**Title:** Catch the Wave!

**Subject:** Science

**Standard:** Physical Science

**Grade:** 8  **Date:** January 2006

**Vision**
We want our students to confidently take on challenges, independently solve problems, and communicate new learning with others.

**Lesson Summary**
This lesson engages students in inquiry-based learning by formulating and connecting prior knowledge with current 8th grade physical science standards. It is a 7-station activity-oriented lesson which covers energy transfer, sound, light and water waves.

**Goal(s) of This Lesson**
- To have students participate in an inquiry-based lesson
- Students compare and contrast different ideas about waves
- For students to be engaged and curious about science
- For students to talk with each other about their observations and conclusions
- Students will walk away with questions about the lesson

**Prior Knowledge/Pre-Assessment**
Potential energy
Kinetic energy
Energy transformation
What is a wave?

**Team Members**
Dawn Barchanowicz, Roehm
Bob Dzurilla, Roehm
Lori Gulley, Ford
Elaine Peduzzi, Ford
Ken Robison, Ford
Jacquie Swartz, Ford
Dale Szymanski, Ford
Joe Zumpano, Ford

**Reflections/Insights**
- It is important to have a time frame for each station based on the personality of the class
- Encourage for out-of-the-box thinking
- This lesson kept students fully engaged and questioning
- It is difficult not to help/lead students; let them discover and explore
### Relationship to the Curriculum

**Ohio Academic Content Standards**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Benchmark</th>
<th>Indicators</th>
</tr>
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<tbody>
<tr>
<td><strong>Science</strong></td>
<td>D. Describe that energy takes many forms, some forms represent kinetic energy and some forms represent potential energy; and during energy transformations the total amount of energy remains constant.</td>
<td>4. Demonstrate the waves transfer energy.</td>
</tr>
<tr>
<td>Physical Science</td>
<td></td>
<td>5. Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves)</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td>B. Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.</td>
<td>3. Read, construct and interpret data in various forms produced by self and others in both written and oral form.</td>
</tr>
<tr>
<td>Scientific Inquiry</td>
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<tr>
<td><strong>Mathematics</strong></td>
<td>B. Apply mathematical knowledge and skills routinely in other content areas and practical situations. E. Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas. F. Use precise mathematical language and notations to represent problem situations and mathematical ideas.</td>
<td>Not applicable (there are no indicators in Mathematical Processes)</td>
</tr>
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<tr>
<td><strong>Mathematics</strong></td>
<td>E. Estimate and compute various attributes.</td>
<td>6. Solve and determine the reasonableness of the results for problems involving rates and derived measurements, such as velocity and density, using formulas, models and graphs.</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
<td>F. Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.</td>
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<tr>
<td><strong>Language Arts</strong></td>
<td>A. Use context clues and text structures to determine the meaning of new vocabulary.</td>
<td>1. Define unknown words through context clues and the author’s use of comparison, contrast and cause and effect.</td>
</tr>
<tr>
<td><strong>Acquisition of Vocabulary</strong></td>
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<tr>
<td><strong>Language Arts</strong></td>
<td>B. Demonstrate comprehension of print and electronic text by responding to questions.</td>
<td>1. Apply reading comprehension strategies, including making predictions, comparing and contrasting, recalling and summarizing and making inferences and drawing conclusions.</td>
</tr>
<tr>
<td><strong>Reading Process: Comprehension Strategies</strong></td>
<td></td>
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<tr>
<td><strong>Language Arts</strong></td>
<td>A. Formulate writing ideas and identify a topic appropriate to the purpose and audience.</td>
<td>6. Organize writing with an effective and engaging introduction, body and a conclusion that summarizes, extends or elaborates on points or ideas in the writing. 9. Use precise language, action verbs, sensory details, colorful modifiers and style as appropriate to audience and purpose.</td>
</tr>
<tr>
<td><strong>Writing Process</strong></td>
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<tr>
<td><strong>Language Arts</strong>&lt;br&gt;Research</td>
<td>A. Formulate open-ended research questions suitable for inquiry and investigation and develop a plan for gathering information.</td>
<td>1. Compose open-ended questions for research, assigned or personal interest, and modify questions as necessary during inquiry and investigation.</td>
</tr>
<tr>
<td><strong>Social Studies</strong>&lt;br&gt;History</td>
<td>A. Interpret relationships between events shown on multiple-tier time lines.</td>
<td>1. Select events and construct a multiple-tier time line to show relationships among events.</td>
</tr>
<tr>
<td><strong>Social Studies</strong>&lt;br&gt;Social Studies Skills and Methods</td>
<td>A. Analyze different perspectives on a topic obtained from a variety of sources.&lt;br&gt;C. Present a position and support it with evidence and citation of sources.&lt;br&gt;D. Work effectively in a group.</td>
<td>3. Compare accuracy and point of view of fiction and nonfiction sources about a particular era or event.&lt;br&gt;2. Construct a historical narrative using primary and secondary sources.&lt;br&gt;3. Write a position paper or give an oral presentation that includes citation of sources.&lt;br&gt;4. Organize and lead a discussion&lt;br&gt;5. Identify ways to manage conflict within a group.</td>
</tr>
<tr>
<td><strong>Technology</strong>&lt;br&gt;Design</td>
<td>C. Understand and apply research, innovation and invention to problem-solving.</td>
<td>3. Recognize the patterns of the technological evolution of an invention.</td>
</tr>
<tr>
<td><strong>Technology</strong>&lt;br&gt;Designed World</td>
<td>A. Develop an understanding of, and be able to, select and use physical technologies.</td>
<td>1. Solve a problem involving energy and power systems.&lt;br&gt;2. Explore ways that energy can be used more efficiently.</td>
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### Materials and Resources

