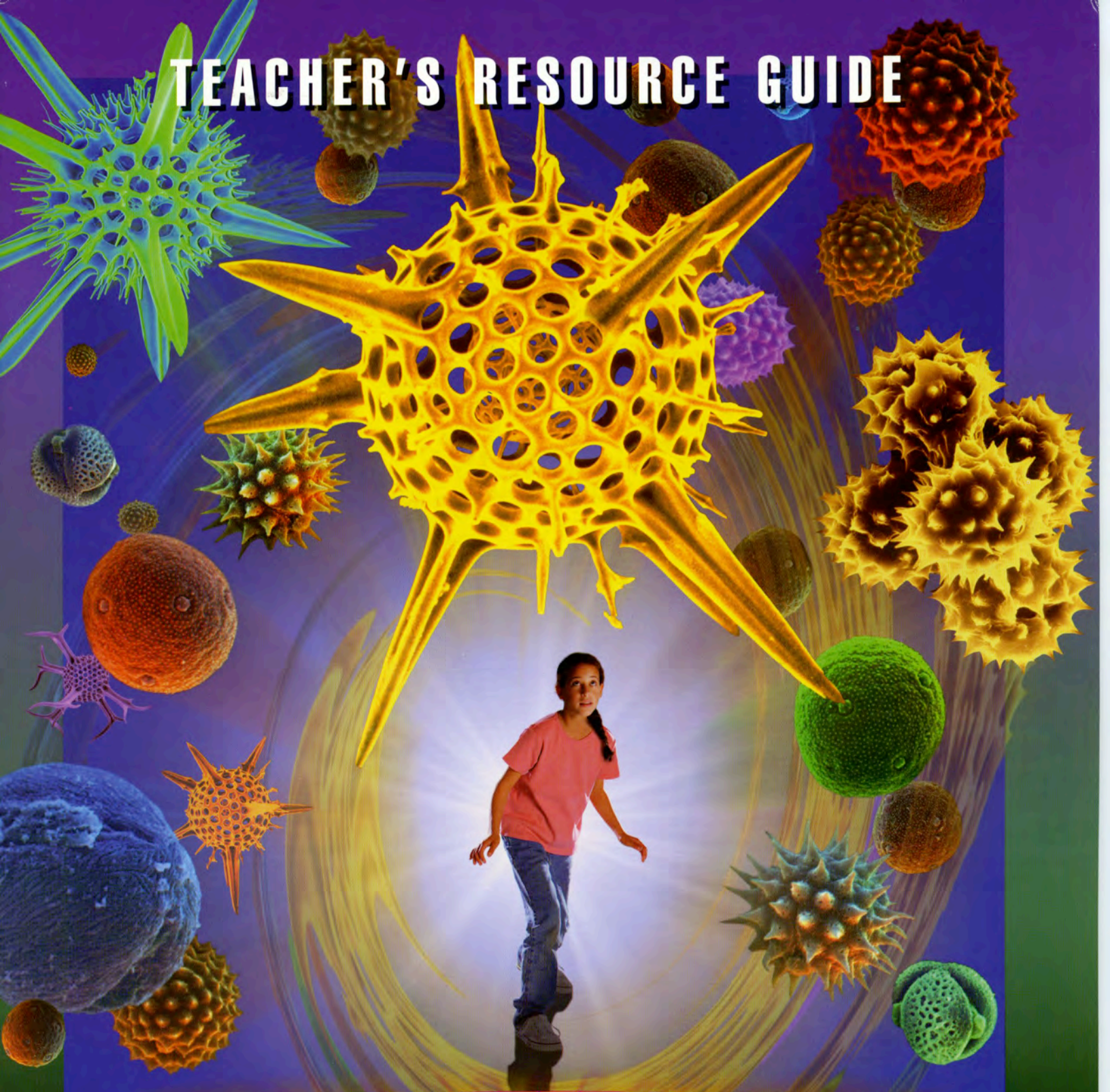


TEACHER'S RESOURCE GUIDE



THE HIDDEN DIMENSION

AN
IMAX[®]
EXPERIENCE[™]
AVAILABLE IN 2D AND 3D

Introduction for Teachers

The Hidden Dimension is the story of a girl who visits her grandfather's house and the lessons she learns about observation and perception. Imax Corporation and ABC/Kane Productions are proud to present this resource guide for use in conjunction with this unique film. This guide will assist teachers in preparing students to view the film and to follow up with discussion and activities. The guide is intended as a classroom supplement for elementary and middle school grades, and is consistent with U.S. National Science Standards published by the National Research Council. The activities support curricula in general science, earth science, environmental studies, language arts, and creative writing.



