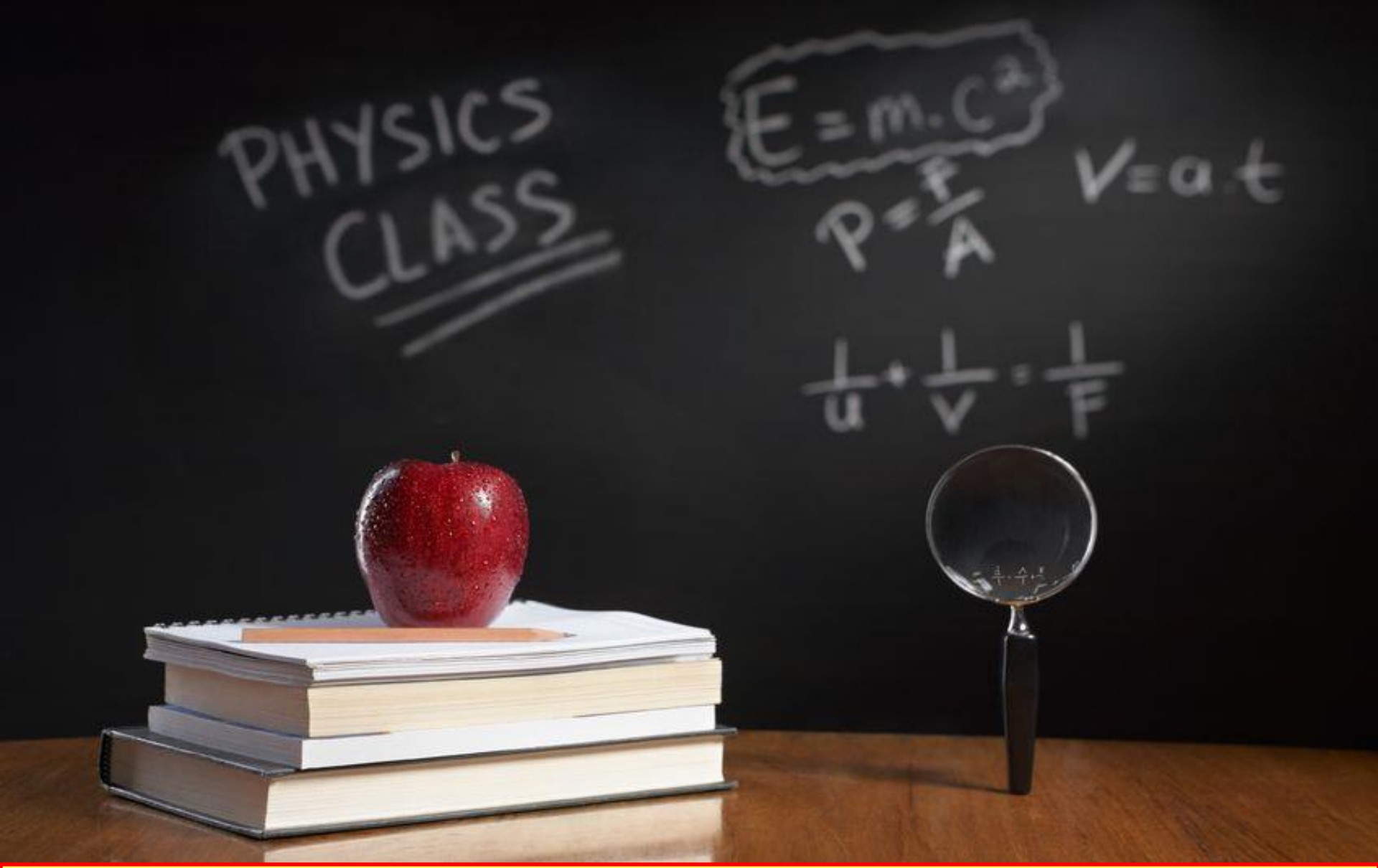
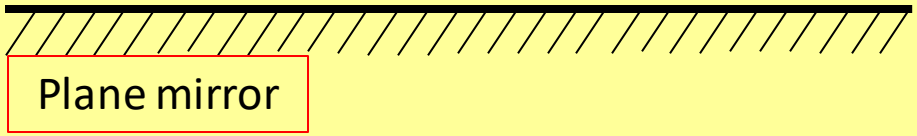


PHYSICS – Reflection and Refraction

LEARNING OBJECTIVES

Core	Supplement
•Describe the formation of an optical image by a plane mirror, and give its characteristics • Recall and use the law angle of incidence = angle of reflection Describe an experimental demonstration of the refraction of light • Use the terminology for the angle of incidence i and angle of refraction r and describe the passage of light through parallel-sided transparent material • Give the meaning of critical angle • Describe internal and total internal reflection Describe the action of a thin converging lens on a beam of light • Use the terms principal focus and focal length • Draw ray diagrams for the formation of a real image by a single lens • Describe the nature of an image using the terms enlarged/same size/diminished and upright/inverted	Describe the formation of an optical image by a plane mirror, and give its characteristics • Recall and use the law angle of incidence = angle of reflection Recall and use the definition of refractive index n in terms of speed • Recall and use the equation sin I / sin r=n • Recall and use n = n = 1 / sin c • Describe and explain the action of optical fibres particularly in medicine and communications technology Draw and use ray diagrams for the formation of a virtual image by a single lens • Use and describe the use of a single lens as a magnifying glass • Show understanding of the terms real image and virtual image

Reflection in a Plane Mirror



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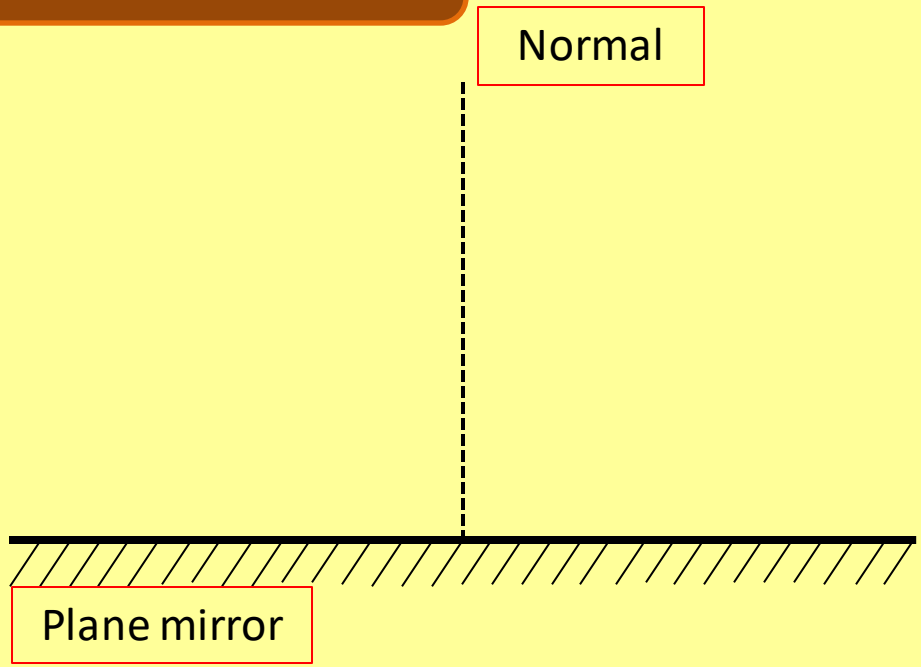

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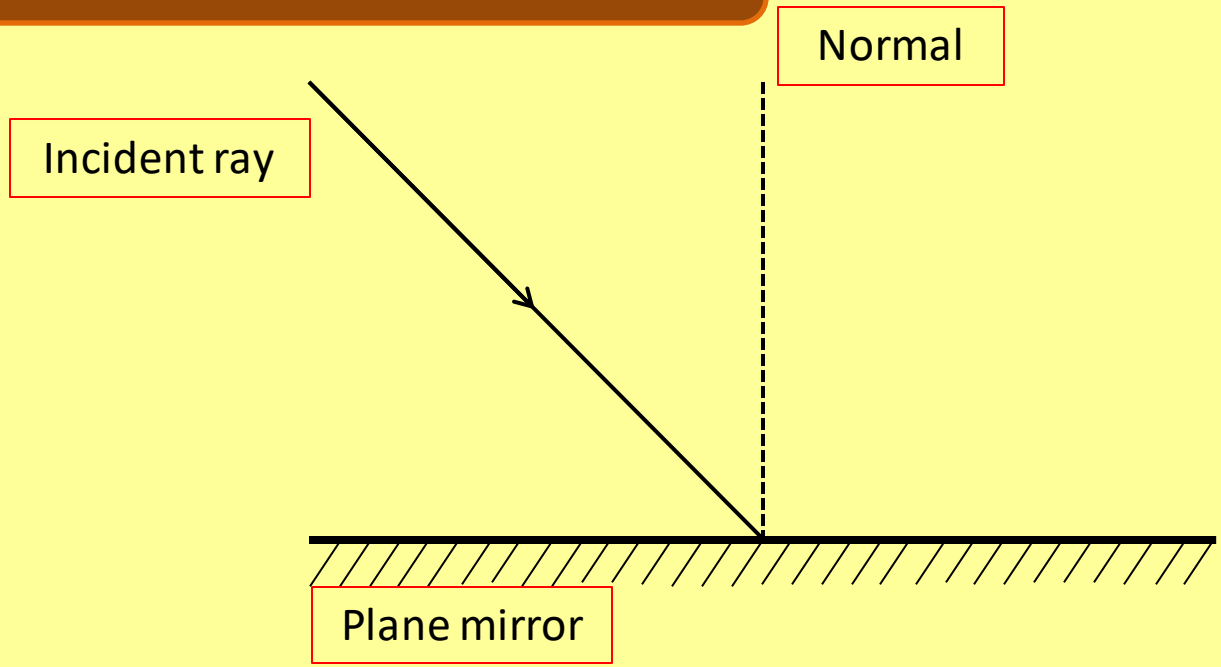

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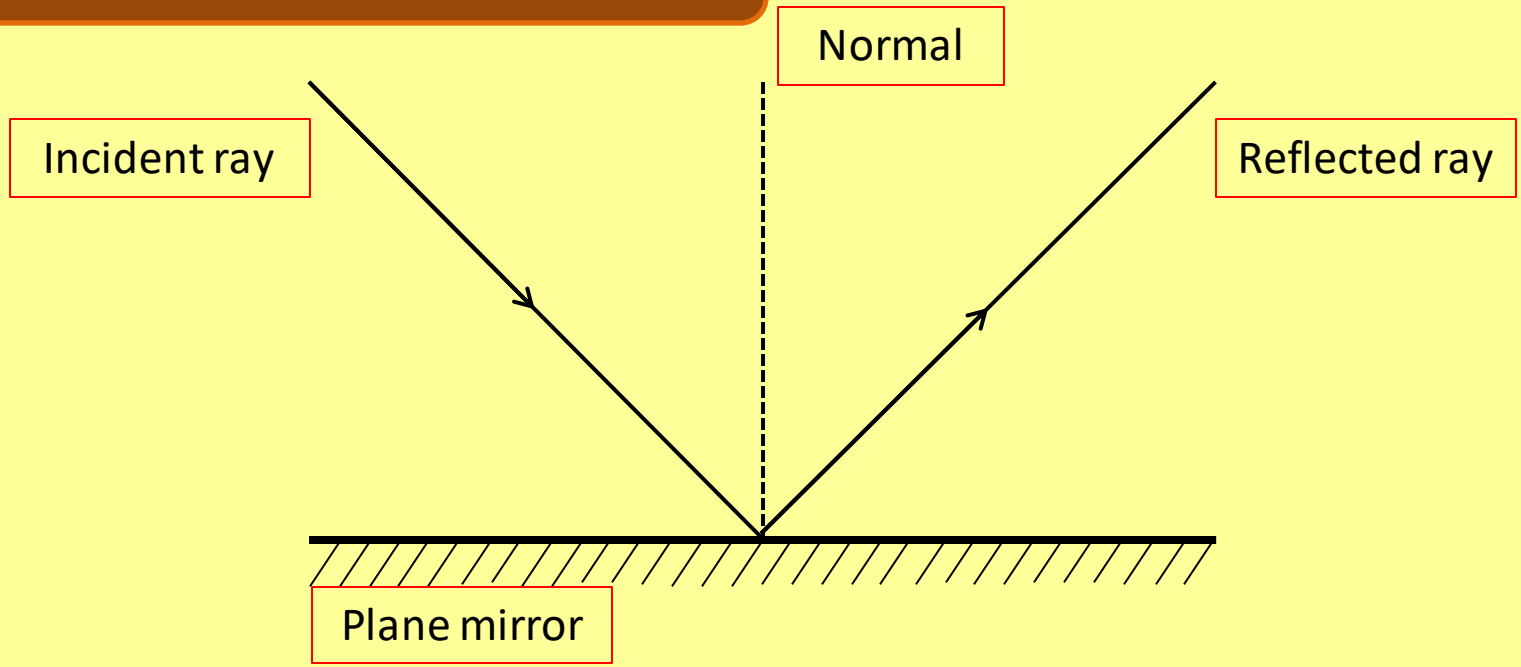

