CONCEPT 1

Light can be reflected, absorbed, transmitted, or refracted.

Light interacts with different materials and surfaces in different ways. Light may reflect, be absorbed, be transmitted, or refract.

reflection the process in which light "bounces off" the surface of an object and travels in another direction

Reflection: Light Bounces Off

When light strikes an object, it often just reflects from its surface. **Reflection** is the process in which light "bounces off" a surface and changes direction. There are two different types of reflection.

Reflection Off an Extremely Smooth Surface

Every time you look in a mirror, you see light reflect off an extremely smooth surface. This produces a clear image (a likeness) of you and your surroundings. This type of reflection also occurs on the surface of a very still body of water, like the one in **Figure 3.17**. You can also observe it on some polished surfaces, such as glass or metal. When such a surface reflects light, the pattern of reflected rays is very similar to the pattern of the incoming rays. This similarity is what lets you see an image when the light reaches your eyes (**Figure 3.18**).

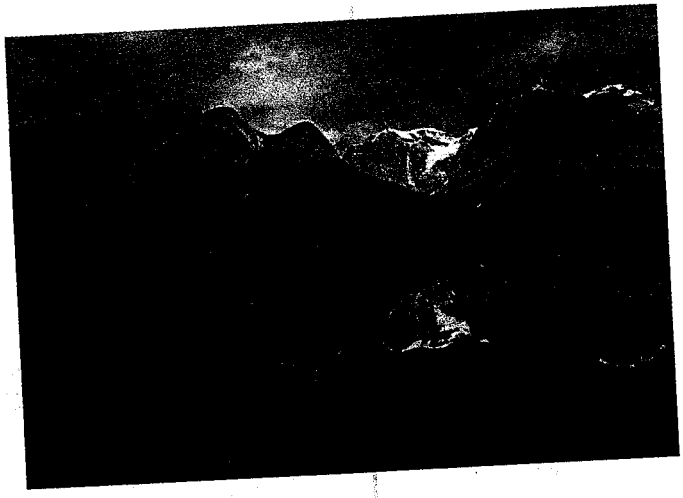


Figure 3.17 In this photograph, Emerald Lake in Yoho National Park has an extremely smooth surface in which an image is visible.

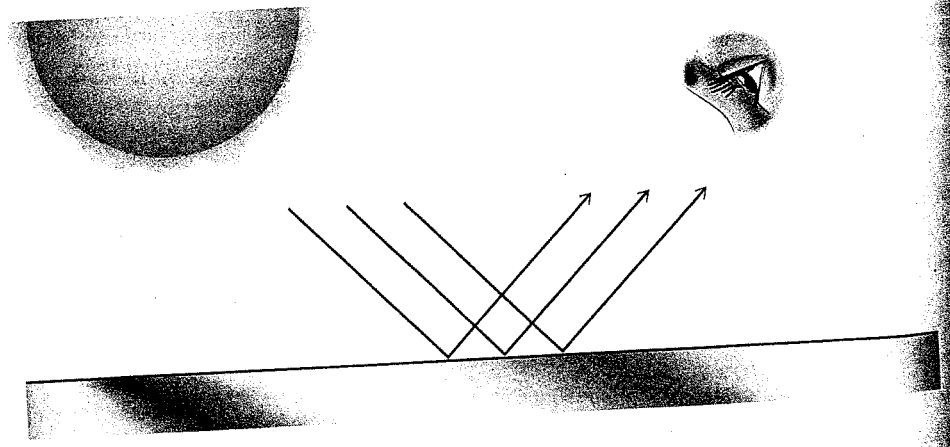


Figure 3.18 Light rays reflecting off a smooth, mirror-like surface have a pattern that is very similar to that of the incoming rays.

Reflection Off a Rough Surface

Light can also reflect off a rough surface, such as a piece of paper. This type of reflection does not produce an image. However, it does make objects visible. **Figure 3.19A** shows how this works. Notice how the reflected rays go in many different directions. The pattern of the reflected rays is no longer similar to the pattern of the incoming rays, so no image appears on the paper. However, some reflected rays do reach your eyes. These make the paper visible.

Why do the rays reflect in all directions? Paper might look smooth to the unaided eye, but **Figure 3.19B** shows otherwise. Under a microscope, the paper's surface looks rough and uneven. When light hits this surface, it scatters in many different directions.

