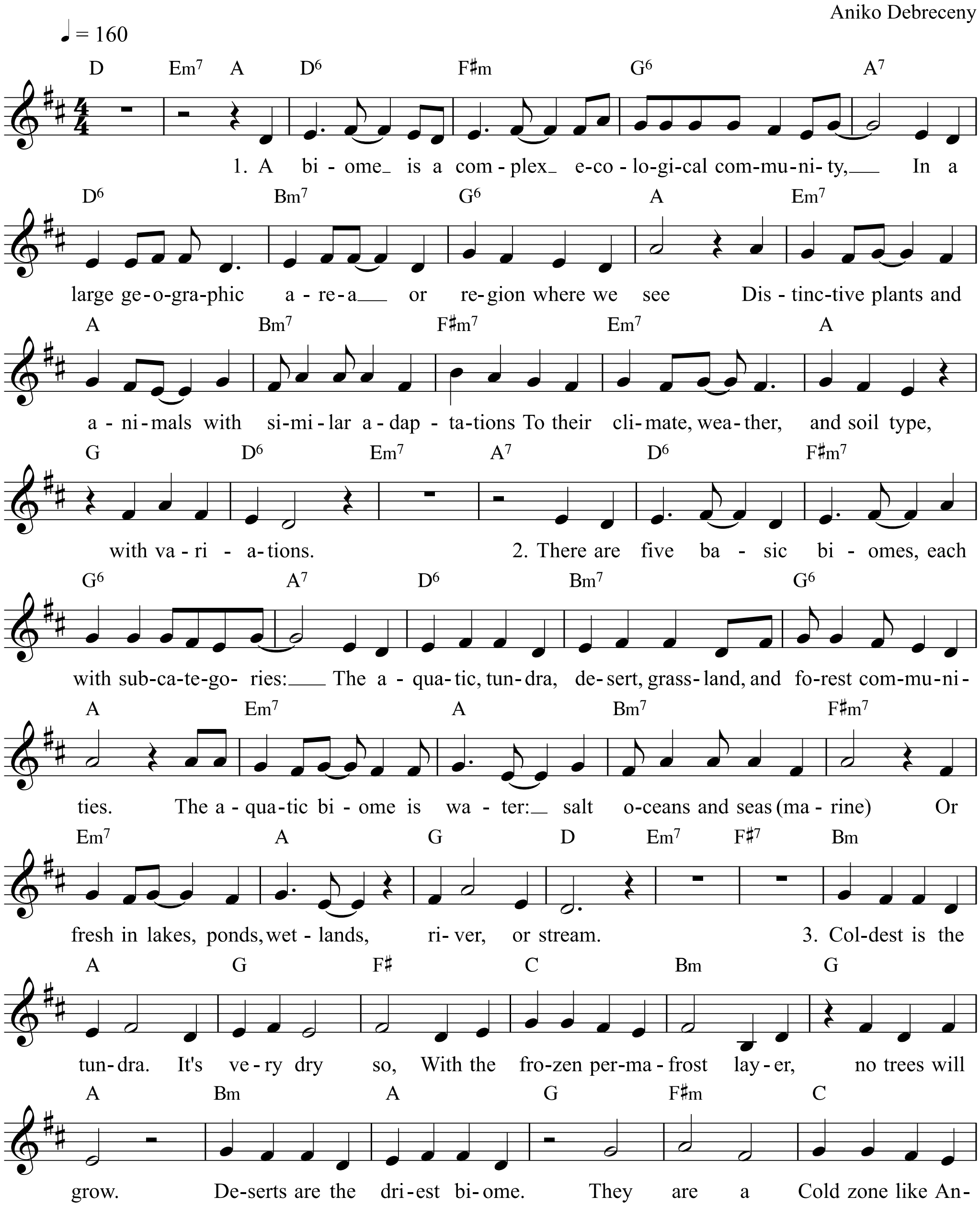
Grasslands, and warm savannas, are mostly open plain.
They don't have many trees because of fires, and little rain.
The forest biome, from tropical to cold, each plant and tree
Stores carbon, and produces oxygen, with great biodiversity.

A biome is a complex ecological community
In a large geographic area or region where we see
Distinctive plants and animals with similar adaptations
Though climate change can rearrange each biome's locations.

https://soundcloud.com/user-58744603/biomes-3

Biomes 2

Aniko Debreceny




Bm F♯ Bm Em7 A7 D6
tarc - ti - ca, or hot like the Sa - ha - ra. 4. Grass - lands and
F♯m7 G6 A7 D6 Bm7
warm sa-van-nas are most-ly o-pen plain. They don't have ma-ny trees, be-cause of
G6 A Em7
fires, and lit - tle rain. The fo - rest bi - ome; from
A Bm7 F♯m7
tro - pi - cal to cold, each plant and tree Stores
Em7 A G D Em7
car-bon, and pro-du-ces ox - y - gen, in great bi - o - di-ver - si - ty.
A7 D6 F♯m G6 A7
5. Yes, a bi - ome is a com - plex e-co - lo-gi-cal com-mu - ni - ty, In a
D6 Bm7 G6 A
large ge - o - gra-phic a - re - a or re - gion where we see Dis -
Em7 A Bm7 F♯m7
tinc - tive plants and a - ni - mals with si - mi - lar a - dap - ta - tions, Though
Em7 A G D Em7 A7 D6
cli-mate change can re - ar-range each bi-ome's lo - ca-tions.

Artefact: Teachers' Guide

Introduction

This guide is written for teachers who would like to use song in their classrooms but are either not confident about their composition and/or performance skills or have limited time to devote to developing curriculum materials in an unfamiliar genre. The guide aims to provide the basic skills and a methodology to create your own songs that are customised for your class(es) and subject(s) and includes links to more in-depth information and supplementary materials. You can write the songs yourself or collaborate with your students.

If you or your students think you cannot sing, don't worry. Chant or rap works almost as well as song to learn and remember information. If you can write poetry or rhyming couplets, you can write a rap or chant.

First, we should understand why song is useful in the classroom. The evidence is clear that song significantly benefits engagement, motivation, social interaction and retention, and that arts integration is beneficial to learning. Arts integration is where the arts and curriculum are connected through students' creativity to build knowledge. It adds the "A" for arts into the standard STEM studies to create STEAM education. Check Arts Integration Benefits.docx and Benefits of singing in the classroom.docx to see the literature. Music and song are already integral parts of our students' lives, with many of them already proficient in creating music digitally. Singing in class provides an opportunity for maximum participation where your students can rehearse the materials simultaneously (yet anonymously) in an engaging, non-threatening modality in a short amount of time

The guide first outlines the basic process, followed by examples of the elements of songwriting. It provides links to supporting information and context if you are interested and have time to read further. Here are the basic steps of the creative process developed over thirty years of experience in composing songs for learning, followed by exemplars.

Subject-based Songwriting 101

1. Select what specific information the song will cover.
2. Collect the essential facts, concepts and vocabulary as outlined in the learning standards and your lesson plans.
3. Rank these in order of importance.
4. Create a word bank of potential rhyming words.
5. Using the word bank, write rhyming couplets.
6. Combine rhyming couplets into verses.
7. Choose/borrow or write a melody and harmony (optional).
8. Revise, revise, revise, depending on how much time you have.
9. Share with your students.

Let’s walk through the process.

1. Select what specific information the song will cover.
2. Collect the essential facts, concepts and vocabulary as outlined in the learning standards and your lesson plans.
3. Rank these in order of importance.

You are the best authority on what your students need to know, and which information and concepts they have difficulty in learning and retaining. Using song to teach these areas will improve engagement, learning and retention. Think about what your students did not remember in previous years, so that you include those facts, terms and concepts.