The material is designed to be flexible, and teachers may modify and duplicate the copyrighted materials to suit their students' needs. Film Synopsis, Program Objectives, and Target Audience information is provided for the teacher. In addition, Pre-and Post-Screening Discussion questions are included to prepare students to view the film and assess student reactions after viewing. Activities have been set up as double-page spreads. Right-hand pages have been designed as reproducible activity masters; left-hand pages contain materials and suggestions for teachers for using the reproducible masters with students. Teachers will find responses to questions in all four activities within the Background Information section.

We hope this guide will enhance your and your students' viewing experience of The Hidden Dimension.

Film Synopsis

Set in her grandfather's enchanted home, *The Hidden Dimension* takes the viewer along with a young girl named Elly on an adventure not unlike that of "Alice in Wonderland". Led by a series of whimsical clues left by her grandfather, an eccentric inventor, Elly embarks on a journey which opens her eyes and her imagination to the world that surrounds her.

Awaking to a playful bubble machine, young Elly discovers several keys, each opening successive layers of imagination and experience. One key, hidden in a wind-up toy, reveals the magic in the world around us. Another allows us to penetrate a less visible world seen through the lens of a microscope. Finally, even her parents get caught up in the intrigue as Elly discovers the *Illuminator*, a curious contraption created by her grandfather, which leads her into an infinite, magical and richly-detailed universe concealed within her everyday world.

The power of the IMAX medium, special photographic techniques such as macro and microphotography, electron microscopes and Schlieren imaging takes viewers along on a fascinating journey unlike anything ever experienced.



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Pre-Screening Discussion

1. The central themes of this film are observation and perception. Ask students: Is there a difference between seeing and observing? As an illustration, try the following activity. Arrange beforehand to have a colleague step into the room for one moment. After the colleague leaves, ask students to write down a description of what your colleague wore. Allow time to compare students' responses. Ask: How many students actually observed the visitor's clothing accurately? Assist students in understanding the value of careful observation.
2. Ask students: What is a microscopic particle? What kinds of microscopic particles might be found in your classroom? your home? outdoors?
3. The action of the film takes place with one important character absent from the home. This character leaves clues as to the kind of person he is and what he does. Ask students: What are some ways you leave clues for others that tell who you are and what you do? For instance, do students bring books or musical instruments to school? What do these say about the student?

Program Objectives

- To enhance students' appreciation of the world around them—including nature, energy, the world of microscopic particles, and more.
- To encourage practice in observation skills.
- To instill appreciation for the way in which our actions affect the world around us, including the natural world.
- To help students practice written and oral communication skills, and strengthen observation and critical thinking skills.

Target Audience

This guide is designed for teachers and students in elementary and middle school who view the film *The Hidden Dimension* at an IMAX theatre.

Post-Screening Discussion

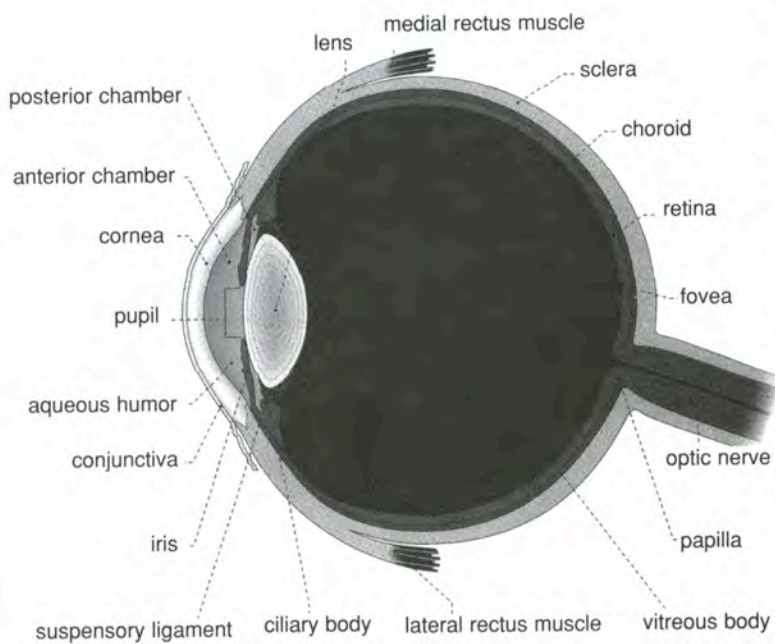
1. Compare the students' reactions to the film with their pre-screening expectations. What new information did they learn? What surprised them?
2. How did watching the film with its large-screen format differ from television and other movie experiences? How did the differences affect your viewing experience?
3. In the film, Elly's grandfather encourages her to look closely at the different forms of things around her. Discuss: What is the relationship between form—that is, how an object appears—and function, that is, how it works? Discuss: How does the form of the wind-up-duck from the film, for instance, tell what it does? (If we had not seen the wind-up-duck in action, we might guess that the wheels were for locomotion, the key for winding and providing power, and the propeller shaft for turning the propeller. We might also guess that the object was for amusement since real ducks do not have wheels.) Ask: How does the form of some other items from the film provide clues as to what the items do?



