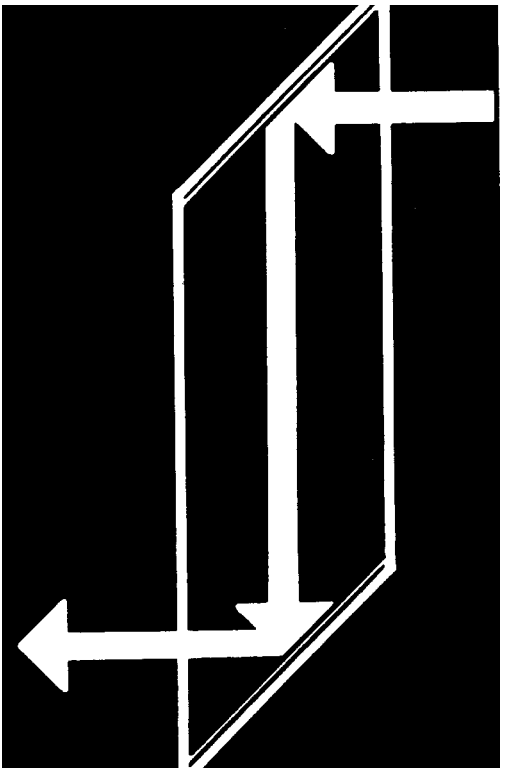


INVESTIGATIONS WITH MIRRORS

65546-05

STUDENT'S WORKBOOK

By Lawrence F. Lowery

STUDENT'S WORKBOOK FOR INVESTIGATIONS WITH MIRRORS

INTRODUCTION

Have you ever wondered what happens when light strikes an object? Did you notice that some objects reflect light (bounce it back), some absorb it, and others let it pass through? Did you realize that light "bounces"?

This package of materials will help you make many discoveries about light and how it can be used.

Exploration 1: Light and Objects

One way to organize objects is by the way light passes through them. If you had the following materials, how would you arrange them into groups according to the way they affect light?

water	paper bag	aluminum foil
chalk	cellophane	sandwich wrap
glass	mirror	plastic bag
leaves	wood	tissue paper
clouds		fog

Which materials prevent the passage of light? Which materials reflect light? Which materials allow the light to pass through?

Objects which permit the passage of light so that you can see images are called "transparent". Glass is a transparent material. Which objects in your package are transparent?

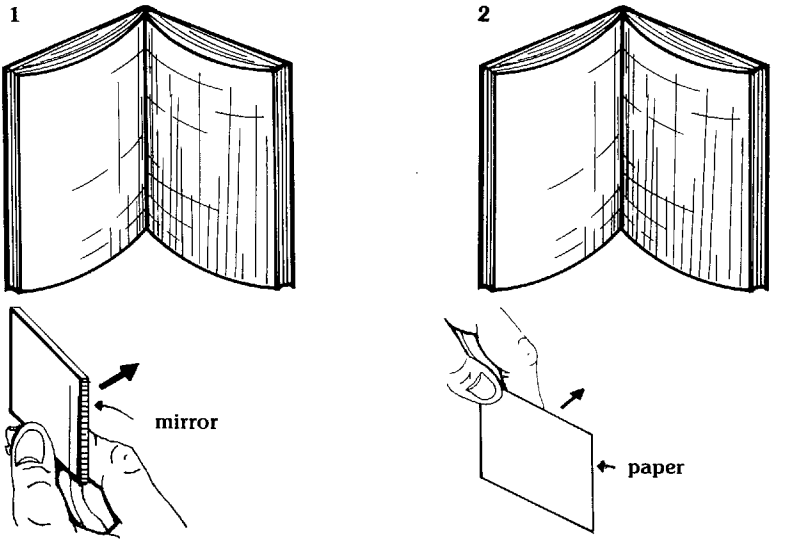
Objects which permit only part of the light to pass through are called "translucent". Frosted light bulbs are translucent. Which objects in your package of materials are translucent?

