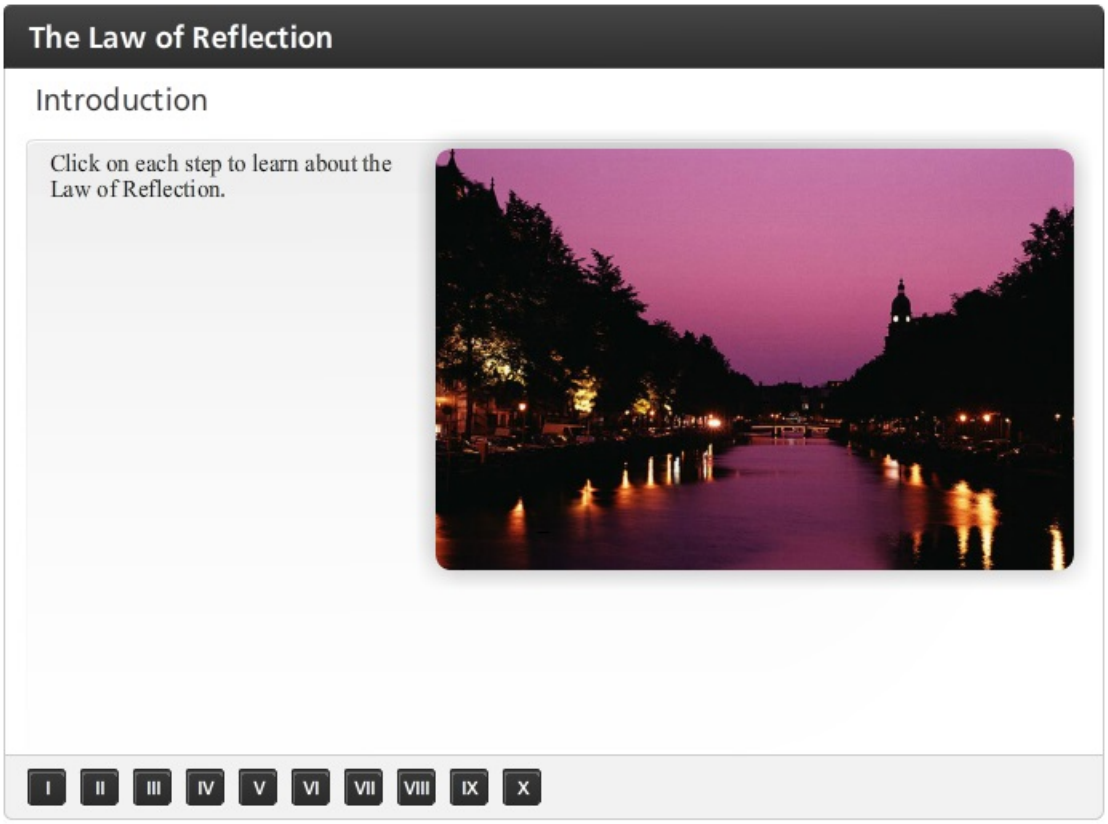
Module 10: Optics
Topic 1 Content: The Law of Reflection

Introduction



In this module we will be learning about the behavior and properties of light. This area of physics is called optics. The first behavior of light that you will learn about is reflection.

When light strikes a surface it can be reflected in two different ways. Smooth, glossy surfaces will show specular reflection while rough, irregular surfaces will show diffuse reflection. Let's look at the differences between these two types. Click on each step to learn about the Law of Reflection.

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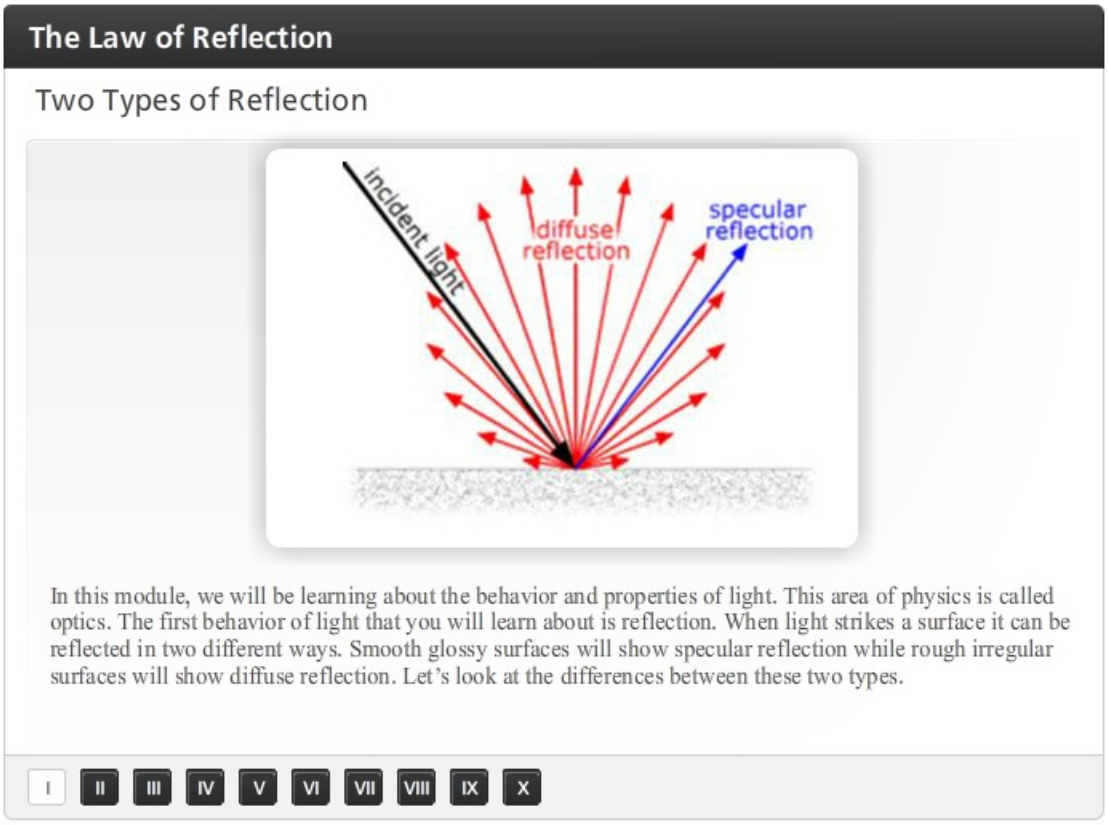
Two Types of Reflection



