Inquiry: Cameras & Lenses

Introduction:

Cameras take pictures by using lenses to redirect the light from an object into a small screen which can record the image using either chemicals or pixels. To redirect that light, every camera uses a lens to *refract* light. The light from that lens is bent such that it all lands on one point a certain length away from the lens. However, the *image* is not always the same size as the original object. The change in the image size is called the *magnification*.

The **magnification** of an object in an image depends on the **ratio** of the object's height to the height of its image. So an image that is half as tall would have a magnification of 0.5, and an image that is twice as tall would be magnified by 2.

Magnification depends on two things: the lens you are using, and the distance from the object you are taking a picture of. Today we are going to test our cameras to see how much they magnify the objects they take pictures of.

Part One - Measuring Magnification:

Find something interesting to take a picture of, either inside or outside. Measure its height, and take three pictures of it at different distances. Measure each distance and then calculate the magnification at each distance by dividing the image height by the original height. Finally, choose a picture you like and upload it to our jam board so we can all see! Write the focal length of your phone next to the picture.
(<Link to jam board>)

Object Name	Object Height (h_1)

BEFORE MEASURING THE IMAGE HEIGHT: Make sure your phone is at %100 zoom on the image.

Distance from camera to object	Image Height (h_2)	Magnification ($\frac{h2}{h1}$)

How does the magnification change as the distance from the camera changes?

How do you represent that relationship mathematically?

Part Two - Painting with Lenses

The cameras in our lenses are made to focus and adjust to taking pictures at different distances. To dig a bit deeper into exactly how they work and how lenses bend light, we are going to make our own 'cameras' using *just* a lens, a piece of paper, and our own artistry.

Instructions:

1. Turn on your lightbulb and choose a color with the remote
2. Draw a small picture on the light with an erasable marker; this makes it easier to tell if the image is focused
3. Hold up a lens some distance from the camera, then hold up a white sheet of paper to capture the image of the lightbulb
4. Move the lens and the paper back and forth until you get the image as clear as you can.
5. Measure the heights and distances from the lens for the light and the image.
6. Trace the image on the paper, then fill in the details of your drawing.

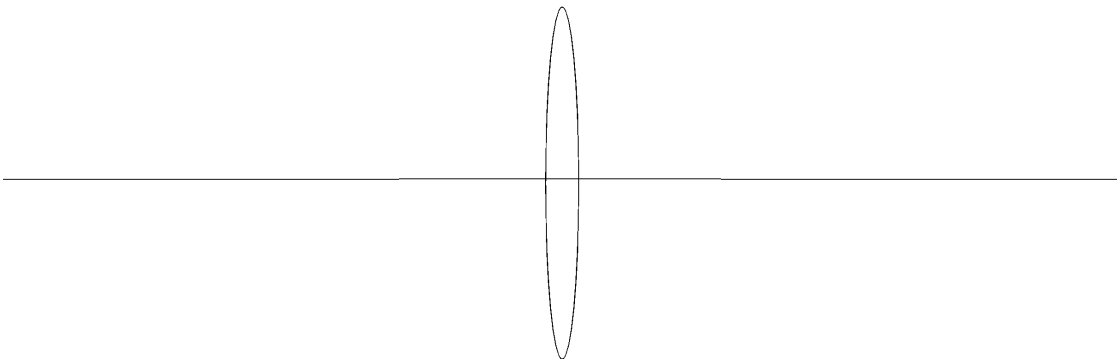
Data:

Height of light	Height of image	Magnification	Distance from light to lens	Distance from lens to paper

Analysis:

1. How does the image you have made compare to the original light bulb? What is the same? What is different?

2. Using the lens diagram below, draw the light bulb and where the image of your light is; label the distances and heights you have recorded above. Note: the object should be going *up* from the center line on the left, while its image should be going *down* from the center line right.



3. Above, draw two light rays from the top of the light bulb: one that is going straight to the right, another that is going through the center of the lens. Think about where they have to go next. Draw the light rays that go from the lens to make the image you have drawn.