The good news is that all the required information and vocabulary words/list for your lyrics are right there in your lesson plans. Rank them from indispensable to “would be nice to include if there is time and space available”. Your lesson plans are the embryos of your songs. If you use certain phrases in your lessons, try to incorporate them into the lyrics to reinforce learning and memory. Use your personal voice – be distinctive.

4. Create a word bank of potential rhyming words.

A word bank is a collection of vocabulary or concept words and the list of words that rhyme with each of them from which you can create pairs of rhyming lines, called couplets. The easiest rhyme pattern to learn and remember is AABB, where the last word of each pair of lines rhymes. Using rhyme is important because it is proven to help learning outcomes and retention. For more than you ever wanted to know about the different types of rhyme with examples, see Rhyme.docx.

To find your potential rhyme words, check out online resources or a good rhyming dictionary (I recommend Whitfield's University Rhyming Dictionary). Remember that even a great rhyming dictionary or website will not offer all the possible rhymes, especially polysyllabic rhymes which sometimes use multiple words.

This word bank can form the basis of your lyrics. Do not despair if there are only a few rhyming words, or they don't link well to the original word. Rhymes need occur only once a line, and you can always add a word that is easy to rhyme at the end of the line if necessary. Important but difficult to rhyme words can be located at the beginning or in the middle of a line of lyrics. When you are feeling more confident, you can add internal rhymes *inside* the line.

5. Using the word bank, write rhyming couplets.

Rhyming couplets are pairs of lines which rhyme, containing related or sequential information. Think of writing a poem, which will magically transform into song lyrics if and when a melody is added. If you decide not to use melody, your 'poem' becomes the rap or chant.

For example, here is the word bank for the song Metamorphic, Igneous and Sedimentary Rock.

Sedimentary – be, key, see, elementary, rudimentary, geology, geography, discovery, extraordinary

Metamorphic – thick, fabric, volcanic

Formed – stormed, warmed, informed, transformed

Classified – guide, slide, glide, ride, wide, beside, inside, identified, modified, liquefied

Earth – birth, worth

Find – lined, defined, grind, combined

Change – range, strange, exchange, arrange

Crust – thrust, dust, just, must, adjust, combust

Flow – go, glow, slow, know, grow, show, ago, below

Sample couplets:

> Earth's crust is made of solid rocks and minerals
> Rocks are solid, mineral materials.
>
> When magma or lava cools and hardens, we find
> Igneous rocks (they're volcanic) defined.
>
> Beneath the Earth's surface, deep below,
> Molten magma and lava flow.
>
> Under Earth's surface metamorphic rock is formed
> By intense heat or pressure, it's transformed.
>
> There are three type of rock in Earth's geology:
> Metamorphic, igneous and sedimentary.

This last couplet became the chorus, as it contains the most important vocabulary terms (metamorphic, igneous, and sedimentary) as well as "geology", which rhymes well with "sedimentary", in just two lines and is the field of science which studies the earth's physical structure and processes.

Words ending in an "ee" sound are easy to rhyme, as there are so many possible rhymes to match. Other word-endings with plentiful rhyme words are "-ate" and "-ation".

6. Combine rhyming couplets into verses.

Here are example verses from the Metamorphic, Igneous and Sedimentary Rock song:

> Tectonic plates collide and grow mountain ranges.
> Rocks caught in between them undergo great changes.
> Their mineral composition and texture are transformed
> By great heat and pressure metamorphic rock is formed.

Here the essential vocabulary term "metamorphic" is placed in the middle of the line, because there was no good rhyme word for it. In the following verse, "sedimentary" is located at the end of the line, as there were many more rhyme options.

> Sand, shells, pebbles, particles and sediment press
> And cement together in layers, a long process.
> Formed where water is, or used to be,
> These soft rocks are sedimentary.

The standard poem and song verse rhythm pattern uses four lines, or two couplets, each containing four strong beats or accents. Depending on how much information you wish to include, you may decide to use a six-line verse instead. Choruses can be two lines at the end of the four-line verse, or a separate two- or four- line repeated section. Here is where you will place the most important information that will be repeated several times, reinforcing learning and retention. Read about the value of repetition at [Benefits of repetition.docx].

It is best to use normal speech patterns to make the song easier to learn. Place the strong syllables of words on the strong rhythmical/musical beats. If the first syllable of a line is not strongly accented, you can use an upbeat, where the word or note is written before the strong first beat of a musical bar.

The lines in each couplet should be similar in length. Length in songwriting does not necessarily mean the same number of words or syllables. Instead, we try to match the number of important beats or stresses in a line. If one line has more words and syllables than its partner line in the couplet, those syllables can be sung faster, while maintaining the same number of beats in both lines. Other options are to make the word rhythm in the line with fewer syllables slower, with longer value notes, or to add rests (which can help with breathing, especially for younger singers who have a smaller lung capacity).

For great information about rhythms and how to write them, check out https://hellomusictheory.com/learn/types-of-musical-notes/.

The length of the song will depend on the age and capabilities of your class, and how much material you need to include. Obviously younger classes will find short songs easier to learn and remember. You may find it is more effective to write and teach several short songs rather than a lengthy and rambling epic, even for older classes. It is very tempting to want to include as much curricular material as possible, but research shows that students prefer shorter, succinct songs (see KISS.docx). Think of distilling your lesson plan so that you write short 'jingles' where the lyrics are triggers or prompts for recall of information.

You now have a poem which can be a chant. Chants or raps can be nearly as effective in improving learning and retention as songs, especially if your class is not enthusiastic about singing (see Chant or Rap.docx). You can chant using a percussion accompaniment, either instruments or body percussion (clapping, tapping, finger clicking, foot tapping, etc.). Vocal percussion or beatboxing sounds great but prevents the performer from benefitting their learning and retention through repeated rehearsal.

So, if you don't have enough time to work on a melody, or you don't feel confident writing one, feel free to leave the melodic element out and teach your class your great new chant or rap.

7. Choose/borrow or write a melody and harmony (optional).

Melodies can be borrowed, in what are termed 'parodies' or 'piggy-back' songs. This entails using a song melody in the public domain that you or your students already know. Common elementary school examples are ‘Twinkle, twinkle little star’, ‘Row, row, row your boat’, ‘Jingle Bells’ and ‘Three Blind Mice’.

There are pros and cons to using well-known tunes. The positive aspect is that you don’t have to teach a new melody as everyone knows it already, which saves classroom time. The negative feature is that students may confuse which set of lyrics they should be singing to the familiar tune. Also, other teachers may have used the same melody for their songs. If you use a current popular song melody, it may be outdated in just a few years’ time. You can also select a well-known song which has lyrics or content which links to the subject matter of your lyrics, e.g., ‘Twinkle, twinkle little star’ melody for a song about stars.

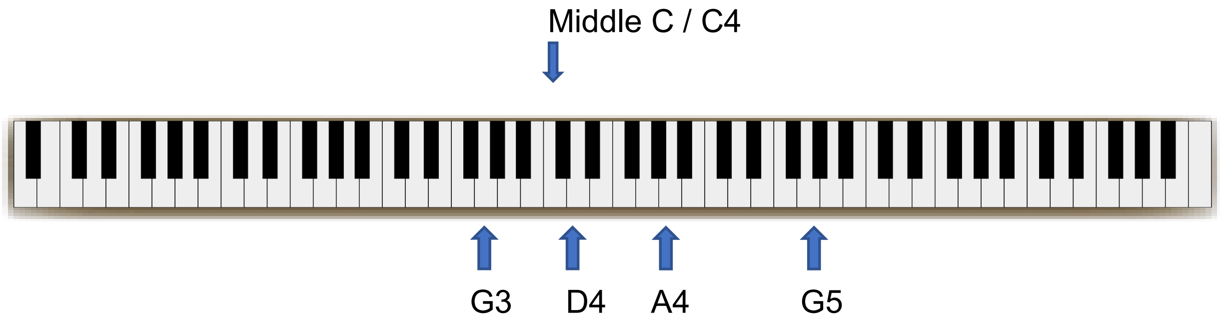
Writing your own melody is more complicated than borrowing one. This is where collaborating with your students or having them work in groups may be effective. They are already immersed in music outside of school. By asking them to play you their favourite music you are validating their musical preferences and identities.