If an object does not let any light pass, it is called "opaque" Most objects are opaque. You are opaque. Opaque objects absorb or reflect light in different amounts.

Some objects reflect ("bounce") light more clearly than others. When light is reflected from a very smooth surface, such as a mirror, it is called "regular reflection". Take one of the mirrors from your package. It has a very smooth surface and reflects light very well. Can you reflect sunlight on the wall with your mirror?

Most objects produce "irregular (diffuse or fuzzy) reflections". Light does not bounce back from them in a clear way. In a darkened room, shine a flashlight upon several kinds of surfaces. Try the wall, a desk top, a piece of aluminum foil, a handkerchief, a window pane. Which objects give regular reflections? Which objects give irregular reflections?

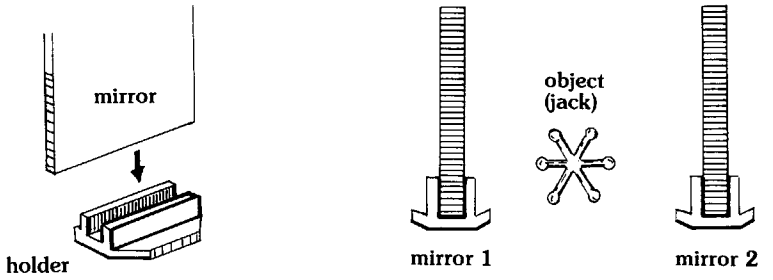
Some objects reflect light better than others. Set a book on your desk and open it up to a clean white page inside the front or back cover as shown in the picture. Place the book so that the page is in as dark a shadow as possible. Hold a mirror in front of the book but out of the shadow and in the light from the overhead lights in the room (or sunlight from the window). What do you see on the dark page?



Now hold a piece of white paper in place of the mirror. What do you see on the book this time? Is the effect the same? Try this again with a piece of dark or black paper. What happens this time? Compare the three tests. Which of the three objects (the mirror, the white paper, or the black paper) reflects light best?

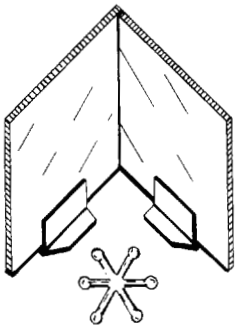
Exploration 2: Studying Reflection

You know that light reflects (bounces) from a mirror. What happens if you put one mirror directly opposite the other? Take the two mirrors from the package, place them in their holder and set them on a flat surface as shown. Put an object between them. Look into the mirror. What do you see? How is the light being reflected?

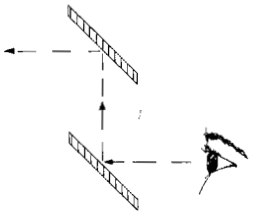


Place the two mirrors facing each other a few inches apart. Look over one into the other. How many mirrors can you see? Move them further apart. What happens to the size of the mirrors you see?

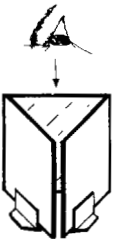
Now place the two mirrors at right angles to each other. Place an object between them. What do you see in the mirrors? Put a watch between them. Are you surprised by what you see? Write your name on a piece of paper and put it between the mirrors. What does the reflection do?



Set the mirrors parallel to each other as shown, about six inches apart. Make sure the front face of one mirror is facing the front face of the other. Place your eye in the position as shown in the picture and look at the face of the first mirror. What do you see? Move the mirrors further apart or closer together, taking care to keep them parallel. What do you see as you move the mirrors? Turn the mirror furthest from your eye slightly either way. What happens?

