LESSON 12 | What is refraction?

teacher

density must change, & must approach at an angle

Light travels in straight lines. But light rays can also "bend." They can change direction.

You have seen that light changes direction when it is reflected. Light also changes direction when it passes at an angle from one medium into another medium. This bending is called **refraction** [ree FRAK shun].

Refraction causes us to see objects at positions different from their actual positions. You may have experienced refraction. Did you ever reach into a fish tank to pick up a rock? Was the rock exactly where you thought it was?

How can refraction be explained?

Light travels at different speeds through different mediums. Light travels at about 300,000 kilometers (186,000 miles) per second in air. But light slows down in other substances. In water, for example, light slows down to about 225,000 kilometers (140,000 miles) per second.

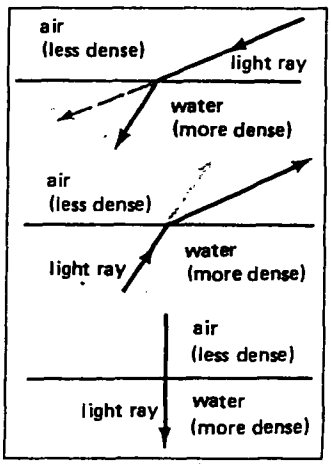
The speed at which light travels through a medium depends upon the **density** of that medium. Density has to do with how closely packed the molecules of a substance are. The more closely packed the molecules are, the more dense the substance is.

* Speed depends on the density

Different substances have different densities. For example, water is more dense than air.

The following are the Laws of Refraction. They explain how light "bends."

- Light that moves at an angle from a less dense medium to a more dense medium bends towards the normal.
- Light that moves at an angle from a more dense medium to a less dense medium bends away from the normal.
- Light that moves straight on from one medium to another does not bend. It is not refracted.



For refraction to happen: need 2 things

(1) the density must change
(2) must approach at an angle.

UNDERSTANDING REFRACTION

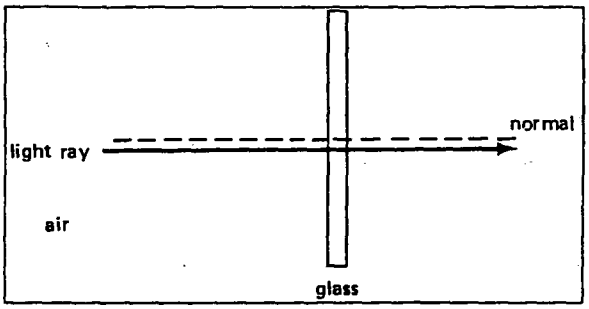


Figure A

1. From your own experience, you know that glass is _____ (more, less) dense than air.
2. The light is hitting the glass _____ (at an angle, straight on).

3. The light _____ (is, is not) bending. It _____ (is, is not) being refracted.
4. Why isn't the light being refracted? its straight on
5. Write the part of the Law of Refraction that explains why this is happening.
Light that moves straight on from 1 med. to another Does not bend It is not refracted

Look at Figures B through G. In each, light is being refracted. The dotted line in color is the normal. Is the light being refracted towards the normal or away from the normal?

Complete the sentence under each figure.