<table>
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<tr>
<th>Station</th>
<th>Items</th>
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<tbody>
<tr>
<td>#1 Rope (Chinese)</td>
<td>Slinky, books</td>
</tr>
<tr>
<td>#2 Guitar</td>
<td>Rubber bands</td>
</tr>
<tr>
<td>#3 Cups</td>
<td>Strings, Hangers</td>
</tr>
<tr>
<td>#4 Water</td>
<td>Water dish, Overhead projector, Materials to drop</td>
</tr>
<tr>
<td>#5 Tube</td>
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<tr>
<td>#6 Light kit (optional; dependent on supplies)</td>
<td>-battery, -clips, -color slides, -index card</td>
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<tr>
<td>#7 Tuning fork</td>
<td>Water bin, Ping pong ball, String, Foil pan, Rice</td>
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</tbody>
</table>

**Student Science Journals or Recording Sheet**

### Unit Suggestions

**Lesson 1:** Energy
- What do you know about potential and kinetic energy?
- Waves
  - Concept web
  - Draw a picture
  - List different types: anticipated answers: water, sound, seismic, hand, stadium, brain

**Lesson 2:** This lesson

**Lesson 3:** Review each station and discuss the waves and energy transfer

### Notes:
- It is good to have 3 laminated copies of directions for each station; color-coded sheets work well
- Have a strategy for moving groups from station to station
- Give a 1-2 minute warning prior to switching stations to allow students to work on the questions
- Be sure YOU know what the students are looking for before you begin the lesson. Try each station yourself to make sure it works.
- It helps to provide a demonstration or direction with the light station.
- Number the stations; strategically place stations to maximize attention and safety.
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<tr>
<th>Suggested Time Frame and Steps</th>
<th>Teacher Direction, Support and Key Questions</th>
<th>Student Learning Activities</th>
<th>Anticipated Student Questions and Responses</th>
<th>Evaluation/Assessment</th>
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<tr>
<td>Prior to the lesson:</td>
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<tr>
<td>1. Teacher should assign students to groups of 4 (there are 7 stations; adjust numbers accordingly) Suggested methods: assign, random cards from a deck of cards, number off by 7’s, etc.</td>
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<tr>
<td>2. Label the stations with numbers or names for easy reference. 3. Set up each station. Have 3 copies of directions at each station.</td>
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<tr>
<td>5-6 minutes</td>
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<tr>
<td>1. Set expectations, group responsibilities, and address safety issues.</td>
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<td>2. Review potential/kinetic energy quickly. Reflect from yesterday on waves.</td>
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<td>3. Today we will explore various types of waves.</td>
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<tr>
<td>7-10 minutes at each of 7 stations.</td>
<td>Each station demonstrates different types of waves. Tomorrow we will review our findings, review the terminology, and have questions and answers.</td>
<td>5. At each station, students work with their group to explore the materials and respond to the questions. Each member of the group should be given the opportunity to try each activity.</td>
<td>“How do you draw a wave?” “What is this type of wave?” “How am I supposed to draw a sound wave?” “What is the relationship between</td>
<td>Grade students for -participation -response/answer (observation) -drawings</td>
</tr>
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<tr>
<td>lessons.</td>
<td>Remember to read the directions.</td>
<td>these stations?</td>
<td>“How do I describe this?”</td>
<td>Collect follow-up questions they might have</td>
</tr>
<tr>
<td>Suggested directions/questions:</td>
<td>Think about ........ (prior knowledge) Help students make connections.</td>
<td>“What are we supposed to do with these materials?”</td>
<td>“How much time do we have?”</td>
<td>Activity Quiz – quiz on main points of each activity</td>
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<td>Focus on differences</td>
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<td>Test on related resources/ Research of text with the activities.</td>
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<tr>
<td>Compare and contrast</td>
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<td>Stay focused on your activity</td>
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<td>How could you do this differently?</td>
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<tr>
<td>What else can you do at this station?</td>
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### Differentiated Instructional Support
- Increased teacher directions and guidance
- Adapt activity according to physical limitations
- Abbreviated note-taking as necessary
- Use a buddy to keep a child on task
- Group the students differently
- Time modifications
- Gifted: Internet based activity for homework
- Limited responses for each station
- Modifications for IEP