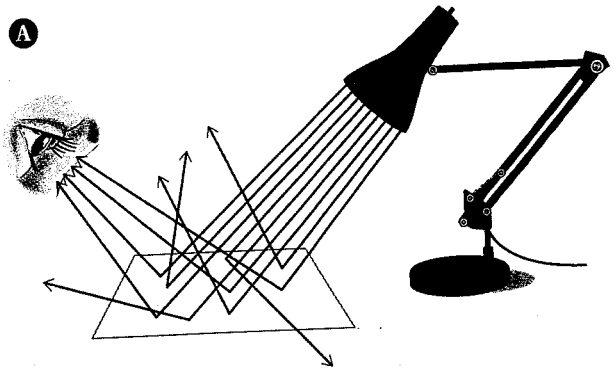


Figure 3.19 When light hits a rough surface, like paper, it reflects in many directions A. Some light enters your eyes, making the paper visible. B shows the paper's surface magnified.

Absorption: Light Energy Is Trapped

Absorption is the process in which light energy becomes trapped in an object as heat. Consider a piece of paper again, but this time one with a black letter on it, as in **Figure 3.20A**. Reflection off a rough surface lets you see the paper itself. However, the printed letter is made up of black ink that completely absorbs all incoming light. No rays reflect off the letter into your eyes, so it looks black.

What if the letter is a colour? You see colour when an object absorbs only part of the visible light spectrum. Some wavelengths of light are absorbed, and the rest are reflected. **Figure 3.20B** shows what happens when the letter on the paper is a colour, such as blue. The letter absorbs all colours except blue. The blue wavelengths are reflected from the letter into your eyes, so it looks blue.

absorption the process in which light energy is trapped in an object as heat

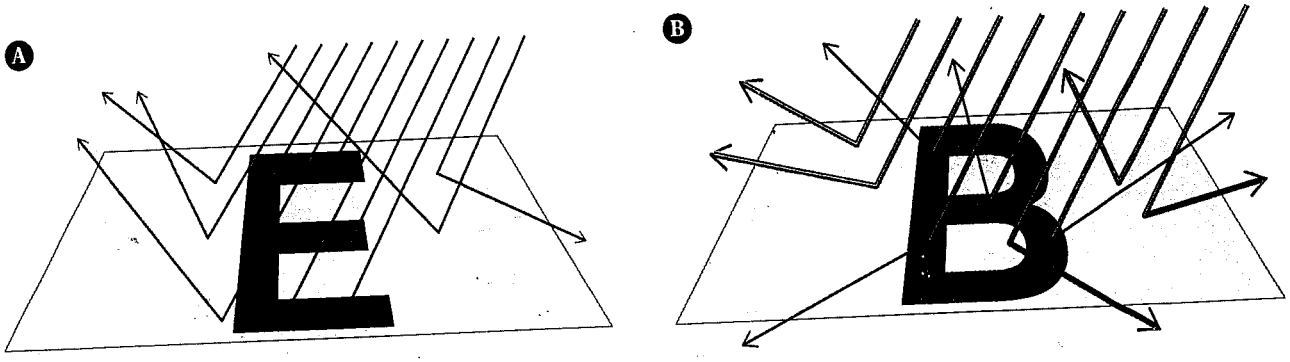


Figure 3.20 A Rays that hit the black letter are absorbed, so the letter looks black. B The blue letter absorbs all wavelengths of visible light except blue. Only the blue light reaches your eyes.

Transmission: Light Passes Through

transmission the process in which light passes through a medium and keeps travelling

Not all materials absorb or reflect all of the light that hits them. Some materials allow different amounts of light to pass through. For example, if you hold a white piece of paper to a light, some light comes through. When light passes through a material, that material is called a *medium*. **Transmission** is a process in which light passes through a medium and keeps travelling. Different materials transmit different amounts of light. For example, a clear glass window transmits more light than a sheet of paper.

Refraction: The Path of Light Bends

refraction the process in which light changes direction when it moves from one medium to another

Light does not change direction when it is travelling through the same medium. However, light does change direction when it moves from one medium to another. This process is called **refraction**. **Figure 3.21** shows light refracting.

Use **Figure 3.22** to see how refraction can trick your brain. The light reflected from the top part of the pencil travels in a straight line to your eyes through the medium of air. The light from the bottom part refracts. It changes direction slightly as it moves from water to glass to air. (Because light travels such a short distance through the glass, you don't really notice the change in direction caused by the glass.) Your brain believes light always travels in a straight line, so it has trouble determining the position of the bottom of the pencil. That's why the pencil looks broken at the water line.

