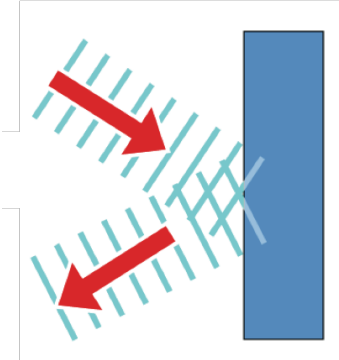

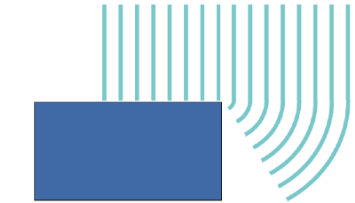
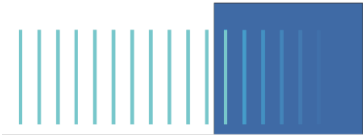
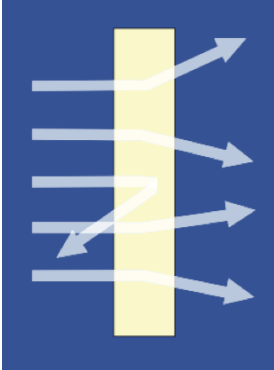


PART 1: Overview of wave boundary phenomena

Definition	Picture	Examples
1. Reflection <i>Wave bounces off a boundary</i>		Sound: Light:
2. Refraction <i>Light wave moves through a boundary and bends</i>		Light:
3. Diffraction <i>Wave bends around a corner</i>		
4. Absorption <i>Wave is converted to thermal energy, and disappears</i>		
5. Scattering <i>Light waves sent in every direction.</i>		

Which one is about light bending as it goes through a barrier?

Which one involves bouncing off a surface?

Which involves light being sent into every direction?

Which involves light or sound turning into thermal energy?

Which involves curving around a corner?

Examples

For each real life example, explain which of the 5 wave activities happens:

Sound echo

Light hits a mirror

Light hits a piece of glass at an angle

Waves curve around a rock at the beach

Wearing a black shirt in the sunlight makes you warmer

Sound reverberates around a room

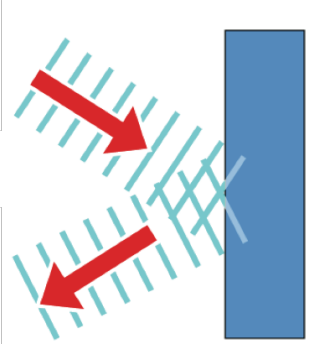
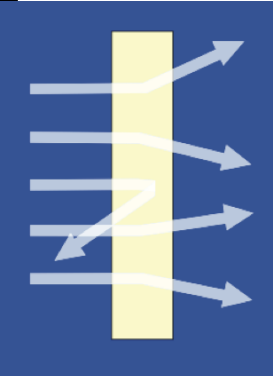


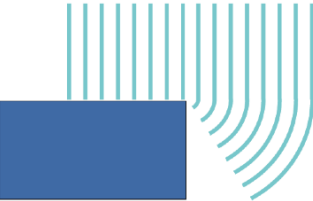
Radar waves hit a plane

Blue waves of light hit the atmosphere.

A sound wave comes to the room from the hallway, through the door. You can hear the sound anywhere in the room.

A straw in a glass of water looks bent at the boundary of water and air.

For each picture, write what type of activity it is:

Part 2: The Law of Reflection**Incident Ray:**

A ray of light that hits a mirror.

Normal Line

A line perpendicular to the mirror.

Angle of Incidence:

Angle between the incident ray and normal line.

