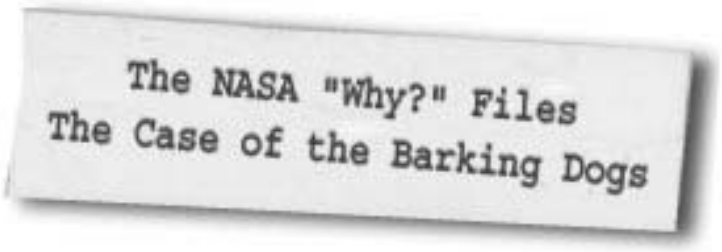


Segment 3

The investigative team continues to search for the cause of the barking dogs. Those pesky dogs are keeping the neighborhoods awake at night, causing the residents to go without their beauty sleep! The tree house detectives examine the matrix to eliminate possible causes and narrow their focus. Using the Methods of Science, they decide to perform an experiment in the classroom to find out how fast sound travels. After repeated trials, they analyze their data and are quite impressed with how fast sound really does travel! Next, they are off to visit Dr. D., a retired science professor, to find out more about how sound travels through different mediums. A NASA scientist, who specializes in acoustics, explains how mediums absorb sound and shares information about sonic booms and high frequencies. Does frequency have something to do with the dogs' barking? The tree house detectives think they are getting closer to solving this mystery.

Objectives

The students will be able to

- measure the speed of sound by creating echoes and using and manipulating the distance formula (S=D/T).
- measure length using the metric system.
- convert decimals to common fractions (1/4, 1/2, 3/4, 1/3, 2/3) by making a correlation between pictures and their corresponding fractions.
- state the properties of the three states of matter (solid, liquid, and gas) through investigation.
- discover the effect that different mediums have on sound through discovery activities.
- write a business letter by writing to various professionals to learn more about sonic booms.
- write a persuasive paper taking a stand on a controversial subject.
- learn more about possible career choices through research and investigation.

Vocabulary

analyze - to examine in detail

average - the result of dividing the sum of two or more quantities by the number of quantities

bounce - to spring back

calculate - to determine by using mathematics

disturb - to interrupt

echo - a reflected sound

elasticity - the ability to return to its original shape or state

eliminate - to get rid of or to remove

high pressure - a high concentration of densely packed air molecules

low pressure - decrease in the concentration of air molecules

medium - states of matter: solid, liquid, or gas

meters - a metric measurement equal to a little more than a yard (3 feet)

rhythm - regular recurrence of a beat

sonic boom - a shock wave caused by something traveling faster than the speed of sound, such as a plane or a clap of thunder

shock wave - an extremely fast movement of air that produces a sonic boom

temperature - the degree of hotness or coldness of anything

tension - stress on a material produced by the pull of forces that causes extension

trials - the process of trying or testing

Video Component (15 min)

Before Viewing

1. Help students summarize briefly what took place in segment 2.
2. Review the scientific method.
3. Ask students how fast they think sound travels in a second.
4. Assess students' knowledge of sonic booms. Brainstorm for ideas about what causes sonic booms and why we hear them.
5. Have students sort and classify vocabulary words for segment 3 into categories according to common characteristics. Share, as a class, the different groupings that have been generated. Using this knowledge, predict what will happen in segment 3.

After Viewing the Video

1. Discuss these questions that are asked at the end of video segment 3.
   - Do you think dog whistles are the source of the problem?
   - Are the dogs hearing a sound from inside their houses or could there be another reason for the barking dogs?
2. Make a display of the Methods of Science Board (p. 14). Refer to the chart as the students go through the scientific method to reinforce that it is not a step-by-step process, but rather an interdependent relationship.
3. Choose from the activities in this packet (p. 43-49) to help reinforce the concepts and objectives being emphasized in this segment.

Careers

Mathematician
Airplane Pilot
Airplane Mechanic
Naval Aviators
Air Traffic Controllers
Research Engineers
Computer Scientist

Resources

Web Sites

Sonic Boom
A NASA site that explains how sonic booms are created.
http://www.dfrc.nasa.gov/PAO/PAIS/HTML/FS-016-DFRC.html

Book Resources

Taylor, Richard: *The First Supersonic Flight: Captain Charles E. Yeager Breaks the Sound Barrier.* Franklin Watts, Inc., October 1997, ISBN 0531201775

Smith, Elizabeth Simpson: *Coming Out Right: The Story of Jacueline Cochran, the First Woman Aviator to Break the Sound Barrier.* Walker and Company, March 1991, ISBN 0802769896

Stein, Conrad R.: *Chuck Yeager Breaks the Sound Barrier.* Children's Press September 1997, ISBN 0516261371

Osborne, Louise and Hodge, Deborah, the Ontario Science Centre, and Mason: *Solids, Liquids, and Gases (Starting with Science).* Kids Can Pr, March 2000, ISBN 1550744011

VanCleave, Janice: *Janice VanCleave's Molecules.* John Wiley & Sons, September 1992, ISBN 0471550541

Activities and Worksheets

In the Guide

On the Web

You can find the following activities on the Web at http://whyfiles.larc.nasa.gov.

