

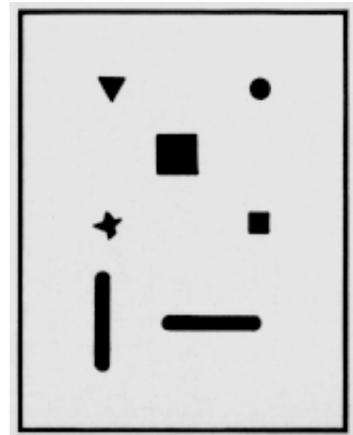
To Do and Notice:

You can duplicate Bob's demonstrations and go on your own Image Walk.

To get started on your own Image Walk, all you need is:

- a "Spots and Streaks" card you can make yourself
- a sheet of white posterboard measuring about 8 1/2 inches by 11 inches
- a sunny day
- a friend to help you hold the cards

Make a "Spots and Streaks" card using an X-Acto(TM) knife or single-edged razor blade and a sheet of stiff opaque paper or cardboard. (The cardboard from the back of a pad of paper will work fine.) In the cardboard, cut a square hole, a round hole, a triangular hole, and a star-shaped hole. Make sure that each hole is no more than about 3/16 of an inch across. Cut two slits that are about 3/16 of an inch wide, about 2 inches long, and at right angles to each other, and cut a square hole about 3/8 of an inch on a side.



[CLICK HERE](#) or on the picture to the right to get a full-size template of the "Spots and Streaks" card that you can print out on card stock and then cut out. (Your browser will need to have the ability to save an image...)

To complete the entire Image Walk, you'll also need:

- an "Array of Holes" card you can make yourself
- masking tape
- a mirror
- a piece of paper
- a large convex lens (such as the lens of a magnifying glass)

Make an "Array of Holes" card by cutting a square array of 8 holes wide by 7 holes high in one half of a Manila folder, making each square about 3/16 of an inch on a side with the centers 3/4 of an inch apart. You can also [CLICK HERE](#) to download a template to print and cut out. If all that cutting seems like too much work for you, you can also use a piece of pegboard from a local hardware supply store. See if you can get a piece with small holes.

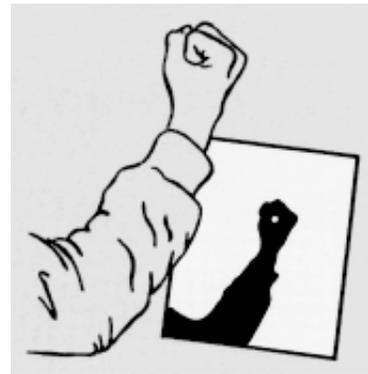
Start under a shade tree, where just a little sunlight leaks between the leaves. (For the best results, look for a short tree with dense foliage; a fir tree or a tall, thin-leaved eucalyptus won't work as well.) Hold the "Array of Holes" card between the sun and the ground, and notice that the spots of light on the ground are rounded. Each one is an image of the sun.

You can catch these sun images on your sheet of white posterboard.

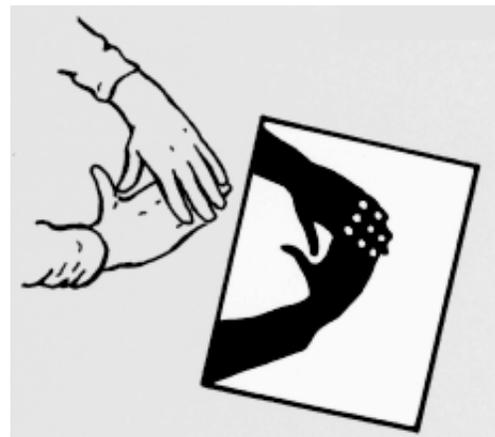
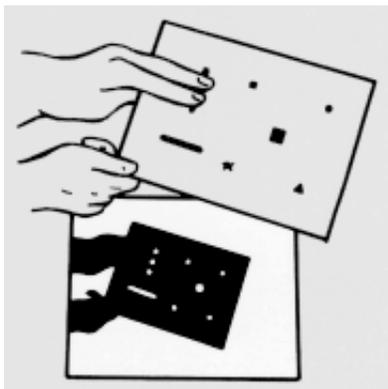


The spots are often oval, rather than round. That's because the sunlight is hitting the ground at an angle and the round sun images are stretching out to make ovals. Hold the posterboard so that it's perpendicular to the sun's rays, and the spots should become round. Throughout the Image Walk, be sure to hold your posterboard perpendicular to the sun's rays.

Have your friend hold the posterboard. Make your hand into a fist, leaving a small gap in the curl of your fingers. Hold your fist so that the sun shines through the gap onto the posterboard, which should be 6 to 8 feet from your hand. (The exact distance depends on the size of the hole: a small hole can make a sun image at just 3 feet.) Notice the sun image in the shadow of your hand.