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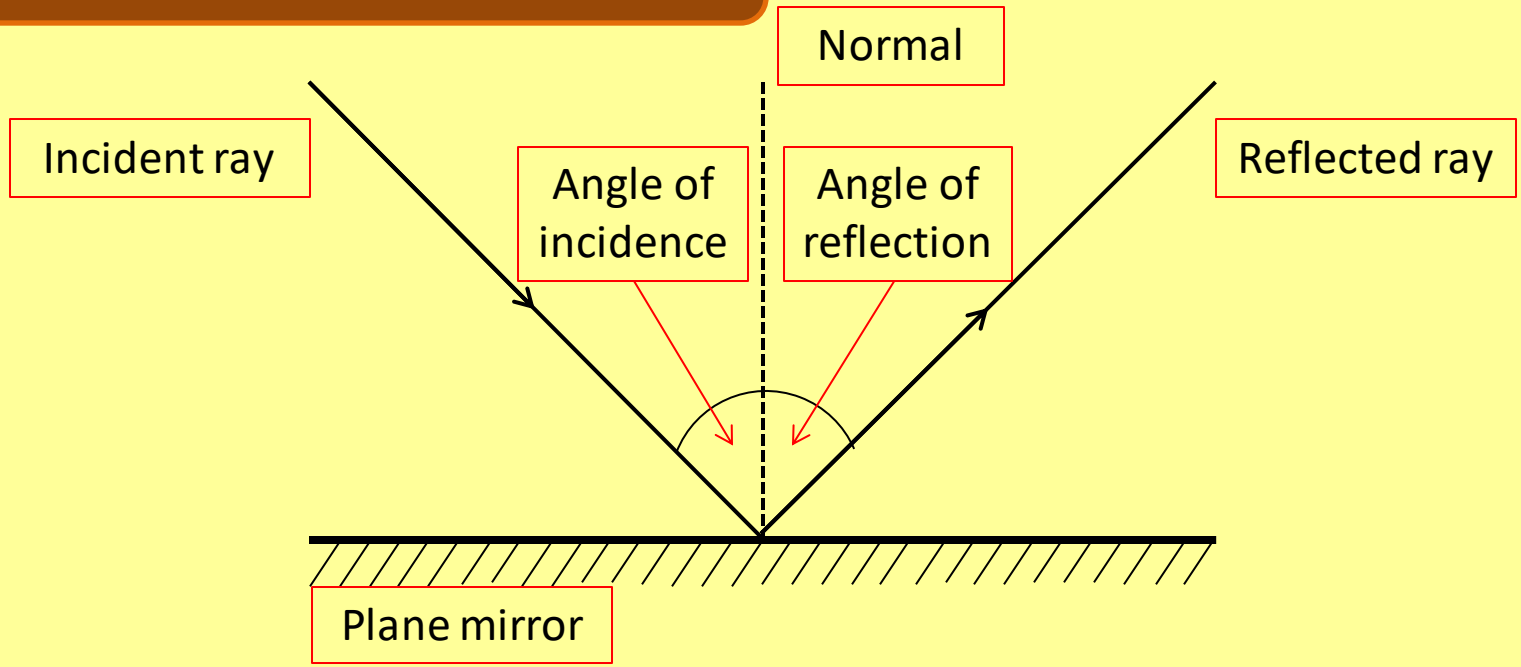

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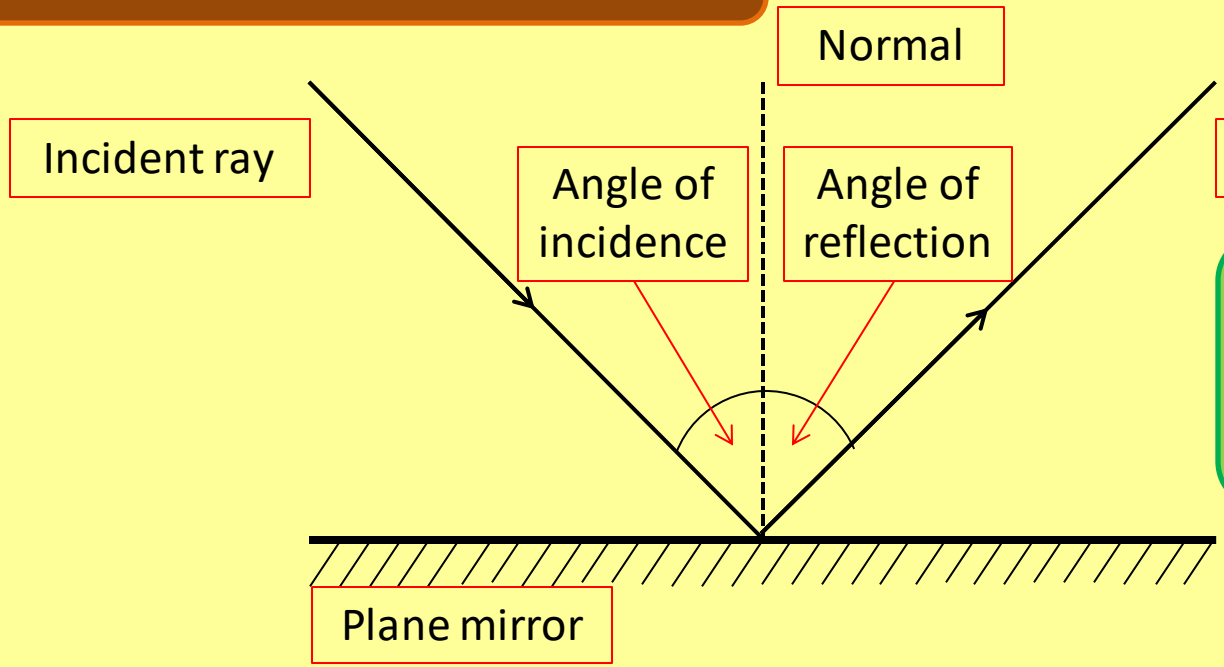
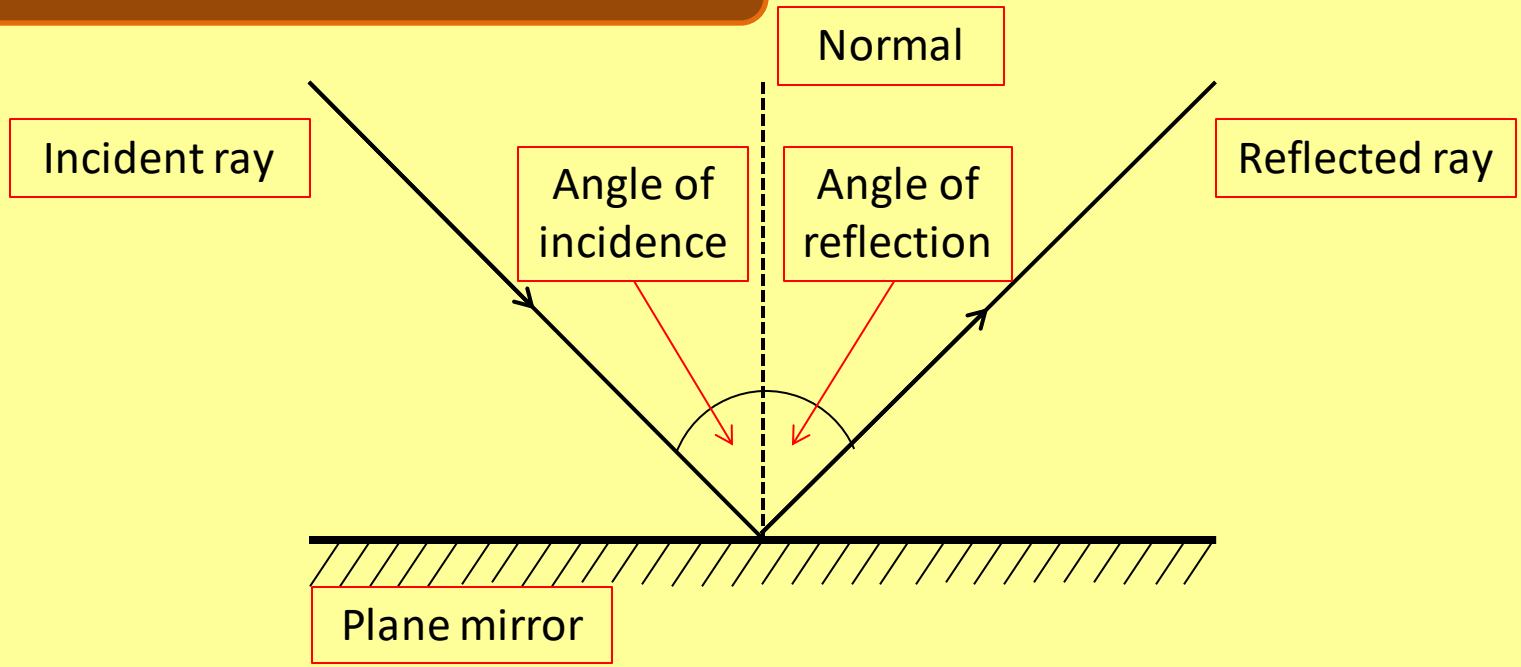


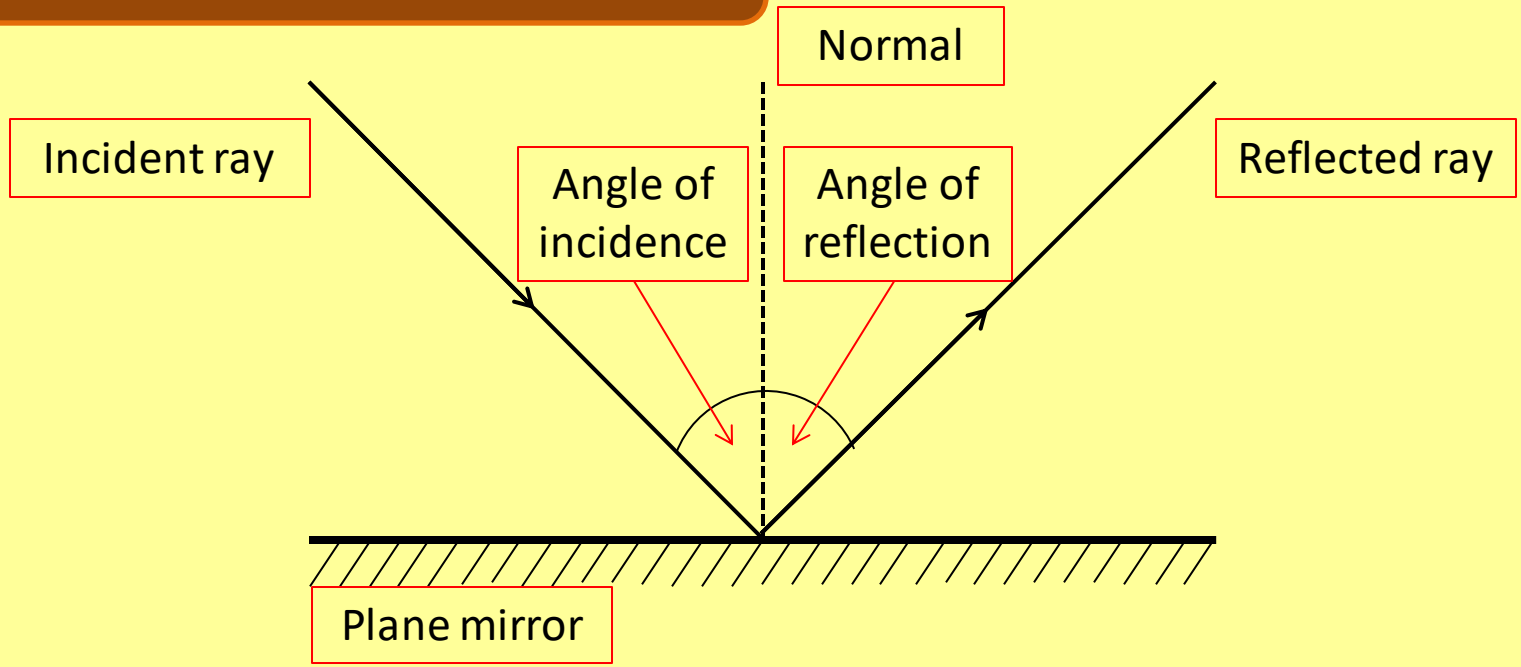
REMINDER: always use a ruler to draw light rays (light travels in straight lines) and don't forget to include arrows showing direction of light.

Reflection in a Plane Mirror



Laws of reflection:

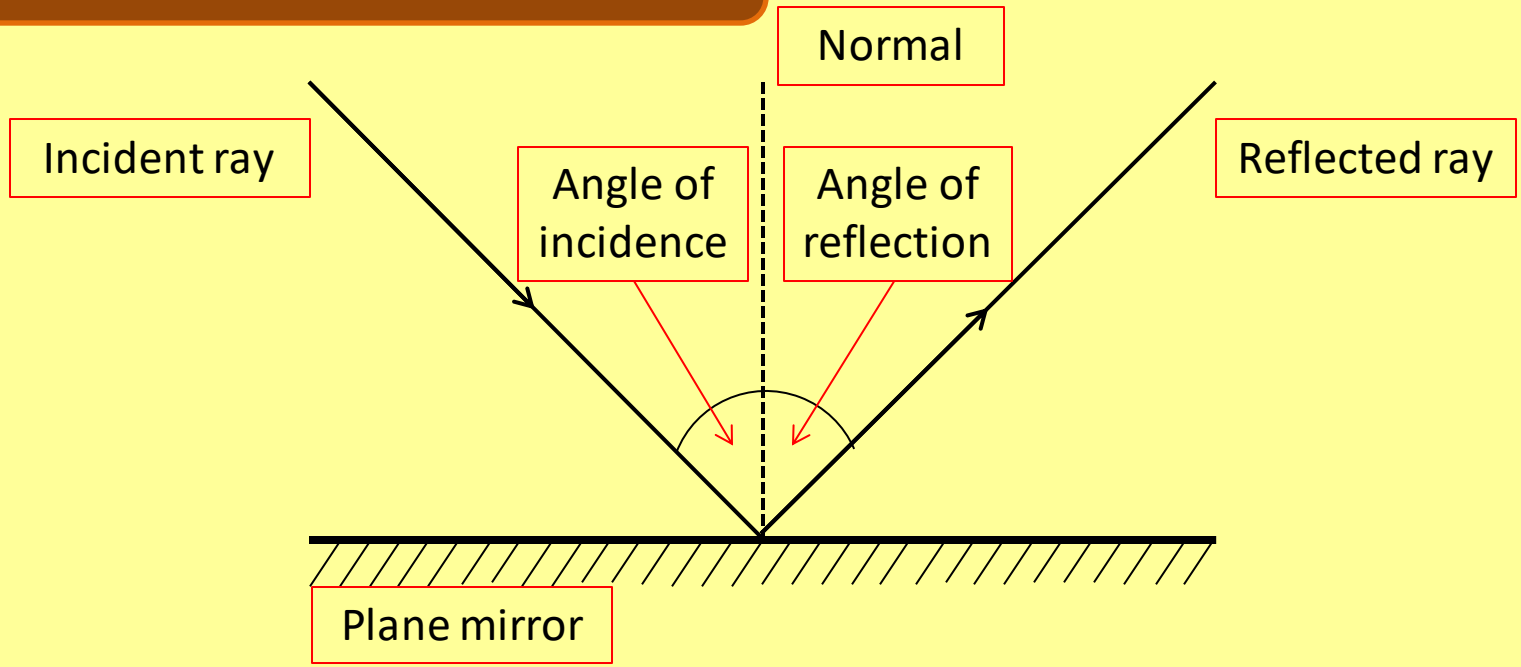
Reflection in a Plane Mirror



Laws of reflection:

1. The angle of incidence is equal to the angle of reflection.

Reflection in a Plane Mirror



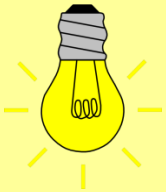
Laws of reflection:

1. The angle of incidence is equal to the angle of reflection.

2. The incident ray, the reflected ray and the normal all lie in the same plane (i.e. the two rays and the normal can all be drawn on a single sheet of flat paper).