Li is greater than Lr so towards

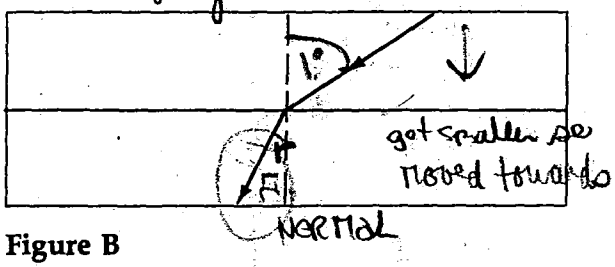


Figure B

L(i) is greater than L(r) so away

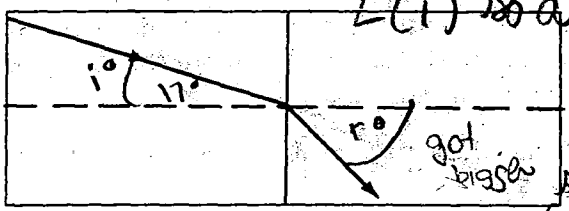


Figure C

6. Light is being refracted _____ (towards, away from) the normal.

towards

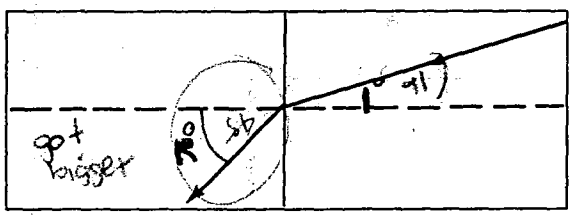


Figure D

7. Light is being refracted _____ (towards, away from) the normal.

away

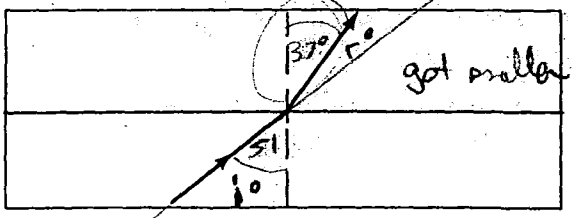


Figure E

8. Light is being away from the normal

9. Light towards the normal

Now, answer with complete sentences.

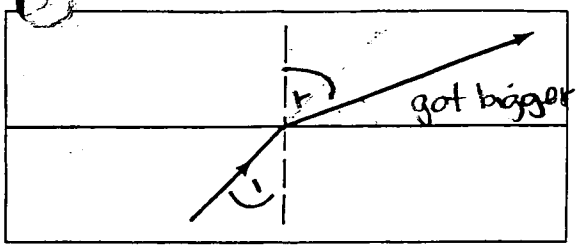


Figure F

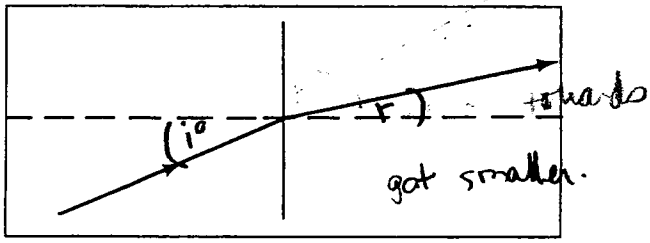


Figure G

10. Light is refracting away from the normal

11. towards from the normal

MORE ABOUT REFRACTION

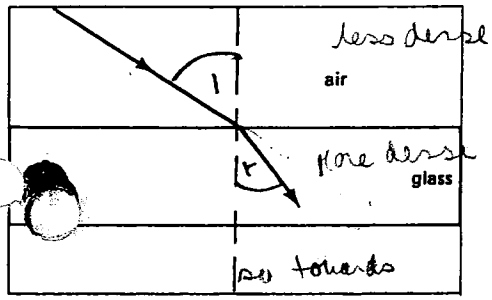


Figure H

Look at Figures H and I. Answer the questions with each.

1. a) In Figure H, light is passing from _____ (air to glass, glass to air).

   b) Glass is _____ (more, less) dense than air.

2. The light is hitting the glass _____ (at an angle, straight on).

3. The light _____ (is, is not) bending. It _____ (is, is not) being refracted.

4. The light is being refracted _____ (towards, away from) the normal.

5. Write the part of the Law of Refraction that explains why this is happening.

   light that moves at an angle from a less dense medium to a more dense medium bends towards the normal

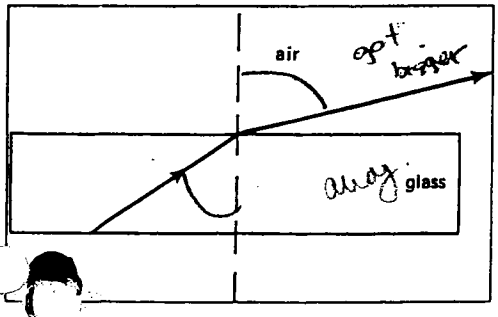


Figure I

6. a) In Figure I, light is passing from _____ (air to glass, glass to air).

   b) Air is _____ (more, less) dense than glass.

7. The light is hitting the air _____ (at an angle, straight on).

8. The light _____ bending. It _____ being refracted.
(is, is not) (is, is not)

9. The light is being refracted _____ the normal.
(towards, away from)

10. Write the part of the Law of Refraction that explains why this is happening.

light that moves at an angle from a more dense medium to a less dense medium moves away from the normal

REFRACTION AND CHANGE OF POSITION

Study Figure J. Answer the questions.