Background Information

How We See

The way in which our eyes and brain work together to produce images is amazing. Light rays from an image travel to the eye. The cornea, the protective surface of the eye, helps to focus the light. The iris controls the amount of light that passes through the pupil to the lens. The lens helps focus light on the retina, which contains a layer of light-sensitive cells. These cells send signals to the brain by way of the optic nerve. The brain interprets those signals. Our brain, for instance, combines the two separate images



seen by our right and left eyes into a single, three-dimensional image.

The retina contains two kinds of cells that are sensitive to light—cones and rods. The cones respond to bright light and different light wavelengths. This allows us to see colors. The rods are sensitive to faint light, but not to colors. This allows us to see in partial darkness.

Marvelous Microscopes

A microscope is a unique device that allows us to see things too small to see with the eye alone. Microscopes have revolutionized the study of science and medicine. In the area of human health, in particular, microscopes tell us

much about the workings of the body. A microscope focuses light or other radiation through one or more lenses to provide an enlarged image of a specimen. A microscope is related to other optical instruments such as a magnifying glass, telescope and binoculars.

Although we usually think of science and technology as ultra-modern, the microscope is one invention that has been around a long time. Microscopes in some form have existed for nearly 400 years! The earliest microscope-like instrument dates from the early 1600s when a father-and-son team of Dutch lens makers, Hans and Zacharias Janssen, first developed a pair of lenses mounted on a sliding tube. Anton van Leeuwenhoek is usually considered the founder of microbiology. He was the first to develop a special microscope lens to aid in the study of bacteria and blood cells.



Improvements in the microscope also led to the work of English scientist Robert Hooke, who observed thin slices of plants and coined the term “cells.”

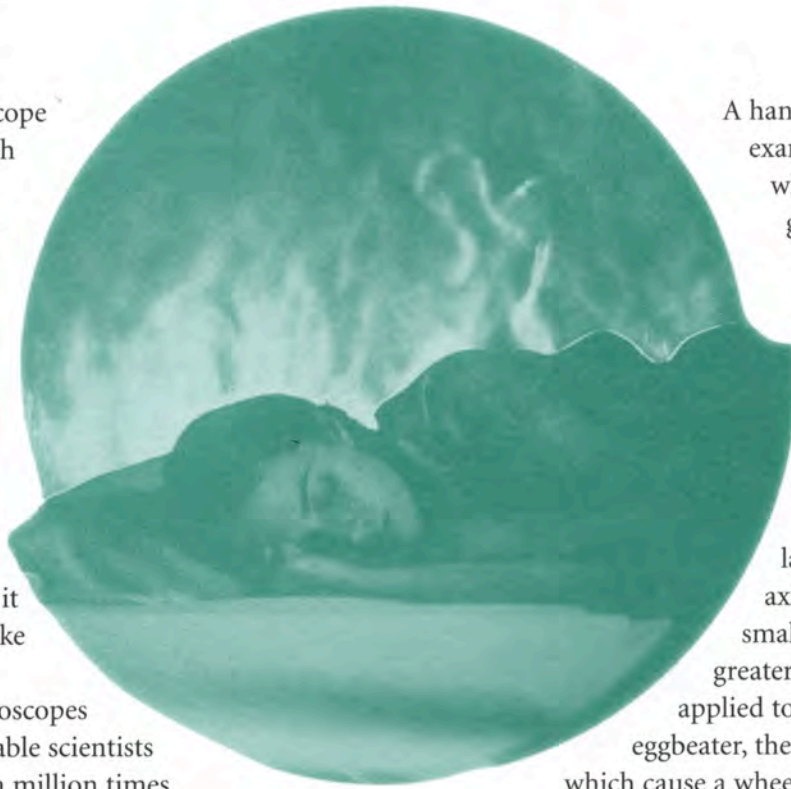
Over the years, additional improvements took place and by 1900, the compound microscope had, for the most part, evolved to its present form. Today, a number of advanced microscopes make it possible to do even more—like observe specimens without staining them. Electron microscopes have been developed that enable scientists to magnify an object over a million times.