Most children's song melodies have the following characteristics:

- In duple or quadruple metre (2 or 4 beats in every bar).
- Major key.
- Melodic range of five to 8 notes (up to an octave).
- Mostly stepwise (conjunct) or skip (3rd) melodic movement.
- Syllabic, with one note per syllable.
- Repetitive.
- Simple, regular rhythms.
- Verses are usually 4 lines long, with four main strong beats in each line.
- Short.
- Normal speech patterns.
- Descending final phrase, ending on the tonic or keynote (first note of the scale).

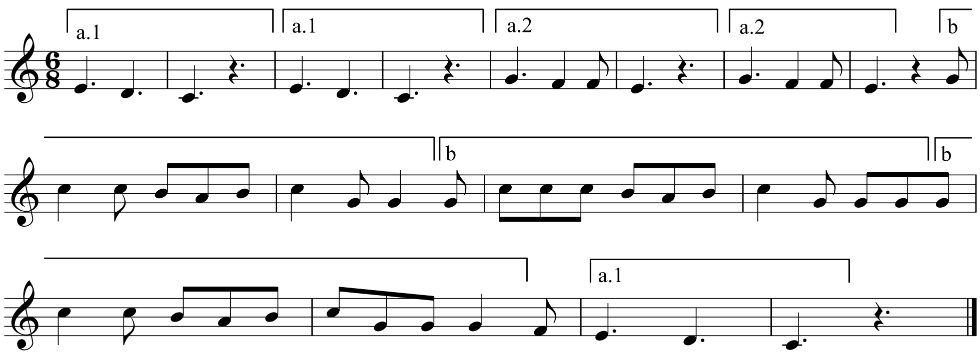
The actual pitch and key of the song will be determined by your students' vocal range, which widens as they mature physically. Generally, children's songs use a small range of six to eight notes. There is a lot of research about children's vocal ranges (see Vocal Range.docx), but most elementary classes will be able to comfortably sing from A or B below middle C (A3, B3) to the A above middle C (A4) or even the C above middle C (C5). Generally, children's songs are published in keys which are higher than their comfortable vocal range.

If your school has a music teacher, check with them as to the best vocal range for your students. If not, borrow a keyboard and ask your students to stand and sing a slow scale to "la" (or any nonsense word you like, e.g. "elephant", "Patagonia" etc.), sitting down when the notes get too high or low for them. Try starting on D4 (the note above middle C) which should be a comfortable note for all singers and go up to G5, then D4 descending down to the G below middle C (G3) as shown on the keyboard below. This exercise will provide you with an instant comfortable pitch range tailored to your class.

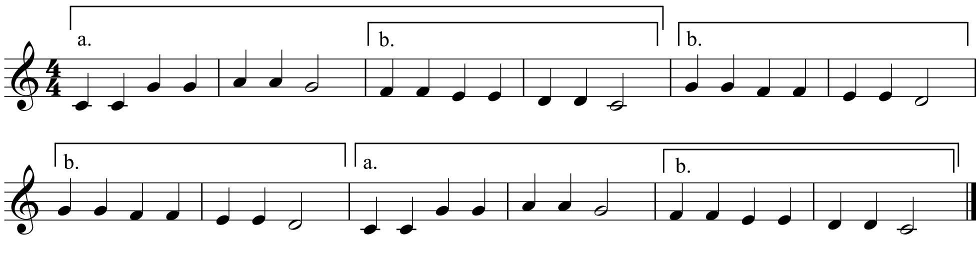


The lyrics will provide the rhythm of your melody in normal speech patterns. The next step is adding pitches. This process varies for each composer. The good news is that we don't need to get complicated. In fact, the best children's songs that are easy to learn and remember use a lot of repetition and mostly stepwise melodic shapes.

Repetition of melodic contours or patterns helps in learning a melody. The melody of the round "Three Blind Mice" shows how two short melodic motives can produce a complete melody. The melodic shape of a.1 is echoed three notes higher in a.2. The descending three notes of a.1 and a.2 are also found in b at a faster speed. Familiarity and repetition help in learning melodies as well as retention.



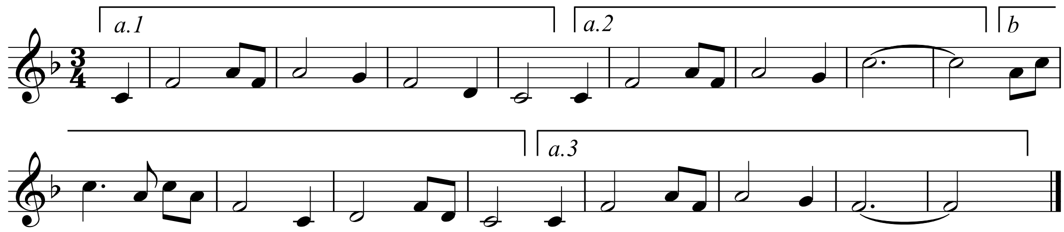
Another common parody song melody is "Twinkle, Twinkle, Little Star", which also incorporates melodic repetition. The opening melody (a) is repeated at the end, while the repeated short phrases (b) in between are the second half of the first melody sung one note higher. This example is different to most children's songs in that each verse is six (short) lines in length, rather than the usual four lines.



Here are lyrics to “Twinkle, Twinkle, Little Star” about parody songs.

> If you need a melody,
> Public domain tunes are free.
> Borrowing a tune saves time,
> Write your lyrics so they rhyme.
> Keep it simple, not too long,
> Short and sweet – the ideal song.

Frequently songs repeat melodic shapes from the first line, as in this example, ‘Amazing Grace’:



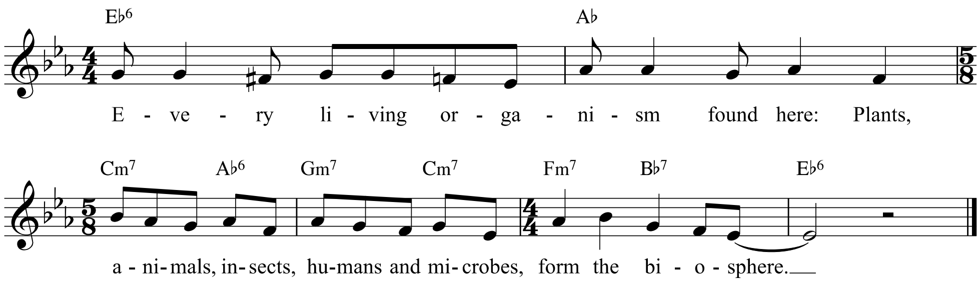
Here the first phrase opening is repeated three times with the third line altered to provide melodic variety. The first two bars of the phrase are exactly the same for each iteration of ‘A’. However, the ‘A’ phrases end on different notes and therefore harmonies, to keep the music interesting (A1, A2, B, A3). The long high C at the end of the second phrase implies the dominant harmony (chord V/C major), which creates tension, while the long F at the end is the tonic or ‘key’ note, providing a sense of harmonic resolution. The melody is primarily based on the notes of the F major chord (F, A and C). Of the 34 melodic intervals, 3 are unisons, 8 are seconds or stepwise, 18 are thirds or skips, and 5 are fourths. Stepwise and skip intervals are the easiest to sing, especially for younger students, and are the most common intervals in children's own songs. Older students are more capable of singing wider melodic intervals.