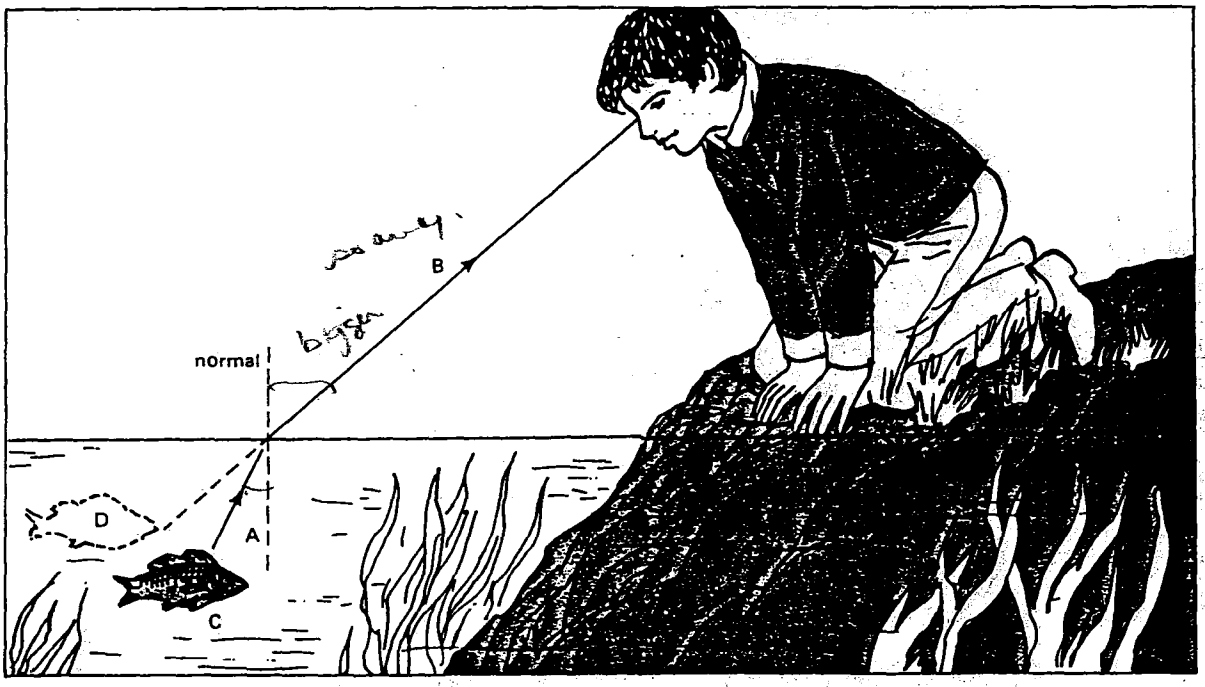


Figure J *The fish is actually at C. But to the boy, the fish appears to be at D.*

1. The boy sees the fish because light is traveling _____
(from the boy's eyes to the fish,)

_____.
(from the fish to the boy's eyes)

2. The fish is _____.
(giving off its own light, reflecting light)

3. The light is moving from _____. more dense to less dense
(water to air, air to water)

4. The light from the fish is being refracted _____ the normal.
(towards, away from)

5. The boy sees the fish in line with the refracted light. The refracted light is _____ A, B .

6. Refraction _____ does / does not seem to change the position of an object.

FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some words may be used more than once.

is not	refraction	more slowly
away from	more	air
at an angle	toward	less

1. The bending of light as it passes from one medium to another is called _refraction_.
2. Refraction takes place when light strikes a surface _at an angle_ to the normal.
3. Light that strikes a surface in the same direction as the normal _is not_ refracted.
4. Light travels at about 300,000 kilometers per second in _air_.
5. Glass and water are _more_ dense than air.
6. Light travels _more slowly_ in glass or water than it does in air.
7. Light that moves at an angle from a less dense medium to a more dense medium is refracted _toward_ the normal.
8. Light that moves at an angle from a more dense medium to a less dense medium is refracted _away from_ the normal.
9. The light ray in Figure K is being refracted _away_ the normal.

A is _less_ dense than B.

