Lights, Lasers, and Optics

Grades K-2
Anti Gravity?

Summary: Students will extend activities with the Anti-gravity mirror that was introduced in the IDEA Place. Students will identify gravity and its forces.

NCTM Standards: Standard 3—Mathematics as Reasoning

National Science Standards: Physical Science
Position and motion of objects

Objectives:
To identify gravity and how to overcome the forces of gravity.

Materials:
1 small baby food jar
1 straw
red or blue food coloring
clay, a piece the size of a marble

Procedures:
1. Press the clay against the inside of the bottom of the jar.
2. Fill the jar one-half full with water.
3. Add three or four drops of food coloring to the water and stir.
4. Slowly lower the straw into the colored water.
5. Push the bottom end of the straw into the clay. The straw can now stand in a vertical position.
6. Quickly turn the jar upside down over a sink.
7. Turn the jar right side up and set it on a table.
8. Observe the liquid level inside the straw, if any.

Assessment: Teacher observation of students’ class participation.


Submitted by Dorothy Watson
Kaleidoscope

Summary: Students will extend the "Duck Under Kaleidoscope" and "Hinged Mirrors" activities that were introduced at the Idea Place. Students will create images with two and three mirrors.

NCTM Standards: Standard 6—Number Sense and Numeration
Standard 9—Geometry and Spatial Sense

National Science Standards: Science as Inquiry
Abilities necessary to do scientific inquiry

Objectives:
To create images with two and three mirrors. To record data.

Materials:
mirrors          crayons
masking tape      activity sheet

Procedures:
1. Make hinged mirrors by taping two mirrors together along one edge so that they bend.
2. Give a hinged mirror and crayons to a small group of children and have them freely explore their materials.
3. Have children place a crayon between the mirrors so that the point of the crayon touches the point where the two mirrors have been joined.
4. Ask children to count the number of crayons they can see.
5. Record this information on the activity sheet.
6. Have children repeat steps 3-5, moving the mirror closer together or farther apart (according to the activity sheet).

Background Information: Plane mirrors use light to produce a virtual image. A mirror reflects light to produce an image. Plane mirrors are used in homes and automobiles. Hinged mirrors are made by taping or fastening two or more plane mirrors together. The numerous images one sees are simply reflections of reflections. The number of images depends on how close or far apart the mirrors are and the number of mirrors used.

Assessment: Teacher observation of students and completed activity sheets.

Submitted by Marie Bryant
<table>
<thead>
<tr>
<th>When The Mirror Was Open This Far</th>
<th>We Could See</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Triangle 1]</td>
<td>crayons</td>
</tr>
<tr>
<td>![Triangle 2]</td>
<td>crayons</td>
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<tr>
<td>![Triangle 3]</td>
<td>crayons</td>
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<tr>
<td>![Triangle 4]</td>
<td>crayons</td>
</tr>
<tr>
<td>![Triangle 5]</td>
<td>crayons</td>
</tr>
</tbody>
</table>
Make a Kaleidoscope

Summary: Students will extend the “hands-on” kaleidoscope activity that was introduced in the IDEA Place. They will create an original kaleidoscope.

NCTM Standards: Standard 9—Geometry and Spatial Sense

National Science Standards: Physical Science
Light, heat, electricity, and magnetism

Objectives:
To discover that light travels in a straight line.
To discover that light bounces (reflects) off some surfaces.

Materials:
three 1” x 4” pieces card stock backed with silver mylar
transparent tape
3/4 oz. plastic portion cup
brightly colored clear plastic beads
toilet paper tube
two pieces of paper towel

Procedures:
1. Join the three pieces of mirrored stock to form a triangular prism using transparent tape along their long edges. Then fold over to tape third side to first (mirrors face inward).
2. Place a small amount of mixed colored beads in the portion cup and secure the lid in place. Position the filled cup in one end of the toilet paper tube.
3. Wrap the triangular prism in paper towel and place in the tube so that it fits snugly in the center of the tube.
4. Point the tube toward a light source and rotate as you look through the open end of the tube. Behold a kaleidoscope!
5. Optional: Decorate the outside of the tube.

Background Information: Plane mirrors use light to produce a virtual image. A kaleidoscope consists of two or more mirrors set at angles that provide many virtual images of the same objects. The objects used to create the colorful reflections may be little bits of colored glass or sand.

Assessment: Teacher observation of students. Teacher will interact with students as they construct the kaleidoscope and let them verbalize how light travels.


Submitted by Edith Hawkins
Make A Kaleidoscope

Materials:

- 3 - 1"x4" pieces of card stock backed with silver mylar
- transparent tape
- ¾ oz. plastic portion cup
- brightly colored clear plastic beads
- toilet paper tube
- 2 pieces of paper towel

Procedure:

1. Join the 3 pieces of mirrored card stock to form a triangular prism using transparent tape along their long edges.

2. Then fold over to tape third side to first (mirrors face inward).

3. Place a small amount of mixed colored beads in the portion cup and secure the lid in place. Position the filled portion cup in one end of the toilet paper tube.