Most children's songs are syllabic, using one note for each syllable, rather than melismatic, where one syllable is sung over several notes. In music notation, this is written using a curved line called a slur above the notes.

syllabic melismatic

The tempo or speed of a song is determined in large part by the number of syllables in each line of lyrics. If a line has multiple syllables to insert into a certain number of beats, they may have to be sung (or spoken) very rapidly, using fast musical note values. This can lead to difficulties with correct pronunciation and enunciation for untrained singers and younger children. Songs with 'dense' or complex lyrics should be sung at a more moderate pace to accommodate the potential "tongue-twister" lyric patterns. You can also teach the "tongue-twister" lyric segments as vocal games or warmups in class. Find other fun tongue-twisters to improve enunciation at Tongue-twisters.docx. Children prefer fast tempo songs, with a strong sense of beat. Check out Music Tempo.docx for more information.

If your lyric line has too many syllables to sing comfortably, and every word is essential for your students to learn and remember, you can always change the time signature for a bar or two. An example is the song Earth Structures for grades 5 and 6, which switches from simple quadruple (4 4) to 5 8 for two bars to make the extra syllables easier to sing.



One way to create a melody is to find a song you or your students like with the same number of beats per line and play with it. Turn the musical shape upside down. Change a couple of notes in each melodic phrase. Alter the rhythm. Combine the best elements of several songs.

For example, the nursery rhyme “Here we go ‘round the Mulberry Bush” is often used as a parody song with other lyrics, such as “This is the way we brush our teeth” or “This is the way we wash our hands” etc. The melody is based on the notes of two harmony chords: F major (F, A, C) and C major (C, E, G), with very few passing notes.

One way to change a melody uses passing notes in stepwise rather than skip motion, eliminating most of the repeated notes. The final phrase descends instead of ascending, as is most common in children’s songs.

Another possibility is to invert the melodic line. Changing some of the repeated notes to skip intervals of the harmony chord alters the melody further.

Another change can be to the rhythm. Here the repeated three even quarter rhythm is altered to a dotted quarter note, eighth note and quarter note.

Combining several of these changes produces a melody which, while based on the original nursery rhyme, is new and different. It conforms to the usual children's song structure of mostly step or skip intervals, small melodic range (a perfect 5th) and a descending last phrase.

Another example of how to rework a well-known melody uses "Incy Wincy Spider" / "Itsy Bitsy Spider". This melody is very simple, repeating the first line as the third and fourth lines (AABA). The second line is the same melodic shape as the first line, three notes higher (A1, A1, A2, A1).

Again, we can turn the melody upside down.

The melody can use fewer repeated notes with more skip intervals at the beginning of the phrase while retaining the stepwise movement in the second half of the phrase.

In this second version with more skip intervals, the third line is altered for variety (A1, A2, B, A1). B is based on the inverted melodic shape of the original first three notes and uses the dominant/chord V harmony for harmonic interest, instead of beginning each phrase with the same harmony.

Or the time signature can be changed from triple to duple.

Here are some other approaches to melody writing:

- Try reading the lyrics aloud several times to see if a melody or melodic shape comes to mind. Be dramatic, even “operatic”, to hear where the words should rise and fall in pitch.
- Listen to songs with the same mood, style and speed that you would like for your song. Analyse what works in these songs, so you can use it. Remember, it is virtually impossible to write a truly original melody that does not contain some musical element from your listening experience and musical vocabulary. All composers steal good ideas and rearrange them into something “new”. Just don’t quote too obviously (unless it is a parody using public domain materials).
- Sing the first line multiple times using different melodic shapes and see which one you like best. Once you have the first line, write it down. Now you have the basis for your melody. You can repeat the first line melody for the second or third line if you want. Write the other two lines, ending the melody on the first note/tonic of the scale to create a harmonic sense of resolution.
- Check for any possible wordpainting opportunities, where the melody depicts the meaning of the lyrics, e.g., move around a note in stepwise motion for the line “planets orbit the Sun” or sing an ascending scale for “the sun rises in the East”.
- Feel free to be interesting. While below are general rules which make songs easier to learn and sing, remember that most children like drama and variety.

Here’s a checklist for melody writing.

- Use a vocal range of 5-8 notes, depending on the age and abilities of the singers.
- Use mostly step or skip intervals, especially for younger singers.
- Use one note per word syllable (syllabic).
- Add rests for breaths at the end of lyric lines (or in the middle if you have fewer syllables to sing).
- Use melodic repetition to make the melody easy to learn and remember.

- Use passing notes to make a smooth melodic contour, rather than 'jumpy', angular chords which are more difficult to sing.
- Add occasional dissonance and syncopation to keep things interesting.
- At the end of the second line (of four) use a note of the dominant chord (the fifth note of the scale) to create harmonic tension (see Amazing Grace example above).
- Finish on the first note of the scale (tonic) for a sense of harmonic resolution.
- If you know the chord of the harmony you will use in each bar, try to use the notes of the chord so that they will harmonise well, e.g. G major: use G, B and D, or D major: use D, F# and A.

Unless you want your song to be sung *a capella* (without accompaniment), you will need to add harmony. Harmony is the sequence or progression of chords to be played while you sing. If you have a music teacher in your school, you can collaborate with them to help provide the harmony for your melody.

Depending on your musical performance skills, you can create simple or more challenging harmonies. Most popular and children's songs can be accompanied using just three chords. These are based on the first, fourth, and fifth notes of a scale. Every note of the major scale can be harmonised using just these three chords, e.g., in the key of D major: D major, G major and A major, or in the key of C major: C major, F major and G major. There are some standard harmony chord progressions that are very common in popular (and folk) music. For more information about harmony in general, see Harmony.docx.

Generally, the harmony changes every bar or two bars. This is not a strict rule – 'Frere Jacques' and 'Three Blind Mice' use one chord for the entire song, but that would get boring quickly. You do not have to play a different chord for each melody note. There will probably be some notes that do not harmonise well with the chord, but that is fine. These are called passing notes, and make the melody flow, rather than sounding too angular and awkward by using only the notes of the harmony chords.

The vast majority of children's songs are in major keys which sound "happy". Minor ("sad") keys and harmonies can be used if appropriate. However, depending on what accompaniment mode you have chosen, be aware that guitarists may find minor chords more challenging than the standard major chord fingerings.

8. Revise, revise, revise, depending on how much time you have.
9. Share with your students.

Once the song is completed, you need to publish it for your students (and posterity). Notating a melody is obviously simple if you know how to read music. There are also various software music publishing packages that will notate recorded music for you, depending on your level of comfort and familiarity with these. However, you might not need to have a music notation version if your class does not read music. It can be helpful to have a visual "map" of the melody, so that they can see the shape of the tune, where it rises, falls and takes a break with a rest. Maybe your class prefers to have just a lyric sheet and to learn the melody by memorisation. Another option is to ask your students to provide notation and accompaniment music sound files, as many of them are highly proficient with music software outside of school.

Boys are usually less enthusiastic about singing, especially in the upper grades. One solution to this issue is to have them 'rap' the lyrics instead of singing. This eliminates the "singing is for girls and sissies" attitude or embarrassment as their voices start to change, but detracts from memorisation, as they are remembering only text and rhythm without the additional memory 'hook' of melody. However, chant, rap, or even reading the lyrics aloud (the production effect) still significantly improve learning and memory.

