Engineering Design Challenge Lesson Template 4_5_18

Standards Addressed (NGSS, Math, ELA, DLCS):
1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. • 1-PS4-4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* • Disciplinary Core Ideas o PS4.A: Wave properties § Sound can make matter vibrate, and vibrating matter can make sound. PS4.C: Information Technologies and instrumentation- People also use a variety of devices to communicate over long distances.

Science and Engineering Practice: Planning and Carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. MATH : 1.MDA.4 Organize, represent, and interpret data up to three categories; ask and answer questions

Scientific Concepts/Vocabulary:

Term	As defined by a Sc or Eng	As defined by a student in your grade.
Vibration	a rapid back-and-forth movement	a shaky movement
Pitch	the quality of a sound governed by the rate of vibrations producing it; the degree of highness or lowness of a tone	High sounds or low sounds
Communication	he act or process of using words, sounds, signs, or behaviors to express or exchange information or to express your ideas,	Talking with someone

	thoughts, feelings, etc., to someone else. : a message that is given to someone	
Frequency	The number of crests of a wave that move past a given point in a given unit of time. The most common unit of frequency is the hertz (**Hz**), corresponding to one crest per second. The frequency of a wave can be calculated by dividing the speed of the wave by the wavelength	The number of times something happens.

Equipment needed: (Post what you can't get on your own on the course materials sheet).

box Scissors, different sized cardboard boxes, Rubber bands Construction paper Markers
oard tube Glue Drinking glass Pencil Optional: glitter, acrylic gems, stickers, colored duct tape

Safety: We will pre cut the holes in the boxes.

Describe the engineering design challenge in general. What are the key points, things you need to know about set up etc.

When a guitar string is plucked, it begins to vibrate up and down. These vibrations cause the air molecules surrounding the string to be pushed together and pulled apart rhythmically, producing high- and low-pressure waves of sound. If you pluck a guitar string that is stretched between two chairs, the sound that is produced will not be very loud. However, when the string is attached to

the sound box of the guitar, its vibrations cause the sound box to vibrate at the same natural frequency. The sound box in turn causes the air molecules inside the box to vibrate, also at the same frequency. Thus, the string, guitar, and enclosed air molecules are all vibrating at the same natural frequency and are all causing surrounding air molecules to vibrate at this frequency. This phenomenon, called resonance, results in an increase in the amplitude and thus the loudness of the sound. It is important to use different types of materials and different sizes to create the guitars. Sounds can be changed by using different lengths and widths of strings, changing the size and shape of the bridge, using different materials, or altering the way the instrument is played (plucking vs. strumming).Sounds can be amplified and pitch can be changed with different playing techniques which produce different vibrations.

Describe the Scenario: What is the guiding question? What is the who, what, when, where? Make it fun and meaningful for your students.

Use the example of the rubber band guitar to explain how we hear sounds.
What starts the rubber band vibrating?
Why do you think making the rubber band tighter changes the pitch?
Does the size of the box make any difference? If so, what is its effect?
How does changing the size of the rubber band change the sound produced from the same box?

This is the order in which you will teach your lesson. Fill in your specific information below as you expect the students to respond. Make notes in your own words for each section so that it will be easy for you to follow as you teach. You are welcome to add in specific questions to your EDC. These questions below are to help you keep true to the process engineers follow.

Define the Problem:

1. Who is the client? What does the client need? Why does she or he need it? Who are the end-users?

The client is the band called Vibration Station because they have a concert coming up, but the lead guitarist smashed his guitar on the stage last week. Their concert is only 1 day away and they do not have the money to buy a new guitar.

2. Why is the problem important to solve? What are the criteria (requirements) of the solution? What are the constraints (limits)?

The band does not have enough money to buy a new guitar before their next concert, so they need to make one out of the materials that they can find. The guitar needs to be at least a foot long, with 5 strings and it must make vibrations in order to produce sound. He only has 30 minutes before he leaves for the tour.

3. Problem scoping: WHO needs WHAT because WHY

The lead guitarist of Vibration Station needs a homemade guitar that produces vibrations and sounds because she smashed his guitar on the stage at the last concert they had.

Learn about the Problem:

1. What kind of background knowledge is needed to solve the problem? What science/mathematics knowledge will be needed? What materials will be needed?

What we call music is sound vibrations that are controlled by the physical characteristics of an instrument. Music is created by manipulating the sound waves that instruments produce.

