10.3 Getting in Light's Way

Imagine a world without glass. Your school would be very different—and very dark. When choosing materials, designers and engineers need to consider which materials block light and which materials, such as glass, let light pass through. **Transparency** is a measure of how much light can pass through a material. Materials are classified as transparent, translucent, or opaque.

Plastic wrap is transparent (**Figure 1**). Particles in a **transparent** material let light pass through easily. A clear image can be seen through the material. Plate glass, air, and shallow, clear water are examples of transparent materials.

LEARNING TIP

Check your understanding of transparent, translucent, and opaque materials by explaining **Figures 1** to **3** to a partner.

Skin is a translucent material (**Figure 2**). Particles in a **translucent** material transmit light, but also reflect some, so a clear image cannot be seen through the material. Frosted glass, clouds, and your fingernails are translucent materials.

A glass of milk is opaque (**Figure 3**). Particles in an **opaque** material do not allow any light to pass through. All the light energy is either absorbed or reflected. Most materials are opaque. For example, building materials, such as wood, stone, and brick, are opaque.

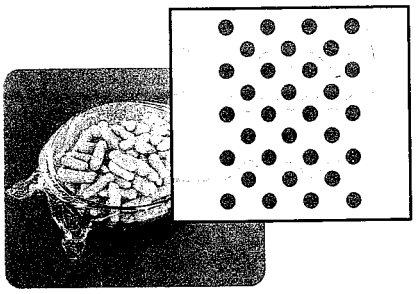

Figure 1
Transparent materials allow all light to pass through.

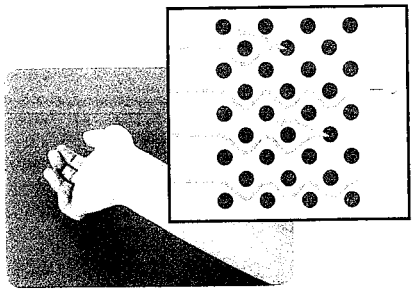

Figure 2
Translucent materials allow some light to pass through.

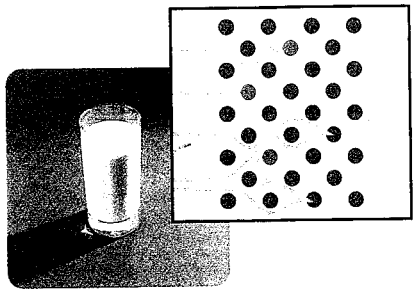

Figure 3
Opaque materials allow no light to pass through.

Classifying materials for transparency can be tricky. For example, a glass of water is transparent. However, you may have noticed that you cannot see the bottom of a deep lake, no matter how clear the water is. Water actually absorbs and reflects light slightly. As a result, small amounts of water are transparent, larger amounts are translucent, and very large amounts are opaque. This is true of all transparent materials. It is also true in reverse. If you cut an opaque material, such as a rock, into very thin slices, the slices will be translucent rather than opaque. Small amounts of an opaque material cannot absorb or reflect all the light.

TRY THIS: Comparing Surfaces

Skills Focus: predicting, controlling variables, observing

You can test how surfaces absorb and reflect light using a flashlight as a light source and a piece of white cardboard as a screen. You will also need a small flat mirror, another piece of white cardboard, and a piece of dull, black cardboard.

Handle mirrors carefully to avoid breakage.

(a) Before testing each surface, predict how strong the reflection will be.

1. In a dark room, shine the flashlight onto the mirror, as shown in **Figure 4**. Observe the effect on the white cardboard you are using as a screen.

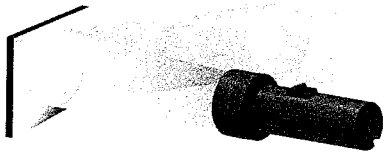

Figure 4

2. Replace the mirror with the second piece of white cardboard, and observe the effect on the screen.
3. Replace the second piece of white cardboard with the black one. Shine the flashlight on the black cardboard and observe the effect on the screen.
4. Try other surfaces—some rough, some smooth, some dark, and some light.

(b) Did your observations confirm your predictions? Explain.

Absorbing and Reflecting Light

When light strikes an opaque material, no light is transmitted (passes through). Some of the light energy is absorbed by the material and is converted into thermal energy. On a warm, sunny day, for example, asphalt absorbs light energy and converts it into thermal energy, becoming hot. Some of the light energy is not absorbed, but is reflected from the opaque material. This allows us to see the asphalt.

Colour, sheen (shininess), and texture are three properties that describe the amount of light energy that is absorbed or reflected. Black and dark-coloured materials absorb more light energy than white and light-coloured materials. This is one reason why builders often use dark shingles on Canadian homes. Similarly, dull materials, such as

LEARNING TIP

When you come across a word in brackets, think about how you can use it to figure out the meaning of words that you are unsure of.

wood, absorb more energy than shiny materials, such as aluminum siding. A material with a rough surface, such as stucco, absorbs more light energy than a smooth surface, such as plaster. Can you decide which materials in **Figure 5** absorb more light energy?

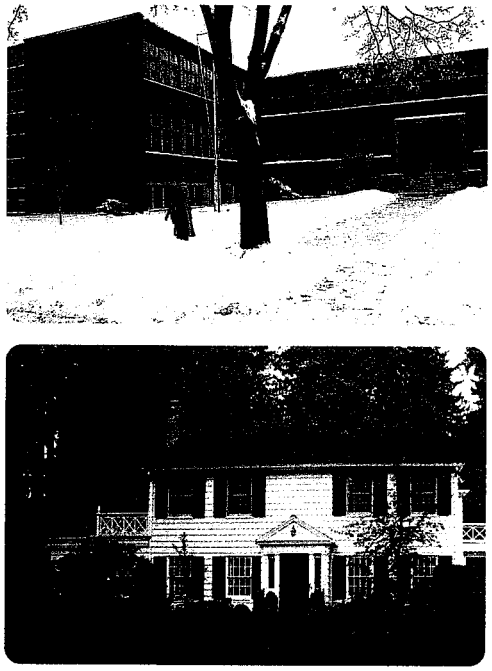

Figure 5
These two buildings are made with different construction materials. Architects choose certain materials for hot, sunny areas, and different materials for cool areas, based on the ability of the materials to transmit, absorb, or reflect light energy.

These properties of materials are also important in the design of posters, magazines, clothing, and solar heating panels. If you were designing a poster, for example, you might use some materials that absorb light and other materials that reflect light, so the contrast would allow the printing or artwork to be easily seen from far away. You might also want to avoid using shiny materials that would cause glare.

10.3 CHECK YOUR UNDERSTANDING

1. Classify the following materials as transparent, translucent, or opaque: milk, apple juice, wax paper, aluminum foil, plastic wrap, mirror, helium, ice cube, smoky air, writing paper, newspaper, cardboard, clear Plexiglas, coloured Plexiglas, silk, rubber, copper plate.
2. Explain how climate is an important factor in deciding what type of building materials to use when constructing a house.
3. Why does fall and winter clothing usually come in darker colours, while spring and summer clothing usually comes in lighter colours?

PERFORMANCE TASK

What parts of your optical device will need to be transparent, translucent, and opaque? Are absorption and reflection of light important?