Once you have a chant, rap or song, how to teach your students to sing it depends on their age and singing experience. You know your students best, so can select the method to suit their learning styles and preferences. Obviously, young students who are not yet fluent readers will learn songs as they learn language, by imitation and memorisation. Some children prefer to learn a song by first hearing it sung through, then learning it line by line, repeating after the teacher. Other students prefer to learn by repeatedly listening to the entire song until it is memorised. You can also teach the song as a poem or chant first so that the students can focus on the lyrics, before adding the melodic element. Songs can be played as students enter the classroom, as a segue into a new activity, or as an accompaniment to quiet work.

When asking your students to sing, make sure that you first sing or play the first note that they are to sing to give them the correct pitch. If you do not have a keyboard or guitar, you can use a pitch pipe, where you blow through the aperture labelled with the note. You should also count in a full bar (1, 2, 3, 4). This provides the correct speed and the opportunity for the singers to take a full breath before starting.

If you have students who tell you that they “can’t sing”, reassure them that they can chant/rap the song instead. If you have students who refuse to sing, ask them why. Usually, boys are afraid of looking or sounding too feminine or are concerned that their voices are not under control, especially when their voices start to change. Some “too cool for school” students think that singing is juvenile and beneath their dignity. Remind them that this is not a competition or audition, but a brain-stretching way to learn and remember what they need to know. If necessary, some students can sing “inside” their heads.

Example 1: The Water Cycle – grades 1 / 2

Essential Curriculum Facts:

- The basic water cycle flows from evaporation – condensation – precipitation.
- The water cycle is also termed the hydrosphere equation.

Word Bank:

- Evaporation – condensation, precipitation, rotation, hydration, migration, equation, explanation, mutation, application, liquidation, irrigation, revelation, percolation, circulation, formulation, information, transformation, operation, transpiration, illustration, transportation, sublimation, infiltration

This song is easy to rhyme, as all the important terms rhyme with each other, each ending in "-ation". This version of the song is for grades 1 & 2, with a longer, more detailed song for grades 5 & 6.

> The basic water cycle starts with evaporation
> Which cools so rain and snow clouds form: condensation.
> Then water falls to the earth: precipitation.
> Our hydrosphere equation – water's constant circulation:
> Evaporation, condensation, and precipitation,
> Evaporation, condensation, and precipitation.

The lyrics provide definitions of each of the three terms which are placed at the end of each line, followed by the term "hydrosphere equation". "Equation", while spelled the same as the other three terms is pronounced slightly differently, so the line places the term first and the definition second, to provide a better end rhyme word, "circulation" to match "precipitation". The three terms are repeated twice like a chorus at the end to enhance memorisation.

To work out the musical rhythm for the lyrics, if you do not know how to write music, underline the accented syllables of the lyrics. Usually the strong (underlined) syllables will be placed on the first and third beats of each four-beat bar.

> The basic water cycle starts with evaporation
> Which cools so rain and snow clouds form: condensation.
> Then water falls to the earth: precipitation.
> Our hydrosphere equation – water's constant circulation:
> Evaporation, condensation, and precipitation,
> Evaporation, condensation, and precipitation.

Dots and dashes can show the long and short syllables.

. __ . __ . __ . ___ __ . __ . __ .
The basic water cycle starts with evaporation

. __ . __ . __ . __ __ __ . __
Which cools so rain and snow clouds form: condensation.

. __ . __ __ . __ . __ __ . __
Then water falls to the earth: precipitation.

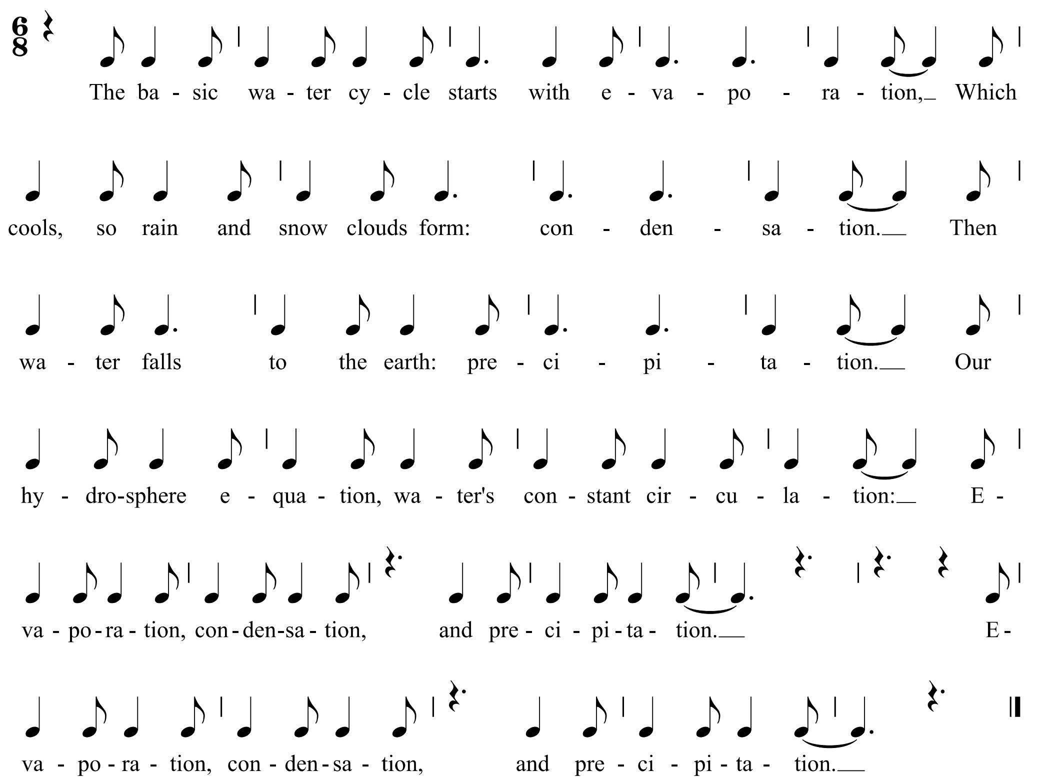
. __ . __ . __ . __ . __ . __ . __ .
Our hydrosphere equation – water’s constant circulation:

. __ . __ . __ . __ . __ . __ . __ .
Evaporation, condensation, and precipitation,

. __ . __ . __ . __ . __ . __ . __ .
Evaporation, condensation, and precipitation.

This conforms to the common four strong beats per line pattern. All the lines start with an unstressed syllable, so we use an upbeat, and place the strong accented syllable on the first beat of each musical bar.

Here is the song written in rhythmic musical notation.



This rhythm could also have been written in common 4 4 time, but the long/short rhythm in 6 8 conforms to standard poetic iambic metre and normal speech patterns. As the final two lines have fewer syllables, there is a rest in the middle of the line before "precipitation". This gives space for an extra breath, which is especially useful for younger singers who have a small breath capacity. The syncopation on the end of each line matches normal speech patterns and provides rhythmic interest. Syncopation is where a strong accent is placed in an unexpected position or beat.

Gesture with speech or song improves retention (see Gesture & Memory.docx). However, gestures need to be iconic and easily associated with the term or phrase and should be consistent all the way through the song. In this song simple hand gestures can depict the actual cycle:

- Circulation – both hands move in a big circle, up then down.
- evaporation - wiggle fingers as both hands rise up.
- condensation – make fists and bring both hands together as 'clouds'.
- precipitation – wiggle fingers as hands move downwards as rain or snow.

