

# The Ray Model of Light

Textbook pages 168–181

## Before You Read

Light reflects from white paper and also from a mirror. Why can you see yourself in a mirror but not in the sheet of paper? Record your ideas on the lines below.

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### Create a Quiz

After you have read this section, create a five-question quiz based on what you have learned. Then answer your quiz questions.

### Reading Check

1. What three things can happen to light when it strikes a material?

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## What can happen when light strikes different materials?

The ray model of light shows the direction of light as it moves in a straight line. You can use this model to show what happens when light strikes different materials. Three things can happen when light strikes a material.

1. The light may be transmitted (pass straight through it).
2. The light may be reflected (bounce off it).
3. The light may be absorbed (become “trapped” in it).

Each of these three outcomes affects what you see when light strikes a material. 

- ◆ If all or most of the light is transmitted, the material is **transparent**. Clear glass, air, and water are transparent because light passes through them.
- ◆ If all or most of the light is absorbed or reflected so that *none* of the light passes through, the material is **opaque**. A book, a metal can, and a wall are opaque because they block light from passing through them.
- ◆ If only some of the light is transmitted, and that light is scattered in all directions, the material is **translucent**. Waxed paper, clouds, and lampshades are translucent because they scatter the light that passes through them.

## What happens when light reflects from a plane mirror?

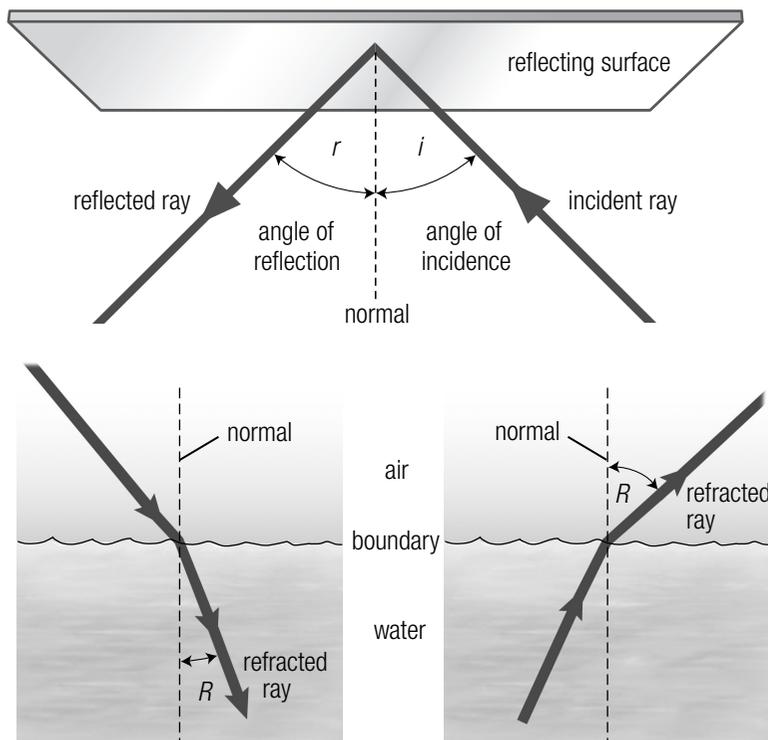
When light reflects from a plane (flat) mirror, the rays of light bounce off the mirror in a regular pattern. The angle of an incoming light ray is the **angle of incidence** ( $i$ ). The angle of the reflected ray is the **angle of reflection** ( $r$ ).

The angle of incidence is always equal to the angle of reflection. You can see yourself in a mirror because of this regular reflecting pattern.

Even when light reflects from a rough, uneven surface, the angle of incidence of the light rays is still equal to the angle of reflection of the light rays. However, on a rough surface, each light ray reflects at a different angle. In other words, there is no regular pattern of reflection. That is why you cannot see yourself in a sheet of paper. ✓

### How is the angle of refraction different from the angle of reflection?

Light rays can refract, or bend. They refract when they move from one material into another, such as from water into air. The **normal** is an imaginary line that passes through both materials at a right angle. If light rays slow down as they refract, they bend toward the normal. If light rays speed up as they refract, they bend away from the normal. The **angle of refraction** ( $R$ ) is the angle of the ray of light that comes out of the boundary between the two materials, measured between the refracted ray and the normal.



### ✓ Reading Check

2. How does the angle of incidence relate to the angle of reflection?

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Use with textbook pages 169–170.

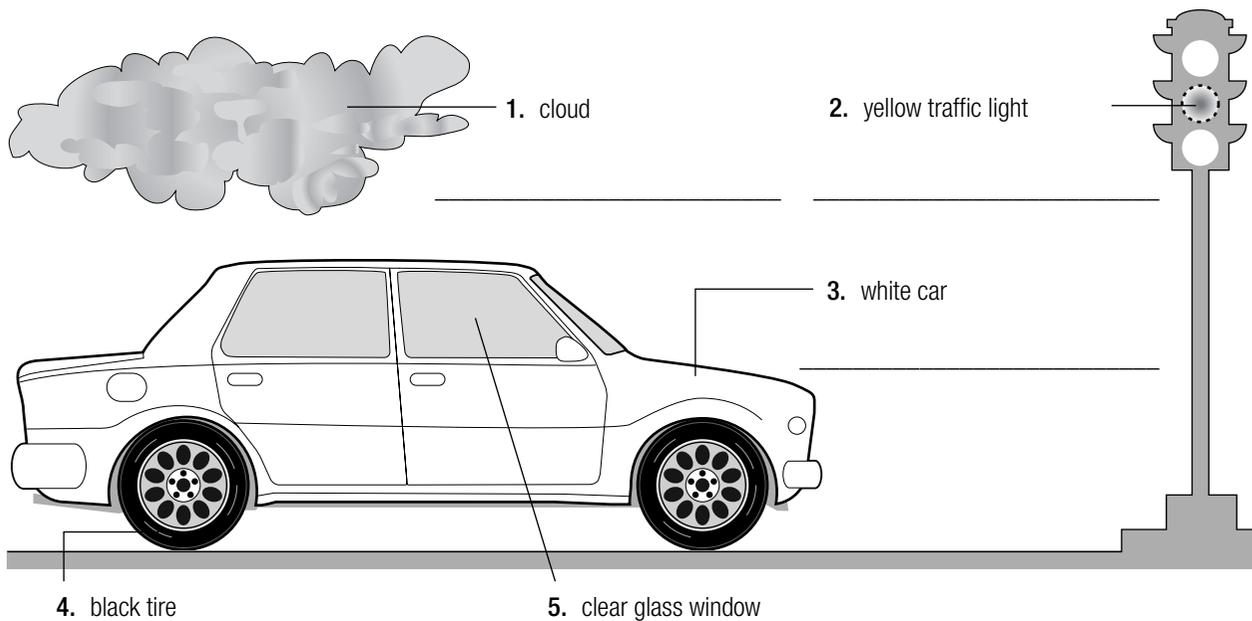
## Getting in light's way

Complete the table and diagram below.

1. Complete the following table.

Materials	What happens when light strikes this material?	Examples of materials
transparent		1. _____ 2. _____
translucent		1. _____ 2. _____
opaque		1. _____ 2. _____

2. State whether light is mostly absorbed, reflected, transmitted, or scattered by each object.

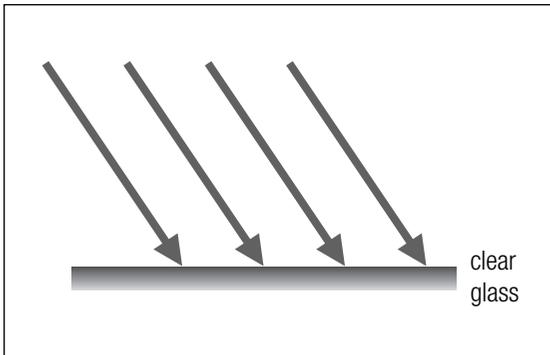


Use with textbook pages 172–175.

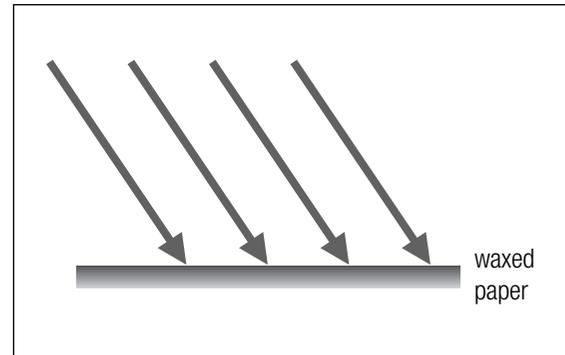
## Predictable behaviour of light

Complete the diagrams below.

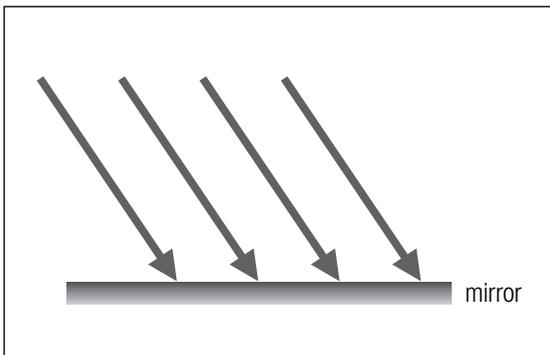
1. Draw the light rays that result when light rays strike a transparent surface.



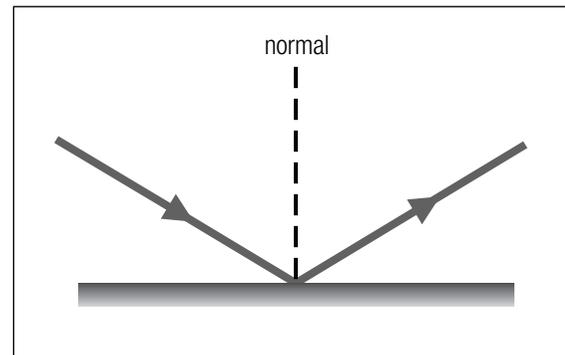
2. Draw the light rays that result when light rays strike a translucent surface.



