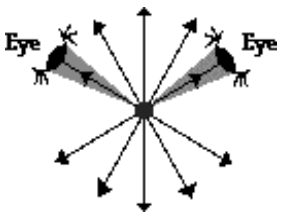
Reflection of Light

Definitions

- **Luminous** objects – generate their own light (the sun)
- **Illuminated** objects – reflect light (the moon)
- **Line of Sight** – a line from an object or image to your eyes (light from the object travels along this line to your eyes)

Slide 2

Line of Sight

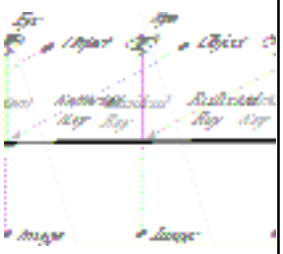


- Both luminous & illuminated objects emit/reflect light in many directions.
- Your eye sees only the very small diverging cone of rays that is coming toward it.

Slide 3

Rays of Light

- Incident Ray – leaves the object and strikes the mirror
- Reflected Ray – leaves mirror and strikes your eye
- The reflected ray is on the line of sight from the image to your eye.



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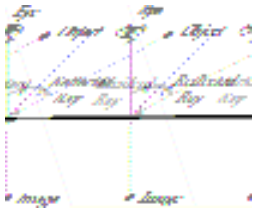
Law of Reflection

- Angle of incidence equals angle of reflection.



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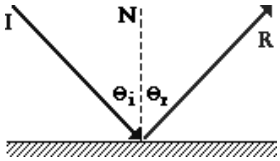
Law of Reflection



- Normal – line perpendicular to the mirror surface
- Angle of incidence – angle between incident ray and normal
- Angle of reflection – angle between reflected ray and normal

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Law of Reflection Animation

$$\theta_i = \theta_r$$

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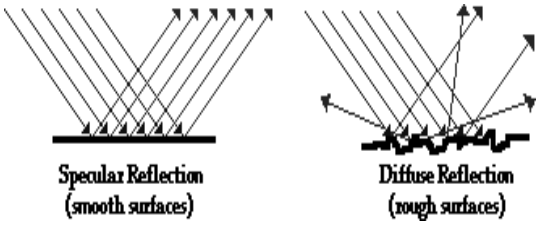
Diffuse Reflection



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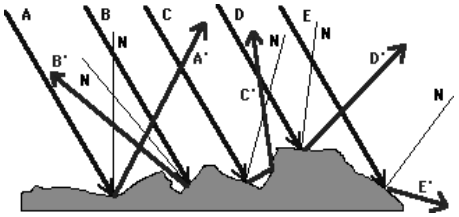
Diffuse Reflection



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Wet Road Glare

A dry asphalt roadway diffuses incident light.

When wet, water fills in the crevices, resulting in specular reflection and a glare.

- Driving at night on a wet roadway results in an annoying glare from oncoming headlights.

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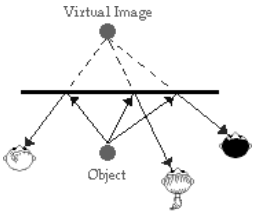
Observing an Image



All observers would perceive light to be diverging from the same point - the image point.

- An image is a position in space from which all reflected light appears to diverge.
- Image formed by a plane mirror is called a virtual image.
- Virtual images are formed in regions where there is actually no light

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Image Location

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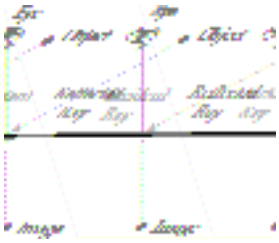
Image Formed By Plane Mirror



- Image is virtual.
- Image is located as far behind the mirror as the object is in front of the mirror.

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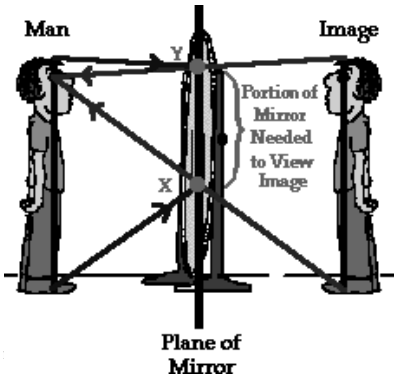
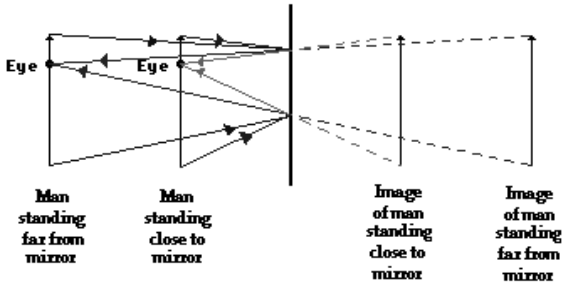
How Big Must the Mirror Be?