Electron microscopes work in a different way than light microscopes. They produce a black-and-white image that may be colored with the help of a computer, but normally they cannot be used with living specimens. A scanning electron microscope gives an almost three-dimensional image.

Simple Machines

We often think of machines as large, noisy metal objects that do complicated jobs—such as a computer, a dishwasher or an automobile. Actually, a machine can be quite simple, a clock, a wind-up toy, and microscope, for instance, all make use of simple machines.

Some simple machines include: wheels, axles, gears, levers, wedges, inclined planes and pulleys.

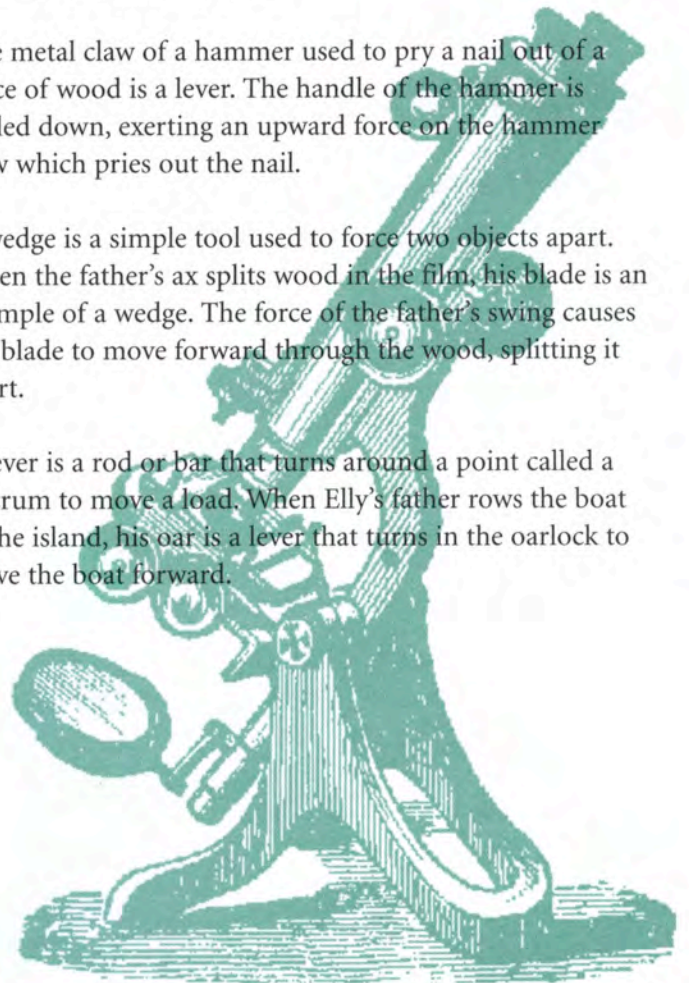


A hand-held eggbeater is an example of a collection of wheels, axles and gears. A gear is actually a wheel with teeth that interlock into the teeth of another gear. Working together, gears can magnify a force. A wheel turning an axle also magnifies force. Because the wheel is larger than the axle, the axle therefore turns in a smaller circle, but with greater force. When force is applied to the handle of an eggbeater, the handle turns gears, which cause a wheel and axle to turn. The axle moves less than the wheel but with greater force, causing the beaters to beat.

The metal claw of a hammer used to pry a nail out of a piece of wood is a lever. The handle of the hammer is pulled down, exerting an upward force on the hammer claw which pries out the nail.

A wedge is a simple tool used to force two objects apart. When the father's ax splits wood in the film, his blade is an example of a wedge. The force of the father's swing causes the blade to move forward through the wood, splitting it apart.

A lever is a rod or bar that turns around a point called a fulcrum to move a load. When Elly's father rows the boat to the island, his oar is a lever that turns in the oarlock to move the boat forward.



