

C4.4 Where do the colors of the rainbow come from?



It's pouring rain. Suddenly the sun comes out again. Mia runs around excitedly in the house and looks out every window. "What are you looking for?" her brother, Ben, asks her. "Well, the rainbow." And indeed, on the west side of the house Mia sees a rainbow shimmering.



How does a rainbow form?



Write down your ideas and guesses:

You need the following for the experiment:

- 1 prism
- 1 sheet of white paper
- 1 smooth drinking glass
- Sunlight
- Water

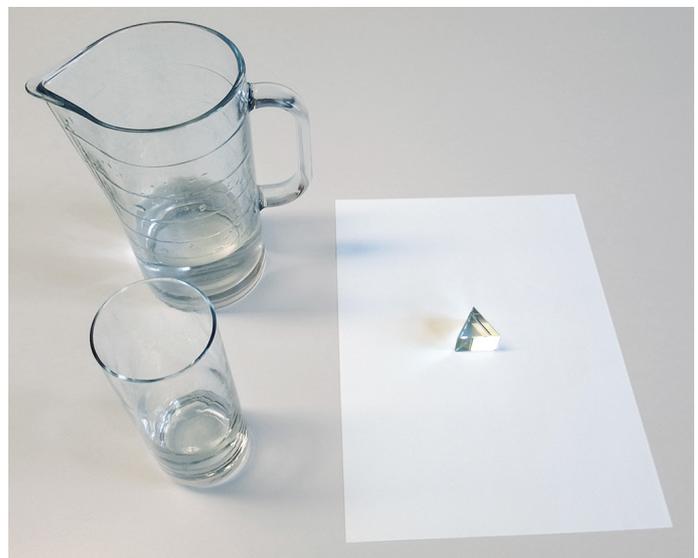
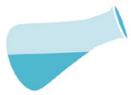


Figure 1: Required materials.



How to set up the experiment:

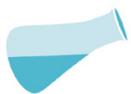
Lay out the materials as shown in the photo.

1. You need a location with direct, bright sunlight for this experiment. If the sky is cloudy or your classroom or playground is completely shaded, the experiment won't work.
2. Fill the glass three-quarters full with water.
3. Look for a location at the window or on the playground that's half in the sunlight and half in the shade.
4. Place the white sheet of paper on the border between the sunlight and shade so that the paper is right at the edge of the shade.

Tip: You can place the paper at the following locations if they are at the edge of the shaded area: for example, on a bench, a table, or a chair, or under a tree. Or you can work with a partner, who will hold the paper at the right location.



Figure 2: How to set up the experiment.



How to conduct the experiment:

1. Hold the water glass in the sunlight approx. 20 cm above the paper so that it makes a bright spot on the paper.
2. Tilt the glass slightly back and forth and change the distance to the paper until you see a sharp, colorful spot on the paper.
3. Look closely at the colorful spot and draw it in the first column of the table using colored pencils.

4. Now do the same experiment, but this time use the prism instead of the water glass:
 Your partner can stand on the other side of the prism while holding the paper (see the sketch).
 Now what do you see? Draw the colorful spot in the table using colored pencils.

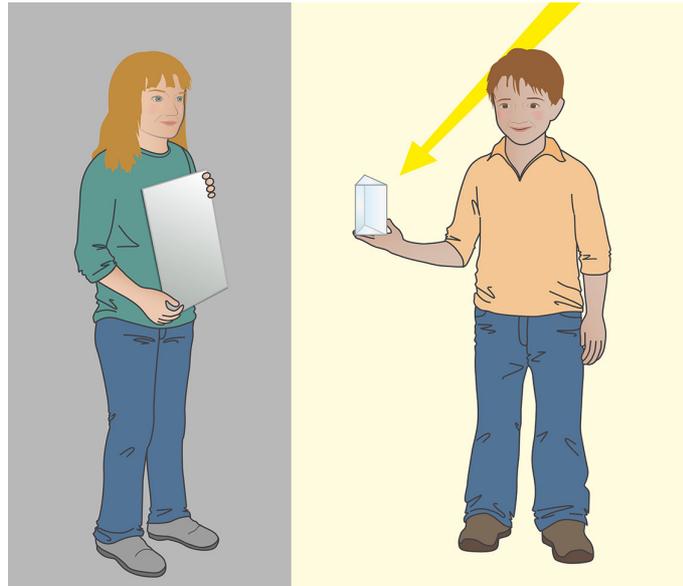


Figure 3: What the experiment with the prism looks like.

At the end, you can also try out the following:

5. Pick up the prism and hold it in front of your eyes.
6. If you are in a room, stand across from a window with daylight coming through it.
7. Look through one of the prism's angled surfaces. Use colored pencils to draw what you see.
8. Hand the prism to your team partners so they can look through it.



Draw your observations in the table:

Sunlight falling on the water glass	Sunlight falling on the prism	Looking through the prism



Evaluate your observations:

- How many different colors did the individual spots have and what sequence were the colors arranged in?

Sunlight falling on the water glass	Sunlight falling on the prism	Looking through the prism
Number of colors: _____	Number of colors: _____	Number of colors: _____
Names of the colors in sequence:	Names of the colors in sequence:	Names of the colors in sequence:

- What do you think? What conditions are necessary for you to see a colored spot?

- Why could Mia be certain that a rainbow had formed?



Doing further research:

Keep your eyes open as you go through your day. Where do you encounter effects like you saw in the experiment? Write down your findings or take pictures.



Tracking down technology

In the experiment you learned that white sunlight is composed of colored light. That's hard to believe at first glance. However, you can try it out yourself.

You know about mixing colors from painting with a watercolor set or from colored markers.

1. Take three felt-tipped pens in yellow, cyan, and magenta and mix the colors by drawing with them on a piece of white paper so that you end up with red, green, blue, and black.
2. Write down in the table what colors you mixed and what colors resulted.
3. Try to make the color white. What do you notice? Write that in the table, too.

Colors of felt-tipped pens	Mixed color
Yellow + magenta	
Yellow + cyan	
Cyan + magenta	
Yellow + magenta + cyan	
	White

4. Find out what happens when colored light is mixed.
 - Take three flashlights and tape a film on the lens in front of the light source of each of the three flashlights: one with a red film, one with a blue film, and one with a green film.
 - Find two partners. Each person shines his or her flashlight on a white wall.
 - Overlap two different colors at a time. Then overlap all three. What do you notice? Write down what colors resulted each time.

Colors of the flashlights	Color of the light spot on the wall
Red + green	
Red + blue	
Blue + green	
Red + blue + green	

In everyday life you constantly encounter the mixing of colors of light, but you probably have never consciously perceived this. The photos show two examples:



Figure 4: Colorful living room lighting.



Figure 5: Television screen.

Look more closely at the screen of a modern device, for example, a television, computer, tablet, or smartphone screen.

5. Use a magnifying glass or glass marble to observe the screen close up. With a tablet or smartphone, you can also place a small drop of water on the display. What do you notice?
6. Which individual points of color can you recognize? Write down your guesses.
7. Do these points of color always shine? Write down your observations.
8. How do you suppose that a colored area, a white area, or a black area can be displayed from the various colors?