



## Lesson Plans: Science of Sound and Musical Instruments

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### OVERVIEW

It is likely that band students were introduced to acoustics and the science of sound in science classes. These short lessons will provide an opportunity to connect learning from one discipline to another through the work they do in the band room. *Rhythm Stand* by Jennifer Higdon provides an entry point for these connections through her use of everyday objects as “found sound” instruments in the piece. In *Rhythm Stand* every musician is a percussionist in addition to their other “job.” This unique orchestration will pique students’ curiosity about various acoustical concepts in both their regular instruments and, beyond that, in other objects that can be used as instruments.

Consider connecting with your school’s science faculty members to collaborate on these lessons.

The three lessons include:

- Lesson One: Probing for Prior Knowledge and Summarizing Sound Concepts
- Lesson Two: The Science of Band Instruments: An Informal Inquiry
- Lesson Three: Connect with *Rhythm Stand*

# Lesson One: Probing for Prior Knowledge and Summarizing Sound Concepts

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In order to set the stage for discussing the properties of their own band instrument, students will first review what they already know about the Science of Sound. Consider assigning the first lesson as homework in order to prepare students for discussions in the second lesson.

## LEARNING GOAL

Students will organize, review, and summarize prior knowledge about the Science of Sound by recalling concepts learned in other classes and looking at available resource. They will demonstrate what they know by completing the *BIG Ideas in Science and Sound* organizer.

## MATERIALS

- Copies of the student organizer, [BIG Ideas in the Science of Sound](#)
- Web resources and texts found by students
- [Reading](#) (optional)

## PROCESS

What do students already know about the science of sound? What do they recall from past science and music classes? What academic language and concepts do they carry into band? What are the big ideas associated with those terms?

1. Connect this homework assignment to *Rhythm Stand* using an introduction focused on the key questions. For example:

*Jennifer Higdon, the composer of "Rhythm Stand," wrote the piece with some interesting sounds through the use of simple objects – the pencil and the music stand. What makes those simple objects sound musical? What makes any sound musical or not musical?*

2. Tell students that they will explore these questions by beginning with what they already know about music and sound. Distribute the Student Organizer. Ask this question:

*"What do you know now about the Science of Sound?  
What do you know about the Big Ideas listed on this page?"*

- Give students the "due by" date.
  - Encourage sharing details of the "found and created" definitions and examples with another pair of students.
3. On or shortly after the due date, conduct a class discussion where students respond to what they know and are able to provide examples. The definitions are important but their examples will provide even more information.
  4. Post definitions on a Science of Sound concept wall in the band room. It will serve as a resource as the terms/concepts are used for other lessons.
  5. Post the student readings included with these lessons on the Band Website. Ask students to read them before a specific date.

## Lesson Two:

# The Science of Band Instruments: An Informal Inquiry

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Students may or may not know a lot about their own instruments, but they know even less about the other instruments. In this lesson, they will answer five specific questions about what they play, then learn from a peer about a contrasting instrument. They will in turn share their findings/opinions with another pair of students.

Consider connecting with your school's science faculty to collaborate on these lessons.

### LEARNING GOAL

In pairs, students will examine the instrument they play and conduct an informal inquiry into five questions related to how the instrument works. Evidence of learning will be summarized in a student organizer.

### MATERIALS

- Student instruments
- Student Organizer [\*Examining Your Instrument through a Scientific Lens\*](#)
- [Reading](#) (optional)

### PROCESS

Some musical instruments are amazing inventions and others are elegantly simple but effective devices for making music. In this lesson students will apply ideas from Lesson One in order to examine the materials and engineering of their own band instrument.

1. Pair students in partners with dissimilar instruments. They will collaboratively inspect both instruments and answer questions about each, entering responses on the Student Organizer. It is intended that they help each other. Here are the question from the organizer.
  - From what materials is this instrument made? (list all the materials you note; guesses are okay)
  - What vibrates to produce the sound waves that lead to sound?
  - What causes vibrations to begin?
  - What causes a change in volume?
  - What causes a change in pitch?
  - How would you describe the timbre of this instrument?

