Activity 7:
Build Your Own Telescope

Print Name: ***Signature:***

1.) _____

2.) _____

3.) _____

4.) _____

Activity:

Almost all astronomical measurements are made with telescopes. There are three main types of telescopes: refracting telescopes, reflecting telescopes and compound telescopes. In this lab we will concentrate on only the most basic type of telescope, a refracting telescope. A refracting telescope is composed of two lenses, configured so that the user can view distant objects. They were originally used on ships as spyglasses. Although Galileo Galilei was not the inventor of telescope, he was the first person to use a telescope to study the heavens. His observations, during the early 17th century, forever changed our view of the universe. The telescope you will build tonight is very similar to the telescope Galileo used to make his surprising observations.

Today, you will build your own basic refracting telescope and determine some of its properties, specifically magnification.

1) Before building your own telescope, ***Predict*** what would happen if you were to use your telescope to observe a distant object, what do you expect to see? Will the image be larger or smaller than the object you look at? Will it be right side up or upside down? Why? (Completion Only)

In this activity, you will use a telescope kit that you will put together to make a telescope. This kit contains the following equipment.

- **2 Cardboard Tubes**
- **1 Foam Lens Holder**
- **1 Red Plastic Cap**
- **1 Large Lens (Objective Lens)**
- **1 Small Lens (Eyepiece Lens)**

Part 1: Properties of Lenses

Before actually building your telescope, you will need to describe the lenses, as well as determine the focal length and type of image.

2) Determine if the lenses are concave or convex. Record the description of each lens in the table below.

Table 1: Properties of Lenses

Lenses	Description	Focal Length	Type of Image
Objective			
Eyepiece		+ 3 cm	Inverted

Each lens has an intrinsic property called the focal length, defined below. You will need to determine this property for your objective lens.

Focal Length = Distance from Lens to where Parallel light focuses.

Remember that the more distant the object, the more parallel the light.

3) Measure the focal length of the objective lens using the following steps.

- **Several white light bulbs are placed around the room.**
- **Choose one bulb to use for your measurements.**
- **Hold a piece of white paper far away from the bulb.**
- **Hold the objective lens close to the piece of paper.**
- **Slowly move the lens away from the piece of paper until an image forms.**
- **The distance from the piece of paper to the lens is the focal length.**
- **Record the focal length in table 1.**

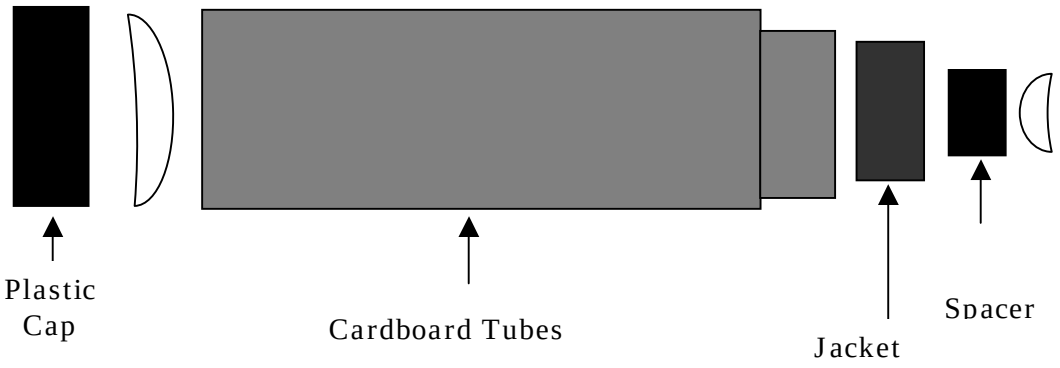
4) Determine if the image formed by the lens is upright or upside down. To this slowly move the lens away from the focal point and observe the type of image. Record this information in Table 1.

Part 2: Building Your Own Telescope

You are now ready to build your own telescope. Follow these steps to successfully build your own telescope.

- **Place the large lens with its curved side against the front of the larger tube. Make sure the lens is positioned perpendicular to and centered on the tube. Place the cap over the tube so that the lens is firmly held in place.**
- **Push the small lens into the foam holder. Then push the spacer into the foam holder such that it pushes against the flat part of the lens. Push the spacer into the holder just far enough so that the end of the spacer is flat with the end of the foam holder.**

- **With the curved side of the small lens facing toward the large lens, slide the foam holder into the end of the smaller of the cardboard tubes. Place the smaller tube inside the large tube.**



Part 3: Calculating Magnification

Mathematically it can be shown that the magnification of a refracting telescope is given by the following equation.

$$M = \frac{ObjectiveFocalLength}{EyePieceFocalLength} = \frac{f_{obj}}{f_{eye}}$$

5) Determine the magnification of your telescope.

M = _____

6) Will the image produced by this telescope be smaller or larger than the object? How do you know?

Part 4: Observing with your Telescope

You will use your telescope to observe a word located at the far end of the room. There are several different words located throughout the room. Specify which location you are using.

7) Before observing, *predict* what the word *Kansas* would look like if observed with this telescope? Explain why you think so. (Completion Only)

8) Observe the word at the end of the room; draw the word *exactly* as you see it.

9) Does the word appear the way you expected? If not, why not?

10) Explain in words and a picture why what you read on the signs appears the way that it does?

11) Looking through your telescope, approximate its magnification.

Magnification:_____

12) How does this compare to your calculation? Discuss reasons for any differences between your two values.

Extra Credit:
How would you make a telescope with a greater magnification?