LESSON/UNIT PLANNER for Arts Integration

TEACHERS: Shawna Longo (music) & Mrs. Leanne Juliano (science)	**UNIT/LESSON:** Sound Waves – Integrating Music with Science
DURATION: 5-6 classes	**GRADE LEVEL:** Middle School (grade 7)

Integration of:	**21st Century Skills:**
♦ Science ♦ Music	❖ Critical Thinking ❖ Creative Thinking ❖ Collaborating ❖ Communicating ❖ Flexibility

Content Standards:

Next Generation Science Standards:
MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

- Science and Engineering Practices – Developing and Using Models
- Disciplinary Core Ideas – PS4-A: Wave Properties
- Crosscutting Concepts – Structure and Function

Arts Standards:
Creating:

- Anchor Standard #2 – Organize and develop artistic ideas and work.
  - Music (MU:Cr2.1.7) a. Select, organize, develop and document personal musical ideas for arrangements, songs, and compositions within AB, ABA, or theme and variation forms that demonstrate unity and variety and convey expressive intent.

Performing/Presenting/Producing:

- Anchor Standard #5 – Develop and refine artistic work for presentation.
  - Music (MU:Pr5.1.7) a. Identify and apply collaboratively developed criteria (such as demonstrating correct interpretation of notation, technical skill of performer, originality, emotional impact, and interest) to rehearse, refine, and determine when the music is ready to perform.

Lesson Description:

Students will learn about sound waves through the use of a Chladni plate as a visual representation. Students will compose and perform a song by connecting the principles of sound waves (production), traditional music composition techniques, and boomwhackers.

Vertical Alignment	**Before Lesson:** Pre-teaching of sound waves concepts. Experience with musical composition and performance using Boomwhackers.	**During Lesson:** Connections made between sound wave concepts and the production of sound by instruments.	**After Lesson:** Use of new knowledge to compose a song and perform it using Boomwhackers.

Key Vocabulary:	**Arts Concepts:**	**Materials:**
Science - wave, medium, mechanical waves, vibration, longitudinal wave, wavelength, frequency, pitch, amplitude *Music* – melody, steps, skips, leaps, harmony, consonant harmony, dissonant harmony, rhythm, form, note, rest, measure	❖ Create ❖ Respond ❖ Perform/Produce/Present ❖ Connect	Computer with Internet Projector & Screen Boomwhackers Boomwhacker color-coded scale diagram Form (Pattern) Poster YouTube Videos Guitar Giant Staff and Boomwhacker Letter Circles Colored Pencils Paper Sounds Like Music Worksheet (attached) Waves Worksheet (attached) My Composition Worksheets (2 attached) Sound Waves – Integrating Music with Science Rubric (attached)

Essential Questions: (Written to show the specific integration of the subjects)

- What are amplitude, wavelength, frequency, and speed of a wave?
- What is sound?
- What determines the pitch and loudness of sound?
- What determines sound quality?
- How do musicians make creative decisions? (NCAS: Anchor Standard #2)
- How do musicians improve the quality of their performance? (NCAS: Anchor Standard #5)

Lesson Sequence:	**Assessments:**
Day 1:	**Type:** Diagnostic

• Start with a Sketchbook Challenge. Students will sketch ideas using colored pencils and a black piece of paper. Give the students the following prompt: *If we could see sound waves…* • Show the students the video explaining sound waves using a Chladni Plate, "Singing Plates – Standing Waves of Chladni Plates" https://www.youtube.com/watch?v=wYoxOJDrZzw&t=36s&list=PLv9E9uhXjhFOpb7Vj-ShRf2C-s-reQiwY&index=1 • Discuss how they were able to "see" the sound waves and the patterns that were created using the Chladni Plate (square metal plate), frequency generator, mechanical vibrator, and sand. • Show the students another video of a "Resonance Experiment" to see more examples of "seeing" sound waves. https://www.youtube.com/watch?v=1yaqUI4b974&t=23s&list=PLv9E9uhXjhFOpb7Vj-ShRf2C-s-reQiwY&index=2 • Have students touch the side of their throat and say "ahh" on a high pitch and then a low pitch. Ask students – "What do you feel?" Students should reply discussing the feeling of the vibrations compared to the pitch (they should feel more vibrations with the low pitch). Connect what they felt to the principle of sound waves. The lower the pitch, the longer the sound wave. The higher the pitch, the shorter the sound wave. • This experiment will lead into a brief review of science concepts via discussion – wavelength, frequency, pitch, and amplitude. • Transfer science vocabulary to music and review the concepts of pitch and sound production. Discuss with students: "Compare a piccolo and flute. Which is smaller? How does the size affect the sound produced by an instrument?" Answer: the smaller the instrument (or tube) the higher the pitch. Discuss how a piccolo plays one octave higher than a flute. Ask students, "Why?" Answer: the length of a piccolo is approximately ½ of the length of a flute. "What happens when we shorten the tube by 1/2?" Answer: the wavelength is also cut in half (much shorter and quicker), so the frequency of the pitch is doubled causing it to play one octave higher. Relate this concept to the Boomwhackers using high C and low C as a visual and aural example. • Distribute the project rubric and a Boomwhacker color-coded scale diagram to each pair of students. Discuss the project requirements while reviewing the music concepts of measures, form (use Form/Pattern poster), steps, skips, leaps, pitches, rhythm, notes, and rests. Make sure that students label the leap up, leap down, consonant harmony,	Assessment **Task:** Sketch to the opening prompt. **Cognitive Demand:** Create **Criteria:** Students will create a sketch that depicts a connection to their visual representation of sound waves. Teacher may also ask students to verbally explain their sketch and its' connection.