4. Wrap the triangular prism in paper towel and place in tube so that it fits snugly in the center of the tube.

5. Point the tube toward a light source and rotate as you look through the open end of the tube. Behold a kaleidoscope!

Optional: Decorate the outside of the tube.

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Magic Mirrors

Summary: Students will extend the “hands-on” mirror activity that was introduced in the IDEA Place. They will explore the number of images produced when looking into a set of hinged mirrors.

NCTM Standards: Standard 9—Geometry and Spatial Sense

National Science Standards: Science as Inquiry
Abilities necessary to do scientific inquiry

Objectives:
To explore the number of images produced when looking into a set of hinged mirrors.
To record data after exploration.
To predict what would happen if you changed the angle of the mirror.

Materials:
hinged mirrors
“A Point of View” activity sheet
“Making the Most of Mirrors” activity sheet

Procedures:
1. Distribute mirrors and activity sheets. Have students place mirrors on dotted line above the bear.
2. Open and close the mirror to find 3 bears, 4, 6, 8 and more.
3. Place a mirror at the dot above the solid line. Open and close the mirrors. Describe what you see.
4. Describe how you can find more bears in your mirrors.
5. What is the greatest number of bears you can find in the mirrors?
6. Record your data on the activity sheets.
7. Describe what happens when the mirrors are on the dot above the line.
8. What happens when the mirrors are closed?

Background Information: Plane mirrors use light to produce a virtual image. A mirror reflects light to produce an image. Plane mirrors are used in homes and automobiles. Hinged mirrors are made by taping or fastening two or more plane mirrors together. The numerous images one sees are simply reflections of reflections. The number of images depends on how close or far away the mirrors are and the number of mirrors used.

Assessment: Observe the students as they predict the number of objects for spatial awareness.


Submitted by Glenda White
Making The Most Of Mirrors

Place an object or picture in front of the mirrors. Predict how many images can be seen altogether.

Use two hinged mirrors... place the mirrors on the dotted lines.

Look into the mirrors. Count and record the total number of objects.

Fig. A

how many? predict count

Fig. B

how many? predict count

Fig. C

how many? predict count

Fig. D

how many? predict count

Fig. E

how many? predict count

Observation: __________________________
A Point Of View

Let's explore:

Use the open mirrors... find 3 bears... find 4, find 6,... 8, 12... find more.

Explore some more: Place the open mirrors at the dot. open and close them.

Explore and describe what you see in the mirror as it opens and closes!

If you could crawl inside those mirrors and nearly close them tight, what might you see forming around you?

Why?
Looking at Shadows

Summary: Students will extend the “hands-on” hand shadows activity that was introduced in the IDEA Place. In this exhibit, students participated in creating shadow magic with their hands.

NCTM Standards: Standard 2: Mathematics as Communication

National Science Standards: Physical Science
Light, heat, electricity, and magnetism

Objectives:
To identify an object by the shadow that is cast when that object is placed in a beam of light.
To observe shadows.
To infer what an unseen object is by its shadow.
To communicate how the identification of the object was made.

Materials:
Bag of opaque objects: Small enough to put on an overhead projector, such as scissors, crayons, pine cone, wristwatch, seashell, etc.
Piece of poster board folded into thirds so that it will stand in front of the overhead projector like a screen to prevent the students from seeing the object placed on the overhead projector.

Procedures:
1. Have a student choose an object from the bag. Do not let the other students see it. Place it behind the screen on the overhead projector.
2. Darken the room. Turn on the projector. Have the students guess what the object is by looking at its shadow. Have them write down their guess on a sheet of paper.
3. After they have written down their guess, show the object. Talk about their guesses.
4. Take turns repeating steps 1, 2, and 3, until all of the objects in the bag have been used.

Background Information: Light travels in a straight line. A shadow is created when some of the light is blocked. Indoors, shadows are created when light from lamps and other indoor light sources are blocked. Outdoors, shadows are formed when objects get between the sun and the ground.

Assessment: Teacher observation of students. The teacher will also encourage the students to verbalize their thinking.

Submitted by Angela Nalitt
Shadow Shapes

Summary: Students will extend the Hand Shadows activity from the Light, Laser and Optics exhibit of the IDEA Place. Students will use light and various objects to explore how shadows form and change.

NCTM Standards: Standard 9—Geometry and Spatial Sense

National Science Standards: Physical Science
Light, heat, electricity, and magnetism

Objectives:
To identify shadows made by certain objects.
To explore how shadows form and change.
To identify shapes/patterns made by the objects’ shadow.

