Peripheral Vision

We are not usually aware of our eyes' limitations.


Perception


Life Science

This Snack is basically a large protractor that lets you test the limits of your *peripheral vision*. With the help of a friend, you can measure how much you can see out of the corner of your eye. You will find that you can detect motion at a wide angle, colors at a narrow angle, and detailed shapes at a surprisingly narrow angle.

materials

- ✔ **Posterboard, cardboard, foamcore,** or other stiff material, 1 x 2 feet (30 x 60 cm).
- ✔ **A pushpin** to use initially in drawing a circle, and finally as a point of reference.
- ✔ **A pencil.**
- ✔ **Scissors.**
- ✔ **1 piece of string** about 2 feet (60 cm) long.

✔ **A small plastic cup.**

✔ **One 6 inch (15 cm) length of 1 x 1 inch (2.5 cm x 2.5 cm) wood** or a few 3 x 5 inch (8 x 13 cm) file cards.

✔ **Glue.**

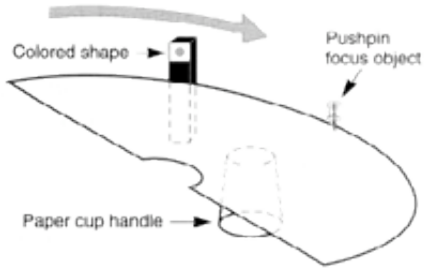
✔ **Marking pens** in different colors.

✔ **A partner.**

assembly

(30 minutes or less)

Stick the pushpin, point down, halfway along the 2 foot (60 cm) edge of the posterboard (or whatever board you use as a base). Tie the pencil to one end of the string, and wrap the other end of the string around the pushpin to improvise a compass. Draw a half-circle with a 1 foot (30 cm) radius. Now shorten the string and draw another, smaller half-circle, about 3/4 inch (2 cm) in diameter. Cut these both out (see the diagram on page 82). The small circle should be just big enough for your nose.



Now stick the pushpin in at the edge of the half-circle, directly across from the nose hole. This will be your focus object.

Use glue to attach the plastic cup to the bottom of the posterboard. The cup will serve as a handle.

Use the marking pens to draw simple shapes (such as rectangles, squares, and triangles), each in a different color, on the faces at one end of the length of wood, or on the file cards. This will allow you to reveal only one shape at a time.

to do and notice

(15 minutes or more)

Using the cup as a handle, hold the posterboard base up to your face and put your nose in the center hole. Have your partner hold the wood or file card so that it is against the curved side of the base, as far from the focus object as possible. Keep your eyes on the focus object while your partner moves the colored shape around the outside edge until you can see it. Note the angle.

Have your partner keep moving the colored shape toward the focus object. Note the angle at which you first detect color. Then note the angle at which you first discern the shape itself. Have your partner expose a different shape and repeat the experiment. You'll probably find that your partner has to move the wood surprisingly close to the focus object before you can make out color or shape.

what's going on?

Your *retina* - the light-sensitive lining at the back of your eye - is packed with light-receiving cells called *rods* and *cones*. Only the cones are sensitive to color. These cells are clustered mainly in the central region of the retina.

When you see something out of the corner of your eye, its image focuses on the periphery of your retina, where there are few cones. Thus, it isn't surprising that you can't distinguish the color of something you see out of the corner of your eye.

The rods are more evenly spread across the retina, but they also become less densely packed toward the outer regions of the retina. Because there are fewer rods, you have a limited ability to resolve the shapes of objects at the periphery of your vision.

In the center of your field of view is a region in which the cones are packed tightly together. This region is called the fovea. This region, which is surprisingly small, gives you the sharpest view of an object. The fraction of your eye covered by the fovea is about the same as the fraction of the night sky covered by the moon.

You can demonstrate this effect more simply by focusing on one of the words on this page while at the same time trying to make out other words to the right or left. You may be able to make out a word or two, depending on how far the page is from your eyes. But the area that you can see clearly is the area imaged on the fovea of your eye.

Generally, you are not aware of the limitations of your peripheral vision. You think that you have a clear view of the world because your eyes are always in motion. Wherever you look, you see a sharp, clear image.

Interestingly, your peripheral vision is very sensitive to motion - a characteristic that probably had strong adaptive value during the earlier stages of human evolution.

etcetera

You almost always need an assistant to do this Snack. As the colored shape approaches the center of your field of view, the temptation to cheat and move your eyes to look at the object becomes nearly irresistible. An assistant can watch you, and stop the experiment when you give in to temptation and move your eyes to look.

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