Formation of images: refraction and plane mirrors

Select LEARNING OBJECTIVES:

- Understand how we use the ray model of light to describe how eyes see objects.
- Be able to apply the law of reflection.
- Be able to identify all relevant angles in a given system.
- Be able to use Snell's law and the model of how eyes see light to predict where we perceive an image of an object is located.
- Practice geometry skills while analyzing light rays and formation of images.

TEXTBOOK CHAPTERS:

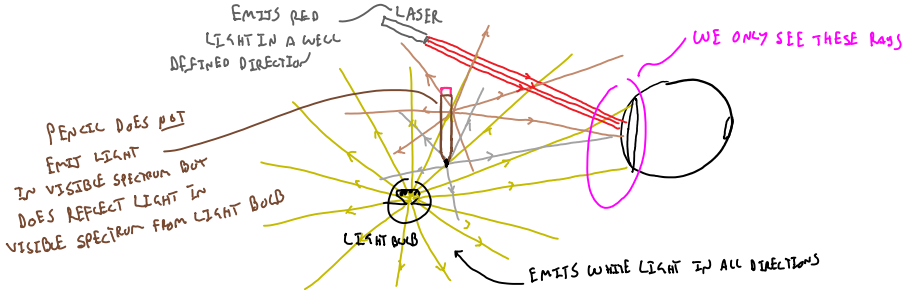
Boxsand :: Snell's law of refraction

WARM UP: How are rays related to the wave model of light?

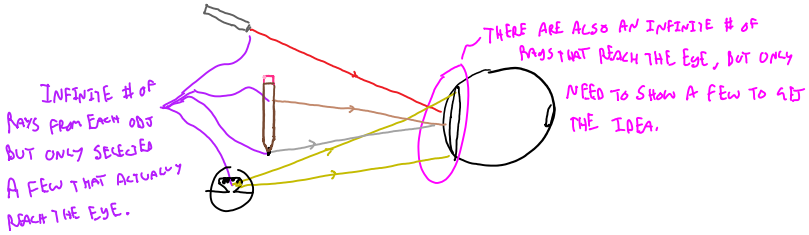
As we have seen, we can use the ray model of light to help explain how light behaves when light encounters objects with a size larger than the wavelength of the light. In this lecture we will use the ray model of light to help explain the images we see. As it turns out the images we see are explained by a few simple rules under the ray model of light. These rules are listed below.

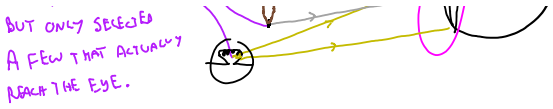
Ray model of light rules for how we see

- We see objects because light rays travel from an object directly to our eyes.
  - The object can be the source of light (e.g. light bulb, or laser). Or the object can reflect light from a different source (e.g. we see paper because it reflects light from light bulbs).



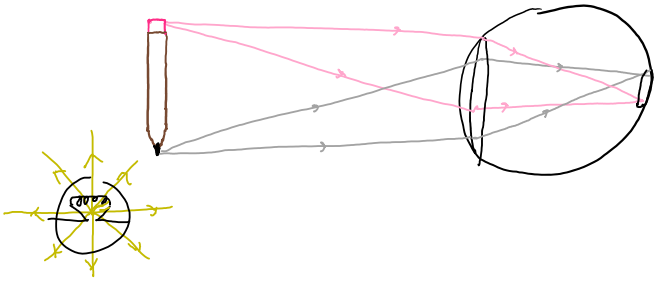
- There are an infinite number of light rays that come off an object (whether the object is the source or is reflecting light). We only need to look at a few light rays to construct the features of the image we will see.
  - Ray diagram model
    - Follow a few specific rays of interest from an object to the eye.



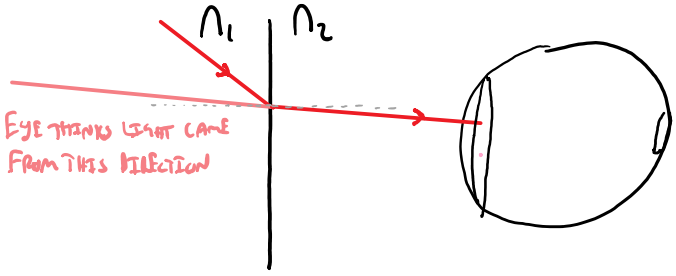


- Rays are not "real" they are just a tool we use to help describe our observations of how light behaves when it interacts with objects larger than the wavelength of the light. This is why there are an infinite number of rays being emitted/reflected/observed.

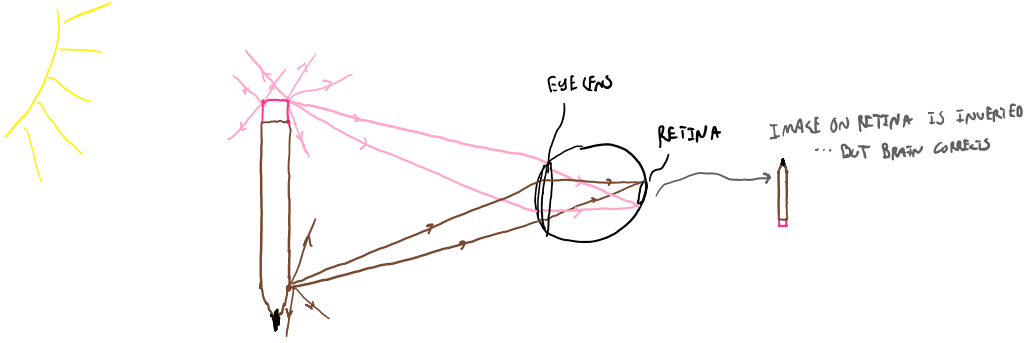
- The eye lens focuses the rays from the object onto the retina to form an image.



