# Simple Lens Prelab

***by***

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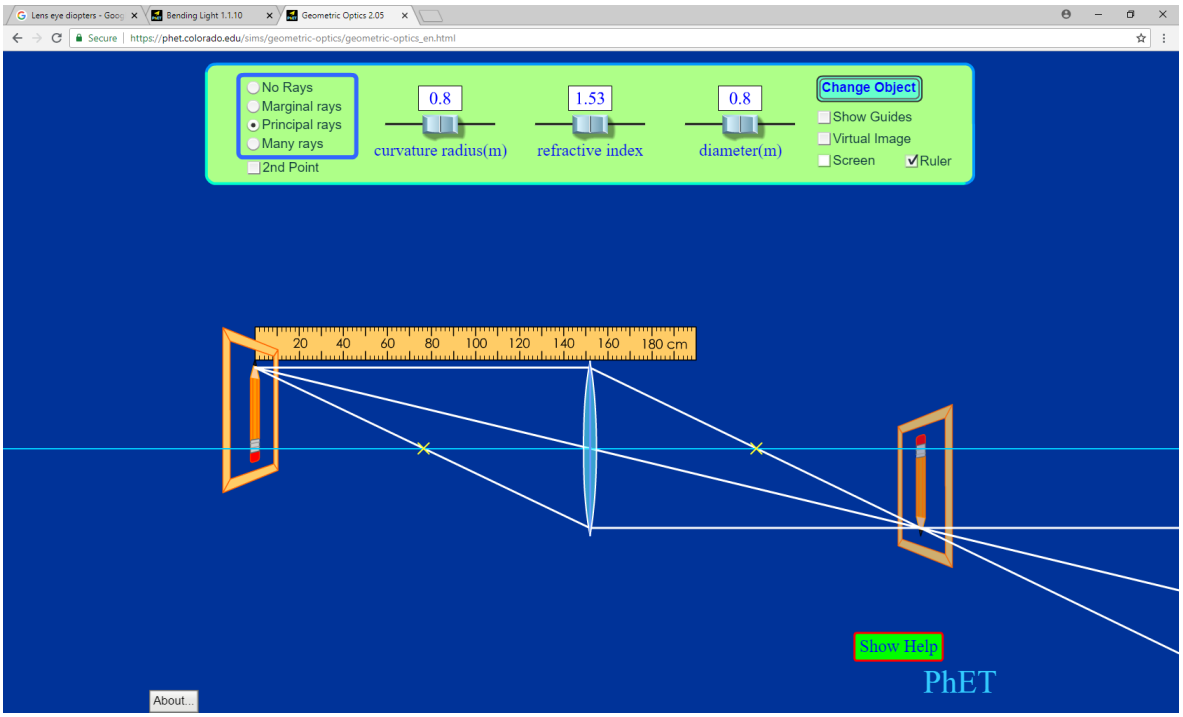
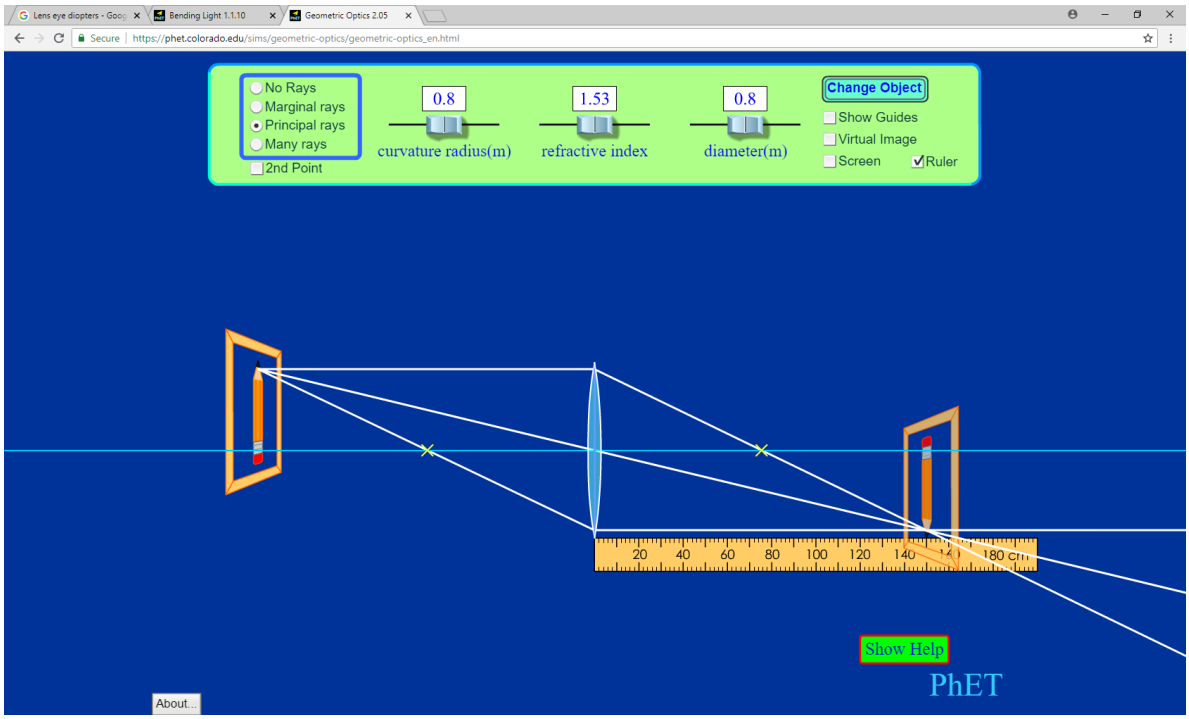
Lenses are a common tool used in our everyday life (eyes, glasses, cameras, telescopes,…). In normal vision, the lens of your eye focuses an image onto your retina. The image is real and inverted, but your brain flips the image so that you process it as right-side up. If you are nearsighted (myopia), then the image is formed in front of the retina, and if you are farsighted (hyperopia), the image is formed behind the retina. The eye has ciliary muscles that help to shape the lens to see at different distances. If you are nearsighted, then things far away are blurry because your lens is too long.[1] Your vision can be corrected with a diverging lens. If you are farsighted, then things close to you are blurry because your lens is too short. Your vision can be corrected with a converging lens.