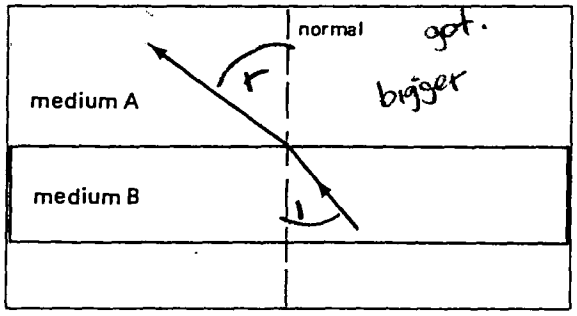
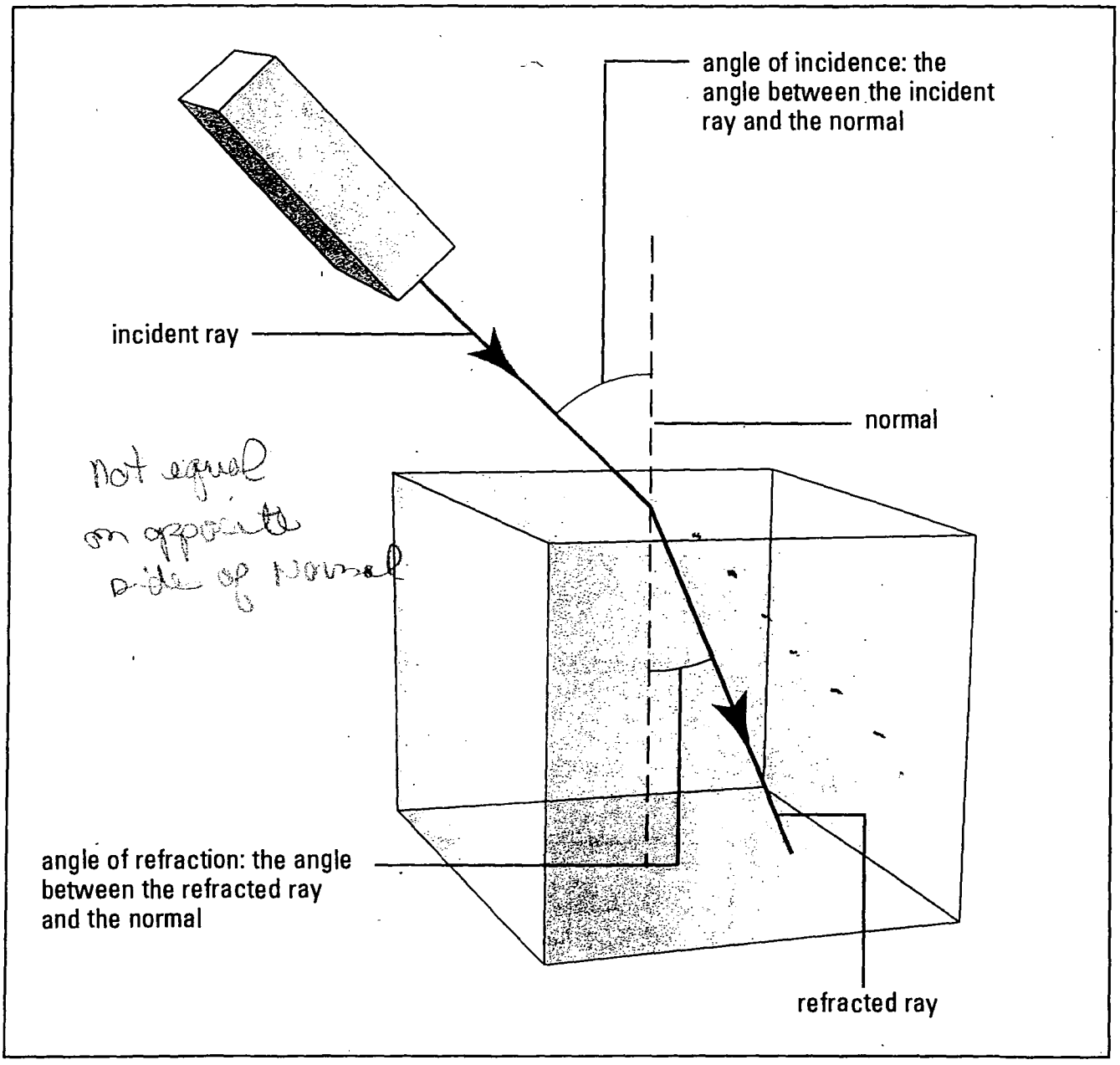


