Project ASSESS (2016-18) – sponsored by
KY Dept. of Education (KDE) MSP Program

NOTE: All materials are those of the project team and do not represent KDE endorsement.

UNIVERSITY OF LOUISVILLE
CENTER FOR RESEARCH IN MATHEMATICS & SCIENCE TEACHER DEVELOPMENT

PIMSER
Partnership Institute for Math & Science Education Reform

Classroom Embedded Assessment [CEA] Title: Bells Are Ringing

a. Targeted Performance Expectation(s)

Working towards: **07-PS4-2**

Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions. Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.

b. Learning Goal(s)

1. Use and/or revise a model to describe how the material of an object behaves when it is producing sound after impact.

2. Extend the model to include the moving of the sound wave across a room (initial ideas only)

c. Instructional Context

This CEA comes early in the unit (www.nextgenstorylines.org How can we hear sounds from across the room?) and is not part of the materials included in the open access storyline. Students have explored a record being played on a turntable by a pin attached to a paper cone, examined records up close, and watched videos of records playing in slow-motion. Next, students explored a variety of instruments to see if the materials they were composed of behaved in a similar manner as the record player. Students explored a guitar, a drum, and a xylophone as well as watched slow-motion videos of them being played. Then, students explored tuning forks and developed a model to describe how the tuning fork moved after being struck with a small, rubber mallet. They also watched a slow-motion video of a tuning fork. Small groups developed the tuning fork model, and then the class used those to develop a consensus model. This CEA is designed to elicit individual understanding of the behavior of the material producing the sound.

d. Student Task/Prompt – *see end of document for exact copy of handouts distributed to students*

- ***See Student Task Sheets at end for the text of this story.***

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e. Success Criteria

Exemplary student response:

Features Correctly Represented in Model of Bell making Sound	**Ideas for travel to the ear: will vary.**
□ starting shape/position described □ unbalanced force causes change in motion □ energy transferred from clapper to body of the bell and takes form of sound, heat, motion □ indicates shape changes of the body/clapper as a result of contact □ sound/vibration indicated □ labels	Student have not yet studied sound waves in this manner, so not expected to have fully-formed ideas for the wave travel to the ear. The intent is to elicit initial thinking at this point. Eventually want to get them to the point of conceptualizing a pressure wave of air molecules vibrating and moving through the air to the ear.

f. Next Instructional Steps

For students who use the class model as part of their model-based explanation but don't relate the behavior of the bell's material to that of the other instruments: provide small squares of various metals (aluminum, copper, steel, brass) and nonmetals (plastic, cardboard, cheese slice) to test flexibility and response to being struck; record videos of the metals before, during, and after being struck to examine their behavior in slow motion. Compare the videos to the tuning fork model, helping students to note similarities and differences. Have students verbalize, then draw, on the consensus model, their thinking.

For students who revise the class model as part of their model-based explanation but their ideas are incomplete or incorrect: use same experience as above, and have students use their model to account for the observations, helping them to adjust/revise their thinking based on additional observations.

For students who understand the phenomenon and have supported their thinking with evidence from observations: challenge them to develop further evidence that would support a generalization about what causes sound (vibrations). As needed, ask them to consider what (beyond slow motion replay) might help provide evidence (they could use hand or another object nearby to touch it and feel vibrations; could put small amount of sand on an index card and touch index card to the bell so see the sand respond to vibrations.) As

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time permits, could extend the challenge to ask them to predict vibration patterns of large bells vs. small [large 'vibrate slower' because more mass to move around – etc.] or vibration patterns of hard substances (metals, rock) vs. soft (Styrofoam, pillow) [which foreshadows upcoming ideas of frequency and relationship with sound pitch, or how different materials transmit waves differently]

g. Student Work Samples

None available.

h. Reflection and Revision

None available.

NOTE: Student handout pages begin on next page

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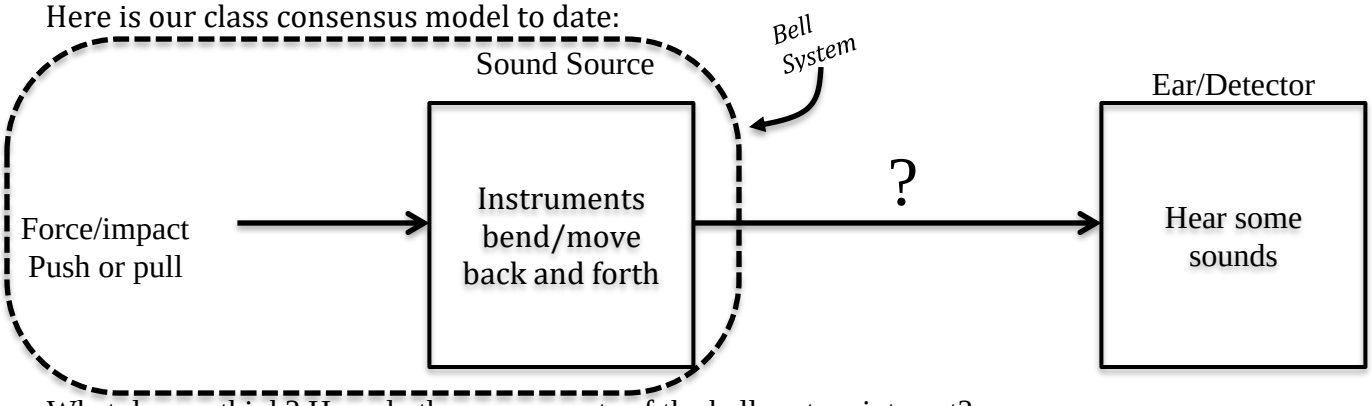
Bells are ringing?

As a class, we have developed a consensus model that we felt accounted for the sound transfer from our homemade record player, several instruments (guitar, drum, xylophone), and tuning forks. However, several of your classmates do not think that the model applies to everything that makes sound. In particular, they are using the phenomenon of a bell ringing to argue for revising our class model.

Here is our class consensus model to date:



What do you think? How do the components of the bell system interact? [components are: (a) impact creator, (b) bell]. Explain below how these components interact for a bell to make a sound.

If you think our class consensus model accounts for a bell making sound, use the model to support your explanation (*write in the box below*).

- OR -

If you think our class consensus model does **not** account for a bell making sound, revise the model to support your explanation (*write in box below*).

Now add 1 more aspect to your model – how does the sound get from the bell to your ear? (the question mark in the model above) Write or draw (*in box below or on back*) at least one idea you have, and explain why you think that might work. We will explore this part of the model next…

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