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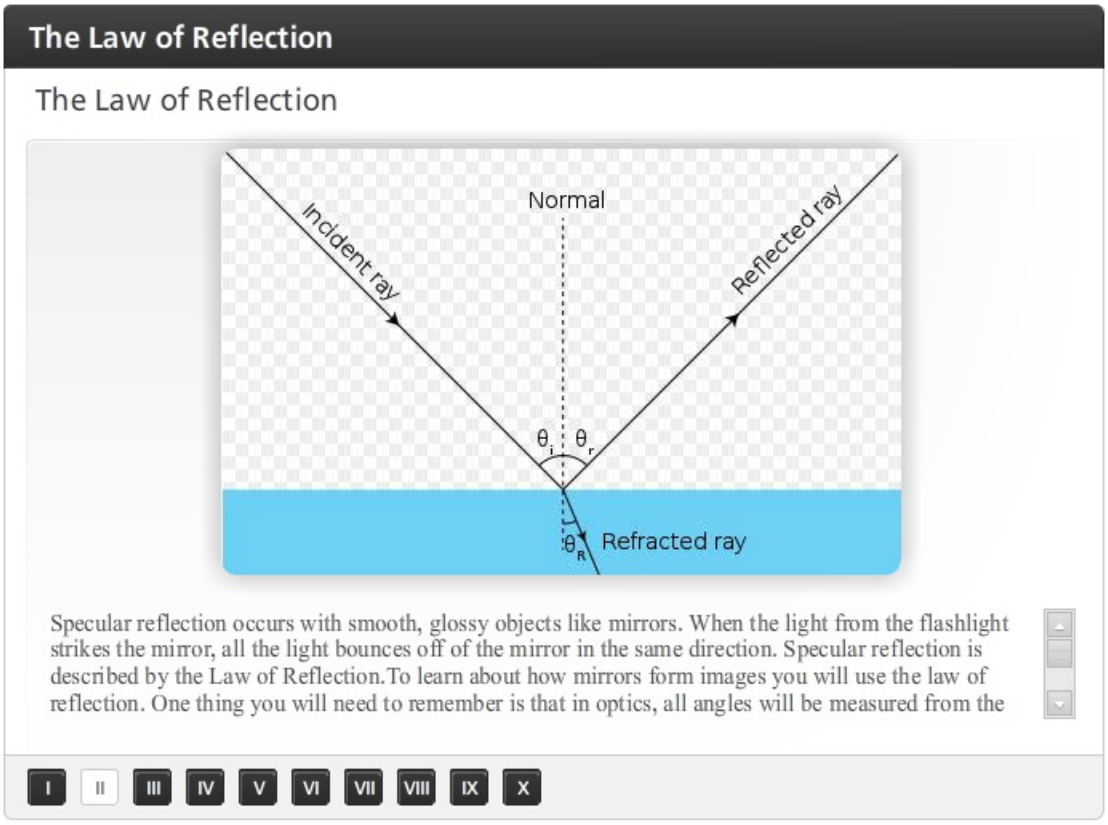
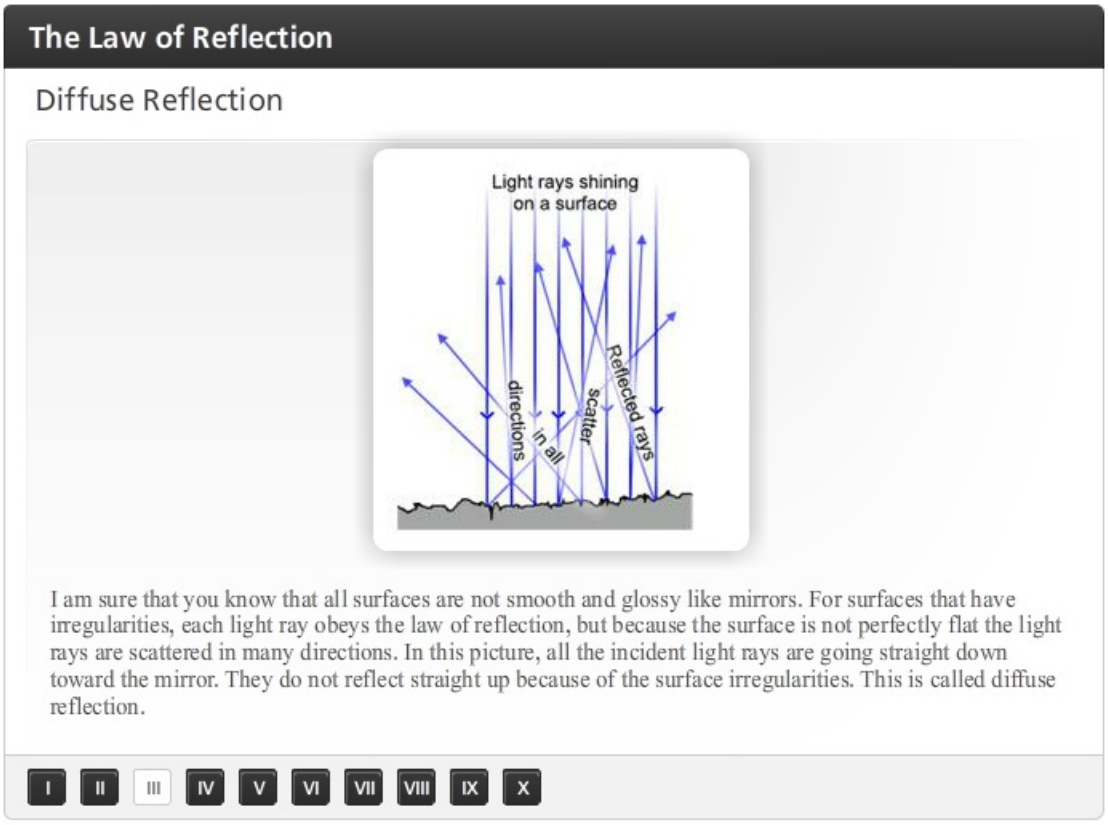
The Law of Reflection