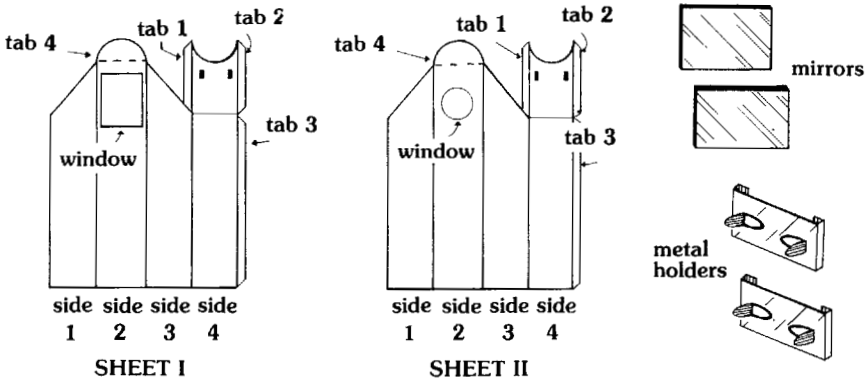


Borrow another mirror from your neighbor. Place the three mirrors on the table to form a triangle. Look down into the opening in the top. What do you see? Put a pencil straight down into the opening between the mirrors. What do you see? How many reflections do you see? Turn the pencil between your fingers and move it from side to side. What happens to its reflections in the mirrors?



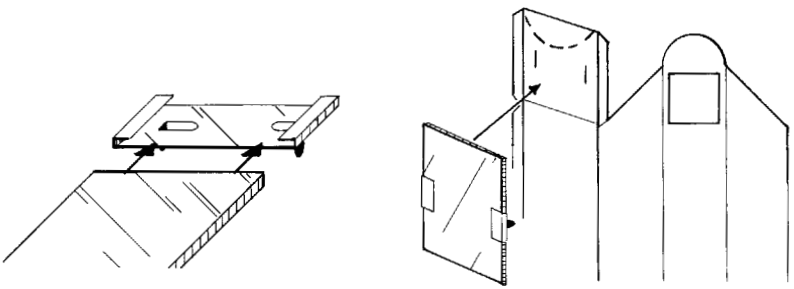
Exploration 3: Making a Periscope

With two mirrors, light can be reflected in many ways. Using mirrors, it is possible to see over high objects and around corners. To do this, put together the following materials from your package.



The cardboard sheets have creases in them. Carefully fold the cardboard sheets along the creases. Fold the creases away from the colored side. Make sure the folds are very sharp.

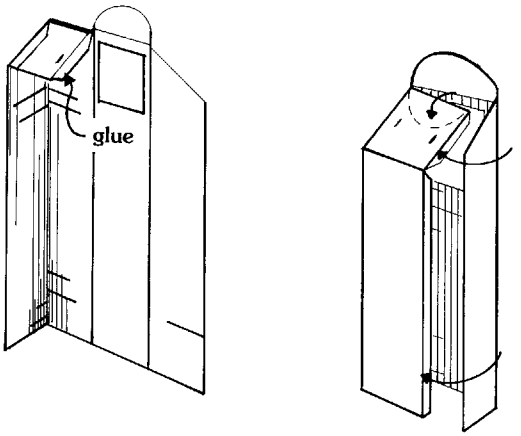
Punch the square window out of Sheet I. Set one of the mirrors in a metal holder. Fasten the holder into the slots on Side 4 of Sheet I. Be sure the mirror is fastened to the non-colored side of the sheet. Bend the tabs over to hold the mirror firmly in place.



You will need to use glue or rubber cement to put your periscope together. Rubber cement is best, but it must be used in a special way. Use it this way:

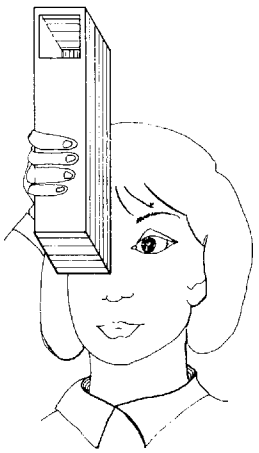
1) Spread a thin coat of rubber cement on both edges to be cemented.
2) Wait until both are sticky to the touch and not shiny.
3) Carefully and exactly fit the edges together. This cement sticks quickly, so be careful.
4) If rubber cement is smeared where you don't want it, rub it off with your fingers after it dries.

