



Grade Level(s): Third, Fourth, and Fifth
Lesson Title: Vibrating Things Sing

Focus: (Concept or skills to be emphasized)
Vibrations, sound, pitch, listening, predicting

Objectives: See end of lesson for objectives and standards achieved.



Background Information:

The violin variation of The Miller's Daughter's theme in *Rumpelstiltzkin* is played by the string instruments of the orchestra. In the Structure of the Orchestra section of the WVSO CD ROM, students can explore each string instrument. Most string instruments are played either by plucking or drawing a bow across the strings. The thickness, length, and tension of the strings are factors affecting the pitch. The material used to make the string affects the quality (timbre). The longer, looser, or thicker a string is, the lower the note sounds. The shorter, tighter, or thinner a string is, the higher the note will be. This lesson will allow students to experiment with varying the lengths of strings (using rubber bands) to produce high and low sounds. (See also Lesson 7 - Sound Production and Lesson 8 - Conditions Affecting Timbre of Sound)

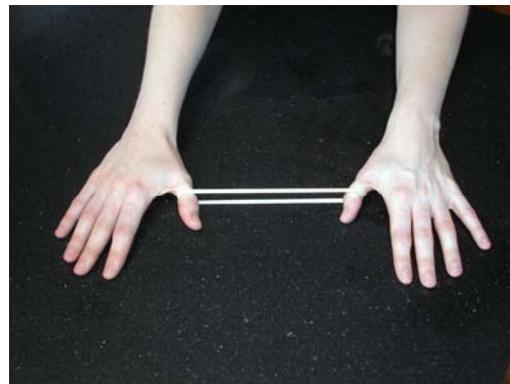
Activities (Procedures):

1. Have students orally read the story of *Rumpelstiltzkin*, as found in the WVSO *Rumpelstiltzkin* CD ROM in The Verizon Literacy Resource Section of the Teacher's Study while listening to the *Rumpelstiltzkin* music on the CD ROM (Tracks 01 - 14) or the WVSO Audio CD Companion. (For teachers using the WVSO Audio CD Companion only, there is a conversion chart of what track you should use for this activity.)
2. Ask the students to identify the instruments in the orchestra that have strings.
3. Play the violin variation of The Miller's Daughter's theme (Track 09 Violin Variation) for your class. Ask students if they know what instruments are used to play this variation of The Miller's Daughter's theme. Explain that this variation is played by violins, violas, cellos, and double basses, which are string instruments. Tell students that although the string instruments playing the violin variation look similar to each other, they are different sizes and have unique sounds. Direct students to the String Family in the Structure of the Orchestra on the WVSO CD ROM and allow them time to look at and listen to each string instrument. If using the Audio CD Companion, listen to the violin variation of The Miller's Daughter's theme while looking at a picture of the String family.

4. Talk about string instruments with students. Ask students to think about how string instruments produce sound. Tell them they will be performing an experiment that demonstrates how sound is created by string instruments.

a. Arrange students into groups of 2-4. Assign the role of "instrument" to one student and the roles of "musician" and "recorder/reporter" to the other student(s).

b. **The Instrument:** Provide each group with one rubber band. Ask the *instruments* to place their hands palm down on a desk or table with their thumbs facing inward and explain that they must keep their hands the same distance apart during the experiment (Note: Tell your students not to stretch the rubber bands so tightly that they will break). Tell the *musicians* to carefully stretch a rubber band between the base of the thumbs of the *instruments* (see picture at right). Remind them to be sure the *instruments* do not let the rubber band slip off. Ask students what they think will happen when the rubber bands are plucked and to explain why they think this will happen.

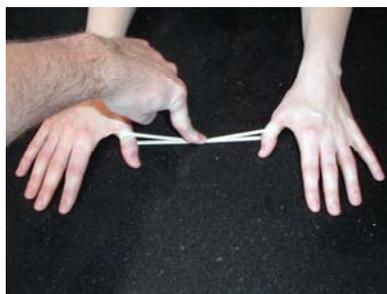


The Instrument

c. Direct the *musicians* to pluck the rubber band and then have the *recorder/reporter* write down what they heard and saw. As a whole group, discuss what happened. Ask students why they think this happened.

d. Explain that the students will now have a chance to experiment with changing the pitch of their "instruments". Demonstrate pressing down at different points along the rubber band (see pictures below). Explain that each group will have the opportunity to experiment with pressing on the rubber bands after they have made a prediction about how this might change the sound produced when the rubber band is plucked. Ask each group to discuss what will happen and have the *recorder* write their predictions. Tell the *reporter* from each group to report their group's predictions to the class.

e. Allow students enough time to experiment with pressing in different points along the rubber band. Direct the *recorder* from each group to record their observations. Return to a full group discussion and ask the *reporter* to talk about what they observed.