Specular reflection occurs with smooth, glossy objects like mirrors. When the light from the flashlight strikes the mirror, all the light bounces off of the mirror in the same direction. Specular reflection is described by the Law of Reflection. To learn about how mirrors form images you will use the law of reflection. One thing you will need to remember is that in optics, all angles will be measured from the normal. The normal is a line that is perpendicular to the mirror surface. All angles will be measured from the normal.

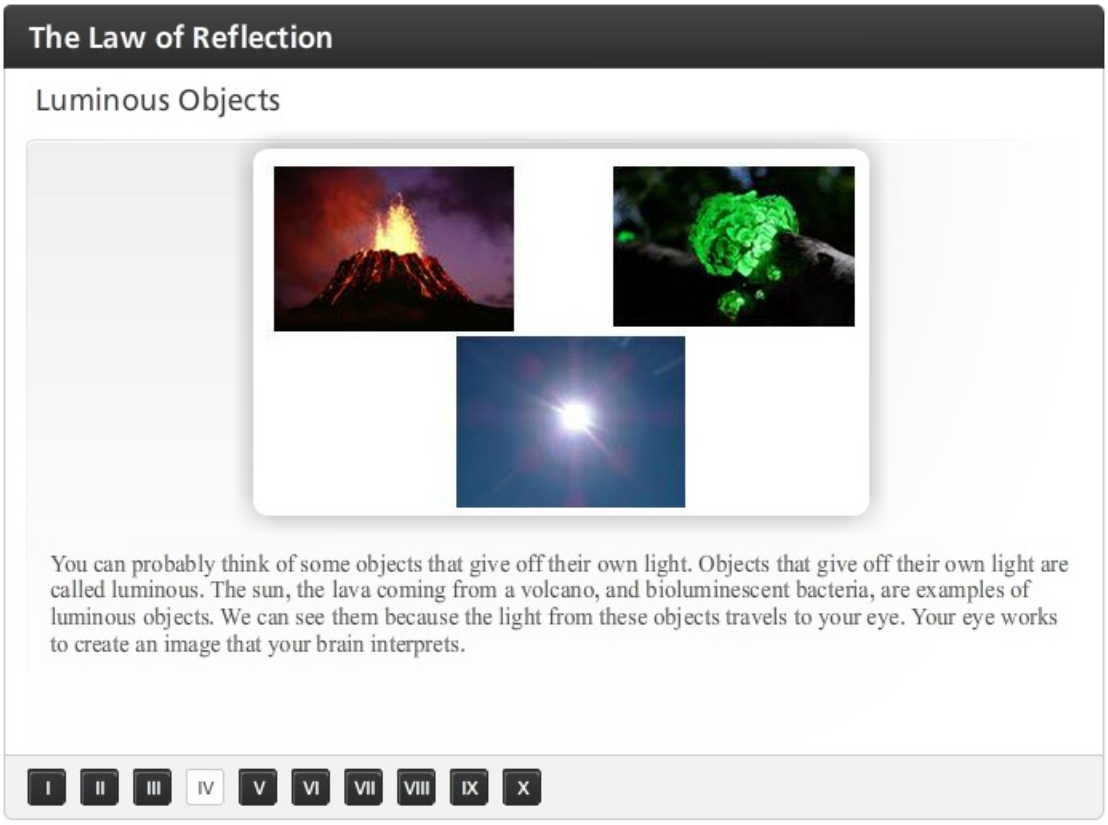
When light strikes a mirror, the angle of incidence is the angle between the light ray and the normal. The angle between the light ray and the normal as the ray leaves the mirror is called the angle or reflection. These angles are equal, this is called the law of reflection. This behavior of light is similar to when you throw a rubber ball against a flat wall, you expect it to bounce off at the same angle that is makes with the normal to the wall. To learn about how mirrors form images you will use the law of reflection.