Finally, here is the song in musical notation and a very simple arrangement sound file.

https://soundcloud.com/user-58744603/the-basic-water-cycle

The Basic Water Cycle

Aniko Debreceny

Example 2: Metamorphic, Igneous & Sedimentary Rock – grades 5 / 6

The following example discusses the chorus of a grade 5 & 6 song about rock types.

The first couplet conforms to the four strong beats per line pattern:

> There are <u>three</u> types of <u>rock</u> in <u>Earth's</u> geolo<u>gy</u>:
>
> <u>Me</u>tamorphic, <u>ig</u>neous, and <u>se</u>dimenta<u>ry</u>.

and includes a rest or space at the end of the first line to accommodate a breath.

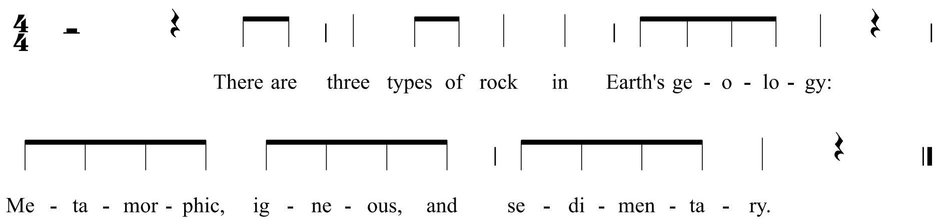
Working out the strong and weak syllables can be notated using lines and dots:

```
 .    .  ___   .    .  ___  .   ___    . . .  ___
There are three types of rock  in   Earth's geology

__ .   .   .  __ .  .    .  __   .  .  . __
Metamorphic, igneous, and sedimentary.
```

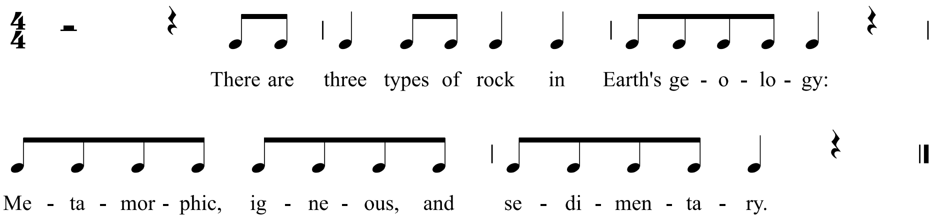
If your lyric line does not begin with a strong accent, you can use a pickup or upbeat rhythm so that the important syllable stress is located on the strong beat (usually the first beat of a musical bar or measure). In this case, "There are" is written before the bar line so that the important word "three" is placed on the strong down beat. So, write a bar line right before the first strong syllable, and work out the beats from there.

```
 .    .|  ___   .    .   ___ ___ |  .     . . .  ___
There are| three types of  rock  in |Earth's geolo - gy

|  .  .  .  .  .  .  .    .  |  .  .  .  . ___
|Metamorphic, igneous, and   |sedimentary.
```

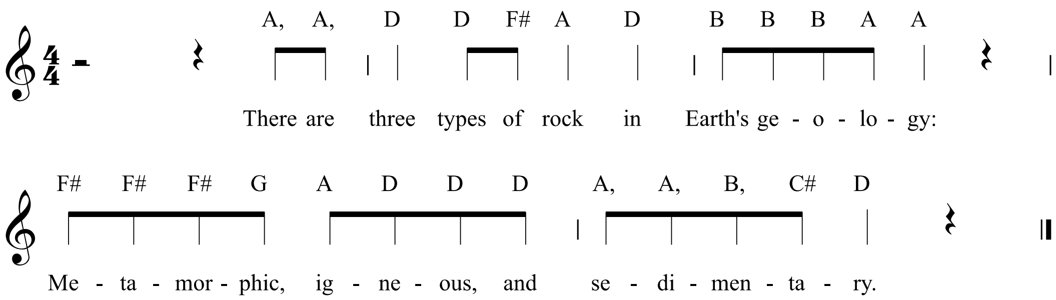
This rhythm can be written using "stick" notation (see [Stick Notation.docx]) which is quick and easy to write.



Or musical rhythmic notation:



If you are adding a melody, you can write it in a variety of ways, depending on what you are comfortable with. If you have a keyboard, or can read music, you can work out what the note is and write the note name above the lyrics and rhythm.



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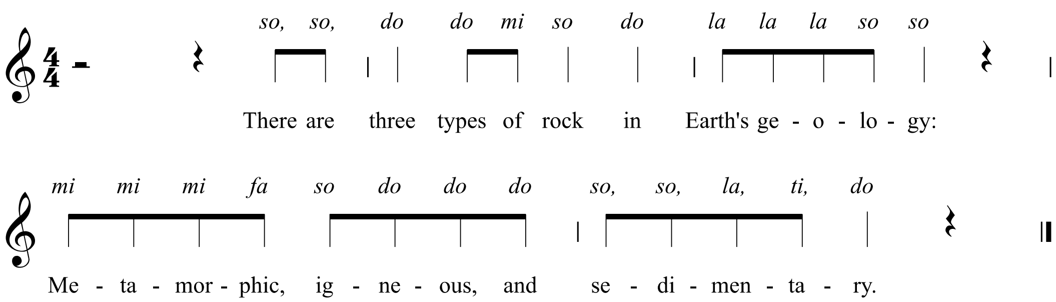
If you have studied Kodály or solfa/solfege (see Solfa.docx), you can use the solfa names (*do, re, mi, fa, so, la, ti*).



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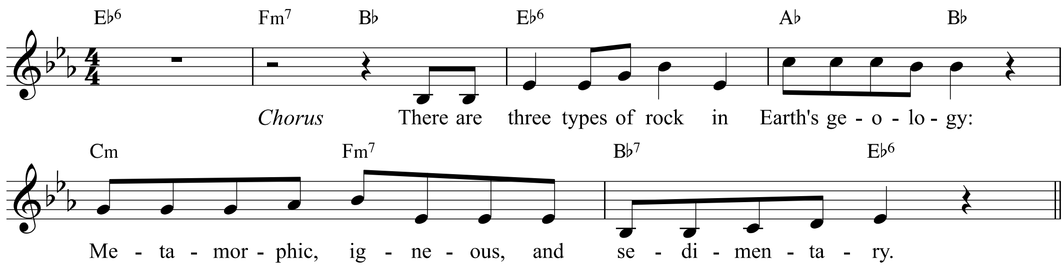
Notated on the musical stave in E flat major to make it easier to sing, the chorus is:



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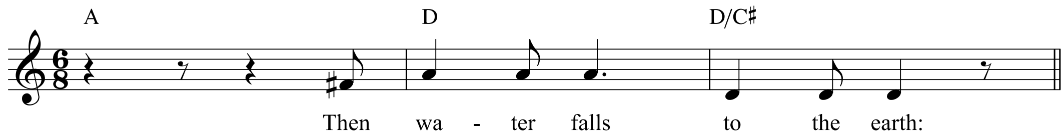
Wordpainting Examples

When crafting song melodies there are opportunities for creativity and imagination. One of these is wordpainting, which is a melodic device where the melodic contour depicts the meaning of the lyric.

The Basic Water Cycle (grades 1 & 2) incorporates this melodic device first in the line “Then water falls to the earth”, with a falling perfect fifth between “falls” and “to the earth”.



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The term “precipitation” uses a descending melodic shape as the term is defined as “water that falls from the clouds toward the ground, especially as rain or snow”.

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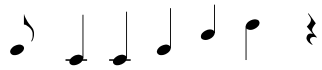
In Tectonic Plate Boundaries (grades 5 & 6) stepwise or conjunct movement conveys closeness for the line “convergent comes together”, and a triadic arc moves upwards for “divergent separates”.