Molecules and Matter
An informational worksheet for three states of matter.

Green Slime (Ooblik)
An experiment to reinforce observations and inferences of solids and liquids.

Take a Stand
An activity for writing a persuasive paper and/or a a business letter.

Zoom! The Speed of Sound

Purpose

To investigate the speed of sound.

Problem

How can the speed of sound be measured?

Materials (per group)

1-3 meter sticks per group
2 metal pipes approximately 1 inch in diameter and 5 inches in length.
Paper and pencil (data chart)
Stopwatch or watch with a second hand
Goggles for each student
A large, open area with a building that will create an echo

Procedure

The first portion of this experiment will be conducted in a large, open area with a building that will create an echo.

1. Divide the students into groups of three.
2. Assign jobs: timekeeper, echo maker, and data recorder
3. Gather materials and go to a large, open area.
4. Use meters sticks to measure, in as straight a line as possible, a distance of 57 meters from one wall of the building to an open area. (This area should be free of other buildings that would be close enough to interfere with the reverberation of sound.)
5. Mark the distance by laying the meter sticks across the ground at the 57-meter point.
6. Wear safety goggles.
7. Have the echo maker begin to clap pipes together and to listen for the echo.
8. Once the echo has been identified, try to establish a rhythm, with the echo coming in between the claps of the pipe.
9 When ready, the echo maker will signal to the timekeeper to begin timing and counting claps for 20 seconds.
10. Timekeeper will announce that 20 seconds has elapsed, and the echo maker will tell the recorder how many claps he counted.
11. Recorder will record the number of claps in the data chart.
12. Repeat steps 7-11 for at least three more trials.
13. Return to classroom.
14. Using the data, find the average for the number of claps. (To average, add all the numbers and divide by how many numbers you added.)
15. To find the time between claps, divide the number of claps by time and round your answer to the nearest hundredth. This decimal represents the time between claps.
    Example: If you had 0.666, round it to 0.67.
16. Since the echo occurred between the claps, the time that it took for the sound to travel to the wall and back is 1/2 the time between claps.
    Example: $0.67 \div 2 = 0.335 = 0.34$
17. The distance the sound traveled was 114 meters (57 meters to the wall and 57 meters from the wall).
18. To calculate the speed of sound, divide distance traveled by time.
    $S = d/t$
    $S = 114 \div 0.34$
    $S = 335.29$ m/sec
19. Compare group answers. Find the speed of sound in a reference book and compare your answers to the correct answer.

Conclusion

1. What affected the differences in the answers from the various groups?
2. How could you have achieved a greater accuracy?
3. What factors could "slow" sound down?
4. What would happen if we went faster than the speed of sound?

Zoom! The Speed of Sound

Data Chart

Trial # (30 seconds)	# of Claps
1	
2	
3	
4	
5	

To find an average, add the number of claps for all 5 trials and divide by 5.

Step 1: _____ (Trial 1) + _____ (Trial 2) + _____ (Trial 3) + _____ (Trial 4) + _____ (Trial 5) = _____ (Sum of all Trials)

Step 2: _____ (Sum of all Trials) ÷ 5 = _____ (Average)

Step 3: _____ (# of claps) ÷ _____ (Time) = _____ (Time between claps)

Step 4: _____ (Time between claps) ÷ 2 = _____ (Time sound traveled)

Step 5: 114m (Distance) ÷ _____ (Time) = _____ (Speed of Sound)

"Ruff" Average

Finding the average is fun! It is also useful to help you calculate your grade in science throughout the year. Here's what you do:

Add all the given numbers in a set of numbers to find the total.

Example: 10 + 4 + 5 + 15 + 2 + 6 = 42

Now, divide your answer (42) by how many numbers you added together. In this example, you added 6 numbers together; therefore, you divide 42 by 6.

Example: 42 ÷ 6 = 7

Find the average in each word problem below.

1. A Siberian Husky eats 15 pounds of food a month. A Labrador Retriever eats 23 pounds of food a month. What is the average amount of food these two dogs eat in a month?

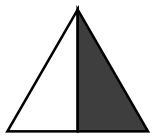
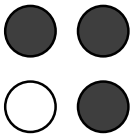
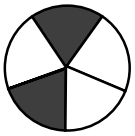
2. It was a dog's day afternoon at the neighborhood park. It was too hot to play fetch and too hot to chase the neighbor's cats. The pooches were panting from the heat. What a gathering of dogs! There were 9 German Shepherds, 5 Airedales, 7 Collies, and 3 Greyhounds. If there were only 4 benches in the shade for the pooches to share, what is the average number of dogs per bench?

3. A Bulldog gets 3 bones a day. A Manchester Terrier gets 1 bone a day. What is the average number of bones they get in a week?