Diffuse Reflection



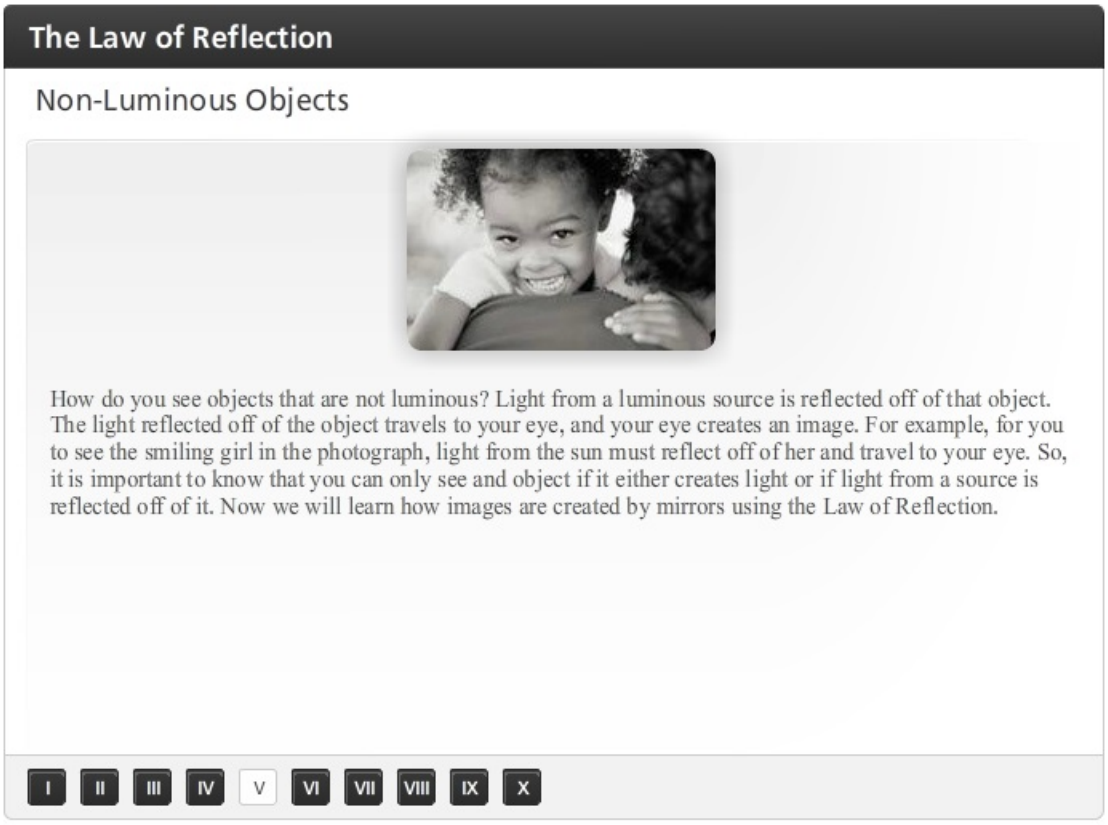
I am sure that you know that all surfaces are not smooth and glossy like mirrors. For surfaces that have irregularities, each light ray obeys the law of reflection, but because the surface is not perfectly flat the light rays are scattered in many directions. In this picture, all the incident light rays are going straight down toward the mirror. They do not reflect straight up because of the surface irregularities. This is called diffuse reflection.

