

# The Visible Spectrum

## 10.4

You have investigated and studied several properties of light. You know that light is a form of energy; it travels in straight lines and it can be reflected, absorbed, and transmitted. None of these properties, however, explains an important fact—we can see colours.

You have probably seen a rainbow like the one in **Figure 1**. A rainbow gives an important clue to help explain colour. The band of colours you can see in a rainbow is called the **visible spectrum**. The visible spectrum has six main colours, called the spectral colours. Starting at the top, the spectral colours are red, orange, yellow, green, blue, and violet.

### TRY THIS: Viewing the Visible Spectrum

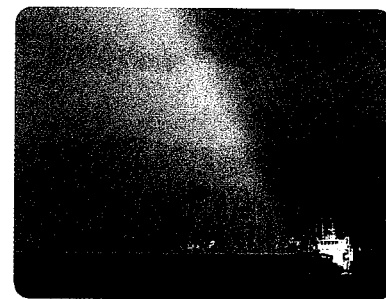
**Skills Focus:** creating models, communicating

In this activity, you will create your own mini-rainbow. You will need two solid triangular prisms (blocks of acrylic) and a ray box or similar light source.

1. Place one prism on a sheet of white paper, and trace around it.
2. With the room lights dim, aim a ray of white light from the ray box toward the prism (**Figure 2**). Move the ray box to adjust the position of the ray until you obtain the brightest possible spectrum.
  - (a) Draw a diagram of your observations. Include the white light ray and the colours.
3. Position the second prism as shown in **Figure 3**, and aim the ray as you did earlier.
  - (b) Draw a diagram of what you observe.
4. Predict what you would observe if you aimed red light at the triangular prism instead of white light.

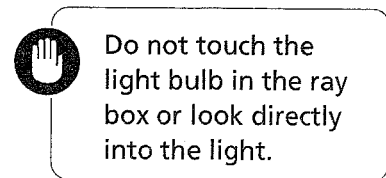
## The Discovery of the Composition of White Light

Hundreds of years ago, scientists thought they could see the colours of objects because the objects added colour to white light. Then, in 1666, an important discovery was made. A scientist named Isaac Newton hypothesized that light from the Sun might be made up of several colours. To test his hypothesis, he passed a beam of sunlight through a triangular glass prism, as in **Figure 2**. Newton discovered that white light is made up of the spectral colours red through violet.



**Figure 1**

For you to see a rainbow, the Sun must be behind you and the water droplets (in the rain and the clouds) must be in front of you.



Do not touch the light bulb in the ray box or look directly into the light.



**Figure 2**



**Figure 3**



Those people who opposed Newton's explanation were quick to argue that the different colours were produced by the prism. They reasoned that the colours must be inside the glass. The light just allowed the colours to escape.

To end the controversy, Newton decided to collect the separate colours of light with a second prism, (**Figure 3**). As he had predicted, the light became white again when the six colours were added together.

Newton's experiments provided evidence that white light is composed of colours, and that each colour acts differently inside a prism. Many years after Newton's discovery, scientists found that the colours of light actually travel at different speeds inside a prism. This causes each colour to change direction a slightly different amount when the light reaches the surface of the glass. The colour that changes direction the most (violet) slows down the most.

## Why We See the Colour of Objects

When white light strikes an opaque object three things can happen: the light may be reflected, the light may be absorbed, or, most often, some of the light is reflected and some of it is absorbed. Different spectral colours are reflected and absorbed depending on the characteristics of the object's material. This is why we see the object as a specific colour. For example, if an object reflects the blue part of the visible spectrum, we see the object as blue. If an object reflects the red part of the visible spectrum, we see it as red. If all of the parts of the visible spectrum are reflected we see the object as white, and if none of the parts of the visible spectrum are reflected we see the object as black.

### 10.4 CHECK YOUR UNDERSTANDING

1. Which statement do you think is correct? Explain.  
A: White light is made up of the spectral colours. The rainbow colours appear when light passes through water droplets.  
B: Water droplets add colour to white light to produce the rainbow.
2. Which colour of light changes direction the most when it leaves the triangular prism? Which colour of light changes direction the least?
3. Briefly describe three places where you have seen the visible spectrum.
4. Why can we see the colour of objects?

#### PERFORMANCE TASK

Does your chosen optical device rely on white light or only on some of the spectral colours? Does it function better with some colours than with others?