Changing Pitch and Plucking Rubber Band (Note: Students can use one hand to press on the rubber band and the

other to pluck the rubber band)

5. Direct students to gather around the teacher to closely watch a stretched rubber band as it is plucked. Ask them to describe what they see (it vibrates). Ask students if they notice anything about the vibrations and the sound (sound is only produced while the rubber band is vibrating). Explain that sound is created when something vibrates. Tell students that all noises, including their voices and musical instruments, are caused by vibrations. Explain that many of the sounds produced by an orchestra, such as the sound of the drums, can be felt, and that what they are feeling is actually the vibrations the instruments are producing as sound waves travel through the air.
6. Explain that the sound made by a string instrument is affected by the thickness of the string, by how tightly the string is stretched, and the length of the string. Explain that in the previous experiment students were changing the length of the "string" allowed to vibrate. When the length of the string allowed to vibrate is shortened, the pitch goes up; when it is lengthened, the pitch goes down. Explain that this is the same thing that string instrument musicians do when they press the strings against the fingerboard of their instruments.
7. Conclude the lesson by playing the Track 09 Violin Variation of The Miller's Daughter's theme (found in either the WVSO CD ROM or the WVSO Audio CD Companion) to your class. Ask your students to close their eyes and imagine what the musicians must be doing to change the pitch of the notes that they are playing.

Extension Activities:

1. Using a string instrument such as a guitar, demonstrate how the pitch of a note changes when someone presses on the string while it is plucked. Allow students to look closely at the thickness of the strings and demonstrate how this influences the pitch of each note. Adjust the tension on each string by tightening and loosening each string by turning the tuning pegs of the instrument and demonstrate how this affects the pitch of each note. (Be aware that this will require the instrument to be re-tuned, so only do this if you know how to re-tune the instrument or if the person who loaned the instrument to you understands.)
2. Ask students why they think the length, tension, and thickness of a string affects its pitch when plucked or bowed.

Modifications (Special Needs):

1. Visual and auditory impaired students will need special consideration during this lesson with seating and materials adaptations.
2. Learning disabled students may benefit by abbreviating this lesson's content and length.
3. Varying learning styles will be addressed with the variety of activities in this lesson - tactile, visual and sensory learning styles are utilized.

4. Gifted student needs are provided through the extension activities.

Assessment/Evaluation*:

1. Formative Evaluation Plan: The teacher will observe student participation and understanding of the exploratory exercise. The teacher will facilitate all discussion points throughout the lesson.
2. Summative Evaluation Plan: The teacher will assess student comprehension by evaluating accuracy of pressure points on rubber bands during the exploratory. The teacher will evaluate the accuracy of the observations recorded by each group.

Supplemental Materials and Equipment Needed:

A copy of the *WVSO Rumpelstilzkin* CD ROM or *WVSO Audio CD Companion*

Computer able to play audio files on CD-ROM

Rubber bands

Paper

Pencils

String instrument(s) (optional)

Resources:

Information about sound:

<http://www.physicsclassroom.com/Class/sound/soundtoc.html>

Information about sound and how musical instruments produce sound:

<http://www.pbs.org/weta/roughscience/challenges/music/>

Information about the parts of an acoustic guitar:

<http://entertainment.howstuffworks.com/guitar.htm>

References:

Ostdiek, Vern J. & Bord, Donald J. (2000). Inquiry into Physics. Brooks/Cole: Pacific Grove, CA.

National Standards:**Music**

- Performing on instruments, alone and with others, a varied repertoire of music.
- Improvising melodies, variations and accompaniments.
- Listening to, analyzing and describing music.
- Evaluating music and music performances.
- Understanding relationships between music, the other arts and disciplines outside the arts.

Science

Content Standard B

Position and motion of objects:

- Sound is produced by vibrating objects. The pitch of the sound can be varied by changing the rate of vibration.

Social Studies

V. Individuals, Groups, and Institutions

- a. identify roles as learned behavior patterns in group situations such as student, family member, peer play group member, or club member.

WV Content Standard Objectives:*Third-Grade*

- GM.3.2.14 evaluate their own musical performances.
- SC.3.4.12 recognize that speed, distance, and time are interrelated.
- SC.3.4.13 recognize that the greater a force is exerted on an object, the greater the change of its motion will be.
- SC.3.6.2 listen to and be tolerant of different viewpoints by engaging in collaborative activities and be willing to modify ideas when new and valid information is presented.