Materials:
white paper
crayons
flashlight
small objects (blocks, ball, miniature animals and shapes, etc.)

Procedures:
1. Working with partners, students will place an object of their choosing on white paper. With lights dimmed and the room darkened, another student will shine a flashlight upon the object.
2. When the object makes a shadow, instruct students to trace the outline of the shadow. Have students identify the following:
   
   What shape (plane figure) is made by the shadow?
   How is the shadow like/different from the original shape?
   How does the shadow change as the objects change?

3. Have students choose another object and repeat steps 1 and 2. Suggest students try holding the light in different angles and compare the changes as the light is moved.
**Background Information:** Shadows may change their size and shapes. The size varies with the amount of light reaching the object creating the shadow. The shape changes because of the angle at which the light strikes the object.

**Assessment:** The teacher will evaluate student learning through observation and careful monitoring of student activity.


Submitted by Kathy Conville Sims
Shadow Play

**Summary:** After viewing the Light, Lasers, and Optics Exhibit, students can make and trace their own shadows from different objects.

**NCTM Standards:** Standard 9—Geometry and Spatial Sense

**National Science Standards:** Physical Science
Light, heat, electricity, and magnetism

**Objectives:**
To determine how shadows are formed.

**Materials:**
white paper
crayons
flashlights
small objects (For example: ball, pencil, mug, orange, book, shoe)

**Procedures:**
1. Place an object on the paper. Shine a flashlight on the object.
2. If the object makes a shadow, trace the outline of the shadow. What shape is it? How is it different from the object? How is it the same?
3. Now choose another object and do the same things. Try holding the light in different places. How does the shadow change? How do you think shadows are made?

**Result:** Have the students infer what causes the shapes of shadows to change. (Moving the light source or changing the number of sources of light.

**Background Information:** Shadows may change their size and shapes. The size varies with the amount of light reaching the object creating the shadow. The shape changes because of the angle at which the light strikes the object.

**Assessment:** Teacher observation of students. The teacher will interact with students as they work and encourage them to verbalize their thinking.

*City-Light and Sound*, Addison-Wesley, Grade 2, Lesson 2.

Submitted by Alida Rachal & Edith Hawkins
Shadows

Summary: Students will extend the Hand Shadows activity from the Light, Lasers, and Optics exhibit of the IDEA Place. Students will experiment with shadows and recognize outlines and shapes of objects.

NCTM Standards: Standard 1—Mathematics as Problem Solving

National Science Standards: Physical Science
Light, heat, electricity, and magnetism

Objectives:
To experiment with shadows and recognize outlined shapes of objects.

Materials:
Cardboard
Two popsicle sticks
Flashlight
Scissors
Glue

Procedures:
1. Cut two circles from the cardboard: one slightly smaller than the lens of the flashlight and one twice as large.
2. Attach each circle to a popsicle stick.
3. Have one child stand a foot away from the wall and shine the flashlight straight at the wall.
4. Tell another child to hold the circles between the light and the wall, one at a time. The larger circle will cast a shadow much larger than its size, while the smaller circle will cast a shadow much smaller than its size. Be sure that the children hold the circles an equal distance between the light and the wall.

Background Information: Light travels in a straight line. A shadow is created when some of the light is blocked. Indoors, shadows are created when light from lamps and other indoor light sources are blocked. Outdoors, shadows are formed when objects get between the sun and the ground. Shadows may change their size and shapes. The size varies with the amount of light reaching the object creating the shadow. The shape changes because of the angle at which the light strikes the object.

Assessment: Teacher and students observe and students verbalize observations about the shadows.


Submitted by Carol B. Massey
Simon Shadow Says

Summary: Students will extend the “Hand Shadows” activity that was introduced in the IDEA Place. Students will create body shadows made by the sun.

NCTM Standards: Standard 9—Geometry and Spatial Sense

National Science Standards: Physical Science
Light, heat, electricity, and magnetism

Objectives:
To create body shadows made by the sun.

Materials:
Sunny day

Procedures:
1. Take students outside on a sunny day. Direct their attention to their shadow.
2. Discuss: What is making their shadow? What would make their shadow disappear? Help them understand that they are making their shadows by blocking the sun’s light.
3. Play a game of Simon’s Shadow Says. In the game, present ways for the children to explore their shadows. Some examples are shake your shadow, hide your shadow, lie on your shadow, and touch someone’s shadow.

Background Information: Light travels in a straight line. A shadow is created when some of the light is blocked. Indoors, shadows are created when light from lamps and other indoor light sources are blocked. Outdoors, shadows are formed when objects get between the sun and the ground. Shadows may change their size and shapes. The size varies with the amount of light reaching the object creating the shadow. The shape changes because of the angle at which the light strikes the object.

Assessment: Teacher observation of students.


Submitted by Staci Thomas