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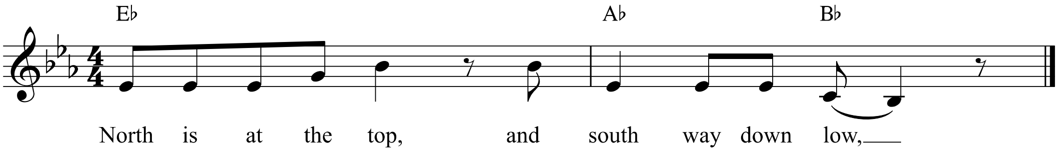
In Compass (grades 1 & 2) the phrase “north is at the top” ascends in a triad to the word ‘top”, while “and south way down low” falls a perfect fifth onto the word “south” and descends on “way down low” to the octave below the note used for “top”. These musical “gestures” can be paired with physical gestures of pointing in the correct position for each compass direction.



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Writing with your students

Creating songs with your students is an enriching educational experience but can be very time-consuming in the classroom. The basic process remains the same as when you write a song, depending on at which stage of learning you incorporate songwriting. Obviously, if you begin the lesson sequence with writing a song, your students have little to contribute as far as vocabulary and comprehension of the required learning standards and material. You can of course provide them with the vocabulary and concepts. However, it is probably more effective to write the song with your students *after* you have introduced the information, so the collection of essential data and relevant potential rhyme words in the word bank is truly collaborative.

There are potential drawbacks to having your students drive the creative bus. The most obvious one is the enormous amount of time this can consume, unless it is assigned as homework. Classroom time is precious, so you may want to start by writing a single verse for the initial project to help your students learn their lyric/poem writing skills. This can be an extra verse to a song they already know, or a single “summary” verse. Once these skills are acquired, you can move on to longer, more complex raps and chants, parodies or songs.

You can also select a different concept or term which needs defining for each group of writer/composers, so that the song will comprise several verses, each written by a different group. This would work best when using a well-known melody as a parody song, so that the melody remains consistent throughout the song. Also, the students have to create only one element – lyrics, rather than three – lyrics, melody and harmony.

Depending on your knowledge of your students and their work habits, you can co-write as one group, or break them into pairs or groups to create lyrics to add to a parody song, or if they are capable, to write their own melody and harmony. Some students may already be experienced with music software or play musical instruments, so they could take on the roles of performer, producer and/or publisher. As with any group work, some students will be happy to be leaders while others prefer to “coast”, and there is always the natural inclination to socialise instead of work. Some students may feel disempowered by more dominant classmates, or that they need to compromise their creativity in order to meet the time deadline for the project.

If you have several groups working at the same time, noise will be a factor. Headphones for keyboards and computers are useful, as is finding several discrete spaces for your students. However, this creates problems for you as a teacher to be able to monitor every group. The lyric and music creation phase can also be set as an online homework assignment, which saves classroom time for other activities. Over time, you can create a unique class musical library of songs, perhaps creating sound files or CDs and performing them for other classes or the school community.

For more about songwriting with students, see Collaborative Songwriting.docx. Link to Anna Miller’s lesson plan for creating a verse about photosynthesis set to the melody of “You are my sunshine” in Activity 3 here:

https://kenanfellows.org/kfp-cp-sites/cp21/cp21/lesson-5-photosynthesis/index.html.

Materials

The materials required for lyric writing are standard classroom issue – paper, pen or pencil, and computer (depending on the grade level). Manuscript paper will facilitate music notation. Rhyming dictionaries are useful. If your students are creating accompaniments, a keyboard, guitar, ukulele or computer is essential. If you have students who are accomplished performers, they can bring their instruments to class to accompany the singing. Make sure to audition them first (privately) to ensure they are capable.

Remember to incorporate the essential incubation phase of creativity, where the students have time away from the task in order to allow the nonconscious mind to work on the project. This can vary from a different task in class for a couple of minutes to allowing a day or more between composition sessions. Remind your students to remain open to new ideas, as generally the initial ideas are not the most creative. This is an opportunity for them to learn that there are multiple "correct" answers or solutions to a creative problem.

Assessment

Assessment is both quantitative (did the students follow directions, create the list of essential information, a rhyme word bank and rhyming couplets?) and qualitative (did the song or rap "sound good", and did students enjoy singing it?). If several groups created their own verse, song, or rap, they could perform them for the rest of the class, with the length of the applause providing a peer assessment grade.

For more advanced students, assessment might include whether they created a melody and harmony with an accompaniment, and was it published in notation or sound file format? Performance evaluations should not be based on students' singing abilities but on level of participation and competence with lyrics, which indicates sufficient rehearsal and absorption of the materials and information. Retention can be assessed through written tests both immediately upon completing the project and after a period of time.

Ways to make singing more interesting for your students

- Depending on their age (and self-control) add body percussion as accompaniment (e.g., clapping, finger clicking, foot tapping, partner clapping sequences, etc.).
- Leave a word out so that they must insert the correct lyric. If this is the final word of a line, it will be easier for them to remember it because it will sound similar to the rhyme word in the couplet.
- Alternate lines with either half the class on different lines, or the teacher and students, e.g., the Basic Water Cycle song shown above:

  [A] The basic water cycle starts with [B] evaporation
  [A] Which cools so rain and snow clouds form: [B] condensation.
  [A] Then water falls to the earth: [B] precipitation.
  [A] Our hydrosphere equation – [B] water's constant circulation:
  [All] Evaporation, condensation, and precipitation,
  Evaporation, condensation, and precipitation.
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- Challenge them to write another verse to the same melody.
- Ask them to create a new accompaniment to a song, chant or rap.
- Alternate singing aloud and silently. When the teacher's (or selected student's) hand is open the students sing aloud. When the hand is closed in a fist, the students sing silently in their heads, ready to sing aloud when indicated.
- Ask your students to add appropriate gestures to songs (where relevant).
- Ask your students to bring their own songs or their favourite songs to use as parody melodies.
- When you have a library of songs, play the first few bars for them to recognise and sing.

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SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20200315%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20200315T014002Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=8a7fb9701662f3c89f743ac9681f2c746ab9ab148ee84bfd6c7ce30f1181109b

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Appendix: Curricular Resources

Grades 1 & 2

The Solar System

U.S. curriculum (BCS, n.d.; NJDE, 2016; NSTA, 2014; SVSD, 2018; TCSS, 2015; TEA, 2017; UEN, 2018; WPS, 2018; YCSD, 2016)

Australian curriculum (ACARA, 2018)

U.K. curriculum (DfE, 2013)

National Geographic (Natgeo, 2019)

Educational websites (Colley, 2016; FOSS, 2018; SFI, 2017)

The Basic Water Cycle

U.S. curriculum (Cey, 2017; SVSD, 2018; USOE, 2010)

Canadian curriculum (British Columbia) (BCME, 2016)

Encyclopedia Britannica (Augustyn, 2018)

NASA (2019)

National Geographic (2019)

NOAA (2019)

Map Legends

U.S. curriculum (APSVA, 2013a; Baresi, 2013; Chmielinski, 2018; Morton, 2010; Tburgschoools, 2019; TSSS, 2018)

Canadian curriculum (OMOE, 2018)

Educational websites (Felima, 2010; TE, 2019)

Compass

Australian curriculum (ACARA, 2015)

Days & Months

n/a

Primary & Secondary Colours

n/a

Continents & Oceans

U.S. curriculum materials (APSVA, 2013a; Baresi, 2013; Chmielinski, 2018; Morton, 2010; Ricker, 2009; Tburgschoools, 2019; TE, 2019; VDOE, 2016)

NOAA (2020)

Online texts (Fishtank, 2019)

Educational websites (7continents5oceans, n.d.; DK, 2020a; Moen, 2020)

Encyclopedia Britannica (Duxbury, 2020)

Parts of a Plant

U.S. curriculum (MTPS, 2018; NGSS, 2013; SCDE, 2014; TEA, 2017; USOE, 2010; WPS, 2018)

Educational websites (CFAC, 2013; DK, 2020b; PS, 2020)

Biomes 1

U.S. curriculum (ESS, 2017; TSI, 2020)

U.K. curriculum (MPS, 2020; OTPS, 2020; Scoffham, 2017)

Australia curriculum (FUSE, 2020; Sydenham, 2018)

Encyclopedia Britannica (Augustyn, 2020; BritannicaKids, 2020a)

NASA (Anderson, n.d.)