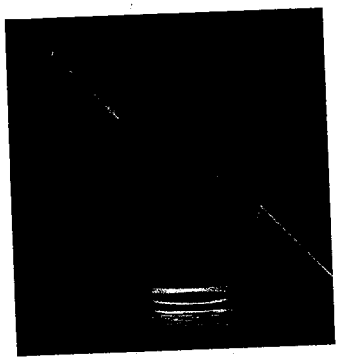


Figure 3.21 This beam of red light allows you to see the path of light bend as it enters and leaves the water.

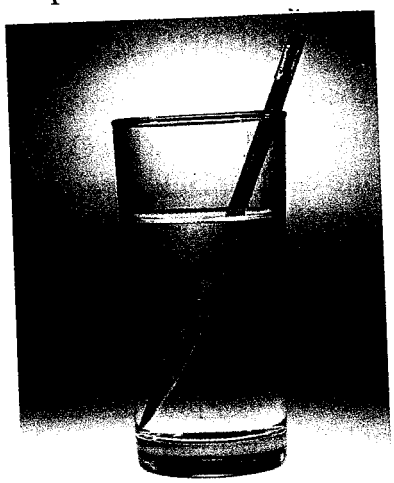


Figure 3.22 This pencil appears broken due to refraction. In reality, the bottom part of the pencil is not where your brain thinks it is.

Before you leave this page . . .

1. Use a flowchart to describe what can happen to light when it strikes an object.
2. The Moon is not a source of visible light. Why does it seem to glow brightly at night?

CONCEPT 2

Light behaves differently when it encounters transparent, translucent, or opaque materials.

Activity

How Is Light Transmitted?

Inspect the materials your teacher gives you. Predict what happens to light as it strikes each one. Use a flashlight to test your predictions. Use your observations to refine your original predictions.

Figure 3.23 shows that a material can be transparent, translucent, or opaque based on how much light it lets pass through, how the light behaves, and if you can see through it.

Figure 3.23 Light interacts with different materials in different ways.

Transparent Materials Transmit Light

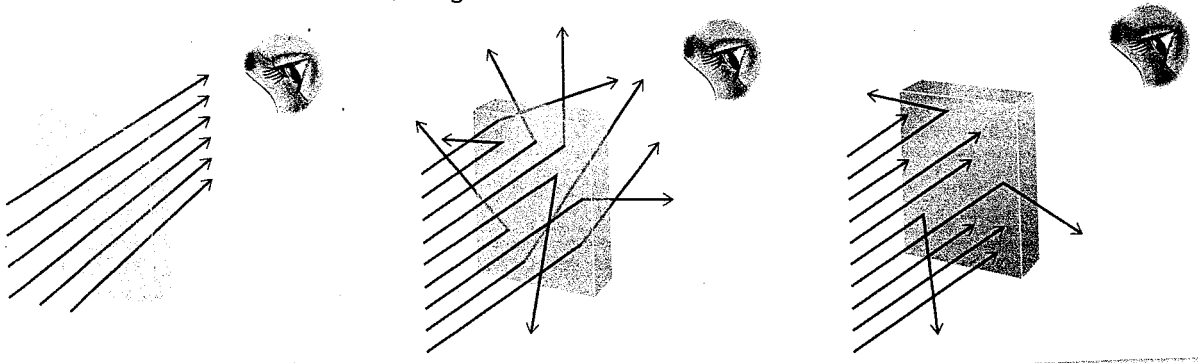
Transparent materials transmit almost all the light rays that strike them. Clear glass, plastic, water, and air are examples of transparent materials. Because transparent materials transmit most light, objects can be seen clearly through them.

Translucent Materials Scatter Light

Translucent materials allow most light to pass through them. However, the light is scattered in many directions as it passes through. Frosted plastic and waxed paper are examples of translucent materials. Because translucent materials scatter light, objects seen through them are usually blurry.

Opaque Materials Reflect and Absorb Light

Opaque materials reflect and absorb light. These materials do not allow any light to pass through them. Wood, metal, and stone are examples of opaque materials. Because opaque materials do not allow light to pass through, objects cannot be seen through them.



Before you leave this page . . .

1. Choose a material from your daily life.
   a) Is the material transparent, translucent, or opaque? How could you confirm your decisions?
   b) Explain how the material's interaction with light is related to its function.
2. Some jellyfish are transparent. How might this affect their ability to survive?