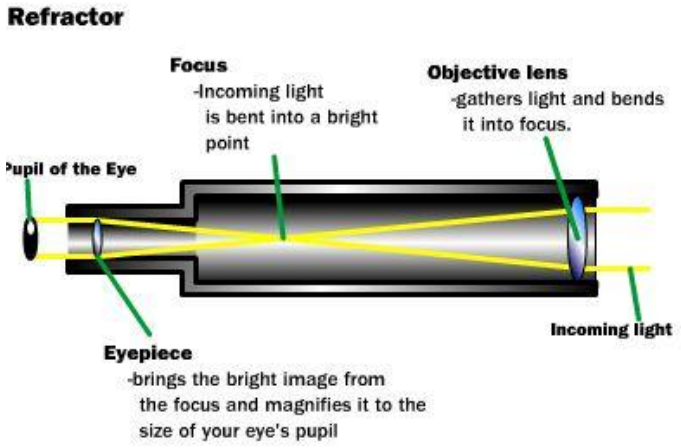
Light and Telescopes **Name_____**
Astronomy objectives sheet

Astronomy Content Standards

SAST1. Students will explain the tools used by astronomers to study electromagnetic radiation to determine composition, motions, and other physical attributes of astronomical objects.
a. Explain the challenges faced by astronomers due to the properties of light and the vast distances in the cosmos.
b. Evaluate the types of telescopes used by astronomers for examining different frequencies of electromagnetic radiation and compare and contrast the uses and advantages of each (e.g. radio, visible, gamma ray, reflector, and refractor).
d. Discuss how spectroscopy provides information about the inherent properties and motions of objects.
e. Quantitatively analyze data from telescopes (e.g. spectra, multi-wavelength photometry, and images) and/or other astronomical sources (e.g. tide tables, sky charts).



Characteristics of science standards
SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.
SCSh3. Students will identify and investigate problems scientifically.
SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.
SCSh6. Students will communicate scientific investigations and information clearly.
SCSh7. Students analyze how scientific knowledge is developed.
SCSh8. Students will understand important features of the process of scientific inquiry.

Essential Questions

- ❑ What are the different frequencies of the electromagnetic spectrum and how do they compare to each other?
- ❑ What are the different types of telescopes and how do they compare to each other?
- ❑ What are the two main types of telescopes we use to image the visible light spectrum, and how do they compare to each other?
- ❑ How is spectroscopy used to identify the properties of celestial objects?

Textbook references: *Foundations of Astronomy* Chapter 6 and 7

Key Terms
Electromagnetic radiation, frequency, wavelength, photon, Doppler effect, inverse square law, spectra, energy level, electron, absorption line, emission line, reflection, refraction, focal length, magnification, primary mirror, secondary mirror, primary lens, secondary lens, CCD, resolving power, aperture, interferometry

Review Questions

1. What are regions of the electromagnetic spectrum? Include all 7 regions in order from low frequency to high frequency.

2. Which part of the electromagnetic spectrum can we see? Which parts of the electromagnetic spectrum can be detected with telescopes and sensors?

3. What is the speed of light in a vacuum?

4. Compare the speed of a gamma ray to the speed of a radio wave.

5. Compare the frequency of a gamma ray to the frequency of a radio wave.

6. Compare the energy of a gamma ray to the energy of a radio wave.

7. How is a light wave produced?

8. Use the wave speed formula to solve this problem. A red light wave has a wavelength of 7×10^{-7} m. Calculate the frequency of this red light wave.

9. If you look at the Sun right now from Earth (which is 1AU away from the Sun), it has a certain brightness. How would the brightness compare if you looked back at the Sun from Saturn, which is 10 AU away.

10. Describe the difference between a continuous spectrum, an emission spectrum, and an absorption spectrum.

11. Explain why we would see an absorption spectrum coming from star.

12. Describe how astronomers use spectroscopy to identify elements and compounds within stars and galaxies.

13. Besides chemical composition, what other qualities of a star can be inferred from spectral lines?

14. If an astronomer finds a galaxy that has emission lines that are highly redshifted, what does this mean about this particular galaxy?

15. Describe how the color of a star can indicate the surface temperature of a star (Wien's Law).

16. Which wavelengths of the electromagnetic spectrum are able to pass through Earth's atmosphere without being significantly absorbed?

17. What are the two main types of optical telescopes? What is the main difference between them?

18. Describe the difference between reflection and refraction.

19. Why do we use telescopes in astronomy? (Hint: there's more to it than just magnification.)

20. Sketch a diagram of a basic Newtonian reflecting telescope and label the aperture, the primary mirror, the secondary mirror, and the eyepiece.

21. You are shopping for a telescope and you see the following information online: $150 - \frac{f}{5}$ with a 25 mm eyepiece included. What is the aperture size? What is the primary focal length? What is the magnification?

22. You have one telescope with a set of three different eyepieces: a 25 mm eyepiece, a 15 mm eyepiece, and a 10 mm eyepiece. Which eyepiece would give you a wider field of view? Which eyepiece would give you the greatest magnification?

23. Telescope A has a 3 inch aperture, and telescope B has a 6 inch aperture. How much more light does telescope B collect compared to telescope A?

24. What is the function of a charge coupled device (a CCD) and how has it improved the capabilities of amateur astronomers?

25. What are some problems astronomers have when observing the night sky through telescopes?

26. If you were to choose a site for a multimillion dollar telescope, where would you suggest it be built? Why?

27. Describe how radio astronomers use large arrays of telescopes for interferometry?

28. Why does the Hubble telescope deliver such clear and defined images of such deep space objects when a regular ground-based telescope cannot?

29. What purpose do the false color images of a radio map serve?