Figure K

(Key)

5.10 Terms Related to the Refraction of Light

Refraction Booklet answer key



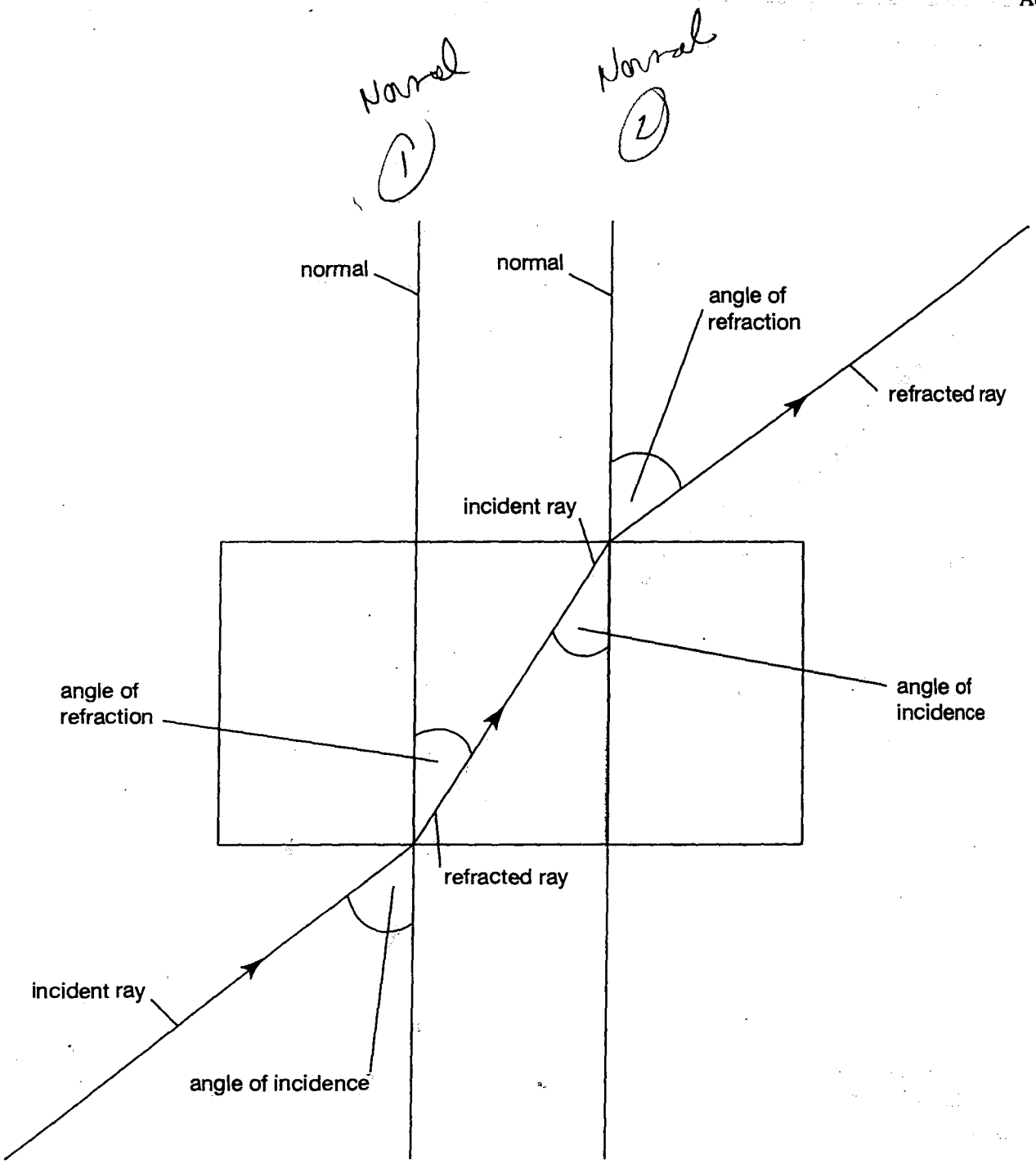


Figure 7.23 Light is refracted as it passes through one medium into a denser medium.