dissonant harmony, high pitch and low pitch on their composition. Have students break into groups of 4. Each group will compose, rehearse, and perform one song. • Discuss consonant vs. dissonant using the Boomwhackers to demonstrate the difference in how each sounds. Ask students, "What would the sound waves look like for two pitches which produce a consonant harmony? What about for two pitches that produce a dissonant harmony?" • Show YouTube video giving examples of "Consonant and Dissonant Music" https://www.youtube.com/watch?v=b1Ph0sa0Gc0&list=PLv9E9uhXjhFOpb7Vj-ShRf2C-s-reQiwY&index=10	
Day 2: • Introduce reading music and rehearsing by projecting a simple melody for Boomwhackers (uses color-coded pitches) using a SMART Board and/or projector. Pass out the Boomwhackers and have the class play the melody together, establishing a steady beat. • It is helpful to have students learn how to play an example of this composition project, whether you use one from a previous year or create your own example.	**Type:** Formative Assessment **Task:** Perform a melody using Boomwhackers. **Cognitive Demand:** Apply **Criteria:** Teacher will observe students successfully performing a melody using Boomwhackers. Students will read the "music" and perform their pitch(s) accurately within the correct rhythm, while keeping a steady beat.
Day 3: • Students work on their music composition projects using improvisation and composition techniques. They will have the opportunity to improvise and "try out" sounds using the Boomwhackers. The melody and harmonies will be composed using the "My Composition" worksheet and colored pencils (matching the colors of the Boomwhacker tubes).	**Type:** Formative Assessment **Task:** Self & Peer Assessments **Cognitive Demand:** Evaluate **Criteria:** Students will complete a self-assessment of their composition using the Continuum Assesssment. Students will also complete at least 2 peer assessments using the Continuum Assessment for students' compositions in other groups. See attached Formative Continuum Assessment.
Day 4: • Students will practice performing their completed compositions within their group of four. Each student in the	**Type:** Formative Assessment **Task:** Perform a melody using Boomwhackers.

group will play two Boomwhackers (pitches), covering the C Major Diatonic Scale. Make sure to reinforce steady beat and setting an appropriate tempo. Use of a metronome during practice is helpful!	**Cognitive Demand:** Apply **Criteria:** Teacher will observe students successfully performing their composition using Boomwhackers. Students will read the "music" and perform their pitch(s) accurately within the correct rhythm, while keeping a steady beat.
Day 5: • Performance of composition projects. SUGGESTION: Collect the students' compositions after class #3. Then, scan in their compositions and displayed them on the SMART Board while they perform, so that the rest of the class can see the music during each performance.	**Type:** Summative Assessment **Task:** Compose and perform a musical composition using Boomwhackers. **Cognitive Demand:** Create & Apply **Criteria:** See attached Checklist
Extension: • Have students transpose their composition using colored pencils to standard music notation (sheet attached). • Have the students create a visual art piece based on the patterns, which are created at specific frequencies using the Chladni Plate. Integrate the concept of color as well with their interpretation of the visual representation of sound wave.	

Sound Waves
Student Formative Continuum Assessment

Student Name: _____ Period: _____

HOW DO I RATE MY SKILLS ON EACH SCALE?

Directions: Place an X on each of the continuum slides where you feel it most accurately depicts your learning. Support where you placed your X by explaining your strengths or making suggestions for improvement.

Form & Structure in Music

My song is in ABA form.  My song is not in ABA form.

Leaps

My melody contains one leap up and one leap down.  My melody does not contain one leap up and one leap down.

Harmony

I have included one consonant and one dissonant harmony.  I did not include one consonant and one dissonant harmony.

Pitch/Frequency Wave

I have included and labeled one high pitch and one low pitch.  I have not included, nor labeled, one high pitch or one low pitch.

What can I improve?

REFLECTION:
How can I apply what I learned about this topic to my own experiences and/or future projects?