Where is the image in a Plane Mirror?

Where is the image in a Plane Mirror?



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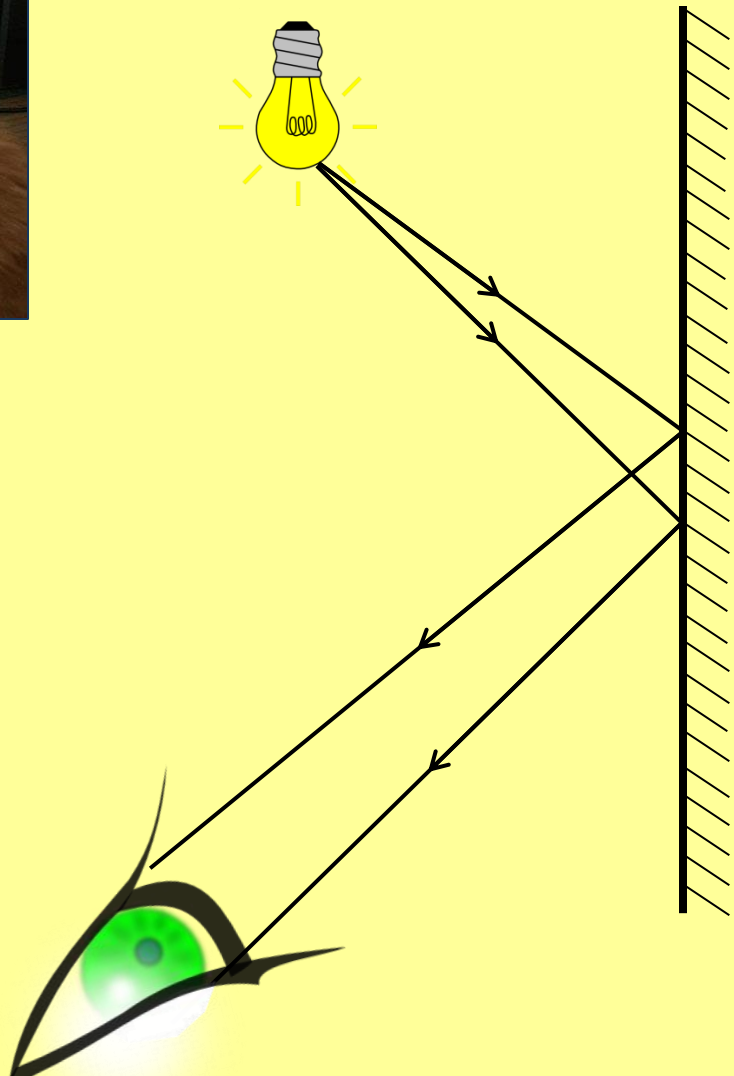
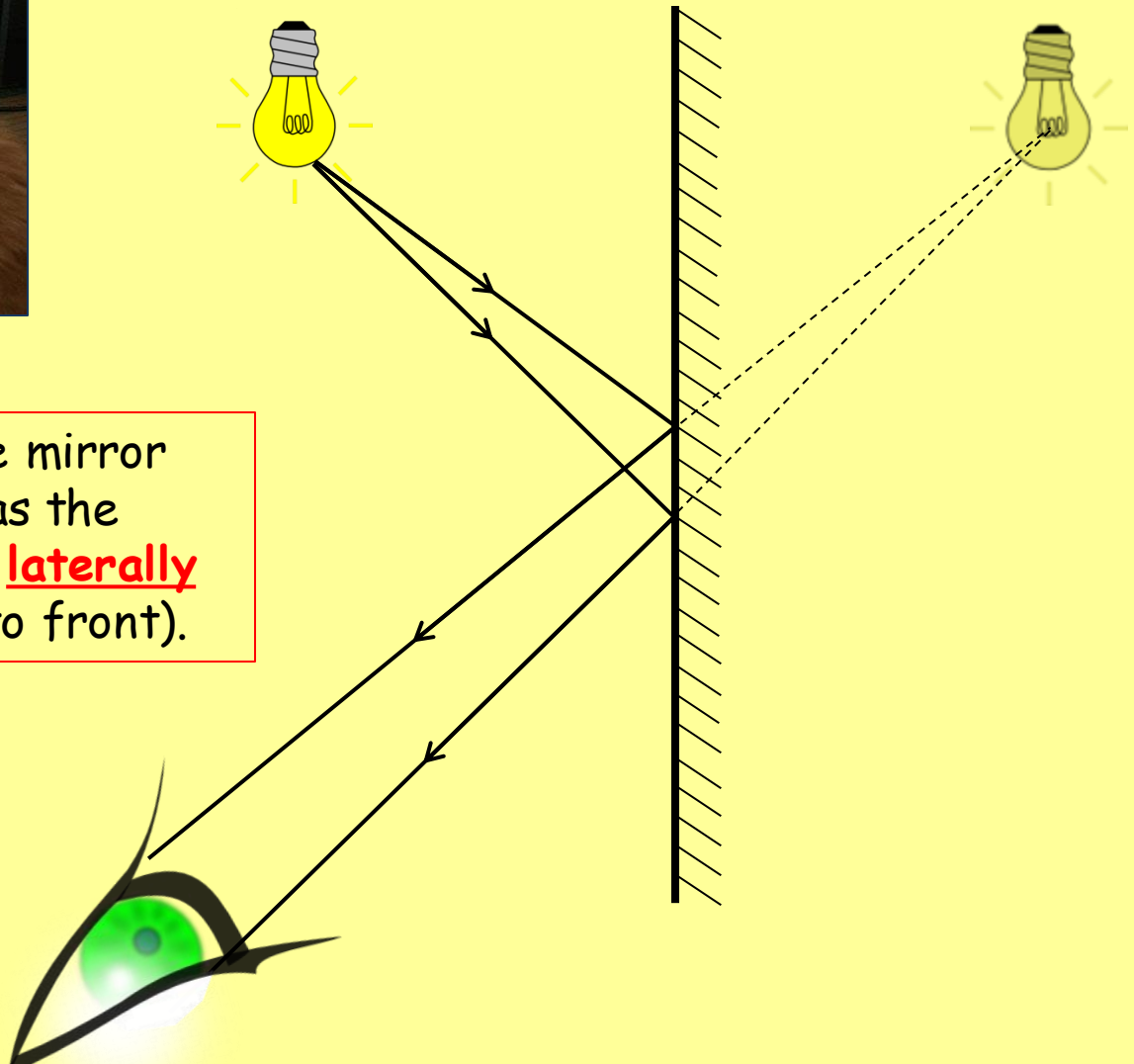


Where is the image in a Plane Mirror?

The image in the mirror looks the same as the object, but it is **laterally inverted** (back to front).



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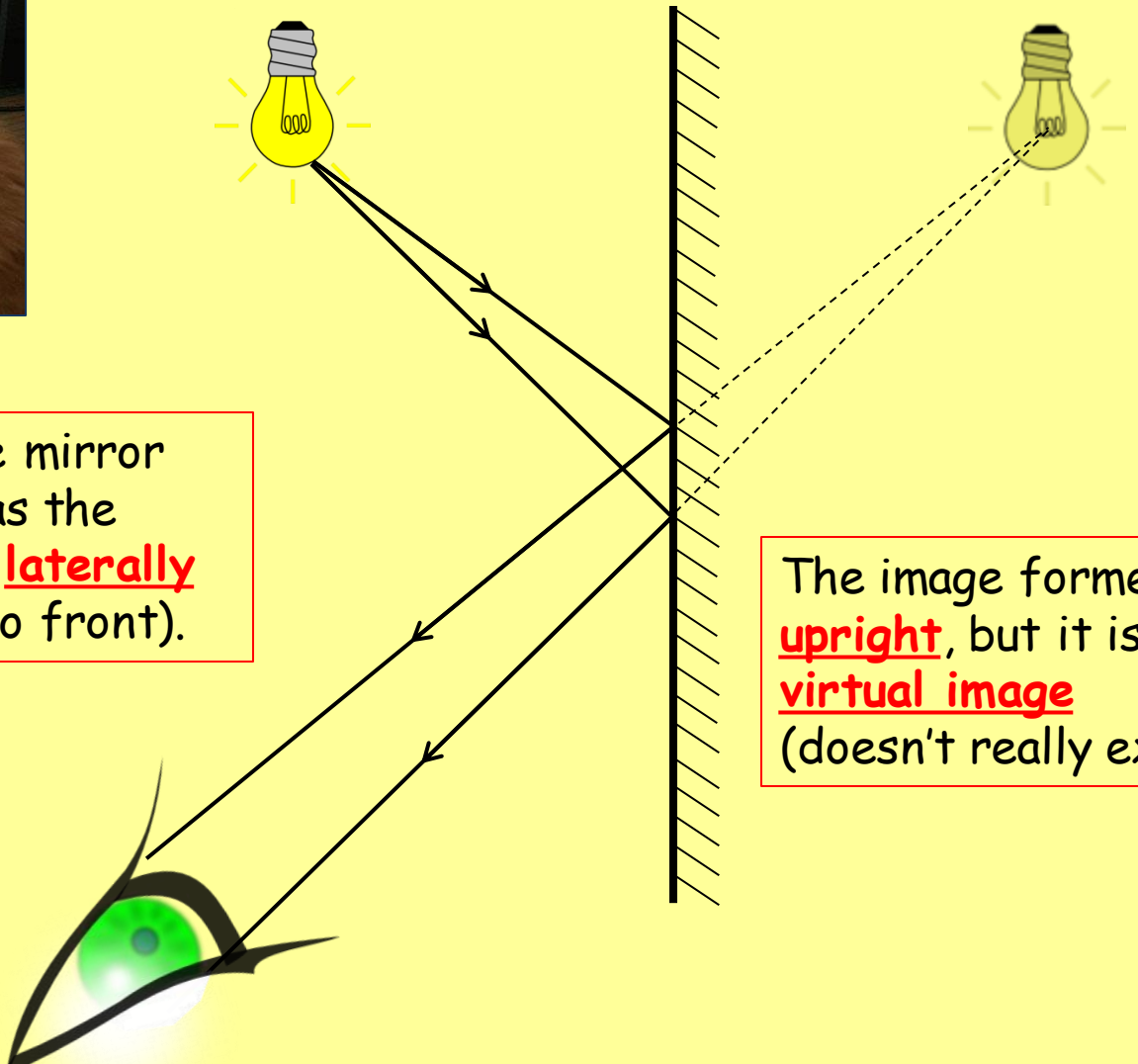
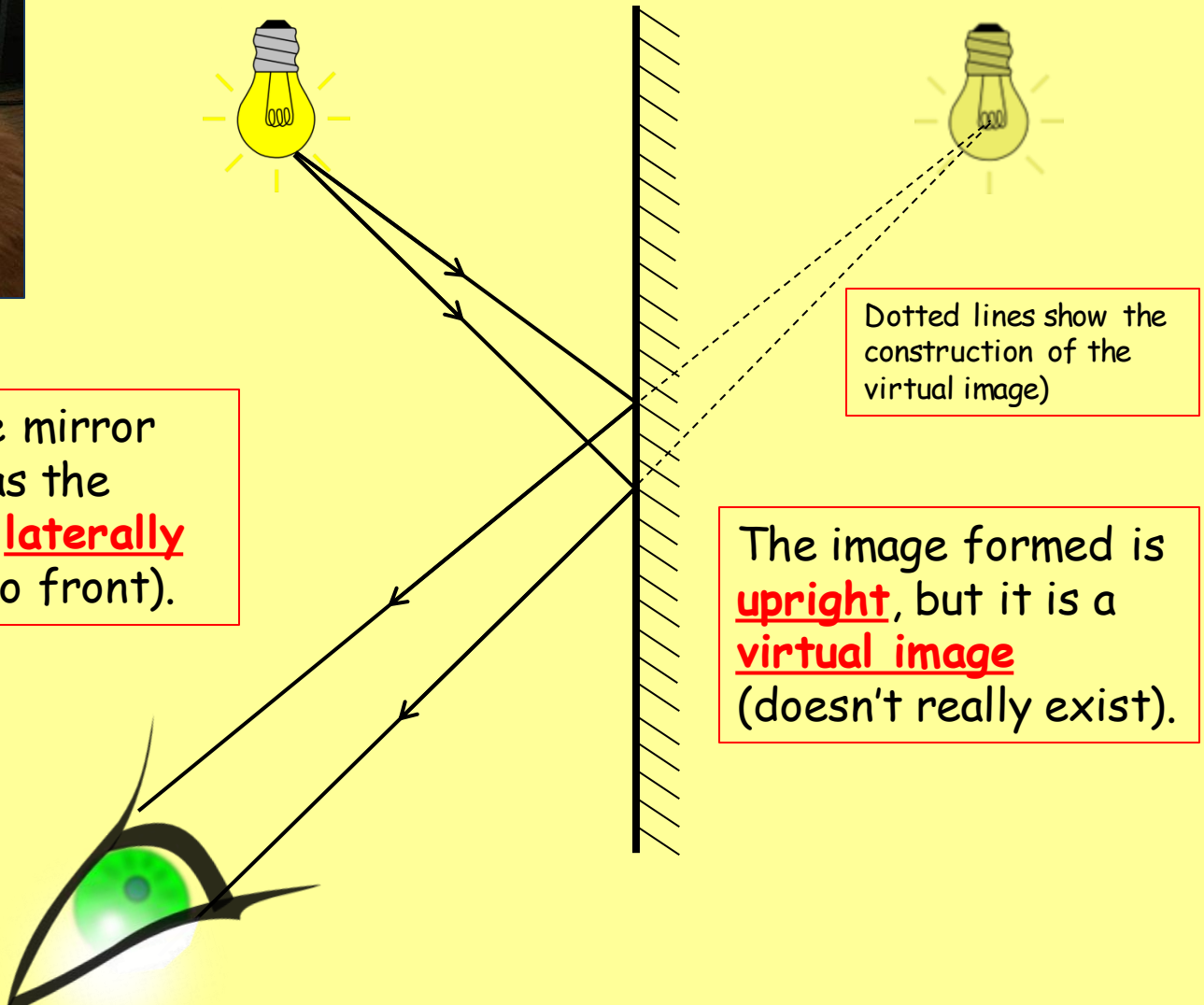


The image formed is **upright**, but it is a **virtual image** (doesn't really exist).