Reflected Ray:

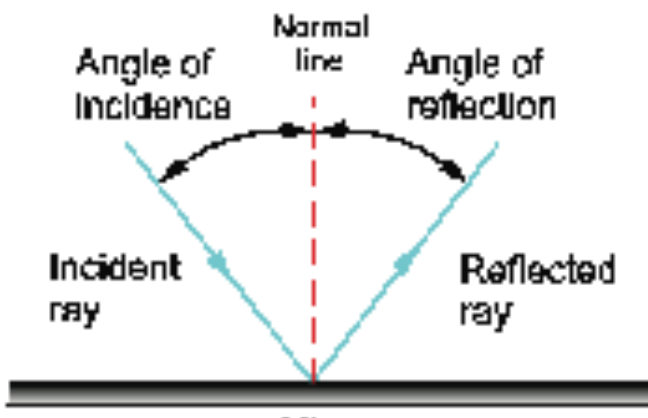
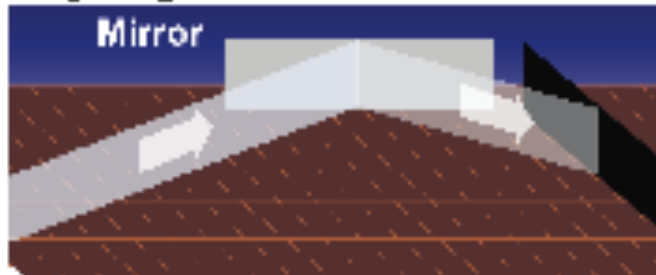
A ray reflected off the mirror.

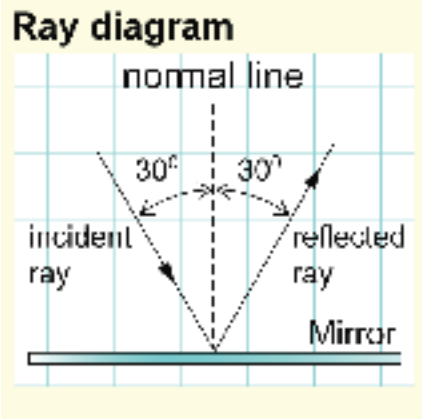
Angle of reflection

Angle between the reflected ray and normal line.

Law of Reflection:

The angle of incidence equals the angle of reflection.

Ray diagram



In this picture,
What is the angle of incidence?

What is the angle of reflection?

Are they equal?

Which LAW OF PHYSICS tells you they must be equal?

Fill in the Blank

A line perpendicular to the mirror is called the _____.

The ray of light that hits a mirror is the _____.

The ray of light that bounces off a mirror is called the _____.

The angle of incidence always _____ the angle of reflection!

How does understanding the LAW OF REFLECTION help you become a better pool player?

Draw your own RAY DIAGRAM. Label the *incident ray*, *reflected ray*, *angle of incidence*, and *angle of reflection*.

Part 3: Index of Refraction Formula**Medium:**

The matter that a light wave moves through.
 Light can move through a medium or a vacuum

Index of refraction

Light moves fastest through a vacuum, and slows down when it moves through a medium.
 (However, it still goes very fast.)

$$v = \frac{c}{n}$$

Symbol	Quantity	SI UNIT
v	Speed of light in medium	m/s
c	Speed of light in vacuum: 3.0×10^8 m/s	m/s
n	Index of refraction of the medium	Unitless

Medium	Index of Refraction
Vacuum	1.0
Water	1.33
Ice	1.31
Glass	1.5
Diamond	2.42

How fast does light move through water?

Looking For	
Already Know	
Formula	Answer in a complete sentence <i>with unit</i> :

How fast does light move through glass?

Looking For	
Already Know	
Formula	Answer in a complete sentence <i>with unit</i> :

How fast does light move through a diamond?

Looking For	
Already Know	
Formula	Answer in a complete sentence <i>with unit</i> :

Through what medium does light travel *fastest*?

Through what medium does light travel *slowest*?

Part 2: Why refraction happens:

Refraction
Refraction is when light bends as it moves between two mediums
Why does refraction occur?
Refraction happens because light changes speed as it moves between two mediums.

True or False?

Light moves the same speed in every medium.

Light typically moves straight from one medium to another.

Light bends as it changes mediums.

Light bends because it changes speed.

Light moves fastest through diamond.

Refraction occurs because light changes speed as it moves between mediums.

Why does refraction happen?

What are some real life consequences of refraction?

Part 3: Pictures of refraction**Boundary**

Where two different mediums meet.

Incident Ray

The ray of light that hits the boundary.

Refracted Ray

The ray of light that goes through a boundary and *bends*.

