**Lesson Plan**

**COSMOS EDUCATIONAL TOOLKIT: LESSON NAME: How do we describe sound in a picture?**

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| **Grade/ Grade Band**: *11* | **Topic:** *Sound and Sinusoidal Waves* | **Lesson #** *1* **in a series of** *4***lessons** |
| **Brief Lesson Description**: *Learning about how sound waves can be expressed in terms of math. Students will explore many aspects associated with a sinusoidal waves. They will discover the basic foundation of how frequency waves move and transform.*  |
| **Specific Learning Outcomes:** *The essential elements that students will know after the lesson will be the ability to graph sinusoidal waves.* |
| **Narrative / Background Information**  |
| **Prior Student Knowledge Required:** *Having a strong background in transformation of functions which is in the Geometry and Algebra II curriculum would aid the students. Spatial understanding and visual representation of how graphs are represented is a needed tool.*  |
| **Problem Solving Practices (Ex: Standards for Mathematical Practice):** *[CCSS.MATH.CONTENT.HSF.TF.B.5](http://www.corestandards.org/Math/Content/HSF/TF/B/5/)**Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.\** | **Main Content Ideas:** *Having the students learn through inquiry and discovery the founding principles related with graphing sinusoidal waves.* | **Possible Multidisciplinary Concepts:** *Other disciplines that would use sinusoidal waves which was in consideration for this lesson were studies in engineering. ie: Pendulum, harmonic balance, and the study of tides.* |
| **Possible Preconceptions/Misconceptions:** *Students may have the preconception of a boring math lesson that requires complex calculations but instead this lesson is geared towards students learning through something most students love, music and how math is associated with it.*  |
| **LESSON PLAN – 5-E Model**  |
| **ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:** **Day 1**1. *Students will work in groups and will be given worksheet #1. Part 1 of the worksheet students will be presented with questions that will bring a group discussion.*
2. *Part 2 of the worksheet #1 takes on the graphical interpretation of different transformations of frequency waves.*
3. *Part 3 is using GNU radio companion software program that will give students the opportunity to explore and discover. (Frequency, Amplitude, wavelength …)*
4. *Students will now explore further using Desmos activity lesson. Computers will be needed.* [*https://teacher.desmos.com/activitybuilder/custom/56b3e682b884dbd81be6ed09*](https://teacher.desmos.com/activitybuilder/custom/56b3e682b884dbd81be6ed09)
5. *Homework would be given based upon the different transformation of a sinusoidal wave most likely using Deltamath.com.*

***Day 2***1. *Students might be continuing with the activity given on Desmos activity lesson.*
2. *Part 4 is worksheet #2. Students will learn about different frequencies associated with an exponential function. They will calculate and follow the questions. Class will come together to discuss at the end.*
3. *Students will then be given a worksheet to start in class and finish for homework.*

***Day 3***1. *Part 5 students would match their voice with the different frequencies. A microphone will be attached to the computer along with a visual representation would aid this part. Students will take notes about the changes and to determine the domain of their frequencies both for male and female.*
2. *Part 6 students will analyze a piece of music. They will take a 20 second clip to determine frequency, amplitude, period and take a screenshot and find the equation that describes it.*
3. *Part 7 students will make their own 20 second music clips based upon using multiple frequencies.*

***Day 4***1. *This last day has different closure options.*

*1st option: To give the students a quiz/quest covering all of the basic concepts for a sinusoidal wave.**2nd option:* Cymatic - Making visual sound waves with change in frequency. Students can explore on their own or in groups.[Experiment #1](https://youtu.be/wvJAgrUBF4w) .[Experiment #2](https://youtu.be/Q3oItpVa9fs)3rd option: Students will connect a picture with there sound. Either a sentence or just a word then to print it out and be artistic. [Example #1](https://youtu.be/S-EyV-B6kWo) [Example #2](https://youtu.be/MtJIEALrgKQ) |
| **EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:** * *Possible Transmission devices: Computer program and COSMOS equipment.*
* *Other equipment may be used.*
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| **EXPLAIN: Concepts Explained and Vocabulary Defined:** *Students in my classes are situated in groups on a daily basis. Students will engage in conversation to answer the questions in all parts 1 - 7. At the end of the lesson the students will share their conclusion statement with the teacher.* **Key Vocabulary:** *Frequency, period, amplitude, midline, phase shift, intervals, wavelength, BPM.* |
| **ELABORATE: Applications and Extensions:** *An extension would venture into some of the other examples that were shared above in the multidisciplinary concept section.* |
| **EVALUATE:** **Formative Monitoring (Questioning / Discussion):** **Summative Assessment (Quiz / Project / Report):**  |
| **Elaborate Further / Reflect: Enrichment:**  |