Slide

Distance from Mirror Irrelevant



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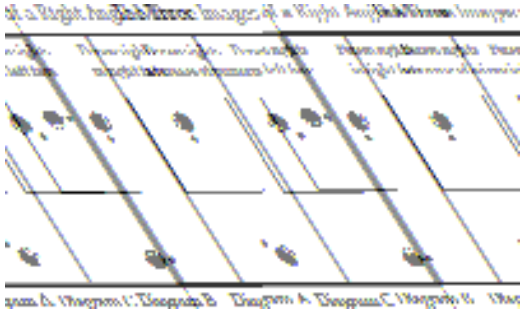
Right Angle Mirror



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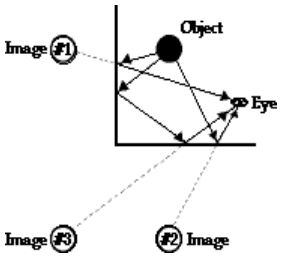
Right Angle Mirror



- Formation of primary and secondary images

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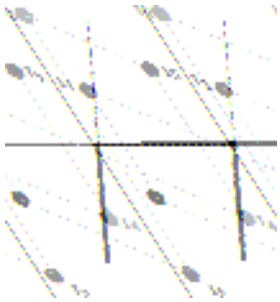
Kaleidoscope



- Angles smaller than 90° produce more than 3 images

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Kaleidoscope Applets

- Hinged Mirror Applet
- Image Formation Applet

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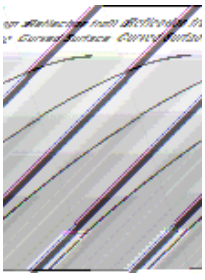
Reflection Applets

- Plane Mirror Image Applets
- Double Mirror Images
- Hinged Mirror Applet
- Rainbow Applets

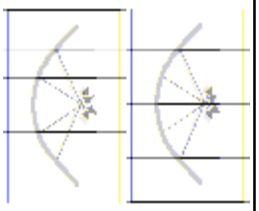
Law of Reflection Curved Mirrors

- Angle of Incidence is equal to the angle of reflection



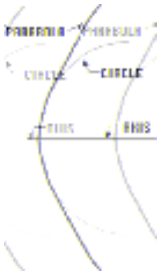
Converging Mirror

- A series of flat mirrors can be arranged to reflect parallel light through a single point.
- Increasing the number of flat mirrors causes the shape to more closely approximate a parabola and causes the reflected light to converge in a smaller area.

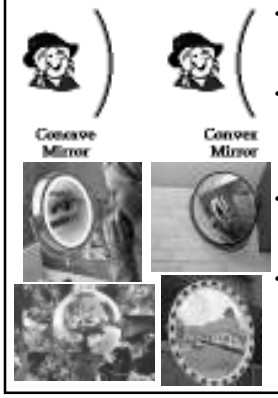


Parabolic vs Spherical

- Close to the axis of the mirror, the parabola and the circle are almost the same shape.
- Farther from axis the parabola flattens out.
- It is easier and less expensive to make spherical mirrors.

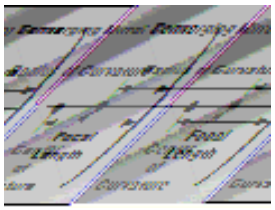


Types of Curved Mirrors



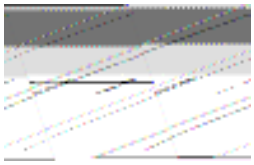
- A concave mirror is silvered on the inside of the sphere.
- A concave mirror is also called a converging mirror because it converges parallel light.
- A convex mirror is silvered on the outside of the bowl.
- A convex mirror is also called a diverging mirror because it diverges parallel light.

Concave Mirror Terms



- Axis
- Center of Curvature
- Radius of Curvature
- Focus
- Focal Length

Three Useful Rays



- Ray parallel to the axis reflects through the focus.
- Ray through the focus reflects parallel to the axis.
- Ray through the center of curvature reflects back on itself.