National Geographic (2011)

Educational websites (biologyonline, n.d.; Dotson, 2019; ESS, 2017; Fries-Gaither, 2009; Moeller, 2013; NCEAS, 2004)

Plant Life Cycle

U.S. curriculum (BCSD, 2020; Dietrichsen, 2005; ISD, 2020; LCPS, 2014)

U.K. curriculum (SeedSite, 2013)

National Geographic (2020b)

Public Broadcasting Service (PBS) (2020)

Educational websites (Bales, 2020; doTERRA, 2020; EW, 2020; GenerationGenius, 2020a; Greacen, 2018; Tornio, 2019)

Butterfly Life Cycle

Educational websites (ANS, 2018; K8schoollessons, 2020; learnaboutnature, 2018; PKLS, n.d.; Washington-Morris, 2017)

National Geographic (Natgeo, 2020a)

Solid, Liquid & Gas

U.S. curriculum (APSVA, 2013c; Crilly, 2005; Stevens, 2005)

Educational websites (BISS, 2012; Guzman, 2015; LAZEL, 2020)

Clocks

U.S. curriculum (CDE, 2015; MPS, 2015; MSDE, 2015; NCDPI, 2017)

U.K. curriculum (DfE, 2021)

Australian curriculum (ACARA, 2010)

Grades 3 & 4

Map Features

U.S. curriculum (APSVA, 2013a; Baresi, 2013; Chmielinski, 2018; Morton, 2010; Tburgschoools, 2019; TSSS, 2018)

Canadian curriculum (OMOE, 2018)

Educational websites (Felima, 2010; TE, 2019)

Bodies of Water

U.S. curriculum (KDOE, 2015; MDOESE, 2016; RTSD, 2020; TSBE, 2017)

Educational websites (ITLP, 2019a, 2019b, 2019c)

Basic Geometry

Triangles

Polygons

Circles

Quadrilaterals

U.S. curriculum (BCPS, 2017; CCSSI, 2020; HCPSS, 2019; National Council of Teachers of Mathematics (NCTM), 2020; NJDOE, 2012)

Encyclopedia Britannica (2020)

Educational websites (Kemeny, 2020; Mathopenref, 2011; OML, 2018; Scottsdale, 2017; SplashLearn, n.d.; Wheatley, 2016)

Phases of the Moon

U.S. curriculum (GenerationGenius, 2020b; Nelson, 2020a; Timberlake, 2015)

U.K. curriculum (Barrow, 2013b)

National Geographic (NatGeoKids, 2020a)

Educational websites (Carr, 2017; Education.com, 2020a, 2020b; T. Smith, 2017)

Food Chains

U.S. curriculum (Alberici, 2010; APSVA, 2013b; NRC, 1996; TEA, 2017; Vincent, 2008; WPS, 2018)

U.K. curriculum (Barrow, 2013a)

Canadian curriculum (FE, 2017; MET, 1999; Pidwirny, 2006; Steele, 2009)

National Geographic (2011)

Encyclopedia Britannica (BritannicaKids, 2020b)

Birds

U.S. curriculum (CAVOC, n.d.)

National Geographic (Natgeo, 2012)

Encyclopedia Britannica (Gill, 2020)

Smithsonian Migratory Bird Center (Deinlein, 2001)
Educational websites (clarendonlearning, 2020; Cornell, 2007; Massaudubon, 2020; Neal, 2009; SI, 2020)

Grades 5 & 6

Metamorphic, Igneous, and Sedimentary Rock
U.S. curriculum (Graham, 2015; NCDPI, 2011; NRC, 1996)
Educational websites (AL, 2016; CAS, 2014)

The Water Cycle 2
U.S. curriculum (Cey, 2017; SVSD, 2018; USOE, 2010)
Canadian curriculum (British Columbia) (BCME, 2016)
Encyclopedia Britannica (Augustyn, 2018)
NASA (2019)
National Geographic Society (2019)
NOAA (2019)

Civilisations – Eight Great Features
U.S. curriculum (NCHS, 2014b; Ormson, n.d.; YCSD, 2012)

Photosynthesis
U.S. curriculum (APSVA, 2013d; DOEVA, 2010; MDOESE, 2018)
U.K. curriculum (SAPS, 2019)
Australian curriculum (ACARA, 2016; Silvester, 2015)
Canadian curriculum (McGill, 2019)
Educational websites (Coss, 2019; Education.com, 2019; Emerson, 2019; Espinoza, 2017; NSTA, 2019; PE, 2018; Smithsonian, 2019)

Earth Structure

U.S. curriculum (Ellis, n.d.; MDE, 2018; NRC, 1996)
Australian curriculum (VSG, 2018)
National Geographic (Crooks, 2015; NatGeo, 2015; NatGeoKids, 2020b)
U.S. Geological Survey (USGS, 1999)
Earth Science Literacy Initiative (2010)
American Geosciences Institute (2020)

Earth Systems

U.S. curriculum (NRC, 1996)
Australian curriculum (VSG, 2018)
National Geographic (NatGeo, 2015)
U.S. Geological Survey (USGS, 1999)
Earth Science Literacy Initiative (2010)
American Geosciences Institute (2020)

The Tectonic Tango

U.S. curriculum (Next Generation Science Standards (NGSS), 2020b)
National Geographic (Boudreau, 2011)
NOAA (2013, 2018)
Earth Science Literacy Initiative (2010)
Educational websites (Bennett, 2018; GNSscience, 2020)

The Nitrogen Cycle

Environmental Literacy Council (2015)
Educational websites (Bear, 2016; BYJUS, 2020; CK-12F, 2020; KAcademy, 2020; Nelson, 2020b)

Tectonic Plate Boundaries

U.S. curriculum (NGSS, 2020a, 2020b; Officer, 2020)
NOAA (2013, 2018)

Biomes 2

U.S. curriculum (ESS, 2017; TSI, 2020)

U.K. curriculum (MPS, 2020; OTPS, 2020; Scoffham, 2017)

Australia curriculum (FUSE, 2020; Sydenham, 2018)

Encyclopedia Britannica (Augustyn, 2020; BritannicaKids, 2020a)

NASA (Anderson, n.d.)

National Geographic (2011)

Educational websites (biologyonline, n.d.; Dotson, 2019; ESS, 2017; Fries-Gaither, 2009; Moeller, 2013; NCEAS, 2004)

List of abbreviations used in Appendix

ACARA	Australian Curriculum, Assessment and Reporting Authority
NASA	National Aeronautics and Space Administration
NCTM	National Council of Teachers of Mathematics
NGSS	Next Generation Science Standards
NOAA	National Oceanic and Atmospheric Administration
PBS	Public Broadcasting Service
SI	Smithsonian Institution