

Do You Hear What I Hear?

Topic(s)
<ul style="list-style-type: none">• Sound

Grade Level
4 th -5 th grade

Time Required
1.5 hours, minimum (can be split in to 1 half hour session and 1 hour session)

Measureable, Process-Oriented Objective(s)
<ul style="list-style-type: none">• Students will observe different pitches using the sound tubes (or water glasses).• Students will formulate a hypothesis about the conditions needed to change the pitch of the drinking straw instrument.• Students will formulate a hypothesis about the conditions needed to change the pitch of a milk carton guitar.• Students will formulate a hypothesis about the conditions needed to change the loudness of the instruments.• Students will experiment with drinking straws to determine how to change the pitch of a wind instrument.• Students will experiment with rubber bands to determine how to make different pitches on a guitar.• Students will communicate with each other while experimenting to test different ideas on how to change the pitch of the instruments.• Students will draw conclusions about how to change the pitch of different instruments.• Students will communicate in writing how to change the pitch and the loudness of the instruments.• Students will infer how a piano (or trombone or drum set) produces different pitches.

Relevant Michigan Science Content Standard(s) and Benchmark(s)

Elementary School Benchmarks:

- Strand 4, Content Standard 4, Benchmark 1: Describe sounds in terms of their properties.
- Strand 4, Content Standard 4, Benchmark 2: Explain how sounds are made.

Materials Needed

- *The Sound Machine*, by Roald Dahl (can be found in the book titled *Skin and other Stories*)
- 1 set of sound tubes (or a set of 8 glasses, each filled with a different amount of water)
- drinking straws – 12 per group of four students
- scissors – 2 pair per group of four students
- variety of rubber bands (thin and thick) – 10-20 per group of four students
- 1 shoe box per group of four students
- 2 pencils per group of four students
- a piano (if not available, a trombone or drum set will also work)

Materials Provided with this Lesson Plan

- musical instrument activity worksheet
- instructions for constructing the instruments

Safety Issues and Requirements

No special safety equipment or facilities are required.

Background Information for Teachers

Sound is caused by back and forth motions called vibrations. Vibrations are produced by forces (pushes and pulls). Vibrations of objects cause air molecules to vibrate, creating sound waves that we can hear. When we speak or shout, our vocal chords vibrate. The vibrations go out in all directions through the air (as waves). This can be pictured by imagining what would happen if we dropped a stone in a pool of water. These vibrations can sometimes also be felt. People that are hearing impaired can sense this movement, so they can feel what they cannot hear.

The **pitch** of a sound is how high or low it is. This is determined by the rate of vibration, which is also known as the **frequency** of vibration. The more often something vibrates, the higher the note. The less often something vibrates, the lower the note. Some sounds are **inaudible** to the human ear because they have either a very high or very low frequency. Sounds that can be heard by the human ear have frequencies ranging from about 20 Hz – 20,000 Hz.

The **volume** of a sound is how loud or quiet it is. Volume is related to the **amplitude** of the sound wave. A large amplitude produces a loud sound and a smaller amplitude produces a quieter sound.

The pitch of instruments can be changed in a few ways. The pitch of the sound tubes changes with length of the tube or the pitch of the water glasses changes with the length of the empty portion of the glass, which is determined by the amount of water in the glass. The pitch of the drinking straw instrument can be changed by changing the length of the straw or by cutting holes in the straw and covering or opening the holes. The pitch changes because the length of the wave that fits in the instrument changes. The shorter the wave that fits into the instrument, the higher the pitch. Therefore, shorter straws (or the ones with holes) have a higher pitch. The pitch of the milk carton guitar can be changed by changing the thickness of the rubber bands. Thicker rubber bands will produce a lower pitch because they will not vibrate as quickly as thinner rubber bands. Changing the distance between the pencils will also change the pitch because it is changing the length of the string that vibrates.

Why might students be interested in, and motivated to learn, this topic?

- Because sound is something they encounter each day.
- Because many of them have played a wind instrument (the recorder) in music class.
- Because many elementary students have or would like to play the guitar.

Student Preconceptions about this Topic

- Hitting an object harder changes its pitch.
- Loudness and pitch of sounds are confused with each other.
- In wind instruments, the instrument itself vibrates, not the internal air column.