Fourth-Grade

- GM.4.2.10 evaluate their own musical performances.
- GM.4.4.2 identify and discuss tone production for instruments.
- SC.4.4.23 explore that sounds are produced by vibrating objects and columns of air and explore the relationship between frequency and pitch of sound.
- SC.4.4.24 investigate the change in the length, tension, or thickness of the vibrating object on the frequency of vibration (e.g., string, wire, rubber band).
- SC.4.6.2 listen to and be tolerant of different viewpoints by engaging in collaborative activities and modifying ideas when new and valid information is presented from a variety of resources.
- SS.4.1.5 describe the qualities of responsible leadership by individuals and in groups.

Fifth-Grade

- GM.5.2.15 evaluate their own musical performances.
- SC.5.2.1 cooperate and collaborate to ask questions, find answers, solve problems, conduct investigations to further an appreciation of scientific discovery.

Kentucky Program of Studies*Third-Grade*

AH-P-M-5

Students will identify and discuss the elements of music.

S-P-SI-2

Students will use simple equipment (e.g., aquariums), tools (e.g., magnifiers, spoons), skills (e.g., observing, pouring), technology (e.g., video discs), and mathematics in scientific investigations.

S-P-SI-3

Students will use evidence (e.g., observations) from simple scientific investigations and scientific knowledge to develop reasonable explanations.

S-P-SI-4

Students will design and conduct different kinds of simple scientific investigations.

S-P-SI-5

Students will communicate (e.g., speak, draw) designs, procedures, and results of scientific investigations.

SS-P-GC-1

Students will recognize and understand the need for rules within the home and school setting.

SS-P-CS-3

Students will recognize the roles individuals have in various groups.

Fourth-Grade

AH-4-M-1

Students will use elements of music (rhythm, melody, form, timbre, harmony, tempo, dynamics) while performing, singing, instrument playing, moving, listening, reading, writing, and creating.

S-4-SI-1

Students will ask simple scientific questions that can be answered through observations combined with scientific information.

S-4-SI-2

Students will use simple equipment (e.g., plant lights), tools (e.g., rulers, thermometers), skills (e.g., describing), technology (e.g., electronic media), and mathematics in scientific investigations.

S-4-SI-3

Students will use evidence (e.g., descriptions) from simple scientific investigations and scientific knowledge to develop reasonable explanations.

S-4-SI-4

Students will design and conduct different kinds of simple scientific investigations.

S-4-SI-5

Students will communicate (e.g., graph, write) designs, procedures, and results of scientific investigations.

S-4-SI-6

Students will review and ask questions about scientific investigations and explanations of other students.

S-4-PS-5

Students will understand that sounds are caused by vibrating objects.

SS-4-GC-4

Students will understand that individuals have rights and responsibilities that change when people assume different roles in different groups.

Fifth-Grade

AH-5-M-1

Students will express elements of music (rhythm, melody, form, timbre, harmony, tempo, dynamics) through singing, instrument playing, moving, listening, reading, writing, and creating.

AH-5-M-2

Students will analyze how elements of music are used in performing, listening to, and/or creating music.

S-5-SI-1

Students will identify questions that can be answered through scientific investigations combined with scientific information.

S-5-SI-2

Students will use appropriate equipment (e.g., watches), tools (e.g., rain gauges), techniques (e.g., classifying), technology (e.g., calculators), and mathematics in scientific investigations.

S-5-SI-3

Students will use evidence (e.g., classifications), logic, and scientific knowledge to develop scientific explanations.

S-5-SI-4

Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.

S-5-SI-5

Students will communicate (e.g., draw, speak) designs, procedures, and results of scientific investigations.

S-5-SI-6

Students will review and analyze scientific investigations and explanations of other students.

Ohio Academic Content Standards, Benchmarks:

Historical, Cultural and Social Contexts

K-4 C. Recognize the interaction of people in music.

Creative Expression and Communication

K-4 A. Sing and/or play instruments, alone and with others, demonstrating a variety of repertoire, using proper technique, accurate rhythm and pitch and appropriate expressive qualities.

Analyzing and Responding

K-4 B. Identify the sounds of a variety of instruments including orchestra, band and classroom instruments.

K-4 C. Discuss and evaluate individual and group music performance.

Valuing Music/Aesthetic Reflection

K-4 A. Reflect on their own performances and the performances of others.

Physical Sciences

3-5 F. Describe the properties of light and sound energy.

Scientific Inquiry

3-5 A. Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.

3-5 B. Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.

3-5 C. Develop, design and safely conduct scientific investigations and communicate the results.

Scientific Ways of Knowing

3-5 A. Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained.

Social Studies Skills and Methods

3-5 D. Use problem-solving skills to make decisions individually and in groups.

*All Assessments are to be at the expected state assessment standard; in West Virginia this is mastery level; in Ohio this is benchmark level; and, in Kentucky, this is academic expectations level.