LAUSD Elementary Engineering

LET'S MAKE A KAZOO CHALLENGE

First Grade – Physical Science

PURPOSE

IN <u>LET'S MAKE A KAZOO</u>, STUDENTS WILL:

- Design and build a kazoo that will sound like a real kazoo using the Engineering Design Process (EDP)
- Exhibit understanding of relevant science content/concepts
- Construct relevant questions
- Use appropriate tools and materials to complete the task
- Determine effectiveness of their design
- Answer the Focus Question: <u>Can you construct a kazoo that mimics the sound you hear from your demonstration kazoo?</u>

Next Generation Science Standards (NGSS)

Students who demonstrate understanding can:

K-2-ETS1-1. **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**

K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.
- Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2-ETS1-1)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems
- A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

ETS1.B: Developing Possible Solutions
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)

ETS1.C: Optimizing the Design Solution
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)

Crosscutting Concepts

Structure and Function
- The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

Articulation of DCIs across grade-levels:
3-5.ETS1.A (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.B** (K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.C** (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3)

Common Core State Standards Connections:

ELA/Literacy —

RI.2.1 Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (K-2-ETS1-1)
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-1),(K-2-ETS1-3)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),*(K-2-ETS1-3)*
SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(K-2-ETS1-2)*

Mathematics —

MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.4 Model with mathematics. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-1),(K-2-ETS1-3)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1),(K-2-ETS1-3)

Students who demonstrate understanding can:

1-PS4-1. **Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations 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. • Plan and conduct investigations collaboratively to produce evidence to answer a question. --- ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Science investigations begin with a question. • Scientists use different ways to study the world.	**PS4.A: Wave Properties** • Sound can make matter vibrate, and vibrating matter can make sound.	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels:

4.ETS1.A

Common Core State Standards Connections:

ELA/Literacy —

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1)

SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. *(1-PS4-1)*

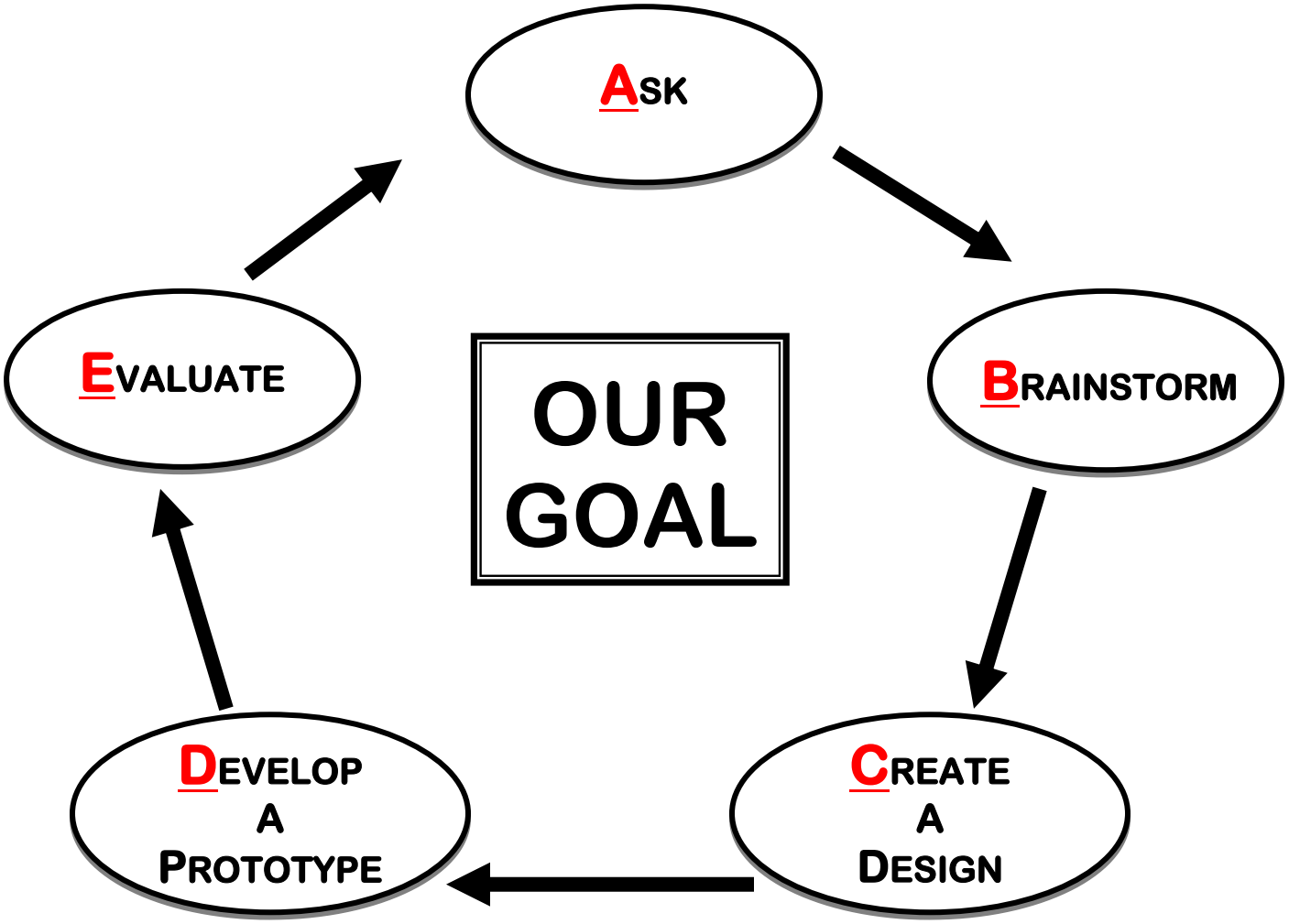
CA ENGLISH LANGUAGE DEVELOPMENT CONNECTIONS

- **ELD.P1.K.A.1**: Exchanging information and ideas with others through oral collaborative conversations on a range of social and academic topics
- **P1.K.A.3:** Offering and supporting opinions and negotiating with others in communicative exchanges.
- **P1.K.C.9:** Expressing information and ideas in formal oral presentations on academic topics.
- **P1.K.C.11:** Supporting own opinions and evaluating others' opinions in speaking and writing.

SPECIAL EDUCATION (SPED):

To make accommodations or modifications for students with special needs, provide simple directions, instructions, provide multiple opportunities for repetition, make frequent checks for understanding, use visuals to accompany all vocabulary, simplify questions, be specific with sequence and steps, provide opportunity for paraphrasing, and adjust time and pacing.

THE ENGINEERING DESIGN PROCESS (EDP)



ENGINEERING DESIGN PROCESS (EDP)

ASK

- What is the **problem** or **need**?
- What is already out there?
- What are the **requirements (criteria)** and **restrictions (constraints)**?

BRAINSTORM

- What are possible **solutions**?
- Choose your two best solutions.

CREATE - A - DESIGN

- **Draw** a diagram with labels.
- Have a critical design review (peer review & input).
- What materials are available?

DEVELOP - A - PROTOTYPE

- Follow your best diagram and **build** a Prototype.
- **Test** the prototype!

EVALUATE

- **Improve** your prototype!
- Conduct more compatibility tests.

BACKGROUND FOR THE TEACHER

- **Vibration** is a rapid **back-and-forth motion**. Matter that **vibrates** between about 25 and 20,000 times per second creates pressure pulses in the air that stimulate receptors in our **ears**. The receptors send messages to the brain, and we **hear sound**. Sounds come from a variety of **sound sources**: people; musical instruments that we **pluck**, tap, or blow through; machines; and nature. Whatever the sound, we can be certain that it was caused by vibrating matter. All sounds, from a **tuning fork**, to a squeaky wagon wheel, to the wind in the willows, are caused by vibrations. Energy is present where there is sound. Sound travels through air, solid and liquid. When the sound wave hits the membrane of the kazoo, the membrane vibrates, move back and forth to produce sound.
- Wind instruments, such as flutes, clarinets, and trumpets, produce vibrations when air blows over (not into) a hole in the instrument, just like blowing over the mouth of an empty pop bottle to produce a deep sound like a boat whistle. Woodwinds use thin, resilient wisps of cane, called reeds, to produce complex vibrations. The column of vibrating air inside the instrument is modified by opening and closing holes to increase or decrease the rate of vibration, resulting in higher and lower pitches.
- The environment is filled with natural and human-made sounds. Some sounds are made intentionally, others accidentally. Regardless of where they come from, many of these sounds convey messages in a code that we have learned to interpret as **information**.
- A ring tone sends us reaching for the phone; not any tone, but the particular tone that we've learned to recognize as the one signaling a call to our phone. Similarly, the sound made by a glass of milk falling to the floor signals a mess, and the sound of a siren alerts us to an emergency vehicle in the vicinity. In each case, we can discriminate a sound in our environment and **identify** it as being different from all other sounds. Some sounds are **loud**, other sound are **soft**.
  We **observe** and **compare** sounds and make judgments about them based on by their **properties**.

