Converging Lens Activity

Getting Ready: Navigate to the **Optics Bench** simulation found in the **Physics Interactives** section of **The Physics Classroom**.

http://www.physicsclassroom.com/Physics-Interactives/Refraction-and-Lenses/Optics-Bench

Navigation:
www.physicsclassroom.com => Physics Interactives => Refraction and Lenses => Optics Bench

Background:

The screen shows a converging lens (note the shape) and an object (a candle) to the left of the lens. A lens has a **principal axis** and a **focal point** (**F**), and a **2F** point. These two points are located on both sides of the lens but labeled as **F'** and **2F'** on the left side to distinguish between **F** and **2F** on the right side. The object (candle) can be dragged along the principal axis and the image characterics can be observed.

What to Do:

Drag the object and make observations in order to answer the following questions.

1. What are the characteristics of the image when the object is positioned more than two focal lengths from the lens (i.e., beyond 2F')? Please circle.

   Location: Left of lens Between lens and F Between F and 2F Right of 2F

   Orientation: upright or inverted Size: magnified or reduced or same size

2. What are the characteristics of the image when the object is positioned exactly two focal lengths from the lens (i.e., at 2F')?

   Location: Left of lens Between lens and F Between F and 2F Right of 2F

   Orientation: upright or inverted Size: magnified or reduced or same size

3. What are the characteristics of the image when the object is positioned between one and two focal lengths from the lens (i.e., between F' and 2F')?

   Location: Left of lens Between lens and F Between F and 2F Right of 2F

   Orientation: upright or inverted Size: magnified or reduced or same size

4. What are the characteristics of the image when the object is positioned less than one focal length from the lens (i.e., between F' and lens)?

   Location: Left of lens Between lens and F Between F and 2F Right of 2F

   Orientation: upright or inverted Size: magnified or reduced or same size

5. Enable the **Show Rays** feature. Principal light rays are shown approaching the lens; their refraction is shown as well. **Real images** are images formed by the convergence of these refracted light rays. **Virtual images** form when refracted light rays diverge. Determine …

   For what object locations will the image of the candle be a **virtual image**?

6. The magnification of an image describes how many times bigger the image is than the object. As a formula, magnification (**M**) is calculated as ...

$$M = h_{image} / h_{object}$$

Use the height slider to adjust the height of the object to some whole number near to 20 cm. Use the focal length slider to set the focal length to a value near 20 cm. Record in Table A. Record the object height in Table A. Then collect values of image height for object distances of approximately 4•f, 3•f, 2•f, 1.5•f, and 1.25•f where f is the focal length. Record the values in the table below and calculate the magnification.

Table A

focal length (cm)	**h_{object} (cm)**	**Object Distance (cm)**	**h_{image} (cm)**	**I M I (absolute value only)**
		~4•f =		
		~3•f =		
		~2•f =		
		~1.5•f =		
		~1.25•f =		

Qualitatively describe how the (absolute value of the) magnification depends upon object distance: