Lab 10: Telescopes

Part I: Telescope Introduction

Watch the Crash Course Astronomy video on Telescopes and answer the following questions. Be sure to use your own words!

    https://youtu.be/mYhy7eaazIk

1. Why is a bigger telescope better than a smaller telescope?

2. What is the objective of a telescope? (hint: it is part of the telescope)

3. What is refraction?

4. Were the first telescopes made with lenses or mirrors? What were these telescopes called?

5. What is resolution?

6. What is the name for a telescope that uses mirrors?

Summary Questions:

I. What are the two main things telescopes do?

II. What are the two main types of telescopes?

Part II: How Telescopes Work

Watch the following video on how telescopes work and answer the following questions. Be sure to use your own words!

`https://youtu.be/5v7bN13PjZ8`

1. What is a lens?

2. What does the objective lens of a refracting telescope do to the light that enters it?

3. The second lens of a refracting telescope is called the eyepiece, what does it do?

4. What are two problems with refracting telescopes? Explain.

5. What makes stars appear to twinkle?

6. Why is the Hubble Space Telescope in space?

Summary Questions:

I. What is the main purpose of the objective of a telescope?

II. What is the main purpose of the eyepiece of a telescope?

Part III: Lenses and Magnification

Watch the following video and answer the following questions.

    https://youtu.be/AXR2baEiPVw

1. What is the focal length of a lens?

2. What two properties of a lens affects the focal length?

The refractive index is a property of the material that was used in creating the lens. It can determine how much the light is bent. Let's not worry about this aspect of the lens and let's focus only on the curvature.

3. To get a longer focal length, do I want a **more curved** or **less curved** lens?

The objective lens or mirror in a telescope is a permanent feature of the telescope. The most important thing about the objective is its diameter. The larger the diameter, the more light the telescope can collect and focus, and the brighter the images it produces. The light-collecting capacity of a telescope also enables faint stars to be seen through a telescope that cannot be seen with the unaided eye. The other important feature of the objective is its focal length. The longer the focal length, the larger the image formed in the focal plane.

The eyepiece lens in a telescope acts like a magnifying glass, magnifying the image in the focal plane so that the observer can see its detailed features. Eyepieces are interchangeable on a telescope. Interestingly, the smaller the focal length of the eyepiece (the more curved it is), the more magnification it provides (recall the previous exercise).

The telescope magnification formula is:

$$Magnificaton = \frac{\text{focal length of objective}}{\text{focal length of the eyepiece}}$$

The larger the magnification, the smaller the patch of sky ("field of view") you will get to see through the telescope. To get a large "field of view" (to see a bigger patch of the sky) you need to use low magnification. Most telescopes enable you to see at most about a 1 degree patch of the sky. Moreover, because the Earth?s atmosphere is turbulent, which blurs out the images of stars, there are limits to how much you can magnify a star image before it just looks like a big fuzzy blob.

4. To get my telescope to have a higher magnification, would I need an eyepiece with a more curved lens or a less curved lens? Why?

5. If the focal length of my telescope (objective) is 4000mm and I use a 20mm eyepiece, what would be the magnification?

Part IV: Building the right Telescope

We are going to play with the telescope builder simulator from NASA:

https://www.jwst.nasa.gov/content/features/educational/buildItYourself/
index.html

Below, you are going to write a paragraph or two about what you are going to observe and how you are going to do it. Let's just use level 1, play around with the options for a few minutes and decide what you would like to learn about. Be sure to read all the information that pops up as you hover your cursor over the images. Once you decide on one thing you would like to observe, follow each step to decide which wavelength (we'll learn more about that in the next lab), instrument and optics you would like to use. Once you get to the end, you'll see real data that comes from the telescope that you built. Some of the data might be a bit advanced, but that's okay. Be sure to read the summary to try to get a sense of what you're looking at.

In your write-up, be sure to include what object you decided on, what instrument, wavelength and optics you chose and explain why you decided to choose them. (ex: how could that instrument benefit you when looking at your particular object?) Finally, explain the data you got, what you think it means and what telescope NASA actually uses to get that data. **It's okay if you don't understand everything** (this is getting into what astronomers actually do and can takes years of study), but this is a chance to explore real astronomical data!

Be sure to use your own words! If you copy anything from the simulation, be sure to site it (you should not be copying more than a sentence).