Luminous Objects



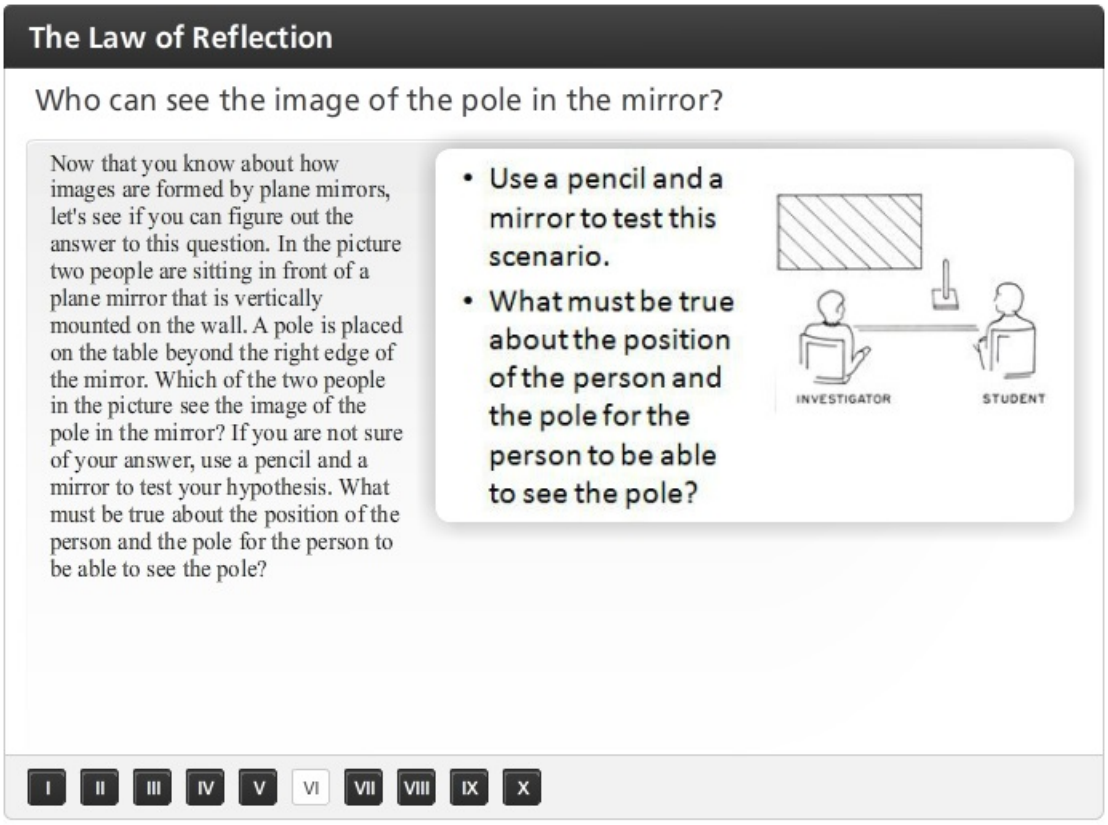
You can probably think of some objects that give off their own light. Objects that give off their own light are called luminous. The sun, the lava coming from a volcano, and bioluminescent bacteria, are examples of luminous objects. We can see them because the light from these objects travels to your eye. Your eye works to create an image that your brain interprets.

Non-Luminous Objects



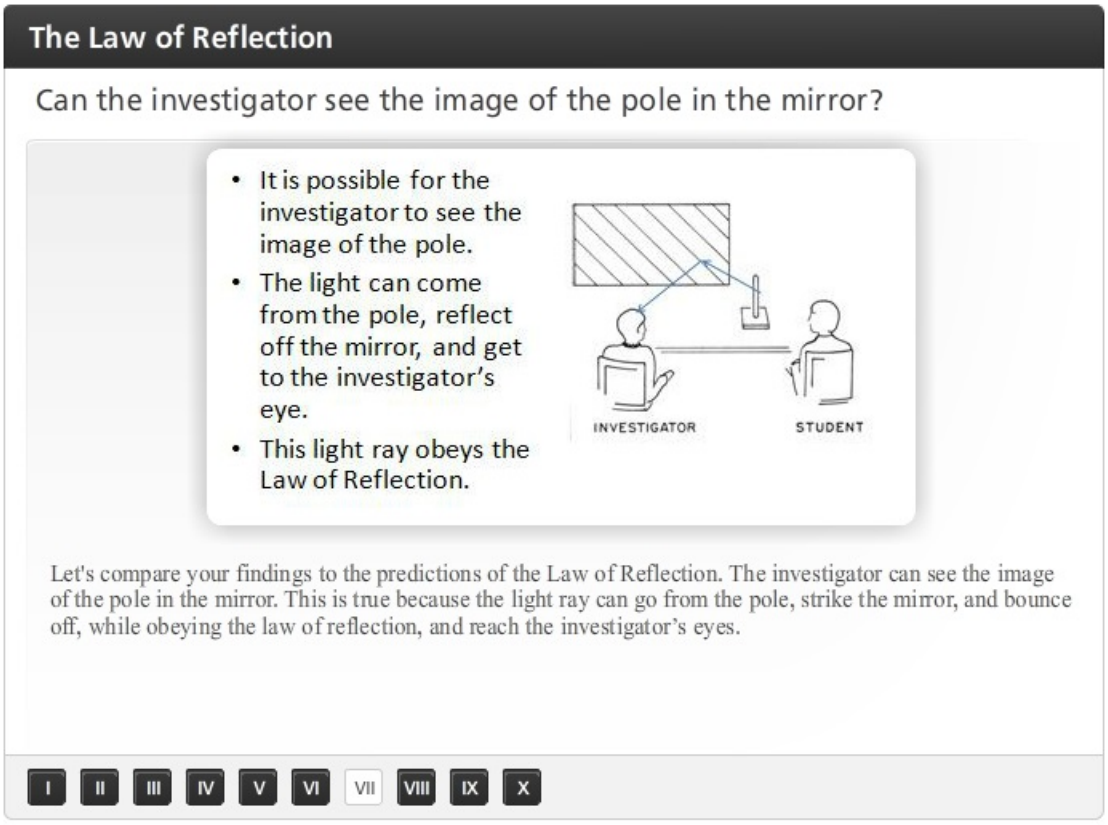
How do you see objects that are not luminous? Light from a luminous source is reflected off of that object. The light reflected off of the object travels to your eye, and your eye creates an image. For example, for you to see the smiling girl in the photograph, light from the sun must reflect off of her and travel to your eye. So, it is important to know that you can only see and object if it either creates light or if light from a source is reflected off of it. Now we will learn how images are created by mirrors using the Law of Reflection.