### Extensions
- Wave terminology
- Energy terminology
- Calculate wavelength, frequency, amplitude
- Show relationships between stations
- Student questions about the stations; then research the answers
- PowerPoint presentation on wavelengths
- Students create station Number 8 (must be school appropriate!)

### Technology Connections

### Literature Links
**Sound and light / David Glover**

**Physics for kids : 49 easy experiments with acoustics / by Robert W. Wood.**

**The science of sound : projects with experiments with music and sound waves / Steve Parker.**

**The science book of energy / Neil Ardley.**

**Making waves : finding out about rhythmic motion / Bernie Zubrowski ; illustrated by Roy Doty.**
Water

No splashing one another, no diving at the shallow end, no running, wear appropriate swimwear at all times, and there will be a break time every 45 minutes for adult swim!

1. Take a few minutes to demonstrate a wave/waves. Drop an item in the middle first, then drop it at the edge, carefully removing the item and waiting for the water to settle.

2. Describe what happens to the wave when you drop the item in the middle.

3. Describe what happens to the wave when you drop the item on the edge.

4. After each item, draw a model of what you observed.

5. Relate what you saw to the waves in an ocean or lake.

6. In this activity, what is the energy source that creates the waves? What is the energy source in an ocean or lake?

Remove any items you have placed in the water before moving to the next station.
Tube

DO NOT HIT ANYONE WITH THE TUBE.

1. Create a wave/waves.

2. After each group member tries, draw a model of what you observed.

3. Describe what you saw.
   What did you do to your item to make a wave?

4. What causes different sounds?

5. How many different pitches can you make?

6. How does the speed affect the pitch?

7. Relate this to a musical instrument.

8. What happens to the wave when you move the tube faster?

9. What happens to the wave when you move the tube slower?

10. Give everyday examples that work similar to a tube.
**Slinky and Rope**

1. Take a few minutes to demonstrate a wave/waves with each item.

2. After each group member tries, draw a model of what you observed.

3. Describe what you saw.
   - What did it look like at the beginning? What did you do to each item to make a wave?

4. Show the location of the maximum potential energy in each item.

5. Show the location of the maximum kinetic energy in each item.


7. What happens to the wave when you move the rope faster? What happens to the wave when you move the slinky faster?

8. What happens to the wave when you move the rope slower? What happens to the wave when you move the slinky slower?
Guitar

1. Create a wave/waves.

2. After each group member tries, draw a model of what you observed.

3. Describe what you saw.
   What did you do to your item to make a wave?

4. What causes different sounds?

5. Apply different forces to the strings/rubber bands. Do they make a difference? Explain.

6. Is heat involved?

7. How do the guitar and the rubber bands relate?

8. What three things change the pitch of the guitar?
Church Bells

1. Create a wave/waves.

2. After each group member tries, draw a model of what you observed.

3. Describe what you saw.
   What did you do to your item to make a wave?

4. What items did sound travel through?

5. Why does it sound different when you hold the cups up to your ears?

6. Compare this to holding a seashell to your ear. What is the same? What is different?

7. What happens if you hit the two hangers together?
**Light (Color)**

Visible light is made of several color waves that travel at different frequencies and have different wavelengths. Use the wires to hook the battery to the light bulb. Hold each of the colors to the light and put the slit of the index card to your eye (vertically).

Look at each color. You should see a band of color due to the light bending through the slit. The wider the band, the larger the wavelength.

1. Which color has the largest wavelength?

2. Which color has the smallest wavelength?

3. List all of the colors in order from longest to shortest wavelength. How does this relate to a rainbow?

4. Are rainbows always the same or could its colors be different? Why?
Tuning Fork with Water

1. Create a wave/waves.
   Strike the tuning fork and put it to your ear.
   Strike the tuning fork and set it on the table.
   Strike the tuning fork and put it in the water.
   Strike the tuning fork and set it next to the ping pong ball.
   Strike the tuning fork and set it in the foil pan with the rice.

2. After each group member tries, draw a model of what you observed.

3. Describe what you saw.
   What did you do to your item to make a wave?

4. Describe how the sound travels.

5. Does each tuning fork sound the same or different? Why?

6. Show the location of the maximum kinetic energy.

7. Show the location of the maximum potential energy.

8. What happens when you hit the tuning fork harder or softer?