Glue Tab 1 to the inside of Side 3. Make sure it is glued firmly and that the corners are sharp. Next glue Tabs 2 and 3 to Side 1, forming a square tube. When these are dry, glue Tab 4 to the outside of Side 4.



Now punch out the round window in Sheet II. Set the second mirror into a metal holder. Fasten the holder into the slots on Side 4 of Sheet II. Fasten the mirror as you did with Sheet I. Fold and glue the tabs as you did for Sheet I.

When the glue has dried completely, slip the smaller tube into the larger one with the two openings facing away from each other. Look through the round opening. Compare what you see with the fourth experiment in Exploration 2.



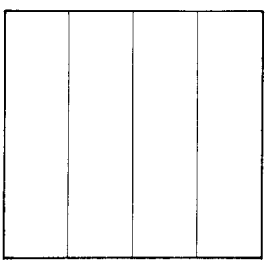
You have just made a periscope. Periscopes are used on submarines to see over the surface of the water while the submarine is submerged. You can use your periscope to look over fences or around corners. If you remove one of the tubes and turn it around, you can see behind you. How could you change your periscope to see to the right or the left? How would you use it to look under a table?

Additional Explorations

Move the tubes apart while looking through the round hole. Does this change what you see? What happens? Can you explain why it happens? Does what you see get larger or smaller? Does the square frame around what you see get larger or smaller as the tubes are moved apart?

Exploration 4: Making a Kaleidoscope

A kaleidoscope makes use of many reflections, using three mirrors. You will need the following parts.

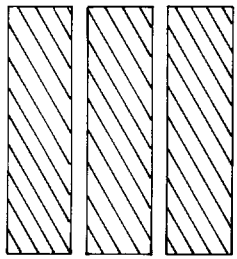


SHEET III

translucent triangles

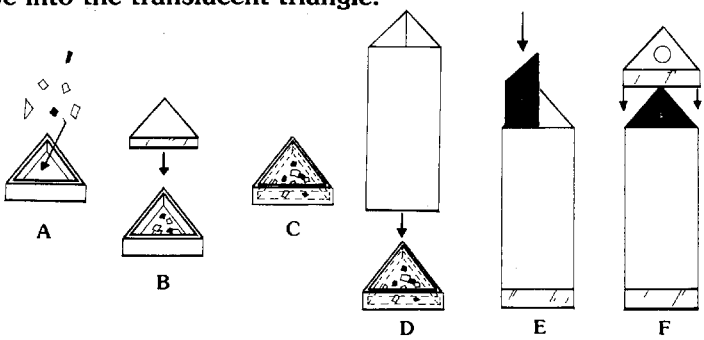
transparent triangle

colored pieces



black mirrors

Fold Sheet III along its creases carefully. Fold the sheet into a triangular tube. Pour the colored pieces into the translucent triangle that does not have a hole in it. Cover them with the transparent triangle. Be sure to place the transparent triangle so that the edges are down. This allows room for the colored pieces to move around. Slip the paper tube into the translucent triangle.



Look at the three strips of black plastic. Do they reflect light? Could they be used like mirrors? Slide them into the tube, one on each side. Slide the triangle with a hole in it over the open end of the tube. Hold the tube up to the light and look into the eyepiece. What do you see? Compare this with what you saw in the fifth experiment in Exploration 2. Turn the tube. Do the patterns change? How many reflections do you see? What other objects could you put into the kaleidoscope?

Dr. Lawrence F. Lowery is a professor of science education at the University of California, Berkeley. He has had extensive elementary and junior high school teaching experience, has written numerous films and books on science and has written many articles for teachers on science instruction.

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