Up Periscope!

Build a mirrored tube that lets you see around corners and over walls.

What do I need?

- Two 1-quart milk cartons
- Two small pocket mirrors (flat, square ones work best)
- Utility knife or X-Acto knife
- Ruler
- Pencil or pen
- Masking tape

DANGER!
An X-Acto knife is very, very sharp. Have a grown-up do all the cutting in this activity.

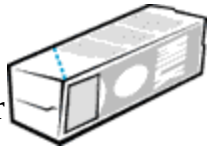
What do I do?

1 Use the knife to cut around the top of each milk carton, removing the peaked "roof."

2 Cut a hole at the bottom of the front of one milk carton. Leave about 1/4 inch of carton on each side of the hole.

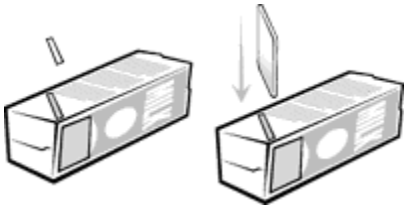
3 Put the carton on its side and turn it so the hole you just cut is facing to your right. On the side that's facing up, measure 2 3/4 inches up the left edge of the carton, and use the pencil to make a

mark there. Now, use your ruler to draw a diagonal line from the bottom right corner to the mark you made.



4 Starting at the bottom right corner, cut on that line. Don't cut all the way to the left edge of the carton-just make the cut as long as one side of your mirror. If your mirror is thick, widen the cut to fit.

5 Slide the mirror through the slot so the reflecting side faces the hole in the front of the carton. Tape the mirror loosely in place.



6 Hold the carton up to your eye and look through the hole that you cut. You should see your ceiling through the top of the carton. If what you see looks tilted, adjust the mirror and tape it again.

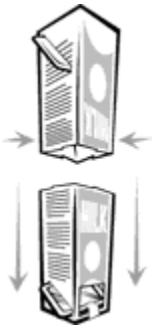
7 Repeat steps 2 through 6 with the second milk carton.

Wow! I Didn't Know That!

Periscope comes from two Greek words, **peri**, meaning "around," and **scopus**, "to look." A periscope lets you look around walls, corners, or other obstacles. Sub-marines have periscopes so the sailors inside can see what's on the surface of the water, even if the ship itself is below the waves.

8 Stand one carton up on a table, with the hole facing you. Place the other carton upside-down, with the mirror on the top and the hole facing away from you.

9 Use your hand to pinch the open end of the upside-down carton just enough for it to slide into the other carton. Tape the two cartons together



10 Now you have a periscope! If you look through the bottom hole, you can see over fences that are taller than you. If you look through the top hole, you can see under tables. If you hold it sideways, you can see around corners.

What's Going On?

What kinds of mirrors can I use to make a periscope?

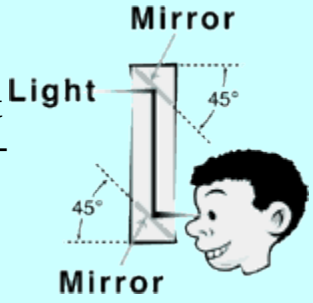
You need two small mirrors, but they don't have to be identical. If you have a rectangular mirror, or one with a handle, it's okay if part of it sticks out the side of the carton. If your mirror is round, like the mirror in a make-up compact, you may want to tape or glue it to a square of cardboard before inserting it into the slot in the milk carton. If you have a mirror with a magnifying side and a nonmagnifying side, have the nonmagnifying side facing the hole.

To make a periscope from a 1-quart milk carton, your mirrors must be smaller than 31/2 inches in at least one dimension. If the only mirrors you can find are larger than that, you can use half-gallon milk cartons instead.

What if I want to use half-gallon milk cartons or some other boxes?

When you are making a periscope, it's important to make sure that your mirror is positioned at a 45-degree angle. If you use a wider milk carton or some other box, just measure how wide your box is. Then measure that same distance up the side of the box and make a mark. The line between your mark and the opposite corner of the box will be at 45 degrees.

How does my periscope work?



Light always reflects away from a mirror at the same angle that it hits the mirror. In your periscope, light hits the top mirror at a 45-degree angle and reflects away at the same angle, which bounces it down to the bottom mirror. That reflected light hits the second mirror at a 45-degree angle and reflects away at the same angle, right into your eye.

Can I make a periscope with a really long tube?

You can make your peri- scope longer, but the longer the tube is, the smaller the image you'll see. Periscopes in tanks and submarines have magnifying lenses between the mirrors to make the reflected image bigger.

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