

Telescopic Observations

Materials: Paper, pencil, camera, Telescope or Binoculars

In this project, you will be observing at least three objects with a telescope or binoculars, and drawing what you see.

If you do not already own and know how to use a telescope or binoculars, **don't** run right out and buy one. They are not very easy to use and are pretty expensive. Binoculars can be bought for under \$100. Telescopes are at least several hundred dollars for ones that are usable. Some people have no problem pointing to things and finding them. Other folks need to practice a lot. I will be glad to schedule a night to help you set up and learn to use your equipment. But that doesn't guarantee that you will get this project done if you are starting anew with equipment

If you want to observe with a telescope, but don't already have equipment, I suggest that you do the star party project. If you are considering buying a telescope or binoculars, the star party will let you see what can be seen with each type of equipment. If you do buy a telescope, I will still be glad to help you learn to use it.)

For this project, you will describe your equipment, and then find and draw at least three celestial objects. The circular forms provided are supposed to represent the circular field of view of the telescope. Most objects will not fill the entire field of view. Draw what you see and be careful to record the data.

Observing

It is necessary to know the name of the objects you are observing. The Moon and the planets are always good and pretty easy to find. It Star clusters and gaseous nebulae are also interesting, but harder to find. Decide what you want to find before you find it.

Use the lowest magnification you have to observe the Moon, at least at first. It is much easier to figure out what you are observing,

The planetarium program that came with your text, SkyChart III can help you decide what to observe. Enter your observing location, the time and the date, to see the sky and what is above the horizon at the time you plan to observe. You can ask it to find objects by name and the program will tell you whether the object is above the horizon or not. The Students for the Exploration and Development of Space site, <http://www.seds.org>, includes a Messier objects area. This has photos of each Messier object, coordinates and the magnitude. Remember, it is harder to find an extended object than a star of the same magnitude.

After you have drawn the objects

- a) Find a picture and description of the object on the internet. Print out the information. These images will generally show .more than you will be able to see with an amateur telescope. Write a paragraph comparing and contrasting what you saw with what is on the photo for each object. **UNLESS** you have drawn the Moon. In that case:
- b) If you have observed the Moon, get a map of the Moon and label at least 6 of its features on your drawing. Tell the proper name for each (e.g not Crater, but Copernicus, the name of the crater) One site with a lunar map is <http://www.inconstantmoon.com/cyclopedia.htm>. The physical and nomenclature maps that say features and show maria, bright, or other are the best ones to look at. If you observed the moon in the early evening and it wasn't full, you were looking at the right hand side of the map. If you observed well after midnight, you saw the left side features.

If you are using an astronomical telescope, be aware that the image will be reversed and upside down. This may make it harder to identify the information on the photo. If you bring in the drawing and the photo, I will be happy to help you find features. Some objects, like globular clusters, are so nearly spherical that you won't be able to tell whether they are reversed or inverted. Astronomical photos are sometimes printed reversed and inverted, sometimes not. Terrestrial telescopes (like for bird watching), telescopes with erecting prisms and binoculars do not reverse.

Turn in

Picture of your equipment

Three drawings, the corresponding photo or map and the comparison write up

For the Moon, identify the names of at least six features on your drawing

Description of telescope or binoculars

Objective and Conclusion

Describing your equipment

Binoculars (telescopes below)

Binoculars usually are specified by two numbers like 7 x 35 or 8 x 50. These would be read, "7 by 35". The first number is the magnification, 7 times or 8 times. Generally the magnification is between 6 and 10. Binoculars generally do NOT have any way to adjust the magnification.

The second number (the 35 or 50) is the number of yards visible in the binoculars at a distance of 1000 yards. So the second number is a measurement of the field of view. If you want the number of degrees, multiply the second number by 0.0573 degrees. So 35 translates to about 2 degrees and 50 translates to 2.865 degrees field of view.