TYPE: Formative, TASK: Self and Peer Assessments, COGNITIVE DEMAND: Evaluate

Adapted from S. Riley, *Education Closet*

Sound Waves Checklist Assessment

TYPE: Summative Assessment, TASK: Compose & Perform, COGNITIVE DEMAND: Create & Apply

Name_____ Date_____ Period____
Partner Name_____

	COMPOSITION REQUIREMENTS	POSSIBLE POINTS	POINTS EARNED
	Create a 12 measure musical composition in ABA form for Boomwhackers.		
1.	• A Section – for measures 1-4	5	
2.	• B Section – for measures 5-8	10	
3.	• A Section – repeat (copy) measures -4 into measures 9-12	5	
4.	1 Leap Up (labeled)	10	
5.	1 Leap Down (labeled)	10	
6.	1 Consonant Harmony (labeled)	10	
7.	1 Dissonant Harmony (labeled)	10	
8.	1 High Pitch (High Frequency Wave) (labeled)	10	
9.	1 Low Pitch (Low Frequency Wave) (labeled)	10	
10.	Start on C	5	
11.	End on C	5	
	Rhythm		
12.	Include at least 1 rest in each line (white block)	10	
13.	Include at least 1 longer note in each line (More than one block colored in as 1)	10	
	PERFORMANCE (with a steady beat)	20	
	TOTAL POINTS	130	

National Core Arts Standards

1. Creating: MU:Cr2.1.7
    a. Anchor Standard #2. Organize and develop artistic ideas and work.
2. Performing/Presenting/Producing: MU:Pr5.1.7
    a. Anchor Standard #5. Develop and refine artistic work for presentation.

Next Generation Science Standards

1. MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
    a. Science and Engineering Practices- Developing and Using Models
    b. Disciplinary Core Ideas- PS4-A: Wave Properties
    c. Crosscutting Concepts- Structure and Function

Sound Waves Checklist Assessment

TYPE: Summative Assessment, TASK: Compose & Perform, COGNITIVE DEMAND: Create & Apply

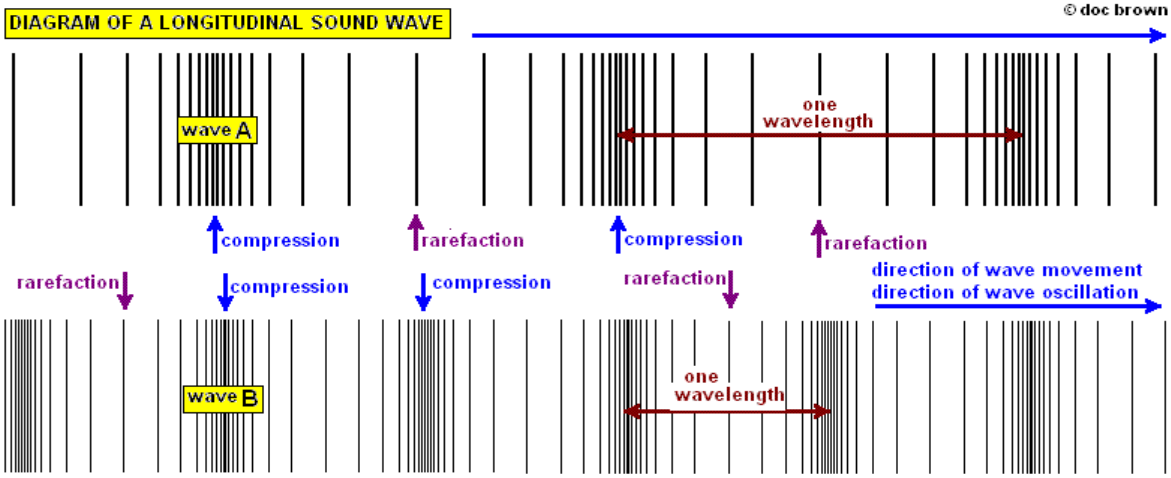
Music Vocabulary Review

1. Steps- two notes that are right next to one another (on the staff)
2. Skips- when two notes have a note in the middle of them.
3. Leaps- an interval larger than a skip, the pitches are more than 5 steps apart.
4. Harmony- two or more notes heard simultaneously.
5. Consonant Harmony- intervals are usually described as pleasant and agreeable. Notes that sound good together when played at the same time.
6. Dissonant Harmony- intervals are those that cause tension and clash. Pitches that sound harsh and unpleasant.
7. Rhythm- a sequence of sounds and silences (long and short) using notes and rests
8. Form- the overall plan or structure to a piece of music. It describes the layout of a composition as divided into sections. Labeling each section with a letter is a common way to describe the form of a piece of music.

Science Vocabulary Review

1. Wave- a disturbance that transfers energy from place to place.
2. Medium- material through which a wave travels (gases, liquids, and solids all act as mediums).
3. Mechanical Waves- waves that require a medium to travel.
4. Vibration- a repeated back-and-forth or up-and-down motion.
5. Longitudinal Wave- a wave that vibrates the medium in the same direction in which the wave travels. **Sound waves are longitudinal.**
6. Wavelength- the distance between two corresponding parts of a wave.
7. Frequency- the number of waves that pass a given point in a certain amount of time.
8. Pitch- a description of how a sound is perceived as high or low.

- The pitch of a sound you hear depends on the frequency of the sound wave.
  - Short wavelength = high frequency = high pitch
  - Long wavelength = low frequency = low pitch



Which sound wave above, A or B has a higher frequency? Explain why?