Periodic Behavior in Music

Math-a-Musicians Open Mic Night

Created By: Ariel DeZeeuw, Keelie Kish, Sam Serio

Why PBL?

What is it?

Project Based Learning is "*a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge.*" (2)

How does it help students in the classroom?

- **Gives material authenticity** by posing a real world scenario.
- **Student Voice & Choice** is awarded to students by letting them make decisions about their own project.
- **Peer Critiques** allow for valuable feedback from peers, which they use to enhance their final product.
- **Collaboration** within groups strengthens the student's ability to work with others.
- **Engaging projects** help students maintain interest in their learning material.

Student Project Objectives

TEKS Assessed

Mathematics Models with Applications

(7) Mathematical modeling in fine arts. The student uses mathematical processes with algebra and geometry to **study** patterns and **analyze** data as it applies to fine arts. The student is expected to:

(A) use trigonometric ratios and functions available through technology to **model** periodic behavior in art and music.

English II

(3) Reading/Comprehension of Literary Text/Poetry. Students understand, **make inferences** and **draw conclusions** about the structure and elements of poetry and provide evidence from text to support their understanding. Students are expected to **analyze** the structure or prosody (e.g., meter, rhyme scheme) and graphic elements (e.g., line length, punctuation, word position) in poetry.

Cross Curricular Lesson Plans

3 Poems submitted individually in English II.
All students bring their own poems to Mathematical Models.
Each group will choose one to use for their song.

Entry Document

AMERICAN MUSIC THERAPY ASSOCIATION

Open Mic Night

Fundraising Event for American Music Therapy Association

Dear Students,

On April 2nd, White Rhino Coffee Shop will be hosting an open mic night where local artists come together to share their talents! Businesses around the community will join White Rhino to help raise money for the American Music Therapy Association, as they graciously donate 10% of the evening's profits to AMTA.

How can we, as music producers, use our knowledge of periodic behavior in music to create an instrumental piece to accompany a famous poem or song written by you and your team to be performed at the open mic night at White Rhino Coffee Shop?

Composing an instrumental piece requires knowledge of period behavior in music, consonance, and dissonance. For this five day project, you and your team must:

- Find a poem that includes:
  - Genre characteristics that are school appropriate and to be approved by the English teacher
  - One verse and a chorus
- Create an instrumental piece:
  - Instrumental piece must be at least one minute long to go along with your poem
  - Must use GarageBand to create instrumental pieces
- Math presentation (4 minutes):
  - Must use professional design standards
  - Create a visual presentation that uses DESMOS to graph frequencies that demonstrate consonance and dissonance
  - Must describe the periodic behavior of the structure of the instrumental piece and describe how it models a trigonometric function, including the specific equation
  - Present song via live performance or video

The winning song of each class period will perform their piece on April 2nd at the White Rhino Coffee Shop in Cedar Hill, TX!

(Final performance can be done with GarageBand recording or live instrument)

We look forward to hearing your musical creations!

Driving Question

How can we, as music producers, use our knowledge of **periodic behavior** in music to create an **instrumental piece** to accompany a **famous poem** to be performed at the Open Mic Night at White Rhino Coffee Shop?

Workshops & DIYs

GarageBand App Workshop: Learn the basics to creating a song in GarageBand

- *Adding instruments, chords, and changing rhythm*

Frequency App Workshop: Learn about period/frequency and how to graph sine waves

- *Frequency = 1/period, where b = 2π*frequency*
- *y = sin(bx) represents the sine function*
- *Graphing functions in DESMOS*

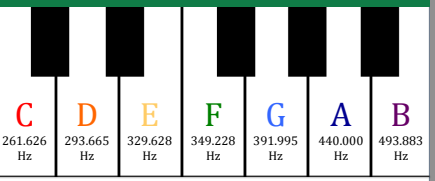
Solving Ratios Workshop: Learn how to solve for unknown variables

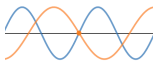
- *Cross multiplication*
- *Solving for x*

Consonance and Dissonance DIY: Learn the mathematical representation of each musical chord

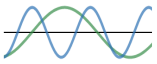
- *Consonance: Sine waves of all notes intersect at y=0*
- *Dissonance: Sine waves do not intersect at y=0*