Where is the image in a Plane Mirror?



The image in the mirror looks the same as the object, but it is **laterally inverted** (back to front).

Dotted lines show the construction of the virtual image)

The image formed is **upright**, but it is a **virtual image** (doesn't really exist).

Where is the image in a Plane Mirror?

Normal view from the front.

Where is the image in a Plane Mirror?

Normal view from the front.

Same view as seen in the rear view mirror of a car.

Where is the image in a Plane Mirror?

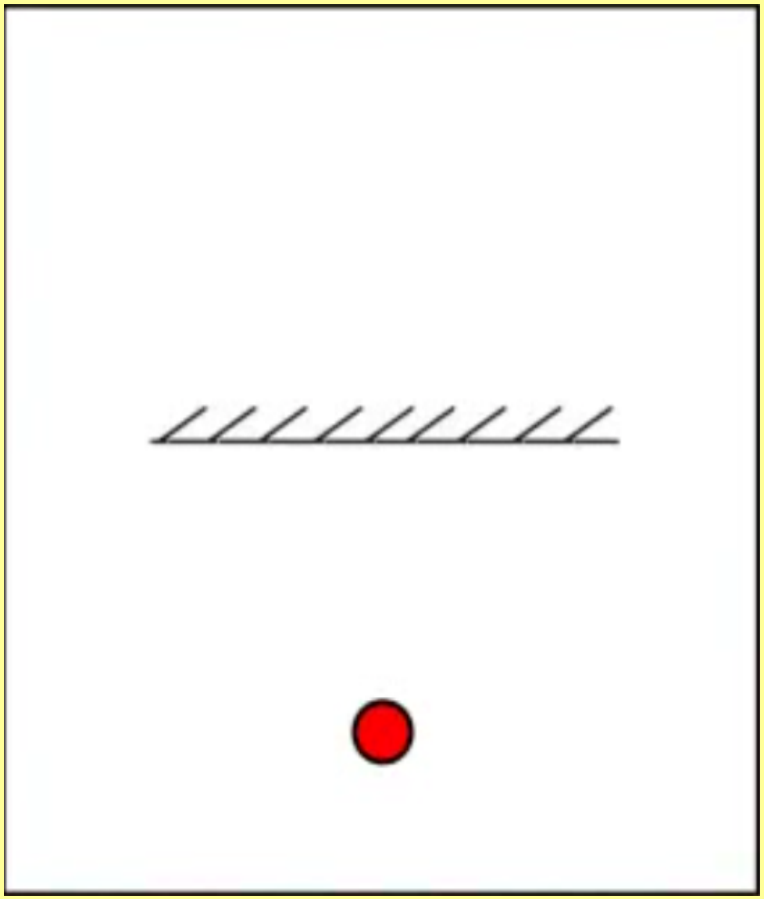
Normal view from the front.

Same view as seen in the rear view mirror of a car.

The word AMBULANCE is laterally inverted so that it reads correctly when seen in a driving mirror.

Where is the image in a Plane Mirror?

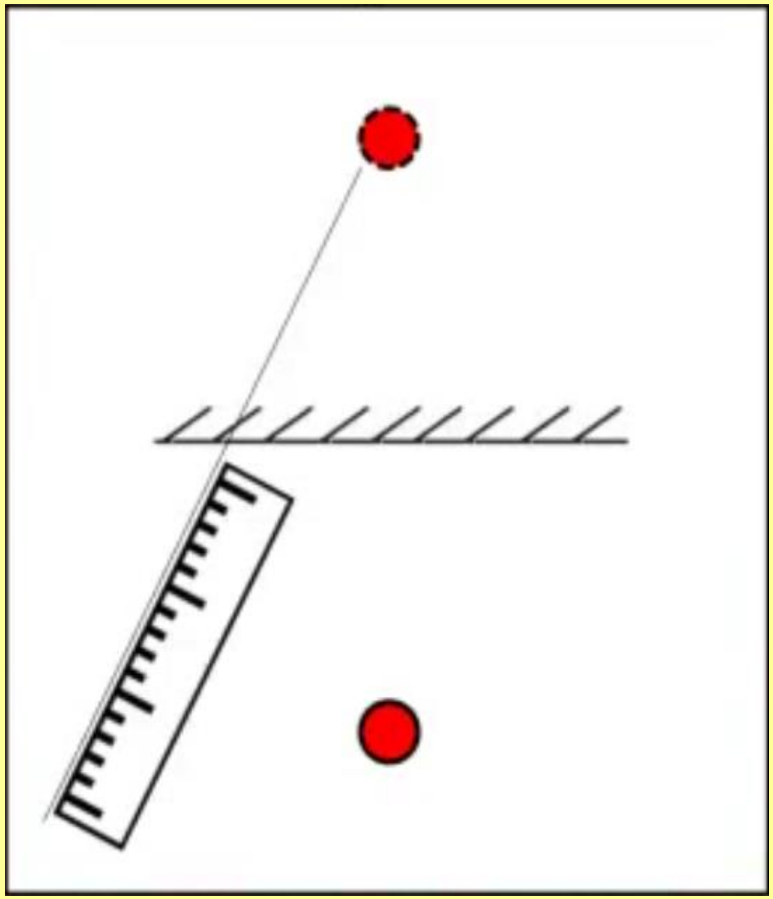
Finding this image by experiment.



Put a mirror upright on a piece of paper. Put a pin in front of the mirror – mark the position of the pin and mirror.

Where is the image in a Plane Mirror?

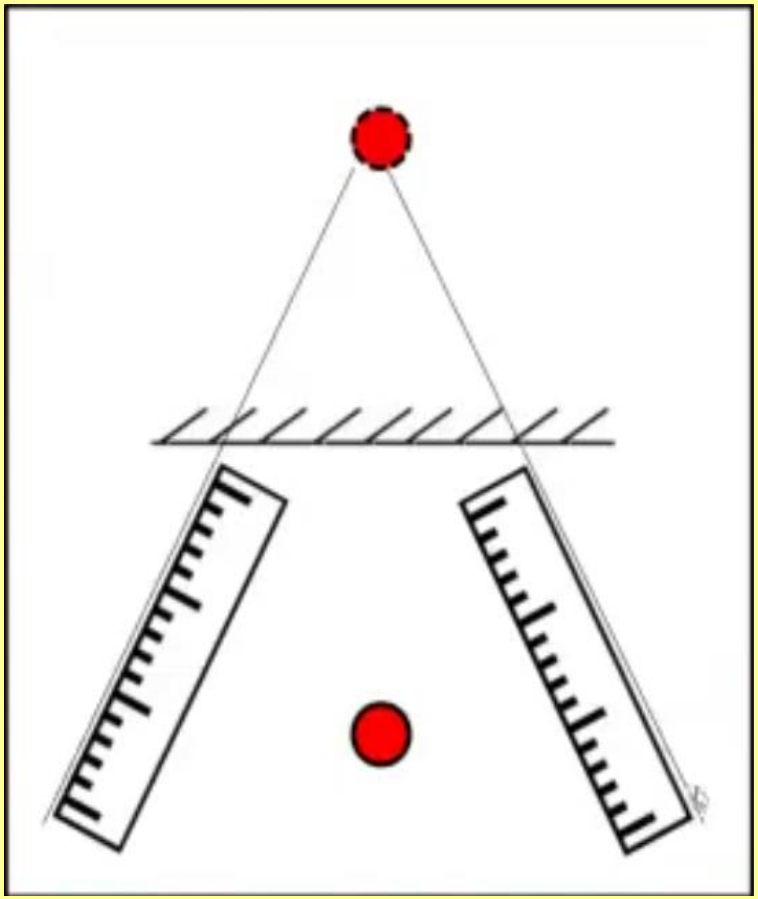
Finding this image by experiment.



Line up one edge of the ruler with the image of the pin. Draw a line to mark the position.

Where is the image in a Plane Mirror?

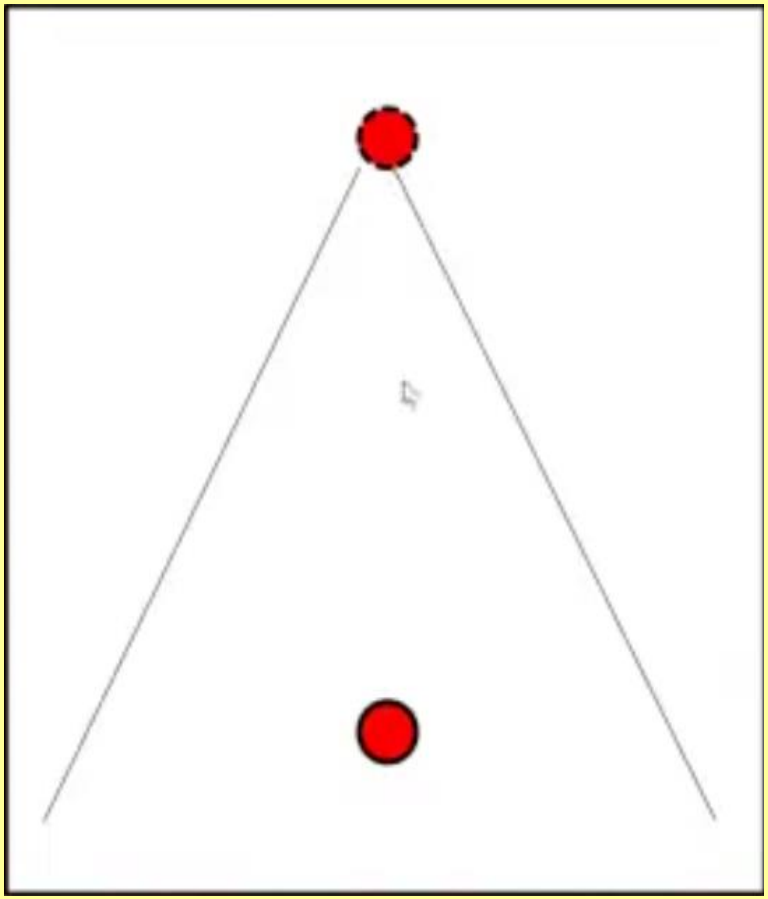
Finding this image by experiment.



Repeat with the ruler in a different position.

Where is the image in a Plane Mirror?

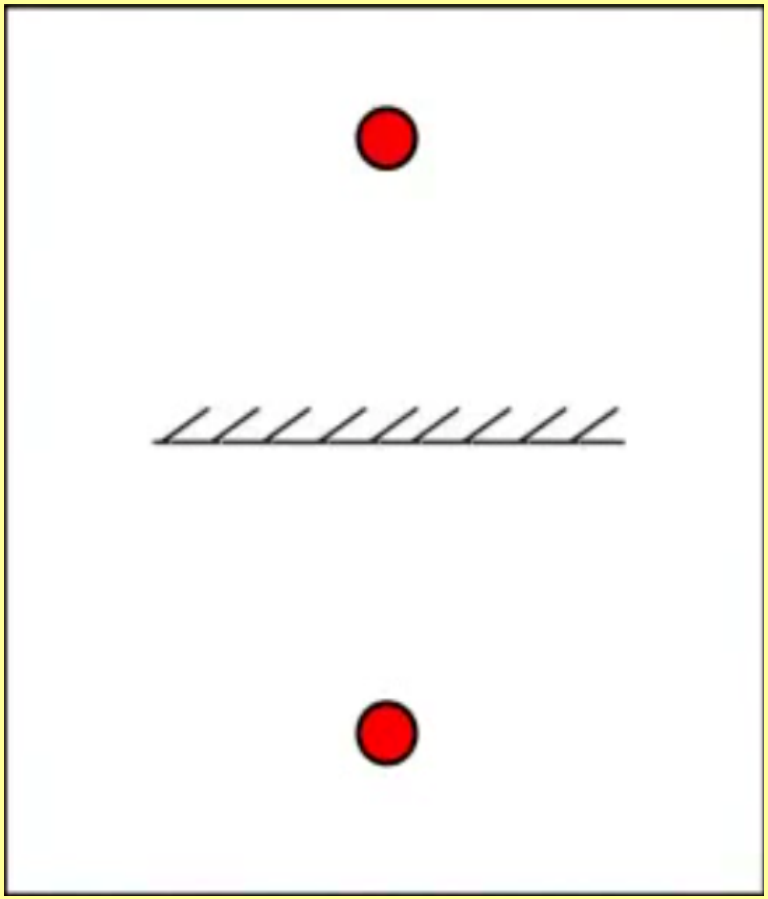
Finding this image by experiment.



Take away the ruler and mirror - where the two lines meet is the position of the image.

Where is the image in a Plane Mirror?