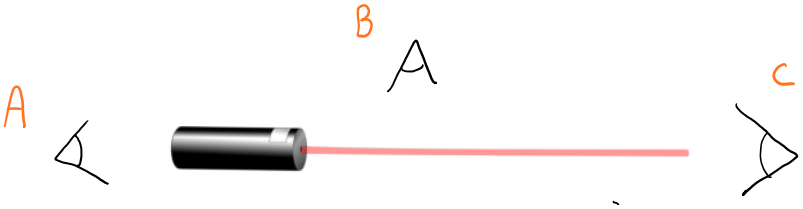
- Our eyes are gullible: they think light rays always travel in a straight line.



Below is a figure highlighting *a few* of the rules stated above.



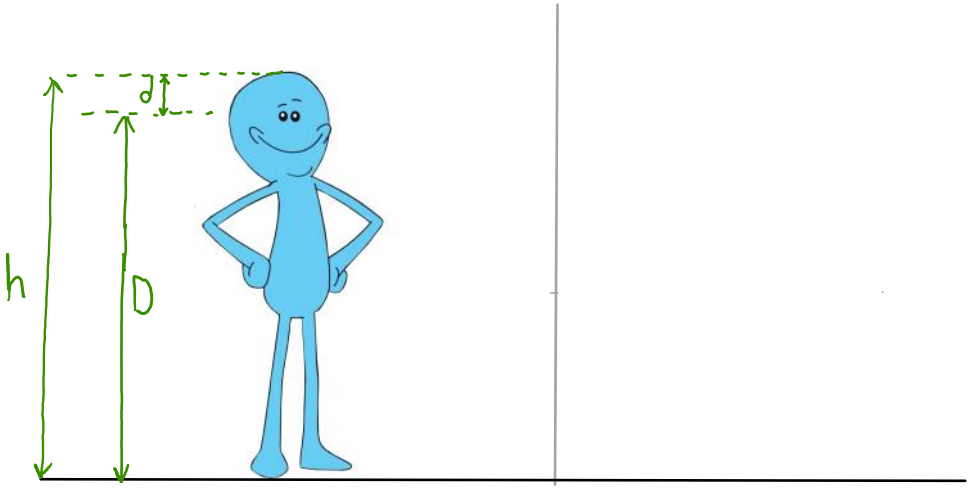
PRACTICE: A laser of wavelength 650 nm is in a vacuum as shown below. Which observers will see the laser light?



What if the laser was located in a room full of dust particles?

Plane mirrors

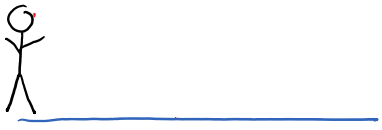
PRACTICE: How tall must a plane mirror be so that Mr. Meeseeks can see his entire body?



Refraction

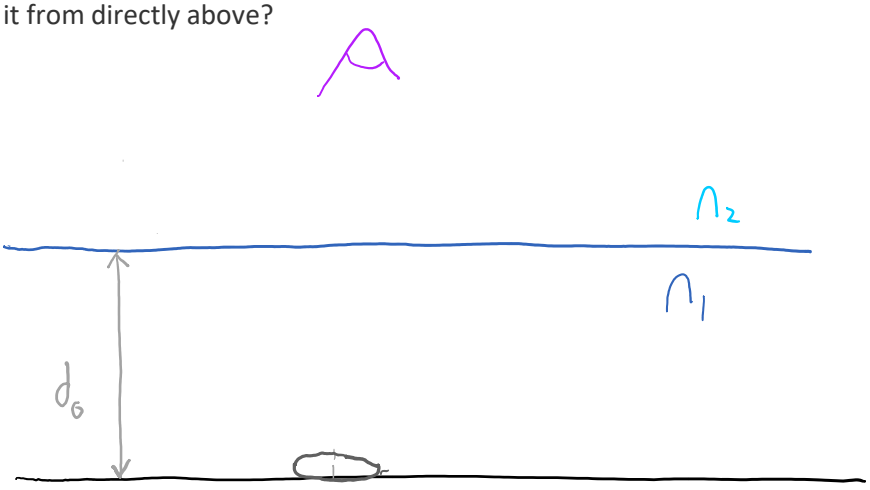
PRACTICE: If you are attempting to cook the fish with a high power laser, while it's still in the water, where should you aim the laser?

1. Directly at the fish
2. In front of the fish (closer to you)
3. Beyond the fish (further from you)
4. In the opposite direction of fish from you



If you are attempting to spear a fish with an arrow where should you aim?

PRACTICE: A rock is at the bottom of a shallow lake. How far under the surface does the rock look if you view it from directly above?



QUESTIONS FOR DISCUSSION:

1. When you place a straw in a glass of water at an angle, it looks as though the straw bends. Explain this observation with the concepts covered in this lecture.