4. The local veterinarian held "weigh day." The dogs lined up around the corner. The dogs' owners were eager to see if the new dog food was getting their hounds in shape. The weights of the first six dogs were 26 pounds, 15 pounds, 28 pounds, 29 pounds, 33 pounds, and 37 pounds. What was the average weight of the first six dogs?

Fractional Relationships

I. Write the fraction that describes the shaded portion of each figure below.

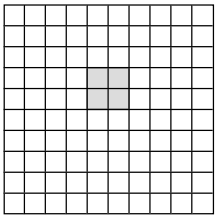

_____ _____ _____ _____ _____ _____

II. Determine if the fraction is less than or greater than 1/2. If the fraction is greater than 1/2, write it to the right of 1/2. If the fraction is less than 1/2, write it to the left of 1/2.

Example: 1/3 1/3 1/2 _____

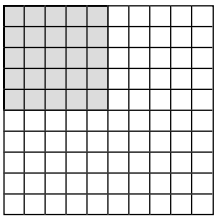
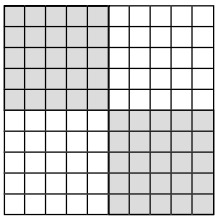
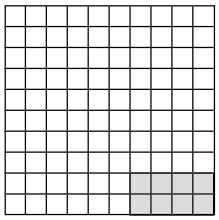
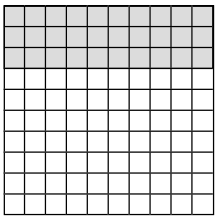
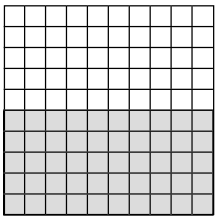
1. 1/4 _____ 1/2 _____
2. 5/8 _____ 1/2 _____
3. 1/6 _____ 1/2 _____
4. 4/5 _____ 1/2 _____
5. 2/3 _____ 1/2 _____

III. Write the fraction (in simplest form) and the decimal that describes the shaded region of each figure. Use your knowledge of writing equivalent fractions to check your answers.



Example: $\frac{4}{100} \frac{\text{(divided by 4)}}{\text{(divided by 4)}} = \frac{1}{25}$

1/25 = .04

_____ = _____ _____ = _____ _____ = _____ _____ = _____ _____ = _____

Matter

Look around the classroom and list ten things that you see. All these things are matter. Matter is anything that has mass (weight) and takes up space. Three forms (states) of matter are solid, liquid, and gas. Your pencil, desk, and paper are examples of solid matter. Water, milk, and juice are examples of liquid matter. Gases are things such as the air you breathe, the air you exhale, and the helium that fills balloons.

Some matter can be found in more than one state. Water is a good example. Under normal conditions, water is a liquid. However, when the temperature drops below 0° C, it changes to a solid state in the form of ice. When the temperature of water is increased to 100° C or higher, it will begin to boil and produce steam. Steam is water in the gaseous form. Water vapor in the air is also a gas which we call humidity.

Some metals, such as iron, are solid until they are put under very high temperatures. Then they become a liquid or molten. Lava is in a molten state, but as it cools it becomes a solid. Mercury is a metal that is in liquid form in its natural state.

Carbon dioxide is a gas in its normal state, but in very low temperatures it will change into a solid form. We call this form dry ice. It is called dry ice because it does not melt like ordinary ice. Instead, it goes directly from a solid to a gas. Dry ice makes a smoky appearance as it melts.

Review Exercises

1. List five objects that are solid.

2. List five objects that are liquid.

3. List five gases.

4. What makes a solid turn into a liquid?

5. What makes a liquid turn into a solid?

6. Define “molten.”

7. List as many metals as you can.

Moving Molecules

Purpose To investigate that molecules are always moving.

Materials

beaker or jar
food coloring
water
eyedropper

Procedure

1. Fill the beaker or jar 2/3 full with water.
2. Place beaker or jar in an area where it can be observed without being disturbed.
3. Let the water "settle" for a few minutes.
4. Add 4-5 drops of food coloring to the water.
5. Observe what happens to the food coloring.
6. Record your observations at the time intervals listed in this chart.
7. Clean and restore materials.

Time	Observations	Picture of Observations
0 min		
30 sec		
1 min		
1 min & 30 sec		
2 min		
3 min		

Conclusion

1. Are molecules always moving?
2. Explain what happened to the food coloring and why.

Teacher Answer Key

Fraction Relationships

I. 1. 1/2
2. 3/4
3. 2/5
4. 5/6
5. 7/8
6. 1/10

II. 1. Left side
2. Right side
3. Left Side
4. Left side
5. Right side
6. Right side

III. 1. 1/4 = 0.25
2. 1/2 = 0.50 or 0.5
3. 2/25 = 0.08
4. 3/10 = 0.03
5. 47/100 = 0.47