Who can see the image of the pole in the mirror?



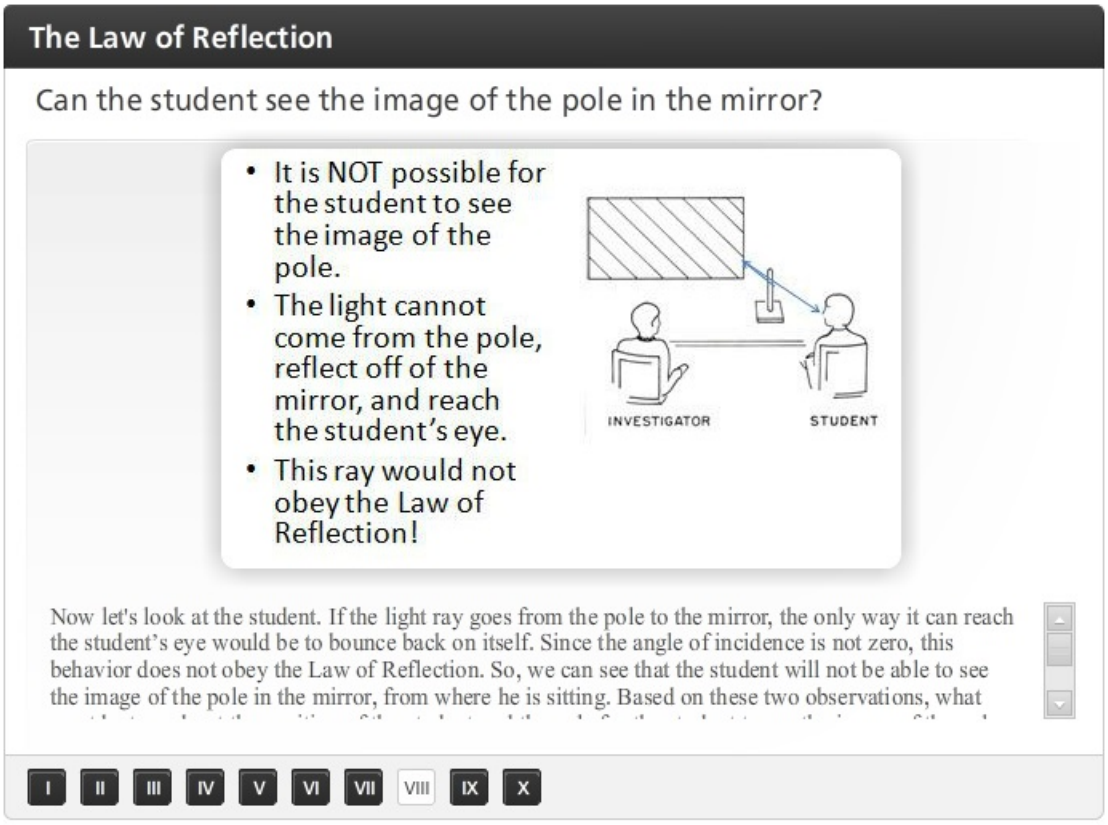
Now that you know about how images are formed by plane mirrors, let's see if you can figure out the answer to this question. In the picture two people are sitting in front of a plane mirror that is vertically mounted on the wall. A pole is placed on the table beyond the right edge of the mirror. Which of the two people in the picture see the image of the pole in the mirror? If you are not sure of your answer, use a pencil and a mirror to test your hypothesis. What must be true about the position of the person and the pole for the person to be able to see the pole?

Can the investigator see the image of the pole in the mirror?