The size of the aperture of a camera lens contributes to the depth of field. A small aperture lens like your phone camera has a large depth of field because only a narrow range of light rays can enter the lens.[2, 3] Everything is mostly in focus, but the camera does not operate well in poor light. Images will not be as sharp. A wide aperture lens will have a narrower range of focusing, but the detail will be much better.

## Real Image, Inverted

Using a Phet simulation (no longer supported so pictures will be shown here),[4] a real, inverted image can be created as shown below.

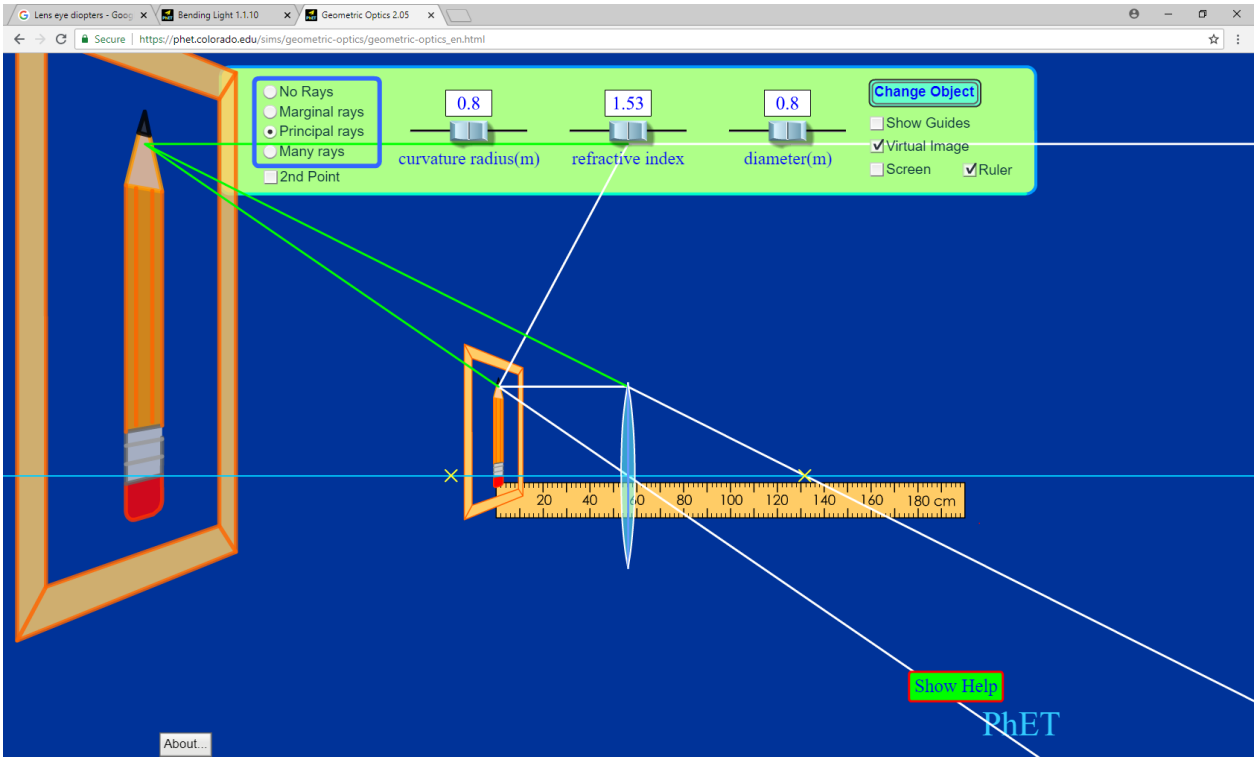


1. What is the object distance (use ruler in the first image)?
2. What is the image distance (use ruler in the second image)?
3. Using the thin lens equation (Equation 1 on p 305 of your lab manual[5]), what is the focal length of the lens in the system shown above? Show your work.
4. Is this what you expect to be your focal length based on the picture? Explain.