Binoculars are not generally sold by aperture, but that is what matters the most for finding faint objects. Aperture means the diameter of the lenses in the front of the binoculars. Generally the aperture diameter is printed on the front end of the binoculars. If you can't find it, measure the diameter with a ruler.

The larger the area of the lenses in the binoculars, the fainter an object you can see and the more things you can find. The fact that there are two sets of lenses in the binoculars doesn't add to the amount of light that can be seen, it just makes it possible to use both eyes.

Equipment Descriptions

Take a photograph of the equipment in the daytime and describe its features as specified below.

Telescope Type

Telescopes come in two basic kinds, reflectors and refractors. Decide which yours is. If you still have the brochure that came with the telescope, it will say the type and the diameter of the aperture.

Refractors are telescopes with lenses, no mirrors. They look like pirates' spyglasses. Light from all over the area of the front lens is collected. This is the lens furthest from your eye, and also the biggest. These diameters are generally less than 5 inches for telescopes that are commercially available. The large ones are very expensive.

Reflectors are telescopes with a curved mirror collecting the light. There are a variety of reflecting telescope designs. These telescopes all have a mirror that you can see. It is generally near the closed end of the tube. Diameters of the mirrors start at about 3 inches and go up. Telescopes over about 17 inches are tough to move even with a car.

Diameter of Objective

Regardless of whether the telescope is a reflector or a refractor, the largest lens or mirror is called the "objective". The area of the objective determines how much light is collected and how faint an object can be seen. Since area of a circle is πr^2 , the square of the radius is what matters. So a 6 inch diameter telescope (area $\pi 3^2 = \pi 9$) gathers four times as much light as a 3 inch telescope (area $\pi 1.5^2 = \pi 2.25$).

Magnification

Telescope magnification depends on the eyepiece being used and it can be changed. There is no maximum magnification, but typically it is not good to use magnification more than 50 x diameter of the aperture in inches.

So for a 6 inch telescope diameter, 300 is the maximum magnification to use. For an 8 inch diameter telescope, 400 is the maximum magnification.

If the image is magnified too much, the image gets weak and watery looking. It's the same kind of thing that would happen if you tried to use a home projection TV to project on a giant screen like at a drive in. The picture would be big, but too faint.

Finding the magnification. The magnification a telescope produces is given by the formula

$$\text{Magnification} = \frac{\text{focal length of the telescope}}{\text{focal length of the eyepiece}}$$

Magnification has no units. The focal lengths should be in the same units as one another. The units cancel and magnification has no units. Typically magnification 50 would be written 50x.

The focal length of the telescope depends on ALL of the glass parts except the eyepiece. The focal length is never printed on the telescope or given in the brochure. In stead, a ratio called the "F number" is provided. It WILL be printed on the scope or in the brochure in most cases. It might look like F10, or F/10. Telescope F numbers range from about 4.6 to 20.

The F number is defined by

$$\text{F number} = \frac{\text{Focal Length of the telescope}}{\text{Diameter of Objective}}$$

Since you know, or can use a ruler to measure the diameter of the aperture, the F number allows you to find the focal length by rearranging to

$$\text{F number} \times \text{Diameter of Objective} = \text{Focal Length of the telescope}$$

The focal length of the eyepiece is normally printed on the eyepiece itself. Typical focal lengths are from 3 mm to 32 mm (with occasional large eyepieces to 56 mm). Larger focal lengths produce lower magnification and are easier to look through.

The lower the magnification, the larger the field of view of the telescope and the easier it is to find things. Most telescopes have an attached finder scope with a fairly large field of view.

The point of the finder is for you to get the object into the center of a large field of view so that it will be easier to find in the smaller telescope field of view. It only works if the finder and the main telescope are aligned so that they both point the same. Many telescopes have finders that shift when the telescope is put away. So be sure to realign it at the start of the evening. Look at the Moon or a bright planet and adjust the finder pointing so the same thing is in the middle on both large and small telescope.

