

5E Arts Integration STEM Lesson

Topic

Trigonometry

Grade Level

11th/12th Grade

Time

5 days

Standards

Ohio Common Core Math Standards

HSF.TF.B.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*

HSF-IF.C.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

HSF-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Next Generation Science Standards

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

National Art Core Standards

MU:Cr1.1.H.IIIa Generate melodic, rhythmic, and harmonic ideas for a collection of compositions (representing a variety of forms and styles), improvisations in several different styles, and stylistically appropriate harmonizations for given melodies.

MU:Cr3.2.H.IIIa Perform final versions of a collection of compositions (representing a variety of forms and styles), improvisations in several different styles, and stylistically appropriate harmonizations for given melodies, demonstrating technical skill in applying principles of composition/improvisation and originality in developing and organizing musical ideas.

MU:Cr1.1.T.IIIa Generate melodic, rhythmic, and harmonic ideas for compositions and improvisations that incorporate digital tools, resources, and systems.

Art Integration

The students will be utilizing glass bottles and water to create different pitches of notes. They will make the connection between the graph of the Sine function and how sound waves work. Each group will create a different pitch so that the end result is the class playing a song all together.

Justification

Sound is created by patterns of higher pressure, or compressions, and rarefactions, or lower pressure areas moving through the air. As these patterns form, they produce noise or notes. Specific notes, such as a C note form by a very specific pattern. In this activity, the students will use their knowledge of how amplitude, period, and phase shifts change the pitch of the water in the bottle.

Measurable Objectives

Students will be able to:

- Describe what happens to the pitch as amplitude changes
- Describe what happens to the pitch as the frequency changes
- Adjust properties of sound waves to reach desired pitch
- Use the TI-Nspire adequately to come to the above conclusions

Lesson Procedure

Engage	Have students engage in a familiar experience of blowing into bottles with different amounts of water in them to create sounds. We have all done this at some point of our lives and will get them engaged on how this could possibly relate to trigonometry.
Explore	Students will work in groups to investigate what happens as you change the amplitude and frequency of sound waves. They will do this using TI-Nspires. (#1-7 on worksheet below)
Explain	Students will draw conclusions about the transformations of a trigonometric graph and the effect it has on the sound waves. (#1-7 on worksheet uploaded)
Elaborate	At this point of the lesson, students will use their conclusions from above to create a specific note. They will then play a song as a class. (#8 on worksheet uploaded)
Evaluate	Students will work as a group to make a final presentation regarding the sound waves and how they can be changed using their knowledge of trigonometric functions.

Assessment:

The project and the class song will be the assessments for this. I will be checking to see if students are able to accurately describe the changes each transformation has on the sound waves. They can work as a group to express these findings in the method of their choice.

Lesson Materials:

- TI-Nspire calculators
- TI-Nspire Lab Cradles
- Vernier Microphones
- Glass bottles
- Water
- Worksheet to guide students