Name: _____

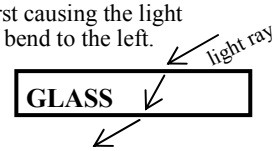
Period: _____

Optics – The Study of Light

Refraction

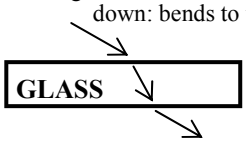
Light ***refracts*** when passing between two substances ***at an angle***.

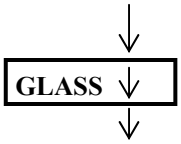
Light slows down in glass. Here the left side slows down first causing the light to bend to the left.



Light speeds up in air. Here the left side speeds up first causing the light to bend to the right.

The right side hits first and slows down: bends to the right.





If the light does not enter at an angle, it does not bend.

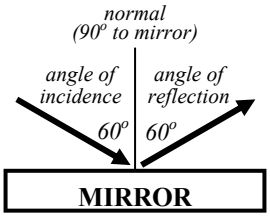
Reflection

Light reflects at shiny boundaries we call mirrors.

Normal – an imaginary line 90° (perpendicular to a surface.

Angle of Incidence – the angle between the incoming ray and the normal.

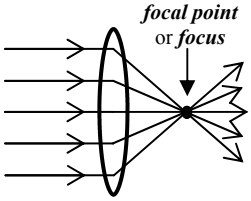
Angle of Reflection – the angle between the outgoing ray and the normal.



angle of incidence = angle of reflection

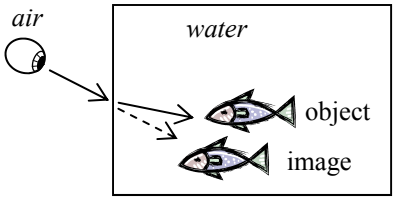
Focus

Every lens or mirror has a place where all of the parallel rays will meet. This is known as the ***focal point*** or ***focus***.



Straight Lines

Mirrors and lenses can make things look bigger or smaller because our eyes always think that light comes from straight lines, even if they have been refracted or reflected.



Object vs. Image

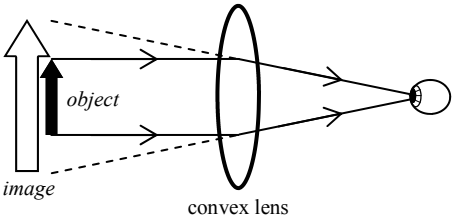
The ***object*** is what you are looking at: the actual thing.

The ***image*** is what you think you see: the object enlarged, reduced, or moved .

Lenses

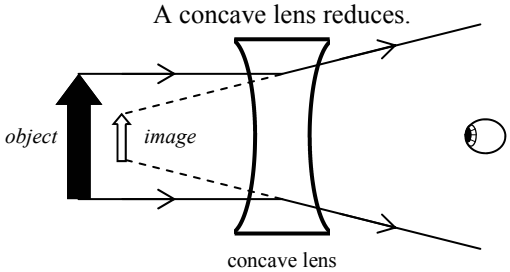
Lenses work by refraction, by the light bending when moving between two substances.

A convex lens magnifies.



*A convex lens is **convergent**— the light rays come together.*

A concave lens reduces.



*A concave lens is **divergent**— the light rays spread apart.*

Lenses and mirrors work opposite of each other. If a concave lens reduces, then a concave mirror magnifies.

Concave or Convex

Concave looks like the sides have caved in.

concave

Convex— the middle is bigger than the ends.

convex

Optical Systems

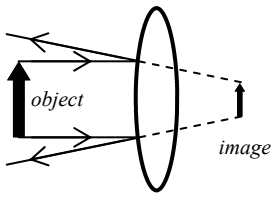
Microscopes and telescopes are ***optical systems*** that use combinations of lenses and/or mirrors to magnify light. Combining optical devices allows us to see very distant or very small objects.