Observing with a Telescope

Name_____

Diameter of objective_____

Describe Your Equipment in one of the boxes

Binoculars

Diameter of objective_____

Field of view (second number)_____ Magnification_____

Telescope

Diameter of objective_____

Fnumber of telescope_____

Focal Length of eyepiece(s) used _____

Magnifications corresponding to the eyepiece(s) _____

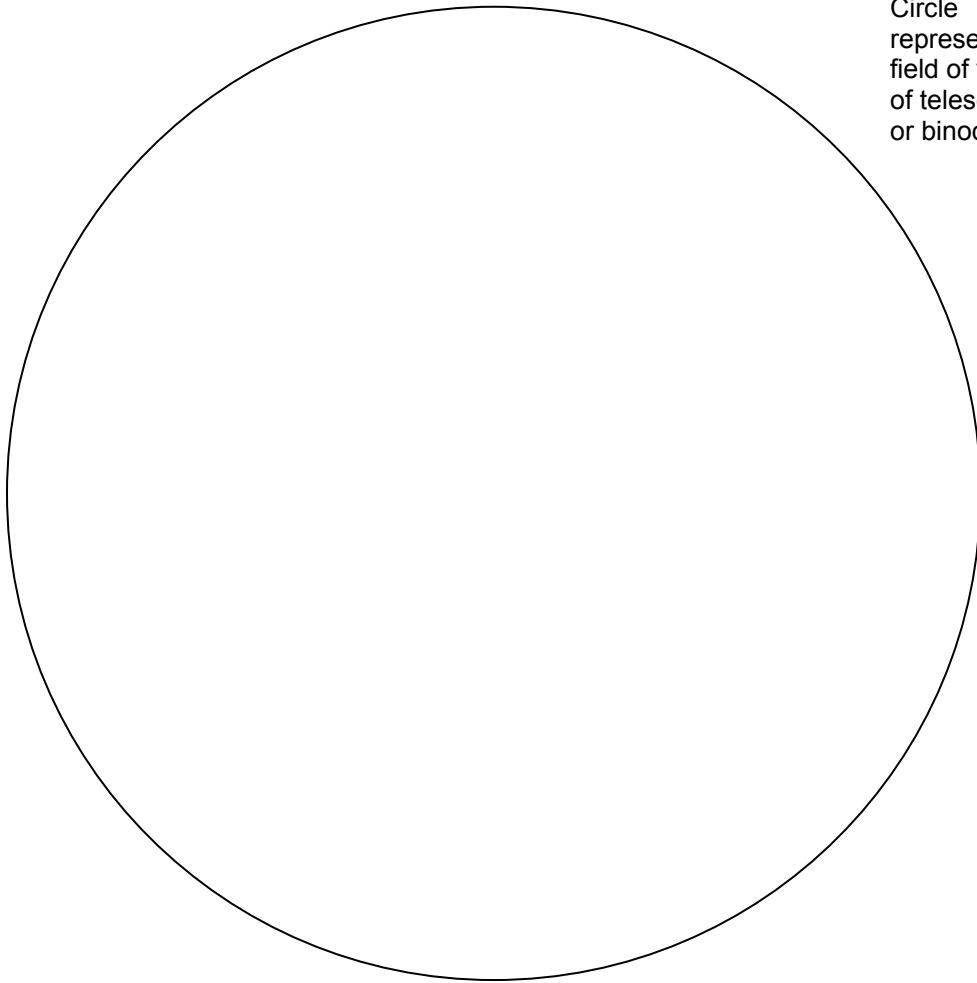
Picture of Equipment:

Date _____

Time _____
(tell zone and whether standard or daylight savings)

Magnification _____

Name of Object _____



Circle
represents
field of view
of telescope
or binoculars

If drawing is of the Moon, label at least 6 features with their proper names, attach map(s)
Comparison with image from photograph (attach data sheet)