Normal Line

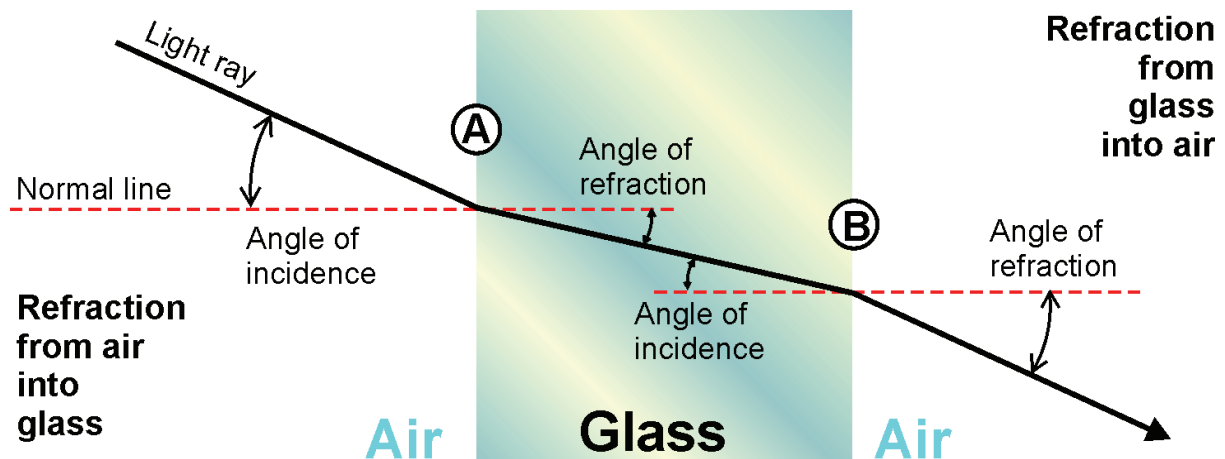
A line perpendicular to the boundary.

Angle of Incidence

Angle between the incident ray and the normal line.

Angle of Refraction

Angle between the refracted ray and the normal line.

**Light moves FASTER**

When light moves FASTER in the second medium, the refracted ray bends AWAY FROM the normal line.

Light moves SLOWER

When light moves SLOWER in the second medium, the refracted ray bends TOWARDS the normal line.

Fill in the Blank

In physics, a line perpendicular to a surface is the _____ line.

A ray of light that hits a boundary is called an _____.

A ray of light that has just bent is called the _____.

The angle between the incident ray and the normal line is the _____.

The angle between the refracted ray and the normal line is the _____.

If light *slows down* at a boundary, the light ray bends _____ the normal line.

If light *speeds up* at a boundary, the light ray bends _____ the normal line.

Pictures

Light moves from AIR to WATER. Does light speed up or slow down?

Draw a picture of refraction as light moves from AIR to WATER. Label the *normal line*, *incident ray*, *refracted ray*, *angle of incidence*, and *angle of refraction*.

Light moves from WATER to AIR. Does light speed up or slow down?

Draw a picture of refraction as light moves from WATER to AIR. Label the *normal line*, *incident ray*, *refracted ray*, *angle of incidence*, and *angle of refraction*.

What is the difference between your two drawings? Which angle changes?

Extra Review

List the types of electromagnetic wave from LONGEST wavelength to SHORTEST wavelength:

List the colors of visible light from LONGEST wavelength to SHORTEST wavelength:

Which types of electromagnetic wave do you think are more affected by refraction: long wavelength or short wavelength?

(hint: you can think of longer wavelength waves being *tougher*, like a truck, and short wavelength waves being *weaker*, like a sedan)

Give an example of each:

SOUND reflection:

LIGHT reflection:

LIGHT refraction:

Water wave diffraction:

Light diffraction:

Light scattering:

Which reflects more light, a white shirt or a black shirt. Why?

Which type of shirt do you want to wear in the summer? In the winter?

EDITS necessary

- at the moment, the first page is dependent upon listening to a lecture of class discussion on optics

--- goal of the 2017 redesign was to make it doable not just in class

---- it's exercises, it isn't a lecture guide