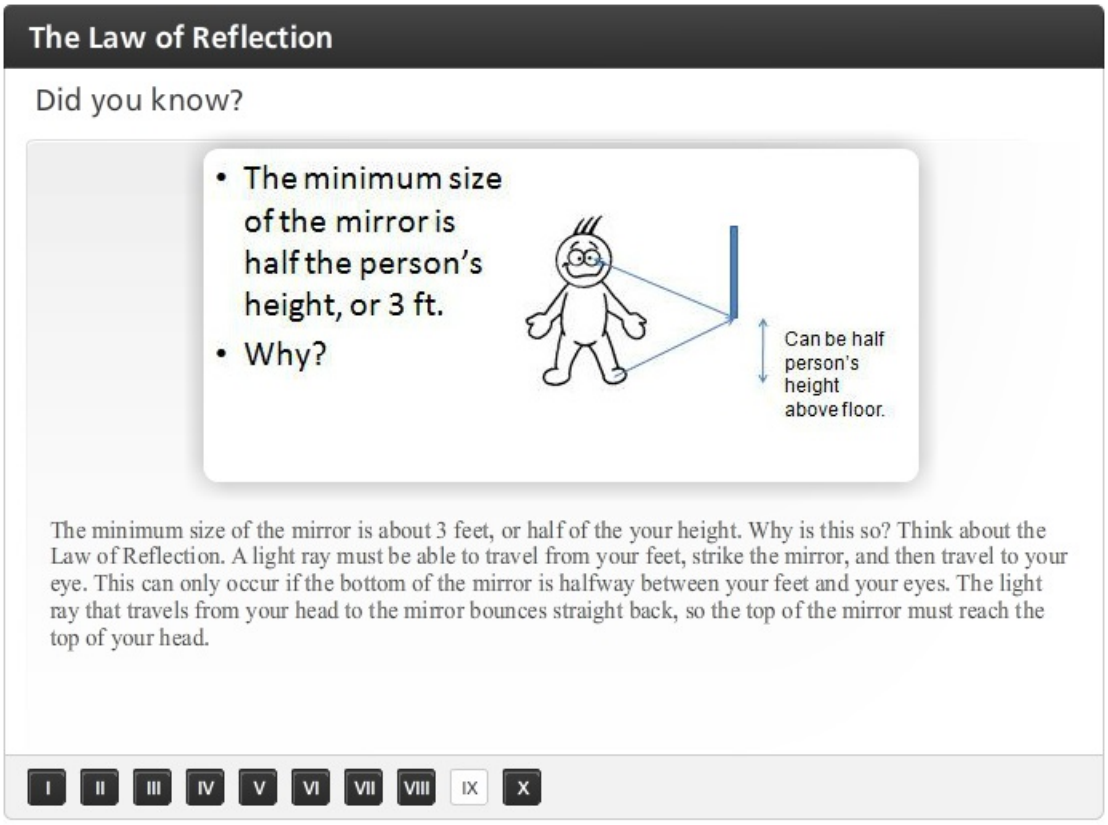
Let's compare your findings to the predictions of the Law of Reflection. The investigator can see the image of the pole in the mirror. This is true because the light ray can go from the pole, strike the mirror, and bounce off, while obeying the law of reflection, and reach the investigator's eyes.

Can the student see the image of the pole in the mirror?



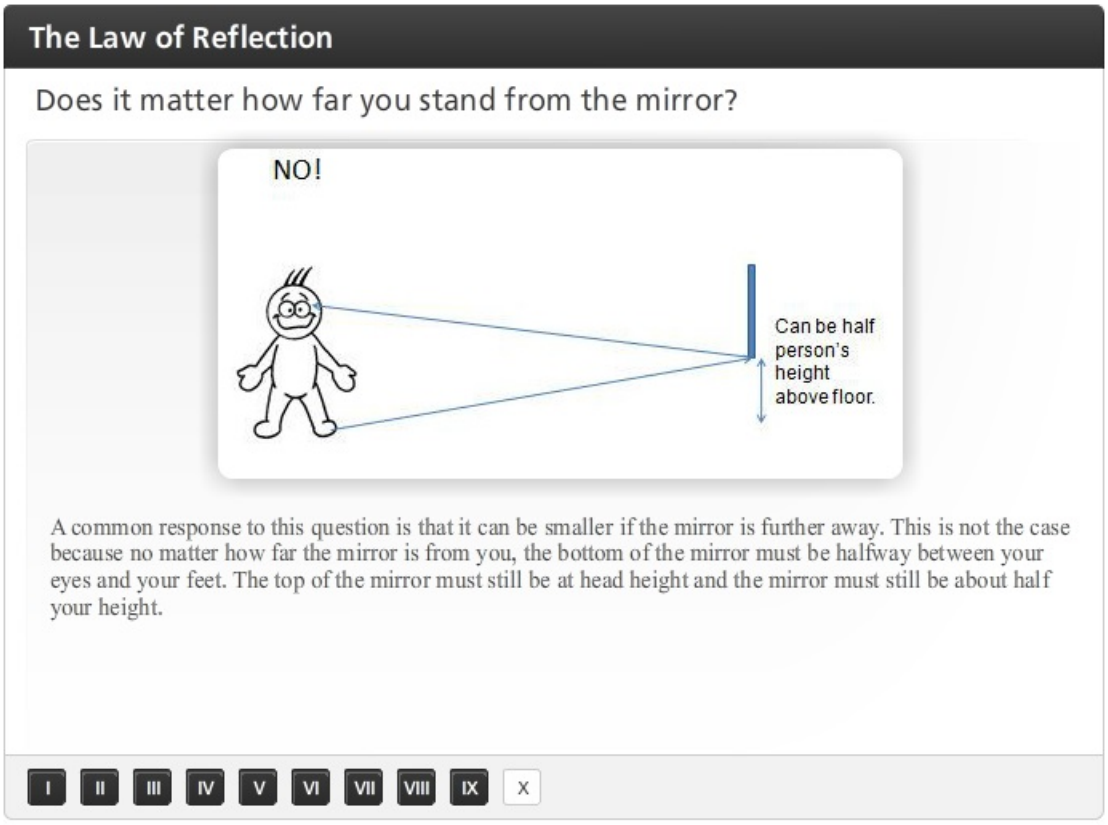
Now let's look at the student. If the light ray goes from the pole to the mirror, the only way it can reach the student's eye would be to bounce back on itself. Since the angle of incidence is not zero, this behavior does not obey the Law of Reflection. So, we can see that the student will not be able to see the image of the pole in the mirror, from where he is sitting. Based on these two observations, what must be true about the position of the student and the pole for the student to see the image of the pole in the mirror? For the student to see the image of the pole in the mirror, the light rays coming from the pole must be able to reflect off of the mirror and reach the student's eye.