Worlds Within Worlds

Materials Needed

One activity sheet per student.

Objectives

This activity focuses on objects too small to be seen with the naked eye. Students are asked to put their hypothesizing skills to work and to stretch their imaginations with creative visualization and story-writing. Use the activity master on the facing page to guide the activities.

Part A

1. Ask: What is a microscope? (Answer: an instrument used to see very small objects.) A microscope can magnify an object clearly up to 2,000 times its size. An electron microscope can magnify up to one million times.
2. Ask students to look at Part A of the activity sheet. Explain that the pictures show objects seen under a high-powered microscope. Ask students to guess what each object is and write their answer in the blank. Have students compare responses and share the correct answer for each photograph.
 1. *Velcro*
 2. *Madagascar moth wing*
 3. *Jumping Spider*
 4. *Peppercorns*

Then have them discuss: What are some of the other "hidden" objects that might be found in their homes?

Follow-up Activity

The world is full of fascinating things to see. Ask students to bring in samples of such items as a toothbrush, a piece of

torn cloth, moss, leaves, soil, sand and so on. Divide students into groups with one magnifying glass and several samples for each. First, ask students to describe each item as seen with the naked eye. Then have them describe each item viewed with the magnifying glass. Have each group record the color, shape, size and texture of the different samples and compare.

Related Activity

Have students research the evolution of the microscope, focusing on these questions:

- Who invented the first simple microscope?
- What early scientists contributed to the microscope's development?
- What changes have taken place in the design of the microscope in the past century?
- What is an electron microscope and how does it differ from a microscope that uses light?

Part B

Ask students to imagine what it might be like to be so small you could ride on the back of a dust mite through your home. Ask: What would you see that you don't see now? What would it be like to take a hike through a "jungle" of house plants? What if you were chased by a spider? Have students develop their ideas into fantasy stories and write their stories on the activity sheet.

Related Activity

Bring bubble wands and bubble-making solution to class. Let students enjoy blowing bubbles as a precursor to critical thinking and writing. Ask students to observe the bubbles carefully. Ask: What colors do you see when you look at a bubble? What shapes? Have students discuss or write their response to the question: What is it like inside a bubble? Is there air?

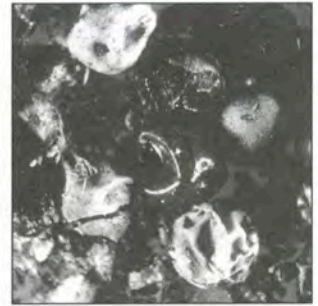
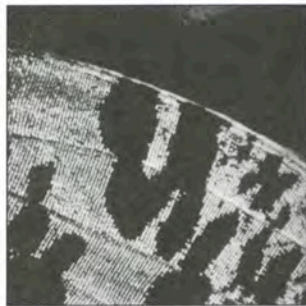
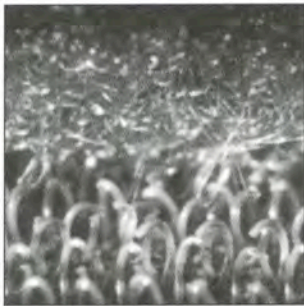


Worlds Within Worlds



Part A

A microscope helps us see things that are too tiny to see with our eyes alone. Microscopes have been around in some form for nearly 400 years! The pictures below were taken with a high-powered microscope. Under each example, write your guess as to what the object is.



Part B

Imagine the microscopic world within your own home. On the lines below, finish this story. Use the back if you need more room.

I was sitting at home when I felt myself growing smaller and smaller. In no time at all, I was the size of a tiny speck. Suddenly, I saw something in the distance. It was coming toward me, moving faster and faster. . .



What's That You See?

Materials Needed

One activity sheet per student.

Objectives

To provide a framework for improving observation skills. Students practice observing, comparing, recalling and predicting.

Part A

Ahead of time, place six to ten objects on a desk at the front of the class. Cover the objects with a cloth. Allow students 90 seconds to observe the objects uncovered. Then cover the objects back up and ask students to describe what they have seen, writing their answers on the activity sheet. Have them compare their responses and note differences.

Follow-up Activity

Challenge students to try the activity again, using different objects and writing on the back of their sheets. Did they observe more carefully the second time?

Related Activity

On a separate sheet, have students list all the items in the classroom that are a particular color. Generate a class list of observed items and have students compare their individual lists to it.