2. What has already been done to solve the problem? What products fill a similar need?

Other string instruments with great acoustics have been created.

3. How should we measure improvement?

We should measure improvement by the students identifying which materials will produce the best sound and what type of sound each band will create.

Plan a Solution:

1. Continue to specify the criteria and constraints

Students need to create a guitar by using and choosing different materials in order to create the best sound.

2. Idea generation - *have students brainstorm on paper. Younger students can brainstorm with you.*

Different size boxes create different sounds and also the size and width of the rubber bands makes a difference in the pitch and the vibrations.

3. Develop multiple possible solution paths

Each student brainstorms their own guitar. Students can choose different types of boxes for the base of the guitar and also different sizes of rubber bands.

4. Consider trade-offs and relative constraints

The students look at all the materials they have for options and figure which would work best for the requirements

5. Choose a solution to try

The students compare their sketches with each other and discuss what they think will work the best and why.

6. Develop plans (blueprints, schematics, cost sheets, storyboards, notebook pages)

Finalize which materials they will use, how much material they need, who will do what. This will all be marked down and sketched out on computer paper.

Try a Solution:

1. Put the plan into action
2. Consider risk and how to optimize work
3. Use criteria, constraints, and trade-offs from problem/plan to build a prototype (a testable representation of a solution), model, or product

Test a Solution:

1. Consider testable questions or hypotheses

- Would a change in materials change the sound produced?
- Would there be a change in the vibrations if there were more or less strings?
- Do you think this would be loud enough to be heard at a concert? How far away can it be heard?
- Ask the students what their hypotheses

2. Develop experiments or rubrics to know if the solution is meeting the state criteria, constraints, and needs

http://rubistar.4teachers.org/index.php?screen=CustomizeTemplateDownloadFile&

3. Collect and analyze data

- We will analyze the product, how well it worked and the materials used. It will be written down.

Decide Whether Solution is Good Enough: **(these questions will be asked on the day of, after the product is complete)**

1. Are users able to use the design to help with the problem?
2. Does your design meet the criteria and stay within the constraints?
3. How could your design be improved based on your test results and feedback from client/user?
4. Iterative nature of design: Consider always which step should be next!

Communication & Teamwork: *Here is the test!*

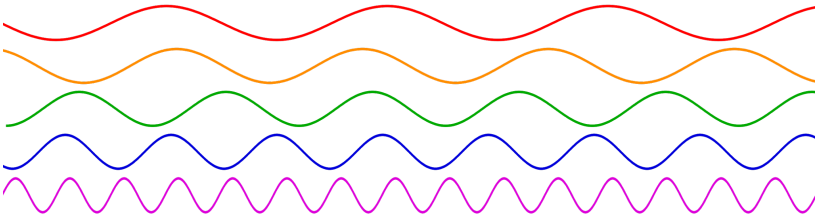
1. Good oral and written communication and teamwork are needed throughout the entire design process.
- We will be there to make sure the students are working equally together and being respectful of each other. We will be there to guide them if they are struggling or getting off track, but we are going to sit back and let the girls to it on their own.

2. The client should be able to create/follow the solution without ever speaking to you. Include claims and use evidence to support what you believe is true about your solution so that the client knows why they should use it.
- Once we have a final solution Kylie and I will test it and give our honest opinions. See where there could be improvement and what they did well on, as if we were the client.
- Students can go back and make changes to improve their final product.

April 2018 1st Grade

What is Your Student Learning In Science Class?

Ms. White and Ms. Bell



Dear Families,

Currently in science, your students has learned all about sound! Students are learning where sound comes from, what and how sound travels over distances, all about how pitch is made and especially sound vibrations! To do this we will be investigating different forms of communication (traveling over a distance) and observing how sound vibrates and creates different pitches. Students will be taking the role of an engineer to build their own guitar using a variety of materials. To further the students understanding, we ask students to continue their investigation at home by exploring loud sounds inside and outside and explore what happens to the waves!

These are a few of our new vocabulary words.

-Pitch - - Vibration - Communication-Frequency

Here are a few fun ways you can help me at home.

- We can put out different sized cooking pans and use spoons to tap on them to hear different sounds.

- We can use a few of the same size drinking glasses and fill them with different amounts of water. Then we lightly tap on them and listen to the different sounds they make.

. There are also a couple of good books that we can get from the library:

- ZIN! ZIN! ZIN! : A violin
- My 5 Senses by Aliki