Mathematical Content

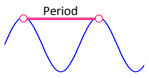




Consonance:
Harmonious chord
Sine waves of notes intersect on the *x*-axis

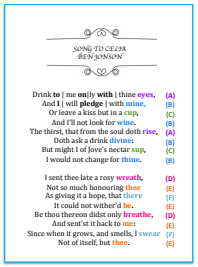


Dissonance:
Disharmonious chord
Sine waves of notes do NOT intersect on the *x*-axis



Graphing Sine Waves:
$y = \sin(bx)$
$b = 2\pi * \text{Frequency}$
$\text{Frequency} = 1/\text{Period}$

English II Product



SONG TO CELIA
BEN JONSON

Drink to | me only with | thine eyes, (A)
And I | will pledge | with mine, (B)
Or leave a kiss but in a cup, (C)
And I'll not look for wine. (B)
The thirst, that from the soul doth rise, (A)
Doth ask a drink divine: (B)
But might I of Jove's nectar sup, (C)
I would not change for thine. (B)

I sent thee late a rosy wreath, (D)
Not so much honouring thee (E)
As giving it a hope, that there (F)
It could not wither'd be. (E)
But thou thereon didst only breathe, (D)
And sent'st it back to me: (E)
Since when it grows, and smells, I swear (F)
Not of itself, but thee. (E)

Rhyme Scheme
ABCBABCB
DEFEDEFE

Meter (Odd Lines)
Iambic Tetrameter

Meter (Even Lines)
Iambic Trimeter

Rubric

1 – Initiating Initial Steps Towards Expectations	2 – Approaching Expectations	3 – Met Expectations	4 – Exceeds Expectations
Students are able to **identify** the sine function but cannot relate the sine function and periodic behavior.	Students are able to **graph** the sine function to **identify** the period of the sound wave using technology.	Students are able to **graph** the sine function to **identify** the period of the sound wave using technology. Students are able to **find** the point of intersection between two sine graphs and **determine** if they intersect on the *x*-axis.	Students are able to **graph** the sine function to **identify** the period and its relationship to the frequency of the sound wave using technology. Students are able to **find** the point of intersection between two sine graphs and **determine** if they intersect on the *x*-axis.
Students are able to **create** an instrumental piece using music software or instruments.	Students are able to **create** an instrumental piece that utilizes consonance and dissonance using music software or instruments. Students can **recite** the definition of consonance and dissonance in relation to trigonometric functions.	Students are able to **create** an instrumental piece that utilizes consonance and dissonance using music software or instruments. Students are able to **model** consonance and dissonance of a chord using the graphs using the graphs of trigonometric functions.	Students are able to **create** an instrumental piece that utilizes consonance and dissonance using music software or instruments. Students are able to **model** consonance and dissonance of a chord using the graphs using the graphs of trigonometric functions. Students are able to **elaborate** on how they utilized consonance and dissonance in their song to elicit particular emotions.

Assessment

Formative Assessments

- ☑ **Knows & Need to Knows** – Prior knowledge
- ☑ **Workshop Probing Questions** – Content understanding
- ☑ **Consonance & Dissonance Quiz** – Sine wave interpretation
- ☑ **Ratio Take Home Quiz** – Solving for variables using ratios
- ☑ **Critical Friends** – Peer feedback used to improve final products

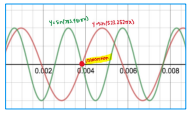
Summative Assessments

- ☑ **Social Contracts** – Group collaboration
- ☑ **Final Presentations** – Presentation skills & content knowledge based off of rubric
- ☑ **Consonance & Dissonance Graphs** – Graphing frequencies of chords & classifying them based on sine wave behavior

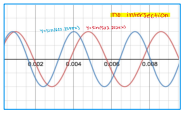
Mathematical Final Products

One-minute song with **poem lyrics**:
Grand Piano – Song to Celia *(poem by Ben Jonson)* (1)

Consonance & Dissonance Graphs:



Consonance: C & G



Dissonance: C & D#

References

(1) "Song: To Celia." *The Norton Anthology of English Literature*, by M.H Abrams, Norton, 1993.

(2) "Why Project Based Learning (PBL)?" *Why PBL?*, Buck Institute for Education, www.bie.org/about/why_pbl