Did you know?



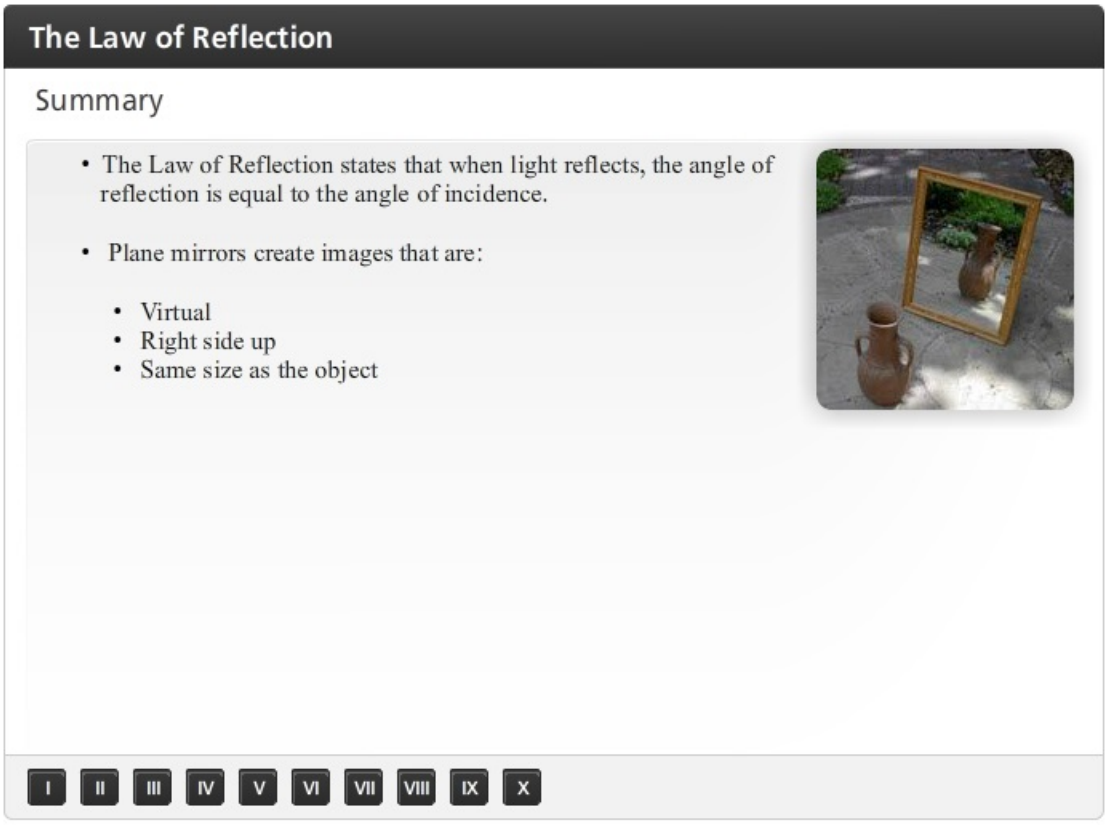
The minimum size of the mirror is about 3 feet, or half of your height. Why is this so? Think about the Law of Reflection. A light ray must be able to travel from your feet, strike the mirror, and then travel to your eye. This can only occur if the bottom of the mirror is halfway between your feet and your eyes. The light ray that travels from your head to the mirror bounces straight back, so the top of the mirror must reach the top of your head.

Does it matter how far you stand from the mirror?



A common response to this question is that it can be smaller if the mirror is further away. This is not the case because no matter how far the mirror is from you, the bottom of the mirror must be halfway between your eyes and your feet. The top of the mirror must still be at head height and the mirror must still be about half your height.

Summary



- The Law of Reflection states that when light reflects, the angle of reflection is equal to the angle of incidence.
- Plane mirrors create images that are:
    - Virtual
    - Right side up
    - Same size as the object