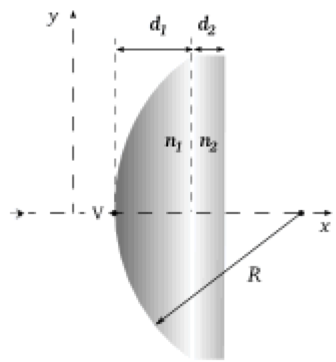
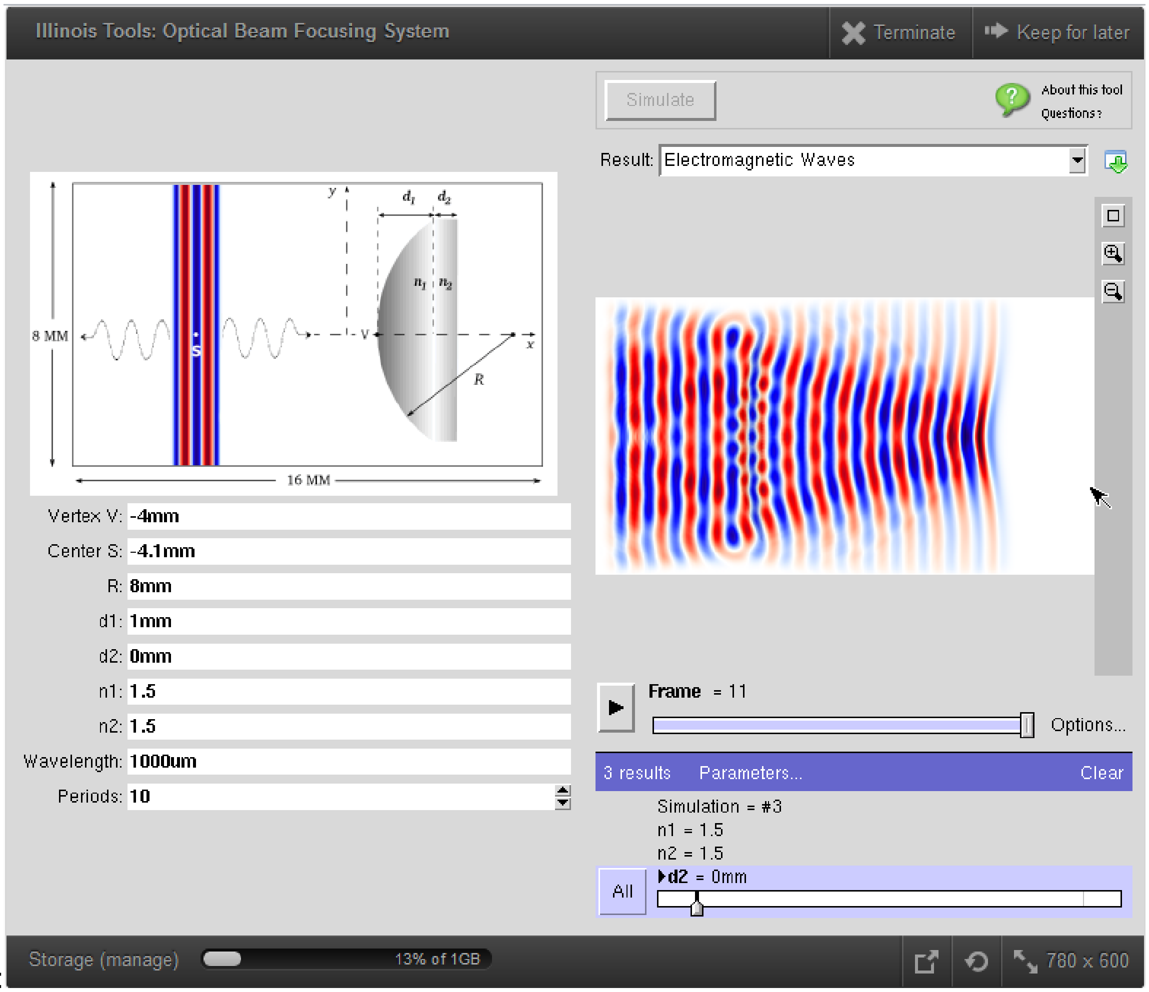
Optical Beam Focusing System tool
on nanohub follow this link: http://nanohub.org/resources/opticslens

Launch this tool and you will see a lens with 6 parameters. These parameters are the radius of curvature for the leftmost side of the lens labeled R, the width of the left part of the lens labeled d_1, the right hand part of the lens labeled d_2, the index of refraction of the left hand part of the lens, labeled n_1, the index of refraction of the righthand part of the lens labeled n_2, and the x coordinate of the leftmost part of the lens labeled V.



There are 3 other parameters to describe the properties of the wave source. S is the x coordinate of where the plane wave will propagate. The wavelength is the distance that the light covers to complete a full period. The Periods mark how long you want the simulation to run. The more periods, the longer it runs.

As a trial, make R=8 mm, d_1= 1mm, d_2=0mm, n_1=1.5, n_2=1.5, Wavelength=1000 um, V=-4mm, S=-4.1mm, and Periods=10. Run the simulation, and the last slide should look like: 

Using this tool, we will explore some properties of the lensmaker's equation. The lensmaker's equation is an approximate relationship between the focal length, the index of refraction of the lens, and the radius of curvature for the left and right hand sides of the lens. This approximation holds true so long as our lens is thin when compared to the actual focal length.

$$\frac{1}{f} = (n-1)\left[\frac{1}{R_1} - \frac{1}{R_2} + \frac{(n-1)d}{nR_1R_2}\right],$$

http://en.wikipedia.org/wiki/Lens_(optics)

In the above equation, f is the focal length, n is the index of refraction for the lens, d is the thickness of the lens, R_1 is the radius of curvature for the lefthand side of the lens, and R_2 is the radius of curvature of the right hand side of the lens. By convention, R_1 is positive, while R_2 is negative. The thin lensmaker's equation assumes that d is zero.

Using the Optical Beam Focusing System tool, you can regard R_2 to be negative infinity, thus making $1/R_2$ and $(n-1)\, d / (n\, R_1\, R_2)$ both zero. As such, you can approximate $f = R/(n-1)$ for this tool.

Question 1.

- If you make R=8mm, d_1=.5 mm, d_2=0 mm, and n=3 what should the focal length be?

- How do the focal length when the wavelength is 200 um and the focal length when the wavelength is 1000 um compare?

Question 2.

- If you make R half as large, how would the focal length change.

Question 3.

- If you doubled the index of refraction from 3 to 6, how would the focal length change?
- How does increasing the index of refraction affect the amount of light that passes through the lens.