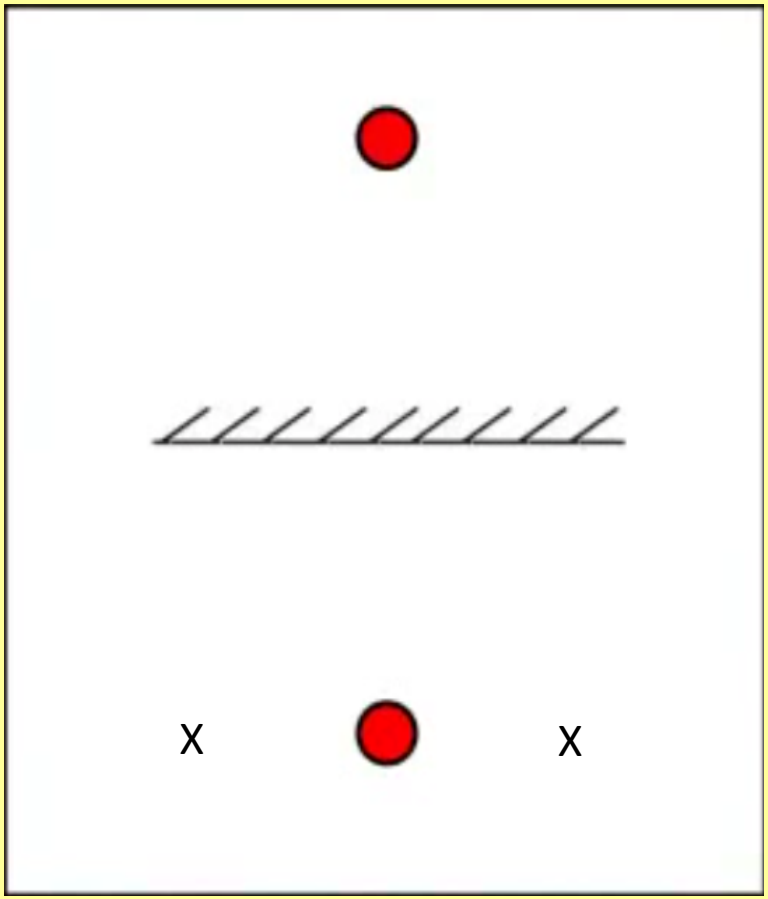
Finding this image by experiment.



Test the position by putting a second pin exactly where the image was marked. The second pin should stay in line with the mirror image where-ever you view it from = **no parallax.**

Where is the image in a Plane Mirror?

Finding this image by experiment.



Rules for mirror images:

1. Image is the same size as the object.
2. Image is as far behind the mirror as the object is in front.

Refraction

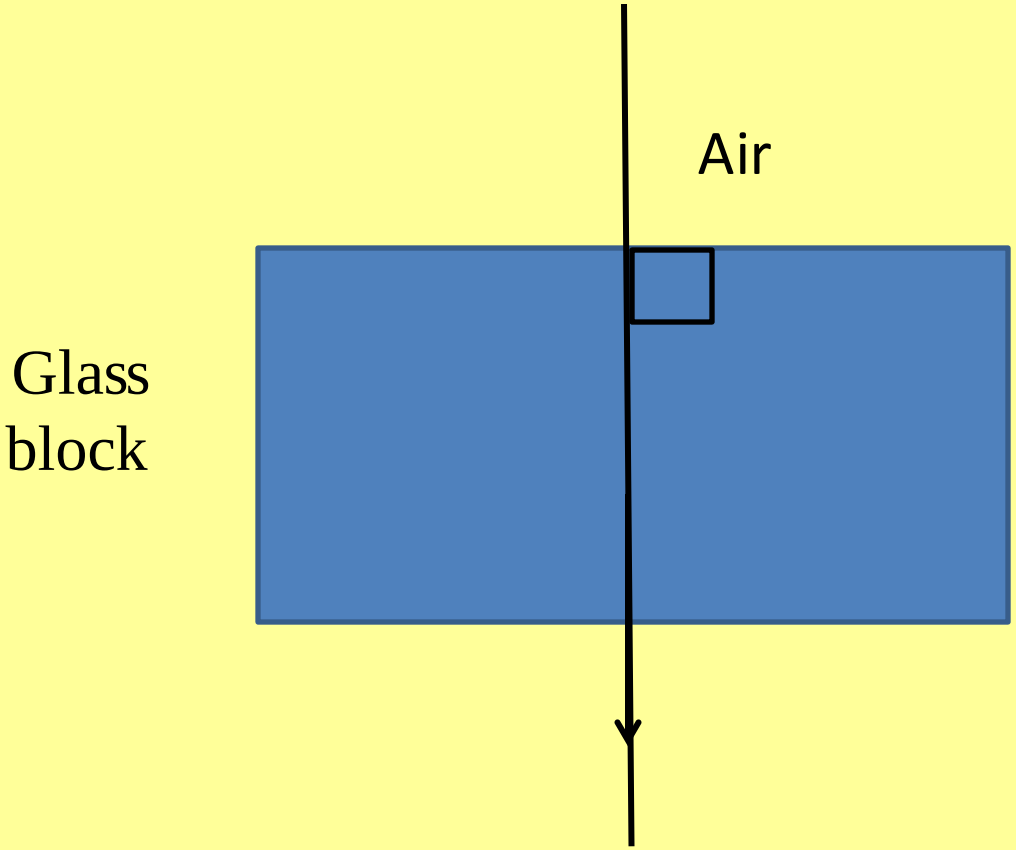
- Refraction is the bending of light when it travels from one medium to another.

Refraction

- Refraction is the bending of light when it travels from one medium to another.

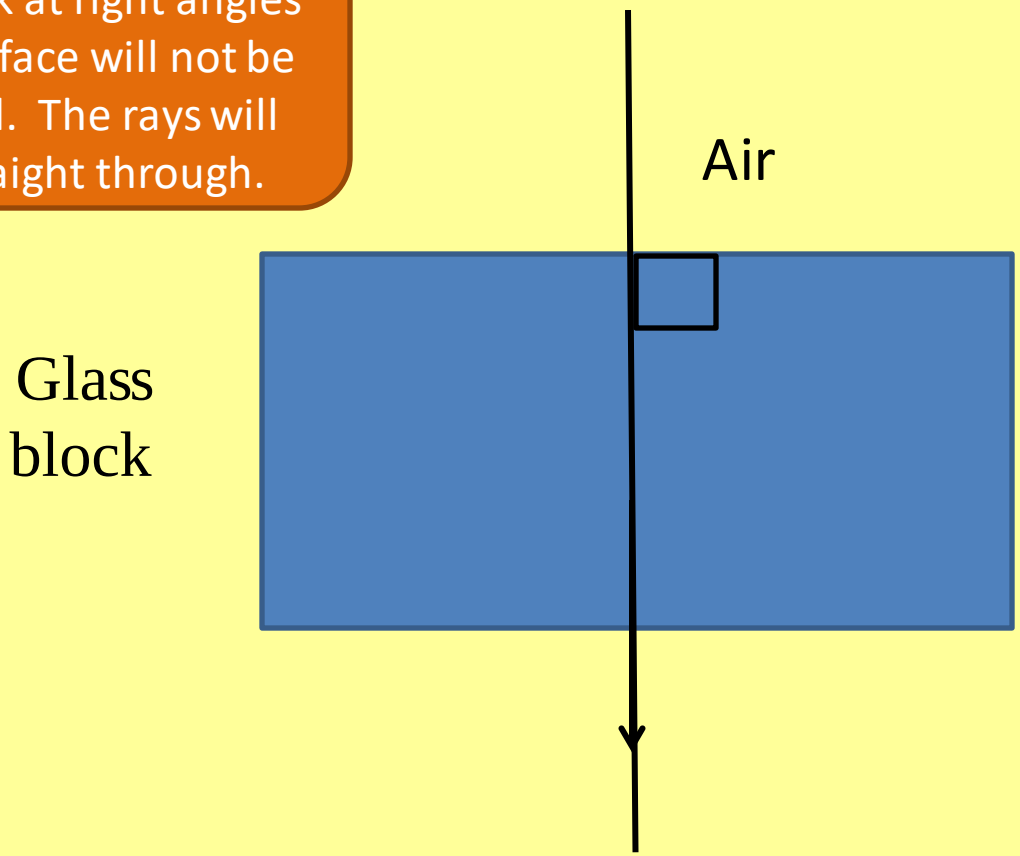
- A ‘medium’ is glass, or air, or water

Refraction

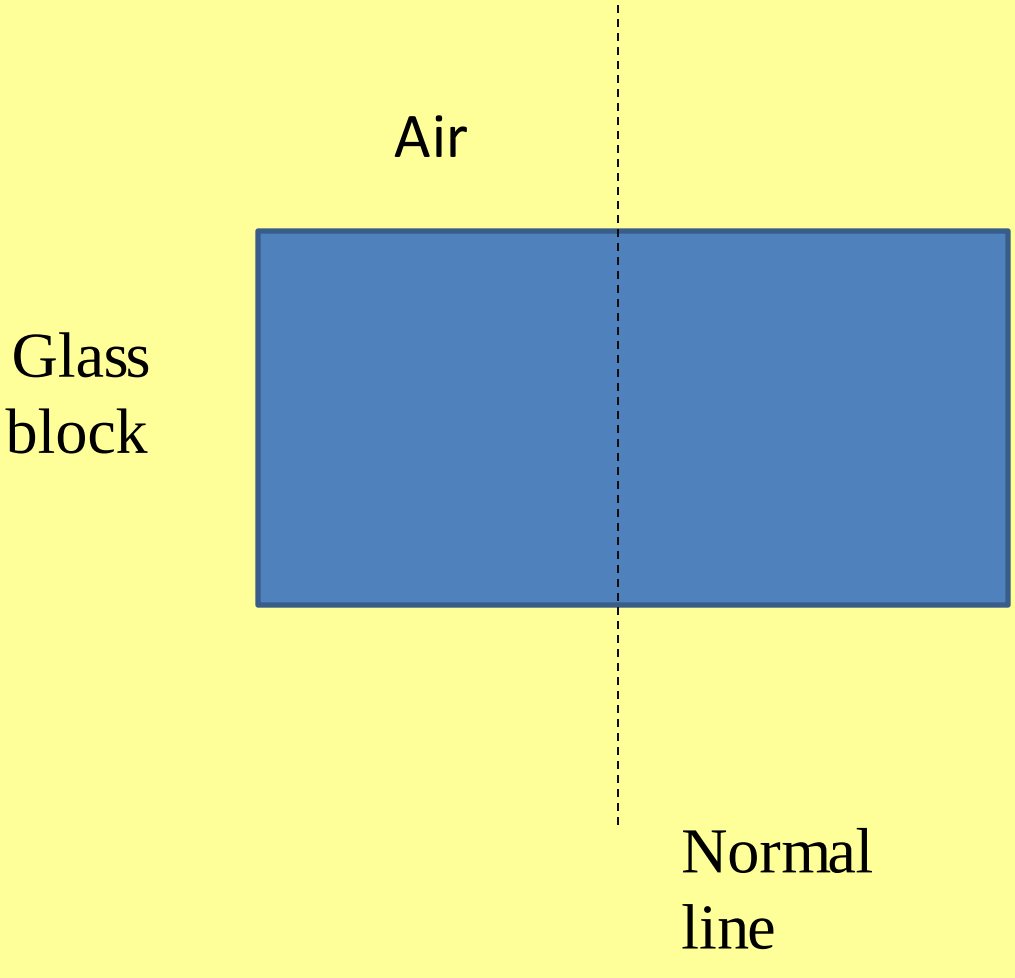


Refraction

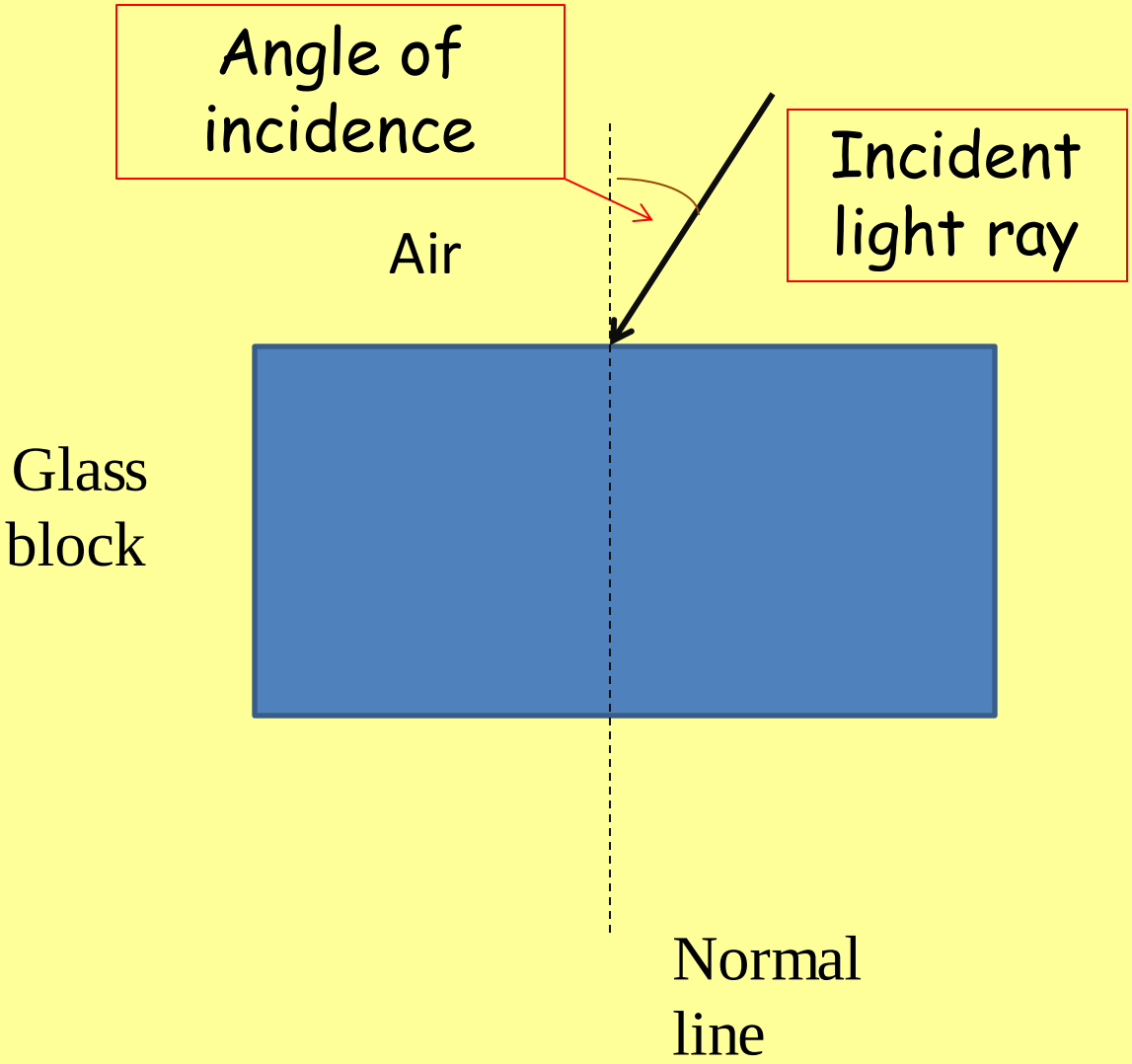
Light passing through a glass block at right angles to the surface will not be refracted. The rays will pass straight through.



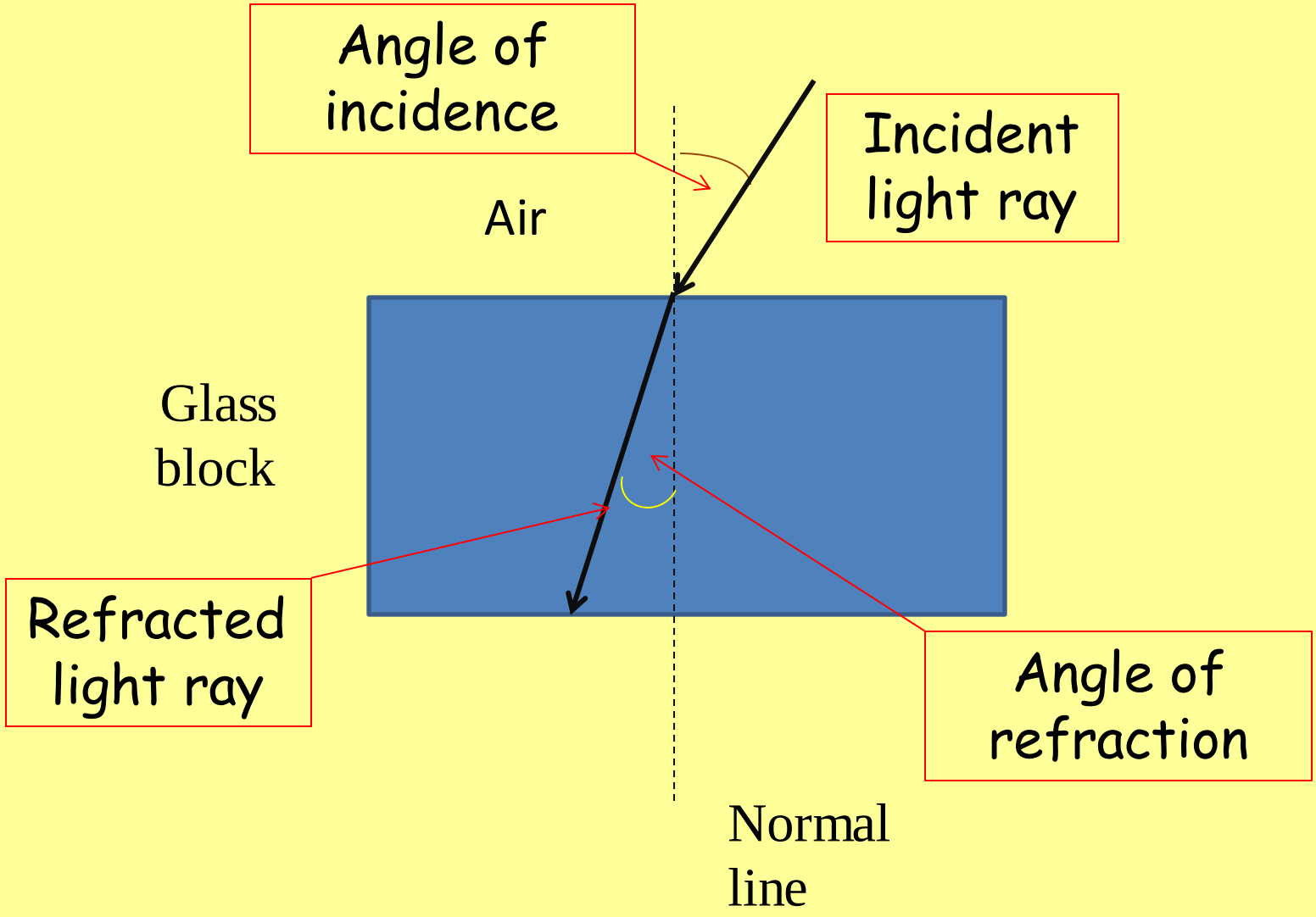
Refraction



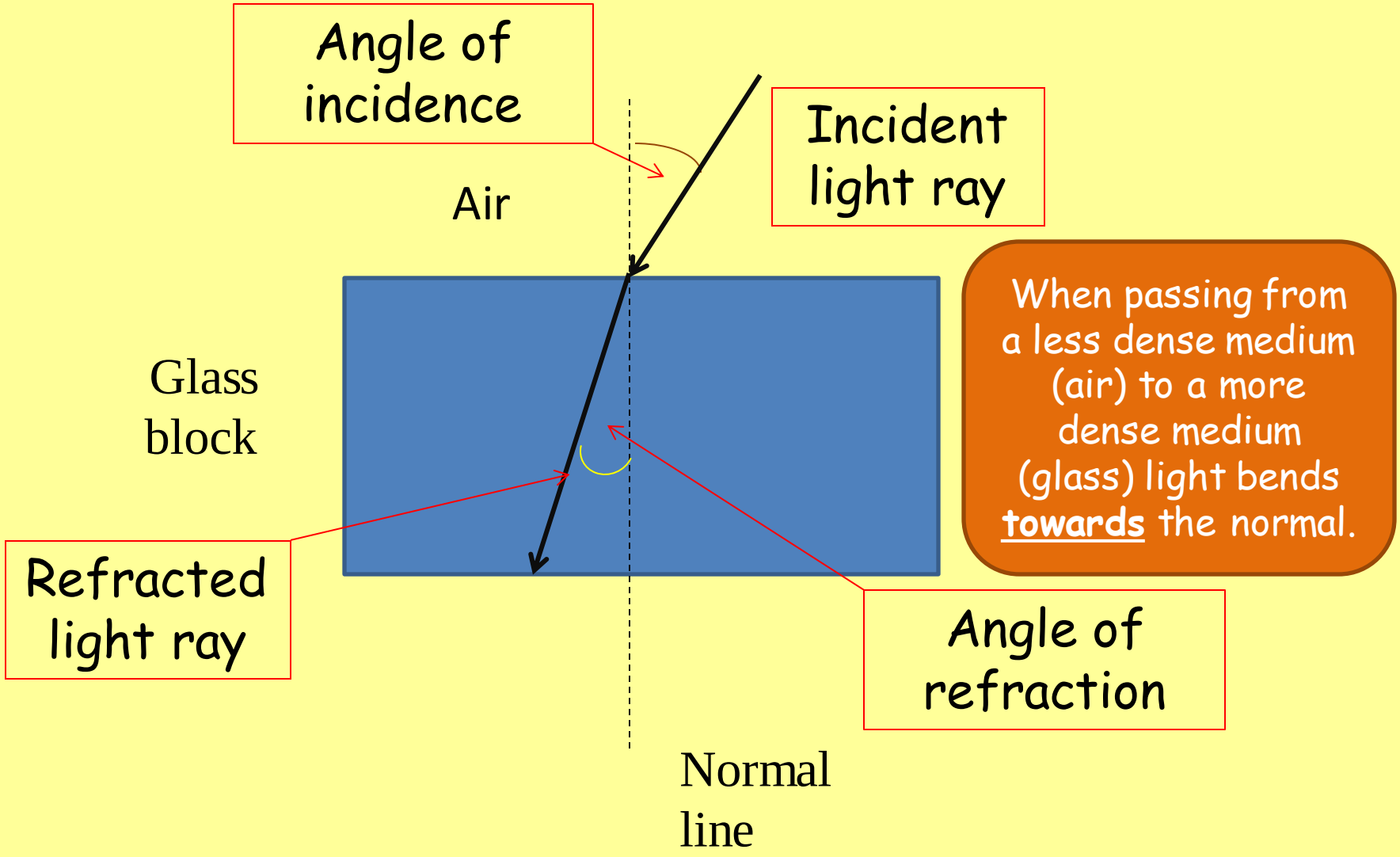
Refraction


Angle of incidence
Incident light ray
Air
Glass block
Normal line

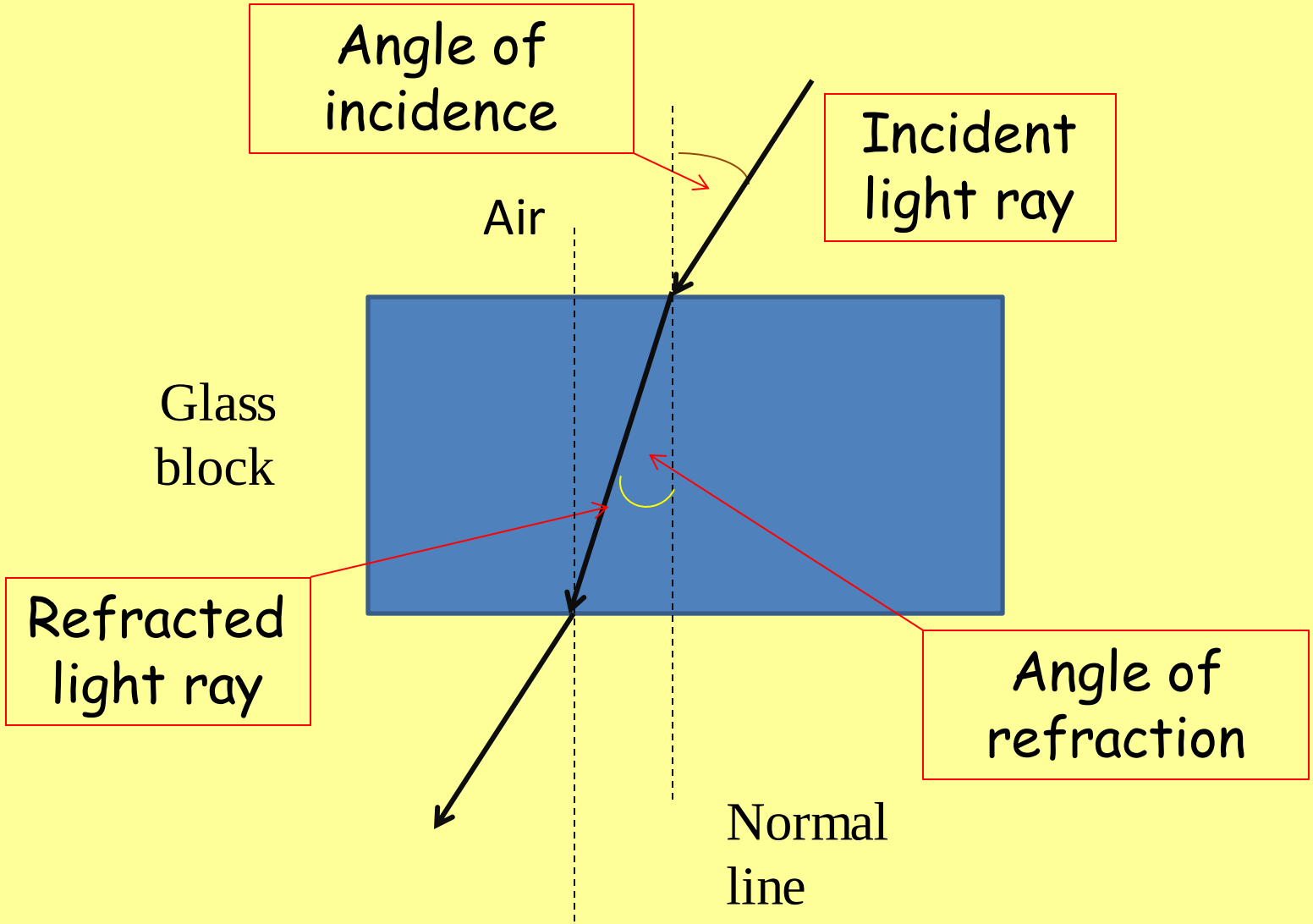
Refraction


Angle of incidence
Incident light ray
Air
Glass block
Refracted light ray
Angle of refraction
Normal line