Outline for Classroom Activity

I. Introductory Set

- Read students the short story, *The Sound Machine*, by Roald Dahl.
- Ask students questions about what they thought of the story.
- Have the students brainstorm everything they know about sound.
- Demonstrate the sounds produced by the sound tubes (or water glasses).

II. Activity

- Break the class into groups of four.
- Show students how to construct both the wind and string instruments.
- Ask them to predict, as a group, how they could change the pitch and the volume of each of the instruments.
- Distribute directions for constructing the wind and string instruments.
- Distribute drinking straws, scissors, milk cartons, rubber bands, and pencils to each group.
- Have the groups build the instruments and experiment with how to produce a variety of pitches.
- Circulate among the groups to observe and answer questions the students may have.
- Have each student complete a worksheet (included at end of lesson), on which they explain the process they used to change the pitch and the volume of their instruments.

III. Concluding Discussion

- Facilitate a whole class discussion about the conditions needed to create an instrument with a variety of pitches.
- Ask the students how a piano (or trombone or drum set) produces many different pitches.

Detailed Directions (including Introductory Set and Activity, with Questions)

Introductory Set:

Begin the lesson by reading the short story, *The Sound Machine*, by Roald Dahl. Then ask students to share some of their thoughts and feelings about the story. What did they think of the sound machine? Could something like this really exist? What is a word that describes a sound we can hear? (Audible) What about a sound that we cannot hear? (inaudible) Use their responses to start a discussion on sound. Get the students to tell everything they know about sound. As the students tell you about sound, write down key words on the board as you hear them. These words should include *vibrations, pitch, frequency, audible, inaudible, volume, and amplitude*. The meaning of these words should also be briefly discussed. Other sound vocabulary may also be written down, but these words should be starred or highlighted because these are the concepts that will be explored during this activity.

Once the students have exhausted the discussion on sound, explain that you have brought some in some tubes (or water glasses) and that the class is going to listen to the sounds that are produced by the tubes. Ask (or choose) some students to help demonstrate the sounds that the tubes make. Line up the number of children that you have tubes in the front of the classroom so everyone can see them. Give each student a tube starting with the shortest tube to the student at the far left and the longest tube to the student at the other end of the line. Have the student on the far left (the shortest tube) strike his/her tube. Then have the student on the far right (the longest tube) strike his/her tube. Repeat that process so the class can hear the sounds once again. Ask the class to think about what the difference was between the two sounds. Then have each student in the line strike their tube, one at a time, starting at one end of the line. Ask the students what the difference was between each of the sounds produced. Discuss that the difference between the sounds were the pitches that were produced by each tube. **Be sure that the students understand that the difference was the pitch, not the volume.** Then ask students to think about how they could change the volume (or amplitude) of the sound produced by the tube.

Activity:

Begin by breaking the class up into groups of four. Explain that each group of four students will construct two instruments – a wind instrument and a string instrument. Show the class how to construct each of the instruments (directions included at end of lesson). Ask them to think about how they could change the pitch and the volume of each of the instruments. Then have them discuss their ideas with their group. Pass out the worksheets and each person in the group should record their predictions on the worksheet. Now distribute the instructions for construction of the instruments and the materials needed to construct each

instrument. Allow the students to construct the instruments and experiment with how to produce a variety of pitches and volumes. The teacher should circulate around the room to each group, observing and answering questions the students may have. Give the students plenty of time to test many ideas they may have for their instruments.

When the instruments are completed, each group will be required to present their instrument to the rest of the class. The group must demonstrate and explain how they can change the pitch and the volume of their instruments.

Concluding Discussion

Have the students, as a class, share their thoughts about how a piano (or trombone or drum set) produces many different pitches. Give the students plenty of time to think of how the piano may work. If the students are having a lot of trouble, let them look inside the piano or show them a picture of the inside of a piano. Once students see that the inside of the piano has many strings they should be able to conclude that each key strikes its own string. When a key is struck, a small mallet inside the piano strikes the string. Have the students come up with the fact that the length of the strings are different.

Learning Styles Addressed, and Possible Adaptations

Learning Styles Addressed:

- Auditory learners are addressed because they need to listen and discuss in order to complete this activity.
- Visual learners are addressed because they get to watch the demonstration at the beginning and they get to look at the materials.
- Kinesthetic learners are addressed because they get to manipulate the materials to construct the instruments.