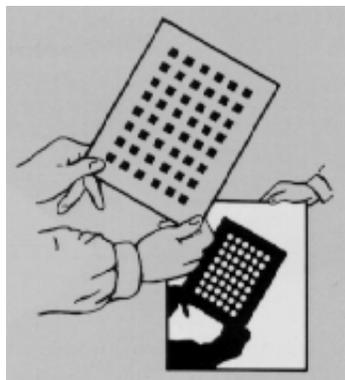


Hold your "Spots and Streaks" card about a foot from the posterboard and let sunlight shine through the holes. At this distance, the spots of light will be the shape of the holes. Gradually move the holes away from the posterboard. The spots will become more rounded. When the holes are about 6 feet from the posterboard, the spots will be round. As you move the holes even farther from the posterboard, the spots remain round, but get larger and larger.



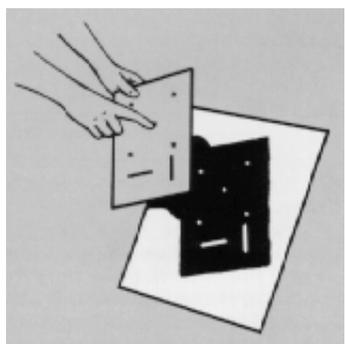
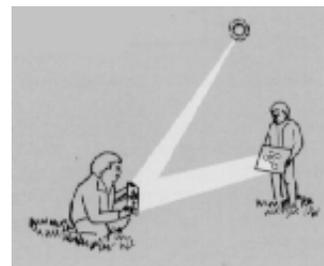
Let the sun shine through the slits to make long streaks on the posterboard. Use your fingers to divide one of the slits into smaller holes. Each small hole will give you a round sun image. Cross the fingers of your hands to make a handful of sun images. (You may have to

experiment to accomplish this. We've found that Bob's long, thin fingers are ideally suited to making sun images; those of us with short, stubby fingers have more difficulty.)



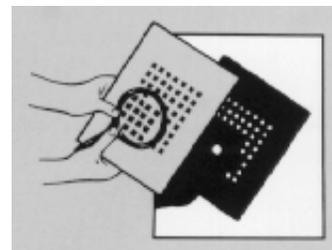
Use your "Array of Holes" card to make an array of sun images on the posterboard. As you move the card away from the posterboard, the images will begin to overlap. Notice that all the images are the same size. Use masking tape to make some of the holes a little smaller. (You can also make some of the holes a little bigger.) Now make another array of sun images. Although all of the images are still the same size, some will be brighter than others. The brighter images are from light shining through larger holes.

You can experiment with reflected sun images by tearing a few irregular holes in a piece of paper and then taping the paper to a mirror. Reflect light from the mirror onto the posterboard. If each hole measures about 1/4 of an inch across, you friend will need to hold the posterboard about 6 feet from the mirror. At this distance, the spots of reflected light will be round images of the sun, no matter what the shape of the holes in the paper.



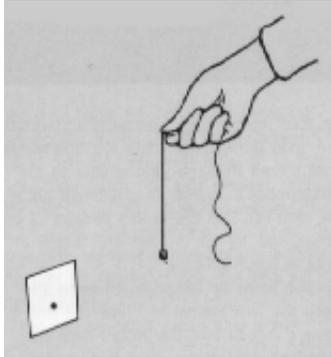
Find the larger square hole in the "Spots and Streaks" card. Cover most of the hole with your finger, letting the light pass through just one corner of the hole. Hold the hole about a foot from the posterboard and notice that the light makes a sun image. Move your finger to let light pass through the opposite corner as well, so that you have two sun images on the posterboard. Move the card away from the posterboard and notice that the images get larger and eventually start to overlap. If you move back far enough, the images get so large that they overlap almost completely.

Hold up your "Array of Holes" card to create an array of sun images. Hold a convex lens, such as the lens of a large magnifying glass, up against the card so that it covers a number of holes. Move the card closer to and farther from the posterboard, and watch what happens to the sun images. Try to find the distance at which the pinhole images focused by the lens overlap, creating a single, bright image of the sun.



Be careful! This bright image can be hot enough to burn you or your posterboard. During our testing of the Image Walk, a staff member noticed that the sun image focused by an inexpensive lens was surrounded by colored light. Why? Because white sunlight is made up of light of all colors, and a lens bends each color a slightly different amount. As a result, each color focuses in a different place.

Find the fuzzy shadow cast by something high above you, such as a tree branch or a telephone wire far overhead. Hold your "Array of Holes" card where the fuzzy shadow falls across it. Have your friend hold the posterboard screen so that you can see the images of the sun and of the branch or wire that blocks the sun. Notice that each image is a little different from the others. Put a 1/4-inch-square spot of masking tape on the mirror and reflect sunlight to the posterboard, held 6 to 8 feet away. Notice that the shadow in the light reflected from the mirror is round: a missing image of the sun.



You can also reveal a missing image of the sun by creating an opaque spot the size of one of your pinholes. Bob does this by slicing the eraser off the end of a pencil and stringing it on a piece of thread. The shadow of the pencil eraser cast on a piece of posterboard that's 8 or 9 feet away is a round missing image of the sun.

QUIT