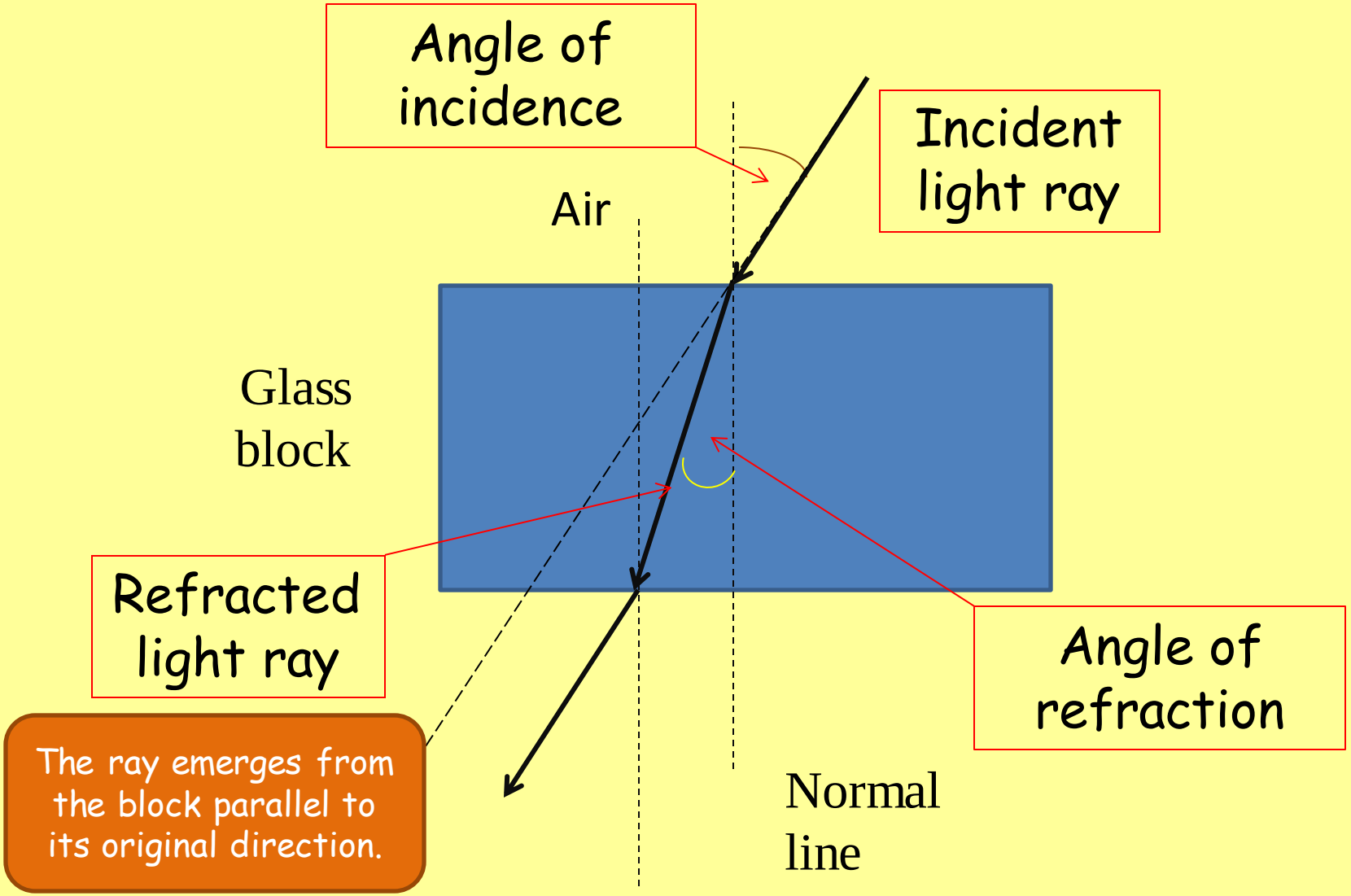
Refraction


Angle of incidence
Incident light ray
Air
Glass block
When passing from a less dense medium (air) to a more dense medium (glass) light bends towards the normal.
Refracted light ray
Angle of refraction
Normal line

Refraction


Angle of incidence
Incident light ray
Air
Glass block
Refracted light ray
Angle of refraction
Normal line

Refraction


Angle of incidence
Incident light ray
Air
Glass block
Refracted light ray
Angle of refraction
The ray emerges from the block parallel to its original direction.
Normal line

Refraction

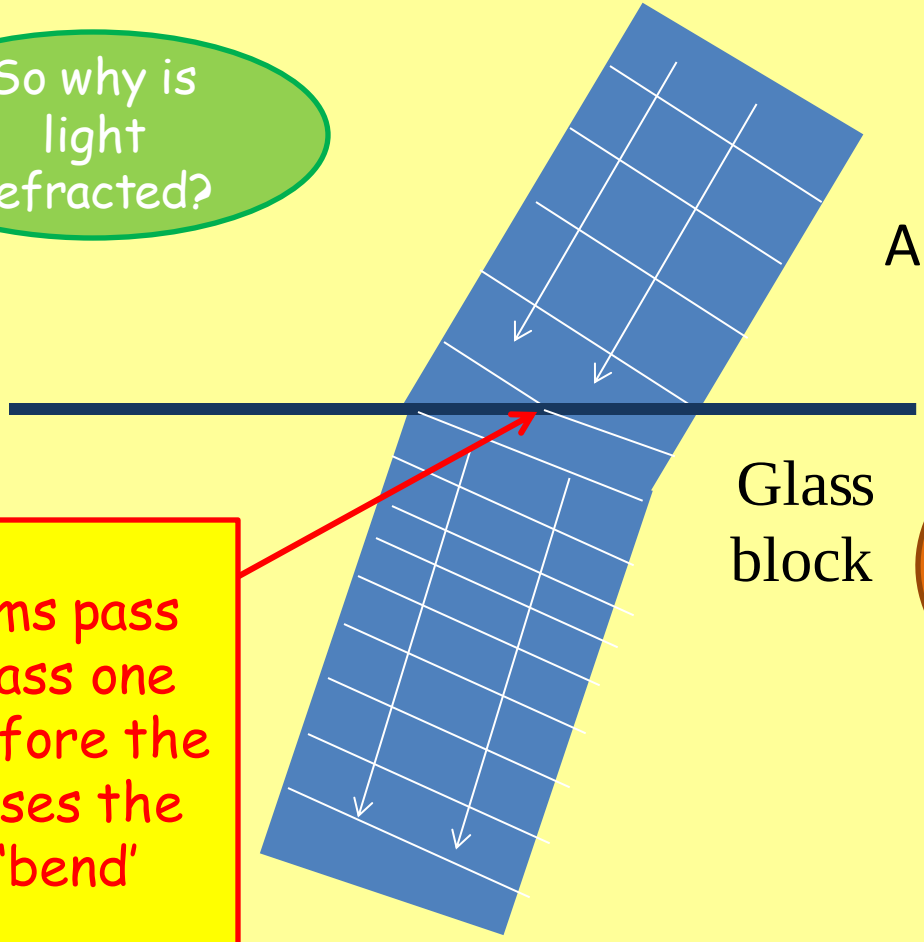
Refraction


So why is light refracted?

Air
Glass block
Normal line


Light is made up of many tiny waves

Refraction



When light beams pass from air into glass one side is slowed before the other. This causes the light beam to 'bend'

Connecting the learning.

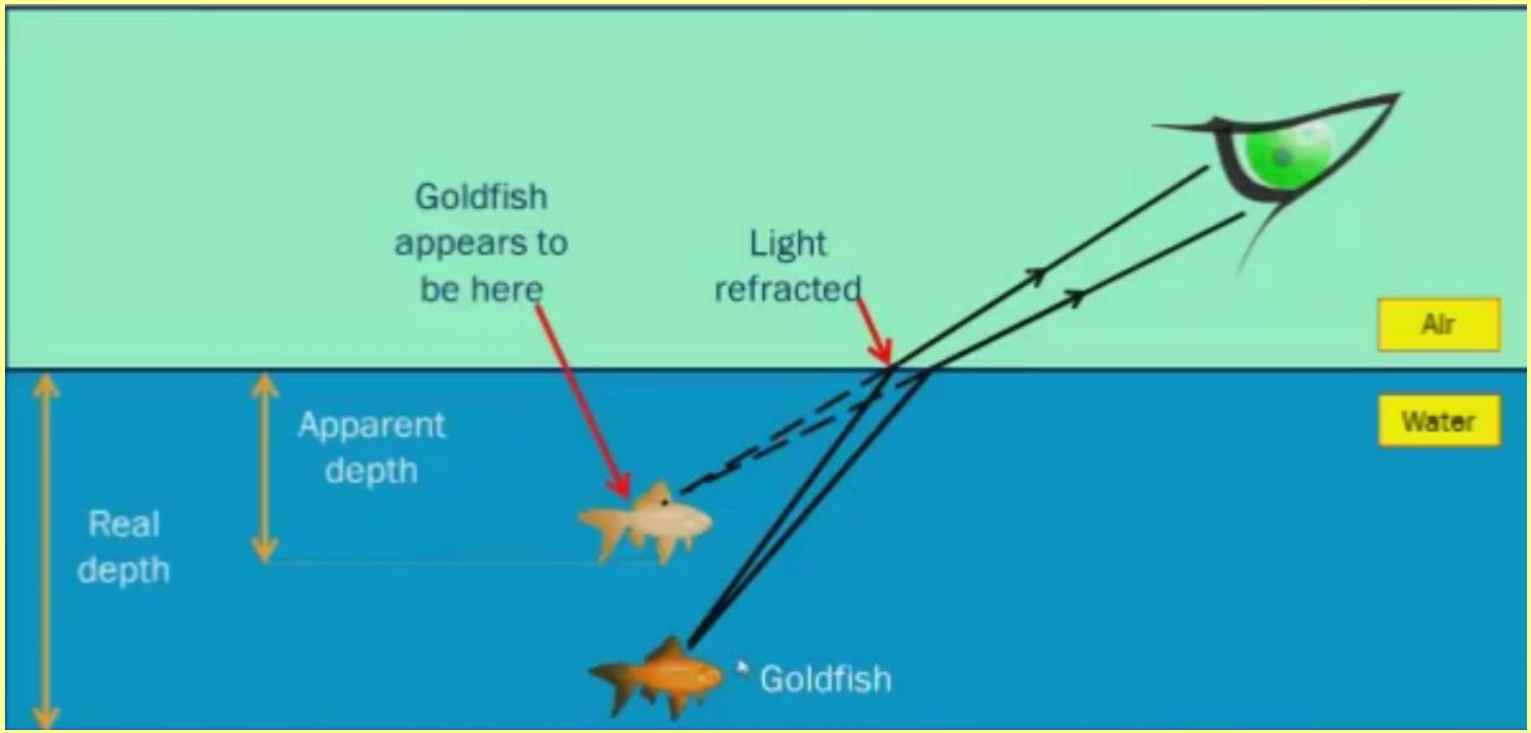
What happens as a ray of light enters a glass block?

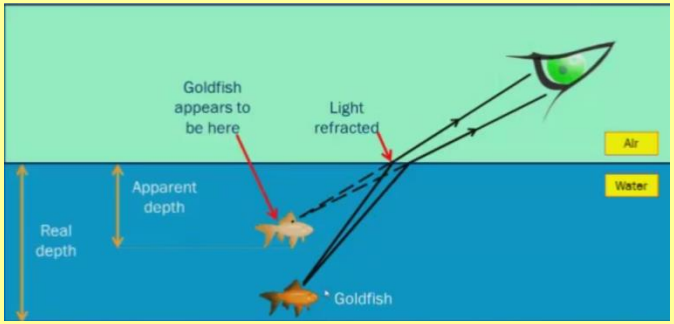
It bends towards the normal.

Why?

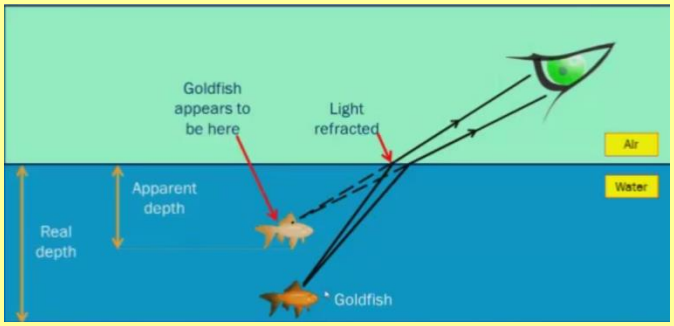
Because the speed of light changes

Real and Apparent Depth



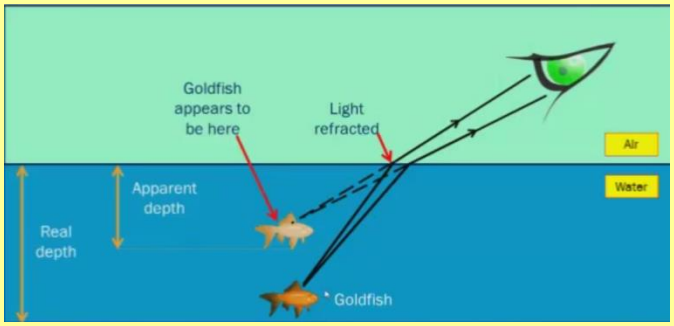


What is the 'refractive index'?



What is the 'refractive index'?

The refractive index of a medium (glass, water) is defined as the speed of light in a vacuum divided by the speed of light in the medium.



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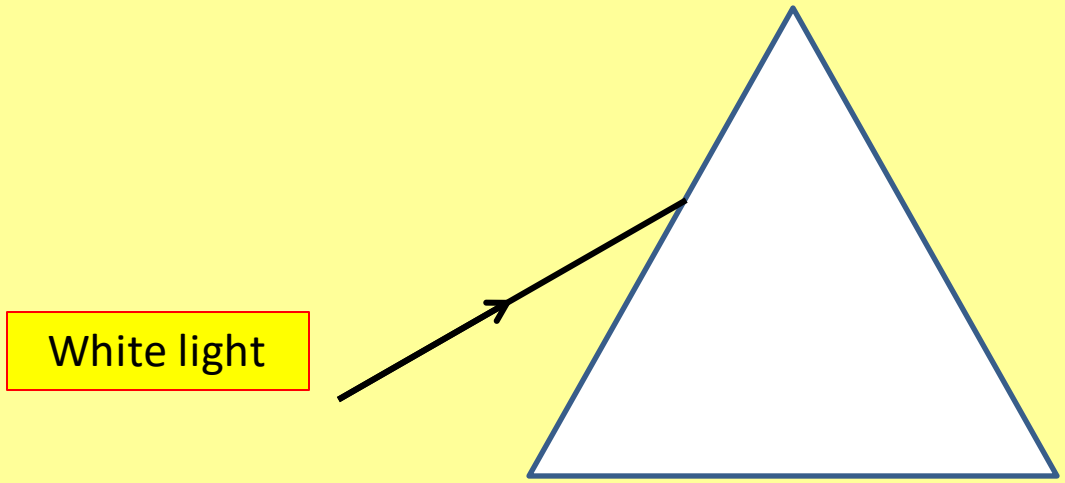
Medium	Refractive index
Vacuum	1.0000
Air	1.0003
Water	1.3333
Glass	1.5200
Diamond	2.4170
Perspex	1.4900

$$\text{Refractive index} = \frac{\text{Speed of light in a vacuum}}{\text{Speed of light in medium}}$$

Refraction of light by a prism.