- Sounds that are loud or that sound for a long time are usually easy to identify. Sounds that we hear on a regular basis are easy to identify. Through experience, we have learned to match sounds to ideas and events: a dog barking, the sound of a saw cutting wood, and the sound of the school bell ringing. We've learned to discriminate the sound "ahh" that we associate with the letter A, "buh" that we associate with the letter B, and so forth, to develop an elaborate auditory code. We can unconsciously form those sounds into words, equate those words with concepts, and derive meaning from sequences of these symbolic concepts. This sequence of one-to-one correspondences is the exquisite human accomplishment called language.

MATERIALS

FOR EACH TEAM

- Cardboard tube
- 6x6" Waxed paper
- 6x6" Aluminum foil
- 6x6" Construction Paper
- Coffee Filter
- Rubber band
- Demonstration Kazoo
- Notebook

FOR THE LESSON

- Individual Student Engineering Notebooks

GETTING READY

1. Schedule The Investigation

- The lesson will take about 45 minutes.

2. Gather/Obtain Materials

3. Prepare Vocabulary Chart

- Aluminum Foil
- Back and Forth
- Wax Paper
- Cardboard Tube
- Coffee Filter
- Construction Paper
- Hum
- Kazoo
- Movement
- Rubber Band
- Sound
- Vibrate

4. Print Focus Question

- Have Focus Questions printed on self-stick labels for each student – "Can you construct a kazoo that mimics the sound you hear from your demonstration kazoo?"

5. Safety Warning

Please do not share tube and kazoo with others.

GUIDING THE ACTIVITY

Students will engage in the Engineering Design Process (EDP)

1. ASK

Setting The Context

- Tell students that the Disney Concert Hall is looking for 1st grade kazoo players. The winners will get to bring their family, grandparents, and friends to see them play for a special night of music.

Present Engineering Problem or Need

- Write the Focus Question

  Can you construct a kazoo that mimics the sound you hear from your demonstration kazoo?

Present Requirements and Restrictions

- **Requirements** (Criteria)
  - The designed kazoo must sound like the original kazoo

- **Restrictions** (Constraints)
  - Use only supplied materials

Hum Into The Large End Of The Demonstration Kazoo

- Listen to the sound.
  What type of sound does it make?
  What part of the kazoo does the sound come from?
  What is coming from the other end of the kazoo?

- Write your responses in your notebook.

2. BRAINSTORM

Brainstorm Solutions

- List possible solutions to the problem or need (See Focus Question). Record in your science notebooks.

3. CREATE - A - DESIGN

- Observe the materials and parts of the demonstration kazoo.
- Observe the properties of the materials / membranes- (wax paper, coffee filter, aluminum foil and construction paper).
- List properties of materials/membranes in science notebook.
- In your science notebook, draw a diagram of your kazoo and label the parts of your diagram.

4. DEVELOP - A - PROTOTYPE

- Choose the materials for your kazoo and build it!
- Test your kazoo!
- In your science notebook, describe the sound of your kazoo and list the materials you used.

5. EVALUATE

- Improve and keep testing your model kazoo and make changes to your prototype until it sounds like the demonstration kazoo.

Reflection / Wrap Up

- In your notebook respond to the following:
- Which material / membrane closely mimicked the sound of the demonstration kazoo?
- Why did this membrane work best?
- What other materials and or tool could you use to improve the sound of your kazoo?

Name: Date:

Mimicking Sound

Which material will best mimic the sound of your kazoo? Why?

Have students observe and feel materials and list their properties on the chart.

Materials	Properties
Construction paper	
Aluminum foil	
Waxed paper	
Coffee filter	

I predict the best material / membrane to mimic the kazoo

is_____because_____

_____.