Their answers can include text and diagrams.

2. After completing their explorations, ask each pair to join another pair with different instruments and teach each other what they learned in response to the questions.
3. Post the completed organizers on the band room wall and encourage students to read other student responses to learn more about how individual instruments work.

### ASSESSMENT

Collect the organizers as evidence of student understanding of basic principles of science and sound. Informally assess student responses to the questions and the discussion for use of key scientific and acoustical terms applied to their instruments and those of other students.

## Lesson Three: Connect with *Rhythm Stand*

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In *Rhythm Stand*, Jennifer Higdon uses traditional band instruments, plus **found sounds** to express her musical ideas. When pencils and music stands become percussion instruments, it opens the door for further exploration of other sounds that students find interesting. Students will draw upon the concepts and terms from the prior lessons to explain the differences in sound in this lesson's activities.

### LEARNING GOAL

Students will use basic vocabulary from the Science of Sound to answer questions about new found sound sources in their classroom – sounds that can be used to review and rehearse passages from *Rhythm Stand*.

### MATERIALS

- Pencils (one per student)
- Music stands
- Metal spoon, ball point pens, metal bolts, or other object to use as strikers (one per student)

### PROCESS

Select a passage from the piece for pencils and stands that all students can play before using this lesson.

1. Ask student to play the passage as written, using pencils and their music stands and following the composer's directions as to where to play on the music stand. Then ask and discuss the same questions from Lesson Two that they applied to their personal band instruments.
  - From what materials is this instrument made?
  - What vibrates to produce the sound waves?
  - What causes vibrations to begin?
  - What causes a change in volume?
  - What causes a change in pitch?
  - How would you describe the timbre of this instrument?
2. Repeat the excerpt, but ask students first to decide on a new place on the music stand (other than the rod and the desk) to play. For example, the base of the stand, a low spot on the rod, and the back of the desk. Ask students to describe the changes in timbre, dynamics, pitch, etc. as they experiment with various places on the stand.
3. Take a step further and explore other nearby sound sources in the band room. Still using their pencils, try out these new sound sources as a group ensemble once they are named. Chair legs, the back of the chairs in front of them, their back packs, shoes, laps, the floor, etc. will all produce a difference in sound because they are made of different materials. Each new sound will have the greatest impact if you quiet students down, then perform the passage several times, moving from one sound source to another.
4. If you are feeling adventuresome, invite students to walk around the room and experiment with other sounds sources (podium, file cabinet, wooden door frame, wall, rim of a tuba, etc.)
5. Pose a question: What happens when you trade the pencil for something else? Try with a plastic pens, metal spoon, metal bolts, etc. Each time, challenge them to draw in the vocabulary of the science of sound as they respond to the sounds.

Links to 'Create' lessons: [Found Sound Imitation Project](#) and [Found Sound Recording Project](#)

### ASSESSMENT

Informally assess student responses to the questions and the discussion for use of key scientific and acoustical terms applied to the found sound sources.

## EXTENDING THE LESSON

Connect the concepts and vocabulary used in these lesson to discuss and evaluation projects in the Found Sound Composition/Create Music lessons.

### Resources

- <http://exploresound.org/terms-definitions/?level=Basic> has definitions for key vocabulary
- Yale New Haven Teacher site has a good introduction and simple lesson plans specific to the science of sound and music:  
<http://www.yale.edu/ynhti/curriculum/units/2000/5/00.05.05.x.html>
- Newsletter from Science Buddies devoted to the science of music.  
[http://www.sciencebuddies.org/science-fair-projects/ScienceBuddies\\_Newsletter\\_2010-05\\_PI.pdf](http://www.sciencebuddies.org/science-fair-projects/ScienceBuddies_Newsletter_2010-05_PI.pdf).  
Science Buddies website has many science/music/acoustics science projects for students and teachers to investigate.