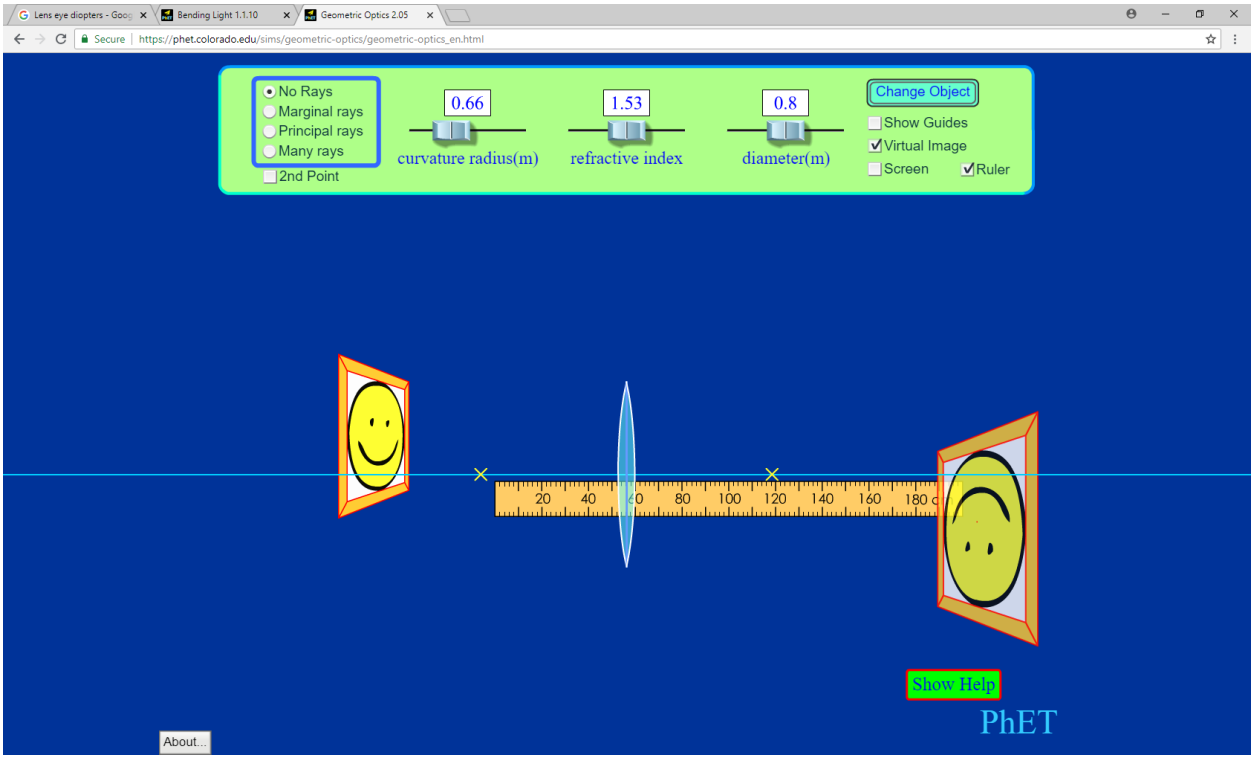
**Virtual Image, Upright**

5. In the picture below, the object (smaller pencil) is placed inside the focal length of the lens (marked by yellow x), and a virtual image is formed. Calculate the image distance using the thin lens equation? Since the lens is symmetrical, there is a focal point on both sides. Use the ruler to measure the focal length and the object distance, and then use the thin lens equation to calculate the image distance. Does your answer make sense based on where you see the image in the picture?



