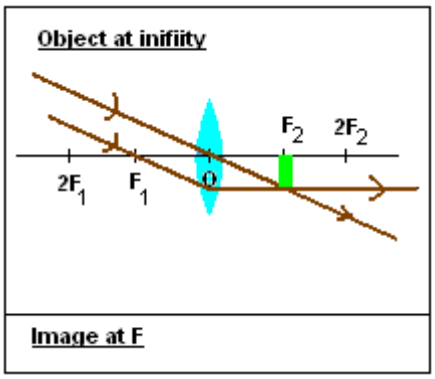
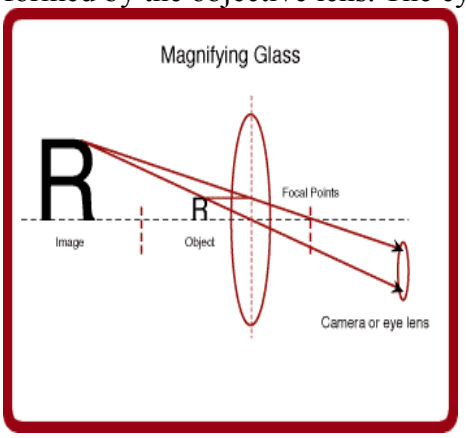
Phys106 /Dr. Lankar lab telescope Name _____

INTRO - PLEASE READ

The astronomical telescope consists of 2 lenses, the objective lens and the eyepiece. The objective is a converging lens of long focal length which forms a real, inverted image of a distance object in its focal plane. See below:

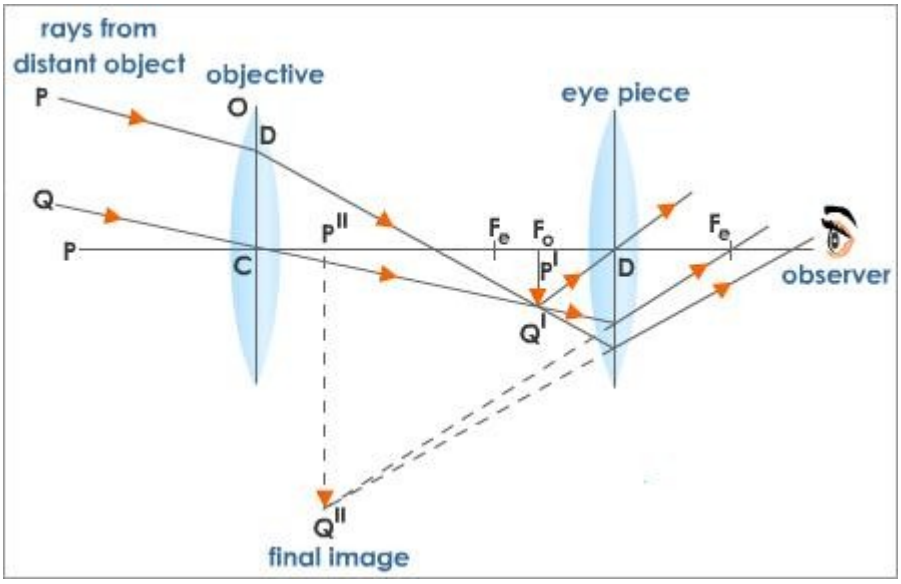


The eyepiece is a converging of short focal length used to magnify the image produced by the objective lens. See below. The eyepiece is used as magnifying glass, by means of which an enlarged virtual image is formed of an object placed just inside its focus. In this case, the object is the real image formed by the objective lens. The eye looks directly at the enlarged image produced by the eyepiece.



Big idea: The objective creates a " real image " (can be projected on a screen) of a far away object like a star. So it " catches" a picture of the star and bring it back to the telescope. Then the eyepiece magnifies this image for our eye. The final image is said virtual because you can't see it on a screen. The lens inside our eye projects the image on our retina.

Here is the whole set up:

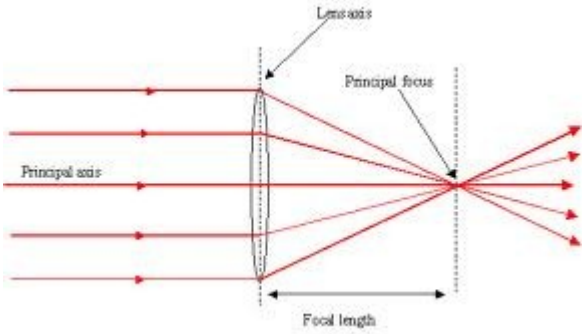


First the objective brings an image (real) of the star in the telescope. The image (P'Q') is formed in the focal plane of the objective (Fo). Then the eyepiece magnifies P'Q' to the final image P"Q".
The object PQ is a star very far away. (that's why the rays are parallel)
Notice that the final image is inverted compared to the object. But it does not matter. You just have to turn your photo around. For terrestrial object we use a third lens to get a upright image.

APPARATUS
optical benches, one long=focus lens (about 40cm), one short-focus lens (about 10cm)
illuminated object , metric ruler …

PROCEDURE:
PART1: Determine the focal length of the lenses

1.Estimate the focal length of the 2 convergent lenses by obtaining the image of a very distant object on the screen and measuring the image distance with a ruler. (use the sun for example and try to get an image on a screen). Ask me.



	Focal length (cm)
Short focal length	
Long focal length	

2.determine the focal lengths using the lens equation: (what you found were approximations)

1/f = 1/p + 1/q

p is the distance between the length and the object (the object is the cross-lamp)
q is the distance between the length and the image (that is the screen)
NOW USE THE OPTIC BENCH

Place the illuminated object at a distance from the lens about **equal to 1.5 times the focal length**. (use the focal lengths computed in 1.) Move the screen until a sharp image is observed. Record object distance, image distance and calculate the focal length of the lens.

	Object distance p (cm)	Image distance q (cm)	Focal length f (cm) **solve the equation: 1/p + 1/q = 1/f**
Short focal length			
Long focal length			

PART2: construct a telescope

The long-focus lens will serve as the objective and the short-focus lens as the eyepiece. Remove the lenses from the holder and now use a meter stick with lens holder. Place the eyepiece (thick lens) at the end. **Place the objective at a distance about <u>equal to the focal length</u> of the thin lens**. Go in the back of the room as far as possible from the door. Aim at the photos of the Physics professors placed outside. Very carefully move the objective away from the eyepiece until you can have a sharp image. Then go outside an try your telescope (not in a sunny place)

PART3; measuring the magnifying power of the telescope

To measure the magnifying power of the telescope, make 2 horizontal chalk marks on the blackboard (or a white board) with a marker about 10cm apart and focus your telescope on them **across the room**. While looking at the marks through the telescope with one eye and at the black board with the other eye, give directions to your partner to make on the black board 2 marks which appear to coincide with the apparent positions of the images as seen through the telescope. Measure and record the distance between each set of marks. Exchange places with your partner and make another trial.

	Size of the object (cm)	Size of the image (cm)	magnification
Trial 1			
Trial 2			

Average: _____

PART4: Try the telescope in a kit

Now place the lenses in the tube so light from outside does not interfere. Use the same distance between the lenses as before. And test it and see if it is better.