Part B

1. Have students look at Part B of the activity sheet. Different kinds of patterns are pictured. For each kind of pattern, have students name an example found in the world around us. Examples:
 - Repeated pattern—a fence or the teeth of a comb
 - Spiral pattern—a snail shell or spiral staircase
 - Symmetrical pattern—a butterfly or a human face
 - Random pattern—the spots on a speckled leaf or flower
2. Explain that many patterns have a reason behind them. Certain patterns, for instance, may help some wild animals and plants stay alive. Have students complete Part B of the activity sheet.

Part C

Discuss examples of optical illusions such as when a road in the distance looks like shimmering water. Explain that optical illusion toys were very popular in Victorian times. Students can make a simple optical illusion toy called a Thaumatrope by following the directions under Part C of the activity sheet. After students have made and spun their Thaumatrope, ask: What do you see when the disk is at rest? (Answer: A picture on either side.) What do you see when the disk is spinning? (Answer: A single picture.) Why? (Answer: The human eye cannot separate the two quickly moving pictures and fuses them together into a single picture.)

What's That You See?



Part A

In the film *The Hidden Dimension*, Elly learns that seeing is not the same as observing. Take a moment to practice your observation skills. Try to recall the objects on the table that you just observed. List each object below and tell what it looks like: its color, shape, size.

Object	Describe the Object
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Part B

Patterns are important in nature. The patterns of some creatures help them stay alive. For each example listed below, describe the pattern and tell what kind of pattern it is (whether repeating, spiral, symmetrical, or random). The first one has been done for you.



Repeating



Spiral



Symmetrical



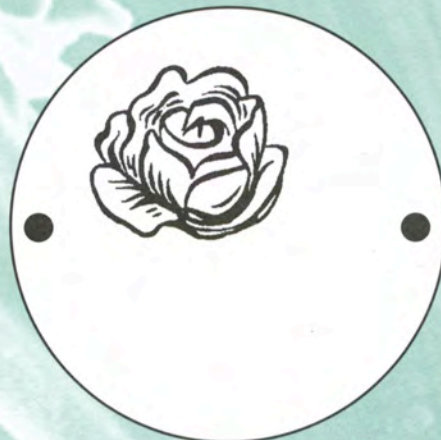
Random

Animal	Pattern	Kind of Pattern
zebra	stripes	repeating
tiger	_____	_____
leopard	_____	_____
snail shell	_____	_____
Dalmatian puppy	_____	_____
butterfly	_____	_____

Part C

Can appearances fool you? See what you think when you make a Thaumatrope. A Thaumatrope is an old-fashioned toy. It is a spinning disk with a different picture on each side. Here's how to make one.

- Step 1.** Cut apart the two circles at right.
- Step 2.** Tape or glue the circles back to back to make a round disk.
- Step 3.** Punch out the two small holes, using a hole punch.
- Step 4.** Tie a piece of string in each small hole. Hold both strings and twist them to spin your Thaumatrope. What happens to the two pictures when you spin the disk?



Simple Machines

Materials Needed

One activity sheet per student and examples of simple machines like a wheel and axle (a toy car), a gear (a hand-held eggbeater), a lever (a stapler), a wedge (a plastic wedge-shaped doorstop), an inclined plane (a piece of wood placed on a book at an angle) and a small pulley.

Objectives

To provide a framework for understanding the concept of a simple machine and to recognize some of the simple machines that play a role in everyday technology. Students are asked to focus on simple machines found in the objects around them.

Part A

1. Discuss the grandfather's inventive nature. Display the examples of simple mechanisms you have brought to class. Ask: What do these items have in common? (Answer: They all feature simple machines.) Explain that not all machines are big and noisy. Many are small and are used to do simple jobs. Whatever their size, all machines make a job easier to perform. Have students look around the classroom and identify additional examples of simple machines. Discuss: How do these machines work? How do they make our lives easier?
2. Distribute the activity sheet to students and ask them to complete Part A. Have students pick a room in their home and list three items in the room that make use of a simple machine. Have them fill in the information on the chart for each object.

Part B

Encourage students to visualize how their lives would be different without simple machines. Have them list answers to Part B of the activity sheet. Answers should be stated, however, using proactive language. For instance, without simple machines, you could not use a bus or car to get to school. You could not use a watch to be on time. Instead of answering "could not ride to school," or "could not use a watch," however, have students answer with what they *would* do instead, e.g., "would walk to school," or "would use a sundial to tell time".