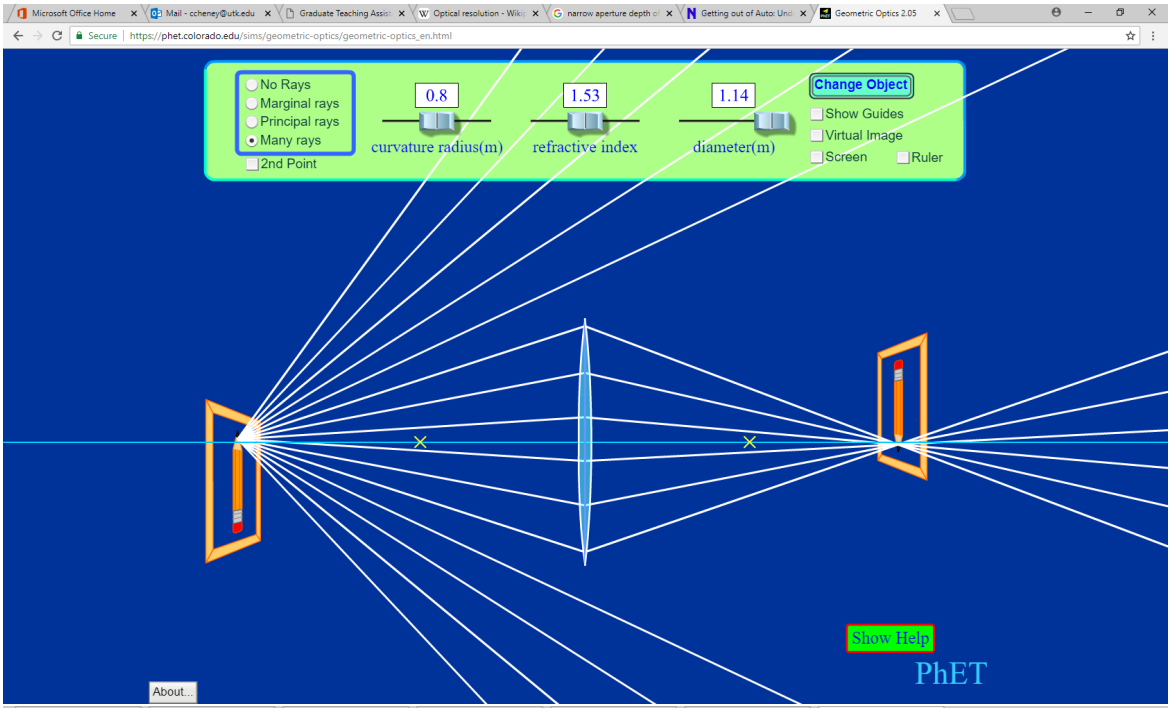
## Ray Tracing

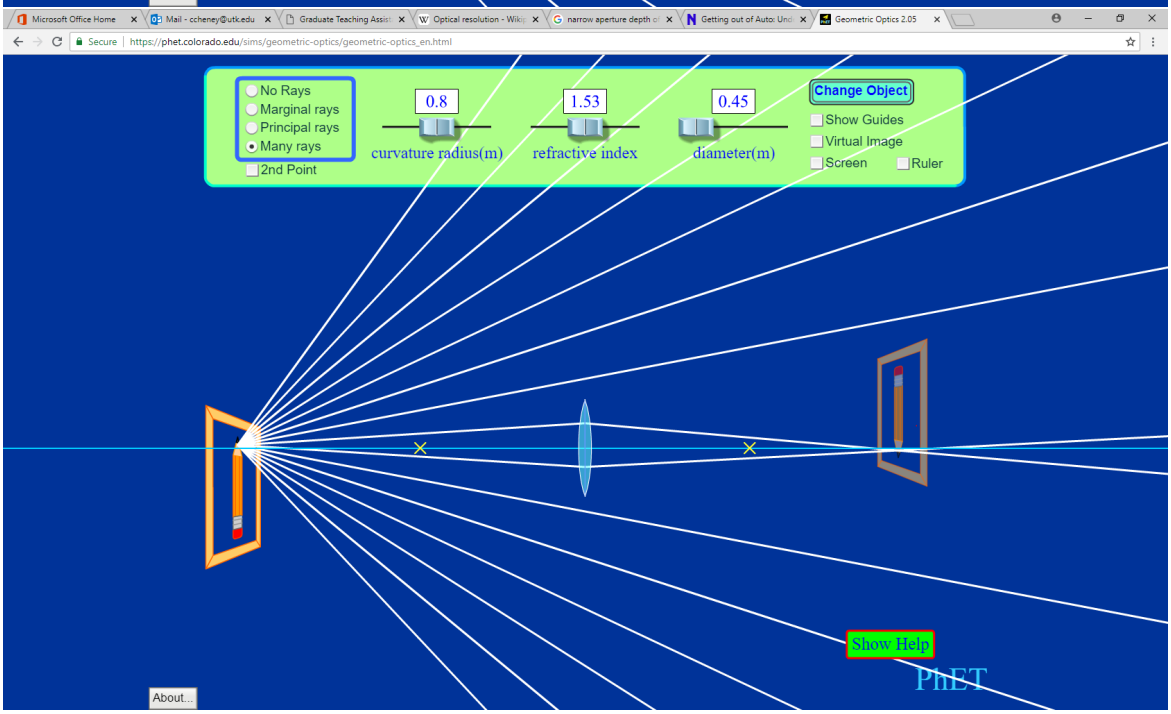
6. Draw the rays on the picture below to show how the image is formed. Remember that a ray from the object will go through the focal point (marked with the yellow x) and then out of the lens parallel to the axis. Another ray will travel from the object straight through the center of the lens and out with no bending. A third ray will travel parallel to the axis, through the lens, and out through the focal point on the other side of the lens.



## Depth of Field

7. Below are two similar scenarios except that the lens diameter has been changed from 1.14 m to 0.45 m. The image with the 1.14 m diameter lens has more light rays forming the image and a narrower focusing field. You should also notice that the image with the smaller diameter lens is less bright.



**Things to remember during the lab:**

1. **DO NOT TOUCH THE OPTICS WITH YOUR FINGERS!!!!** Touch the black holders not the optics.

**References:**

[1] https://www.cvilleeyecare.com/primary-eyecare-news/conditions-treat-myopia-nearsightedness/

[2] Bloomfield, Louis A. *How Things Work, 4th edition*, John Wiley & Sons, Inc: New Jersey 2010.

[3] https://newatlas.com/exposure-triangle-photography-guide/48143/

[4] https://phet.colorado.edu/sims/geometric-optics/geometric-optics_en.html

[5] Parks, James E. *Contemporary Introductory Physics Experiments, 2nd Edition*, Hayden-McNeil Publishing: Plymouth 2014.