Possible Adaptation:

For lower elementary students, allow each student to build his/her own instrument. For younger students it will be much more of a direct lesson. Build the instruments together so the students can follow along. For the wind instruments, have each student make two instruments of different lengths. Have the students compare the sounds that are produced by each of the wind instruments. For the string instruments, have each student place two identical rubber bands on their guitar and have them change the length of one of the rubber bands and listen to the sound that each rubber band produces. Have them compare the sounds that are produced by each.

Assessment Plan

Assessment will be performed in different ways both during and after the activity. In particular:

- The students will be observed during the activity.

The teacher will circulate throughout the classroom and observe the students. The teacher will check to see if they are actively participating in the group. The teacher will note, and if necessary, modify the behavior of any student who is not participating. The teacher will also note the students who are especially helpful within the group and help the group make progress.

- The construction and presentation of working instruments is an authentic assessment.

Rubric

Grading will be based on the following requirements:

- Wind instrument is constructed correctly.
- String instrument is constructed correctly.
- Demonstration of how to change the pitch of the wind instrument.
- Demonstration of how to change the pitch of the string instrument.

20 points: group meets all four of the requirements

15 points: groups meets three of the requirements

10 points: groups meets two of the requirements

5 points: groups meets one of the requirements

0 points: groups meets none of the requirements

- The activity sheets will be evaluated using the following rubric:

Rubric

Check plus: if the answer to each question shows evidence of thought and effort.

Check: if the answer to one question is cursory and does not show evidence of thought and effort.

Check minus: if the answer to two or more questions are cursory and do not show evidence of thought and effort.

Ideas for Integration with other Disciplines

Integrate with a music lesson. The teacher or the students can play a song using the tubes. Students can learn about the concept of pitch as it relates to a musical scale. The term octave can be introduced.

Integrate with a lesson on different types of communication. Students can learn not only how hearing impaired people communicate but how they can sense vibrations to feel the beat and tone of music.

Integrate with an art and music lesson. Many artists get their inspiration for a work of art from music. Have the students create works of art while listening to music with mostly high pitches and then mostly low pitches. Compare the two sets of pictures. Students can also listen to music that demonstrates a drastic change in loudness. What kind of feeling do they get from the quiet parts? What about the loud parts?

Follow up Ideas and Applications

Look at other musical instruments. How do these musical instruments produce different pitches?

Investigate the way in which sound travels. Sound travels in waves. Students are familiar with the idea of sound traveling through air. Have the students experience sound traveling through liquids and solids.

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Adapted from the Hands-On Technology Program – The Science of Sound.
www.galaxy.net/~k12/sound/

STRAW INSTRUMENT

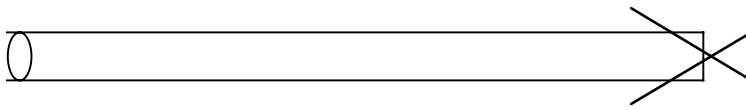
WHAT YOU NEED:

- plastic straw
- scissors

PROCEDURE:

1) Squish or bite one end of the straw flat.

2) Cut the flat end into a point as shown.



3) Put the cut end into your mouth far enough so that you can put your lips around the point of the straw.

4) Now blow and listen to the sound that is produced.

SHOE BOX GUITARS

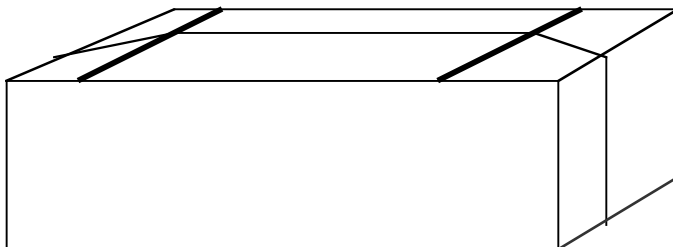
WHAT YOU NEED:

- variety of rubber bands
- 1 shoe box
- 2 pencils

PROCEDURE:

1) Put a rubber band around the shoe box the long way.

2) Put one pencil under the rubber bands near each end of the box as shown.



3) Pluck the rubber band and listen to the sound that is produced.

Name _____

Predict how you could change the pitch of the instruments.
Record your predictions in the correct box.

Wind Instrument

String Instrument

Now discuss your predictions with your group and test your ideas.

How did your group change the pitch of the instruments?

Wind Instrument

String Instrument

Discuss with your group how you might change the loudness of the instruments.

** Be ready to present and explain how you changed the pitch of your instruments.