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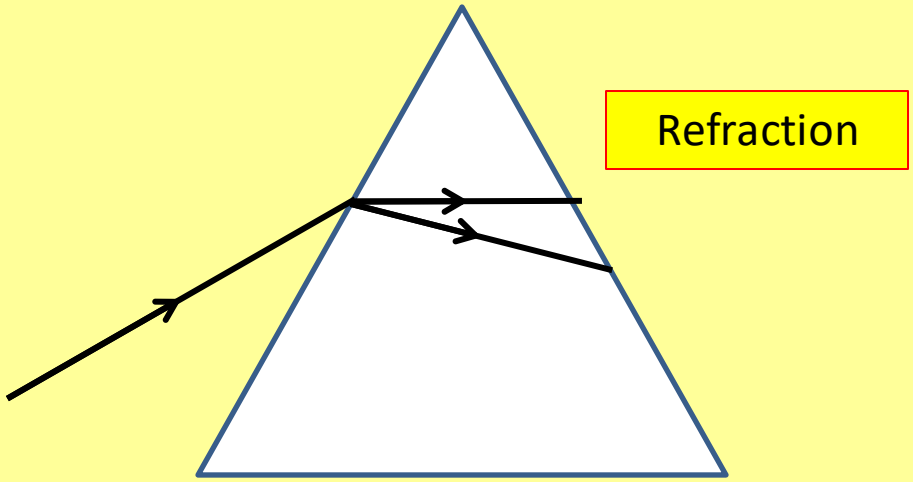

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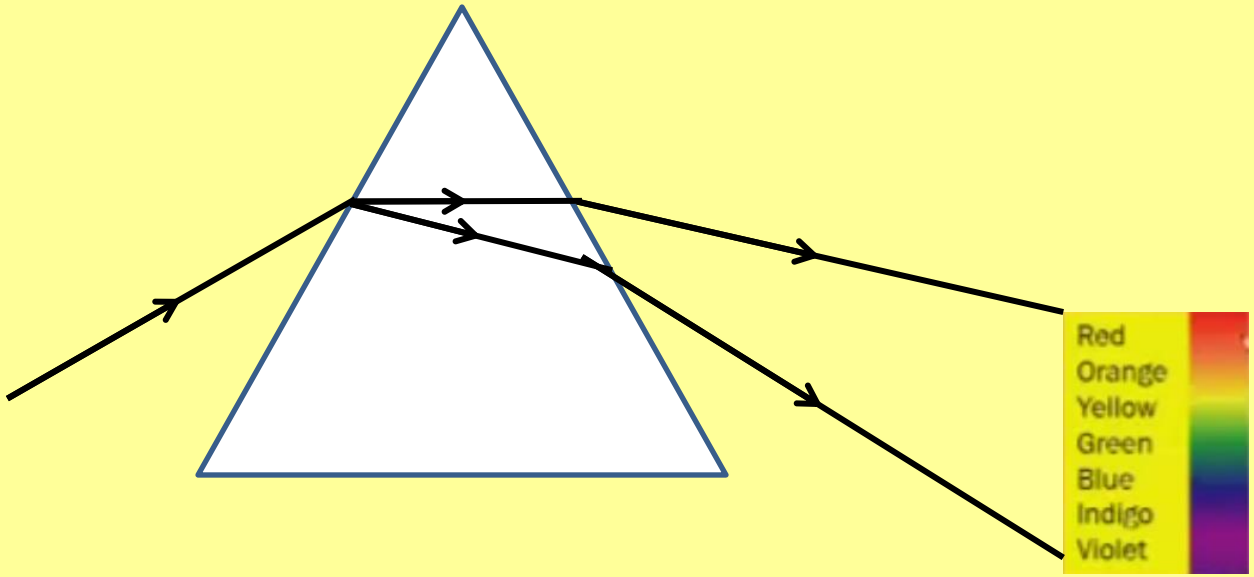

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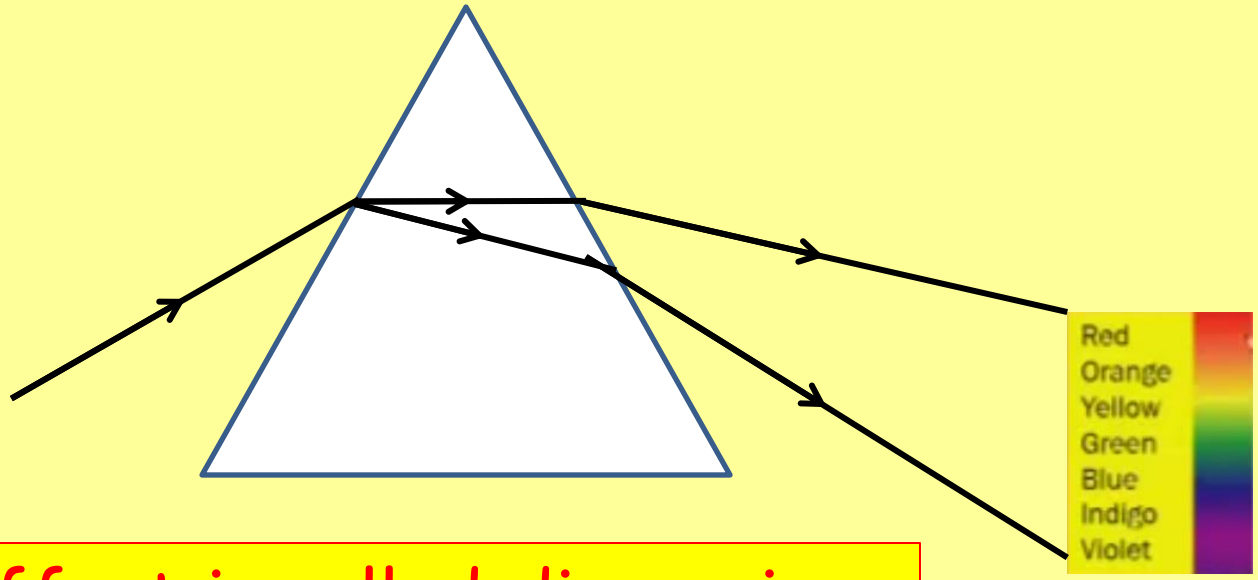

This effect is called dispersion

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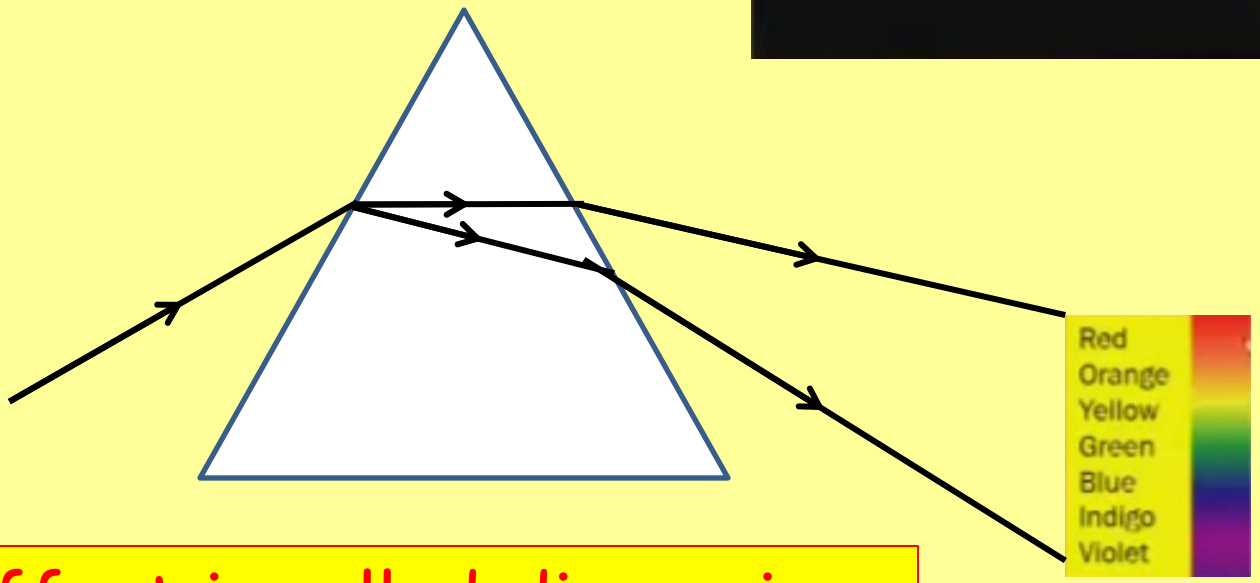

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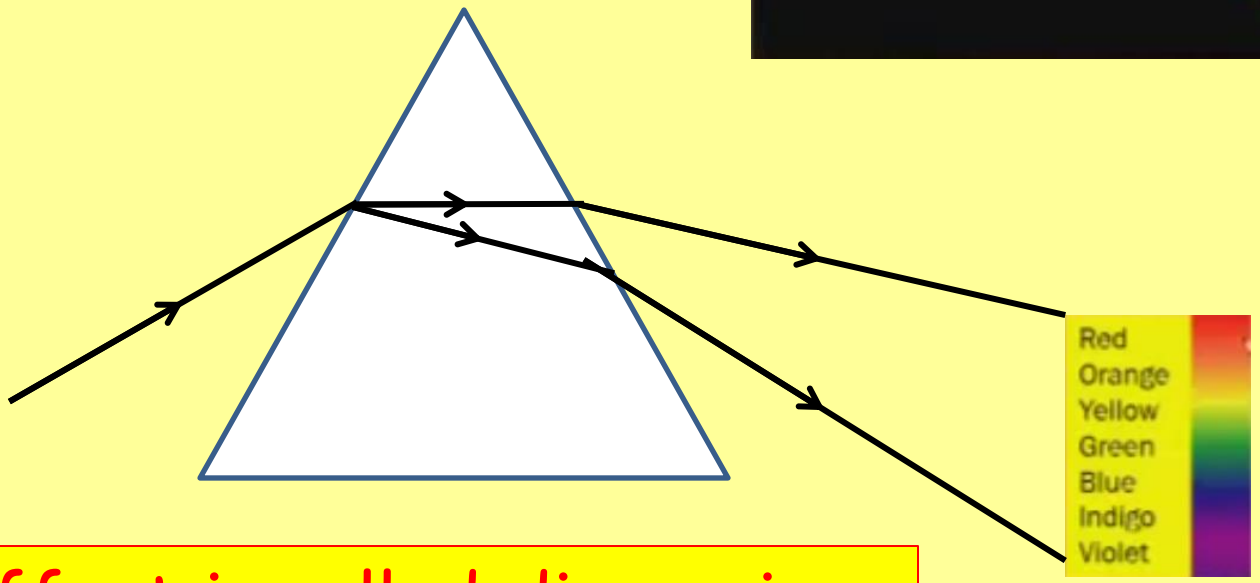

This effect is called dispersion

It happens because white is a mixture of all the colours in the rainbow

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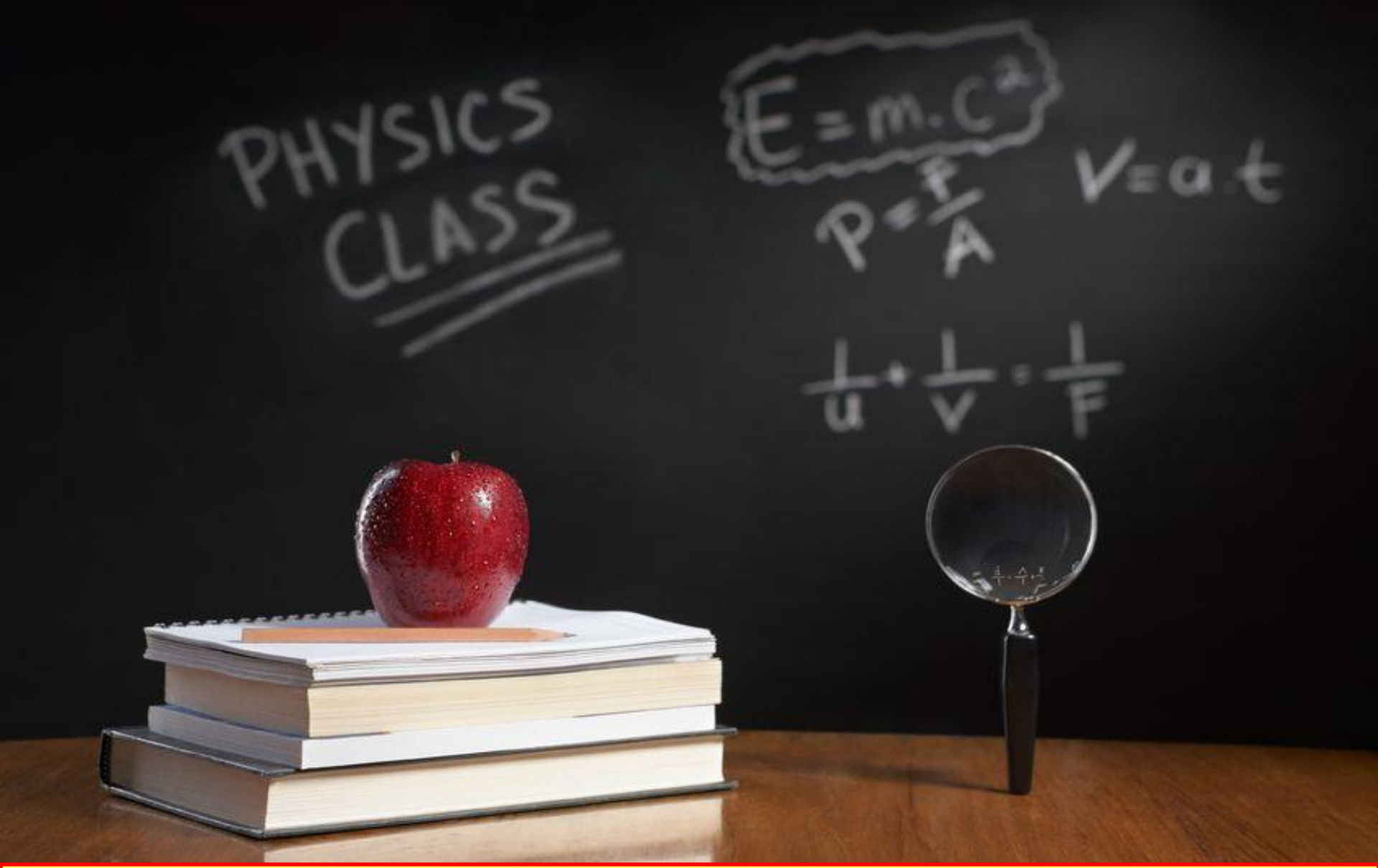

PHYSICS – Reflection and Refraction