Mirrors

Mirrors work by reflection, by the bounding of light off of a shiny surface. ***Images in mirrors always look twice as far away as the object.***

Ex. An image looks 20 m away in a mirror. How far away is the object?
Answer: Half the distance: 10 meters.

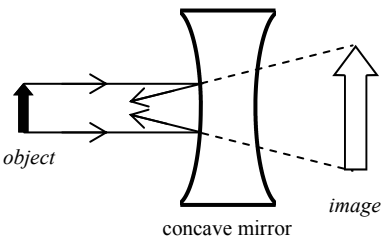
A convex mirror reduces.



convex mirror

A convex mirror is divergent.

A concave mirror magnifies



concave mirror

A concave mirror is convergent.

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Name: _____

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1. Optics	A. The study of how light behaves.
2. Image	B. A lens or mirror that is bigger in the middle.
3. Object	C. Light rays that spread apart.
4. Concave	D. Where your eyes think something is.
5. Convex	E. Light rays that come together.
6. Convergent	F. What you are actually looking at.
7. Divergent	G. A lens or mirror that is bigger at the ends.

1. Normal	A. A line drawn perpendicular to the surface of a mirror or lens.
2. Mirror	B. An optical device that works by refraction to bend light.
3. Angle of incidence	C. From the normal to the incoming ray.
4. Angle of reflection	D. From the normal to the outgoing ray.
5. Lens	E. Where all parallel rays come together.
6. Focus	F. An optical device that works by reflection.

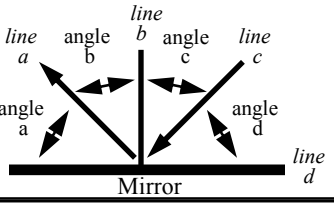
The angle of incidence is: _____

The angle of reflection is: _____

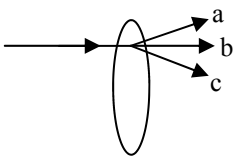
The normal is: _____

The incident ray is: _____

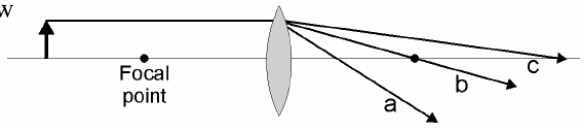
The reflected ray is: _____



Which letter shows where the incoming light ray will go?



Which arrow shows the path taken by the lens?



You stand 2 feet in front of a mirror. How far away does your image seem?

A convex lens is convergent/divergent and magnifies/reduces.

A concave lens is convergent/divergent and magnifies/reduces.

A convex mirror is convergent/divergent and magnifies/reduces.

A concave mirror is convergent/divergent and magnifies/reduces.

The angle ***between*** the incident ray and reflected ray is 60°. What is the angle of reflection?

The angle of reflection is 40°. What is the angle of incidence?

If a wave's fourth harmonic has a frequency of 24 Hz, what is its natural frequency and what is the frequency of H_6?

What quantities are these units for?

$\frac{m}{s^2}$ _____	$\frac{mi}{hr}$ _____	$\frac{m}{s}$ _____
Km _____	volts _____	Kg _____
Sec _____	Meters _____	Joules _____
N _____	Watts _____	Ω _____
	Amps _____	Hz _____

If a sound is 60 dB loud. Answer how many dB these would be:

1) A sound twice as loud:

2) A sound half as loud:

A sound wave has a wavelength of 20 m. Find its frequency.

If a sound wave's frequency is 100 Hz. What is its period?

You yell into a canyon and it takes 3 seconds for the echo to come back to you. How far away is the other side of the canyon?

Find its period: _____

What harmonic is this? _____

Could a human hear this frequency? _____

Mark the nodes and anti-nodes.

How many wavelengths is it? _____

Find the fundamental frequency:

_____

5th harmonic frequency:

_____

Can we hear this frequency? _____

100 Hz

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