

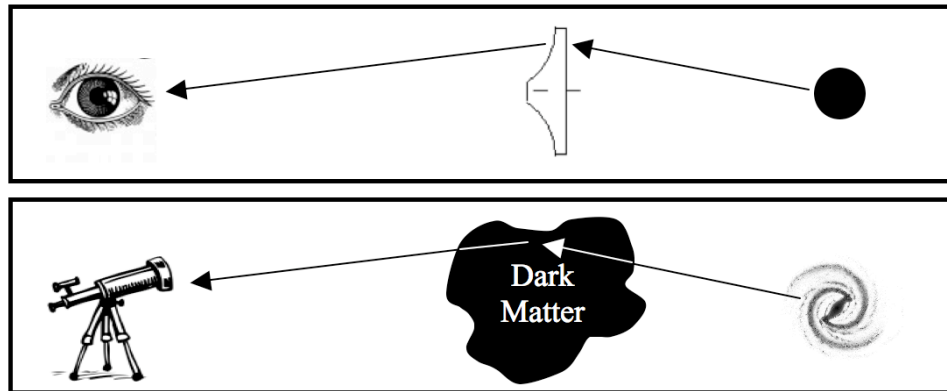
Gravitational Lensing

Background:

Dark Matter is invisible, but astronomers can detect it is using Gravitational Lensing. Gravitational Lensing is just an *optical illusion* caused by the gravity! Anything very massive works – examples are galaxies, dark matter, or black holes.

Introduction:

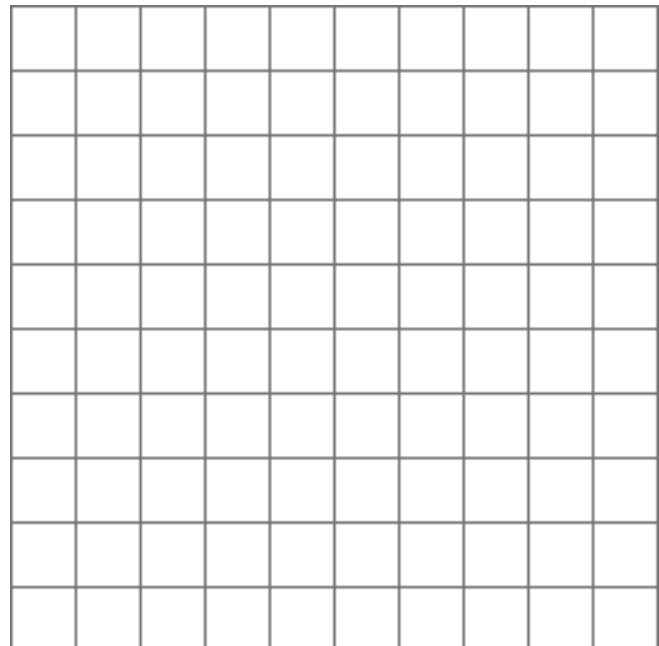
In this activity you will use the base of a wineglass to replicate the effects of a gravitational lens. Light passing through the glass is bent in a very similar way to light passing near a black hole, or a blob of dark matter:



Part 1: Look straight down onto your “gravitational lens”. Write down your observations below.

What happens to the grid lines? Do the squares appear bigger or smaller? Do their shapes change? Is it different near the center than near the edges?

Try moving your “lens” slowly over some text and watch how the words are distorted.



Part 2: Gravitationally lens this black dot (slide your lens *slowly* over it). You will see the same kinds of distorted images that astronomers see of distant galaxies.



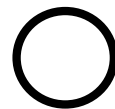
A) This is called **shear distortion**. The circle is slightly stretched.



B) How many **multiple images** (more than one dot) can you make? Can you get two dots of the same size? When one dot is bigger than the other, is it closer or farther away?



C) A full circle is called an **Einstein Ring**. Can you change the size of the ring by lifting it off of the paper?



Bonus: Try lensing other objects or pictures that you have around your desk. How would your partner's face appear if a black hole passed between you?

Lots of everyday objects bend or alter the path traveled by light, so they can also create optical illusions and distort what you see. Compare your "gravitational lens" with another type of lens. Anything transparent will do (eyeglasses, water bottle, etc). Compare how the grid lines look. Try distorting other pictures. What are the differences & similarities between the lenses?