Part C

1. Have students bring in examples of items from home that make use of a simple machine. Have each student in turn describe their item for the rest of the class without letting others see it. The speaker may only tell what the item looks like—not what it does or how it is used. Emphasize that speaking carefully is as important as listening carefully.
2. As the class listens, each student should list three clues to the object's identity. When the speaker is done, have students guess the object. Have the speaker tell what the object is used for. Allow students to change their guesses, if needed, based on the new information. Finally, have the speaker reveal the object. Discuss: Did anyone guess correctly?

Simple Machines



Part A

In the film *The Hidden Dimension*, the grandfather's home is full of inventions. Many of those inventions make use of simple machines. Pick one room in your home. List three items in that room that make use of a simple machine—an eggbeater (axle and gears) or a toy car (wheels and axle), for instance. Fill in the chart below, listing the object, what the object is used for and the simple machine (or machines) that are part of it: wheel and axle, gear, lever, wedge, inclined plane, or pulley.

Object	Object is Used For	Simple Machine
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Part B

We don't always notice the simple machines around us. But, do you think they make our lives easier? On the lines below, list some of the ways in which your life would be different without simple machines.

Part C

Listening carefully is just as important as seeing carefully. Your classmates are going to describe some objects. As each object is described, write at least three clues about it. Then, write your guess as to what the object is.

Object 1 _____

Clue 1: _____

Clue 2: _____

Clue 3: _____

I think the object is: _____

Object 3 _____

Clue 1: _____

Clue 2: _____

Clue 3: _____

I think the object is: _____

Object 2 _____

Clue 1: _____

Clue 2: _____

Clue 3: _____

I think the object is: _____

Object 4 _____

Clue 1: _____

Clue 2: _____

Clue 3: _____

I think the object is: _____

Fun With the Senses

Materials Needed

One activity sheet per student, rulers and small objects for students to examine.

Objectives

The world is a fascinating place just waiting to be explored. This section focuses on a variety of observation and sensory activities designed to help students improve thinking, questioning and observation skills.

Part A

1. You can choose to have students complete this part of the activity sheet outside in the schoolyard or inside at their desks. Ask: What does it mean to be a good listener? Why is this important? Indicate that some people are better at listening than others, but we can all improve our listening skills.
2. Ask students to describe four sounds that they hear within a defined time period and list a possible source for each on their activity sheet. Have students share their responses aloud. Did anyone hear something that is not on anyone else's list?

Part B

1. Ask students to recall some of the ways other than seeing in which Elly understands information about the different objects in the film. (Answer: by using her sense of touch and by using her critical thinking skills.) Challenge students to suggest senses other than seeing that they might use to learn about different objects. For instance, in nature, they might listen to the calls of birds, smell a flower, or touch the bark of a tree.
2. Have students complete Part B of the activity sheet. Discuss answers. Have the class vote on the most creative "exploration" techniques.

Part C

1. Ahead of time, collect small, not-so-easily-identified objects for students to examine: flowers, erasers with an unusual shape, or small toys, for example. You will need one object per student and a box for collecting all the objects.
2. Remind students that the emphasis in the film *The Hidden Dimension* is on observation. Ask: What other senses can we employ to experience an object? Then, explain that students are to close their eyes and examine an object that you will place on their desk. Proceed as outlined, then collect the objects in the box and have students open their eyes. Ask students to fill in the blanks for their object on Part C of the activity sheet.
3. Discuss responses. Then pass around the box full of objects and have students identify theirs. Did anyone guess correctly?

Fun With the Senses



Part A

Are you a good listener? Here's an experiment to test your listening skills. On the lines below, describe four non-human sounds that you hear. Write what each sounds like—a buzz, a siren, a squeak, or a clicking noise, for instance. Then write who or what made the sound.

Describe the Sound

Sound Made By

Part B

In the film *The Hidden Dimension*, Elly learns there are many ways to explore an object: with her eyes alone, with the help of a microscope, or by touch, for instance. For each example below, name three creative ways to explore the object. The first example has been done for you.

apple smell an apple blossom
 taste a glass of apple juice
 plant an apple seed and watch it grow

water _____

star _____

sand _____

Part C

Here's an activity to test your senses. Your teacher will ask you to close your eyes and examine an object placed on your desk. After you are asked to open your eyes—but before you see the object itself—describe it carefully by filling in the blanks. Include your guess as to what the object is.

Object Description

size: _____ shape: _____
texture: _____ smell: _____
sound: _____ taste: _____

I think the object is: _____

Additional Resources

Books

101 Physics Tricks: Fun Experiments with Everyday Materials

Terry Cash
New York:
Sterling Publishing Company, 1992.

Extremely Weird Insects

Sarah Lovett
Santa Fe: John Muir Publications, 1991.

Incredibly Small (Frontiers of the Invisible)

Nina Canault
Parsippany, N.J.:
New Discovery Books, 1993.

Janice VanCleave's Microscopes and Magnifying Lenses

Janice VanCleave
New York: John Wiley & Sons, 1993.

Microaliens: Dazzling Journeys with an Electron.

Howard Tomb.
New York:
Farrar, Straus & Giroux, 1993.

The Microscope Book

Shar Levine
New York: Sterling Publishers, 1996.

Optical Illusions

Laurence B. White, Jr. and Ray Broekel
New York: Franklin Watts, 1986.

The Secret House

David Bodanis
New York: Simon & Schuster, 1986.

The Way Things Work

David Macaulay
Boston: Houghton Mifflin, 1988.

You Won't Believe Your Eyes

Catherine Grace
Washington, D.C.:
The National Geographic Society, 1987.

Video

The Secret Life of 118 Green Street

Dennis Kane Productions, 1993.
50 minutes.

Web Sites

If you or your students have access to the Internet, you may want to browse the World Wide Web for more information about topics discussed in the film.

<http://www.imax.com>

This web site offers a worldwide map of IMAX® theatres, show times, and more information about the IMAX format.

<http://www.npac.syr.edu/textbook/kidsweb/biology.html>

See the world through the eyes of a honeybee at this site sponsored by Syracuse University.

<http://www.its.nbs.gov/features/kidscorner>

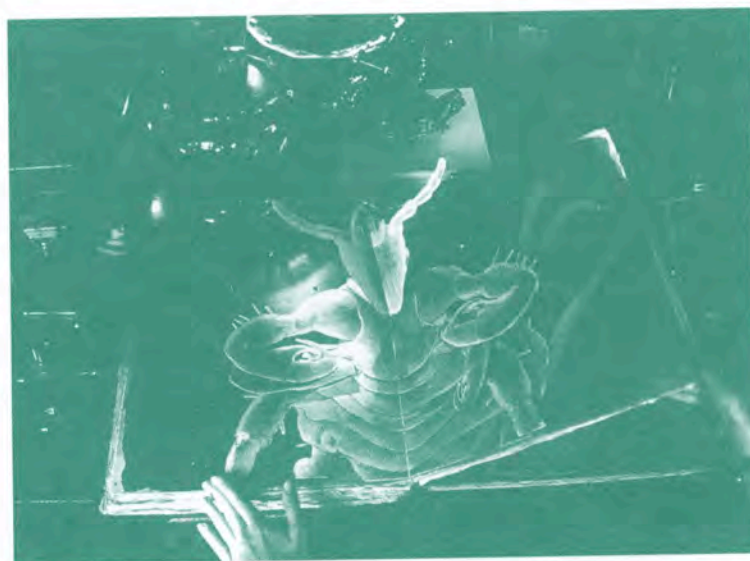
Learn more about the natural world at this site sponsored by the U.S. Department of the Interior.

http://www.duke.edu/~tj/hist_mic.html

History of the Light Microscope by Thomas E. Jones lets you find out more about the development of this scientific instrument.

<http://www.invent.org/book/index.html>

Discover more about inventors and inventions at the National Inventor's Hall of Fame.



Acknowledgments/Credits

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Film Credits:

IMAX CORPORATION and ABC/KANE PRODUCTIONS Present "THE HIDDEN DIMENSION"
Starring CHARLOTTE SULLIVAN C. DAVID JOHNSON
GOSIA DOBROWOLSKA and Featuring the Voice of JAMES GARNER
Director of Photography VIC SARIN, c.s.c.
Narration Written by MARC STRANGE
Music by RICHARD ROBBINS
Executive Producers ANDREW GELLIS DENNIS B. KANE and JONATHAN BARKER
Produced by SALLY DUNDAS BARBARA KERR and LORNE ORLEANS
Directed by PAUL COX



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**THE HIDDEN
DIMENSION**

A Presentation of IMAX CORPORATION and ABC/KANE PRODUCTIONS.