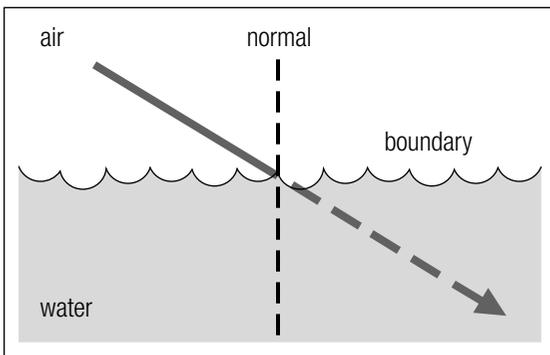
3. Draw the light rays that result when light rays strike an opaque surface.



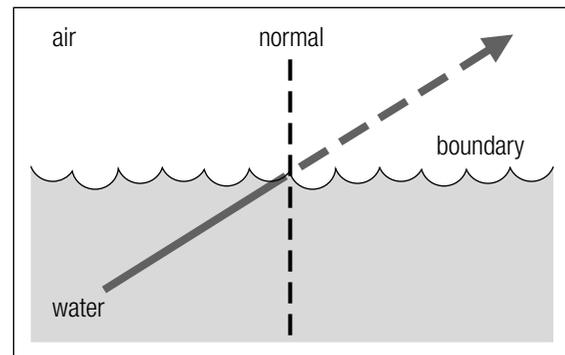
4. Label the angle of incidence and the angle of reflection.



5. Draw the refracted ray that results when light passes from air to water. (Light travels more slowly in water than in air.)



6. Draw the refracted ray that results when light passes from water to air. (Light travels more slowly in water than in air.)



Use with textbook pages 168–175.

## Light can reflect and refract

### Vocabulary

incidence	refracted ray
material	refraction
normal	sheet of paper
plane mirror	transparent
ray model of light	translucent
reflected ray	opaque
reflection	

Use the terms in the vocabulary box above to fill in the blanks. You will not need to use all the terms.

1. In the \_\_\_\_\_, light is described as a ray that travels in a straight path.
2. When light strikes \_\_\_\_\_ materials, it passes through them.
3. When light strikes \_\_\_\_\_ materials, it passes through them, but it is scattered from its straight path.
4. \_\_\_\_\_ materials do not allow light to pass through them.
5. The angle of reflection is equal to the angle of \_\_\_\_\_.
6. Light rays bounce off a \_\_\_\_\_ with a regular reflecting pattern.
7. The angle of \_\_\_\_\_ is the angle of a light ray that comes out of the boundary between two materials.
8. The angle of refraction is measured between the \_\_\_\_\_ and the normal.

Use with textbook pages 168–181.

# The ray model of light

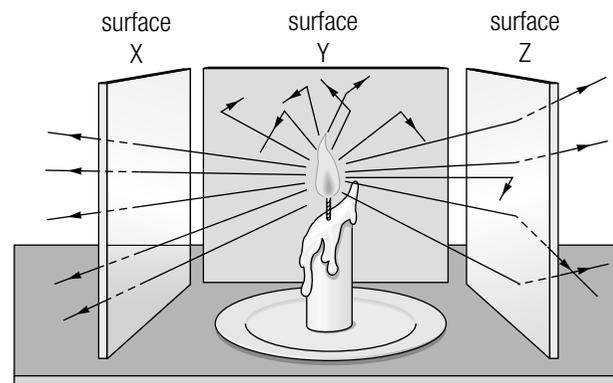
**Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.**

Term	Descriptor
1. _____ normal	<b>A.</b> equal to the angle of reflection
2. _____ angle of refraction	<b>B.</b> measured between the refracted ray and the normal
3. _____ angle of reflection	<b>C.</b> angle of reflected ray
4. _____ angle of incidence	<b>D.</b> imaginary line that passes through materials at right angle
	<b>E.</b> the surface that reflects

**Circle the letter of the best answer.**

- Which of the following statements describes a property of light according to the ray model of light?
  - Light travels like waves.
  - Light travels in a straight line.
  - Light is made up of different colours.
  - Light has characteristics like frequency and wavelength.
- If the angle of incidence is  $50^\circ$ , what is the angle of reflection?
  - $5^\circ$
  - $25^\circ$
  - $50^\circ$
  - $100^\circ$

Use the following diagram to answer questions 7 and 8.



- Which of the following is a translucent surface?
  - surface X
  - surface Y
  - surface Z
  - surface X and surface Z
- Which of the following surfaces allow all the light rays to pass through?
  - surface X
  - surface Y
  - surface Z
  - surface X and surface Z
- Which of the following correctly describes opaque objects?
 

I.	they can absorb all the light
II.	they can reflect all the light
III.	they do not allow light to pass through them
IV.	they transmit all light

I.	they can absorb all the light
II.	they can reflect all the light
III.	they do not allow light to pass through them
IV.	they transmit all light

- I and III only
- II and III only
- III and IV only
- I, II, and III