

Worksheet: Telescopes

COORDINATED SCIENCE 1

Background: Constellations and the stars that make them up are visible with the unaided eye. However, to see other objects in space, or to see some objects better, you need a telescope. Scientists and amateur astronomers use many different types of telescopes. **Optical telescopes** are used to study objects in visible light, and **radio telescopes** are used to study objects in the radio wavelengths.

A refracting or **refractor telescope** is a type of **optical telescope** that uses a lens as its objective to form an image (also referred to a dioptric telescope). The refracting telescope design was originally used in spy glasses and astronomical telescopes but is also used in other devices such as binoculars and long or telephoto camera lenses.

Refractors were the earliest type of optical telescope. The first practical refracting telescopes appeared in the Netherlands in about 1608, and were credited to three individuals, Hans Lipperhey and Zacharias Janssen, spectacle-makers in Middelburg, and Jacob Metius of Alkmaar also known as Jacob Adriaanszoon. Galileo Galilei, happening to be in Venice in about the month of May 1609, heard of the invention and constructed a version of his own. Galileo then communicated the details of his invention to the public, and presented the instrument itself to the Doge Leonardo Donato, sitting in full council. Galileo may thus claim to have invented the refracting telescope independently, but not until he had heard that others had done so.

A **reflecting telescope** (also called a reflector) is an **optical telescope** which uses a single or combination of curved mirrors that reflect light and form an image. The reflecting telescope was invented in the 17th century as an alternative to the refracting telescope which, at that time, was a design that suffered from severe chromatic aberration. Although reflecting telescopes produce other types of optical aberrations, it is a design that allows for very large diameter objectives. Almost all of the major telescopes used in astronomy research are reflectors. Reflecting telescopes come in many design variations and may employ extra optical elements to improve image quality or place the image in a mechanically advantageous position. Since reflecting telescopes uses mirrors, the design is sometimes referred to as a "catoptric" telescope.

A **radio telescope** is a form of directional radio antenna used in radio astronomy and in tracking and collecting data from satellites and space probes. In their astronomical role they differ from optical telescopes in that they operate in the **radio frequency** portion of the **electromagnetic spectrum** where they can detect and collect data on radio sources. Radio telescopes are typically large parabolic ("dish") antenna used singularly or in an array. Radio observatories are located far from major centers of population in order to avoid electromagnetic interference (EMI) from radio, TV, radar, and other EMI emitting devices. This is similar to the locating of optical telescopes to avoid light pollution, with the difference being that radio observatories will be placed in valleys to further shield them from EMI as opposed to clear air mountain tops for optical observatories.

Directions: Using the information above and in your textbook (pages 1819-822) to answer the following questions:

1. What types of telescopes are considered to be **optical telescopes**?

2. What other things were developed using the ***refracting telescope design***?

3. Which **type** of telescope was designed first? By whom?

4. Who is generally credited with inventing the telescope first?

5. What is the main advantage of a ***Reflecting telescope*** design?

6. What portion of the ***electromagnetic spectrum*** do radio telescopes use?

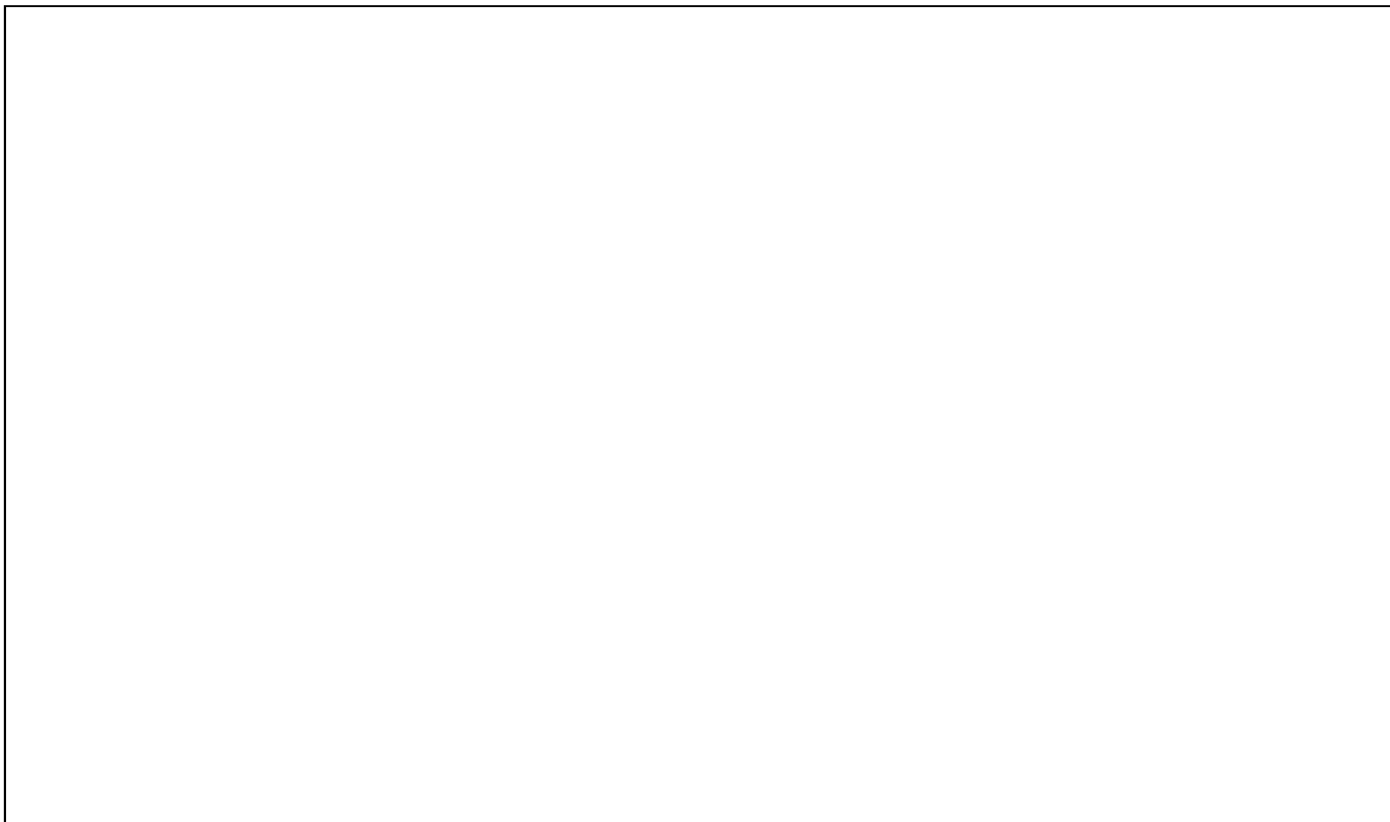
7. What is ***EMI***, and why does this interfere with radio telescopes?

8. What are some reasons that we place telescopes on satellites in orbit around the Earth instead of building them on the ground.

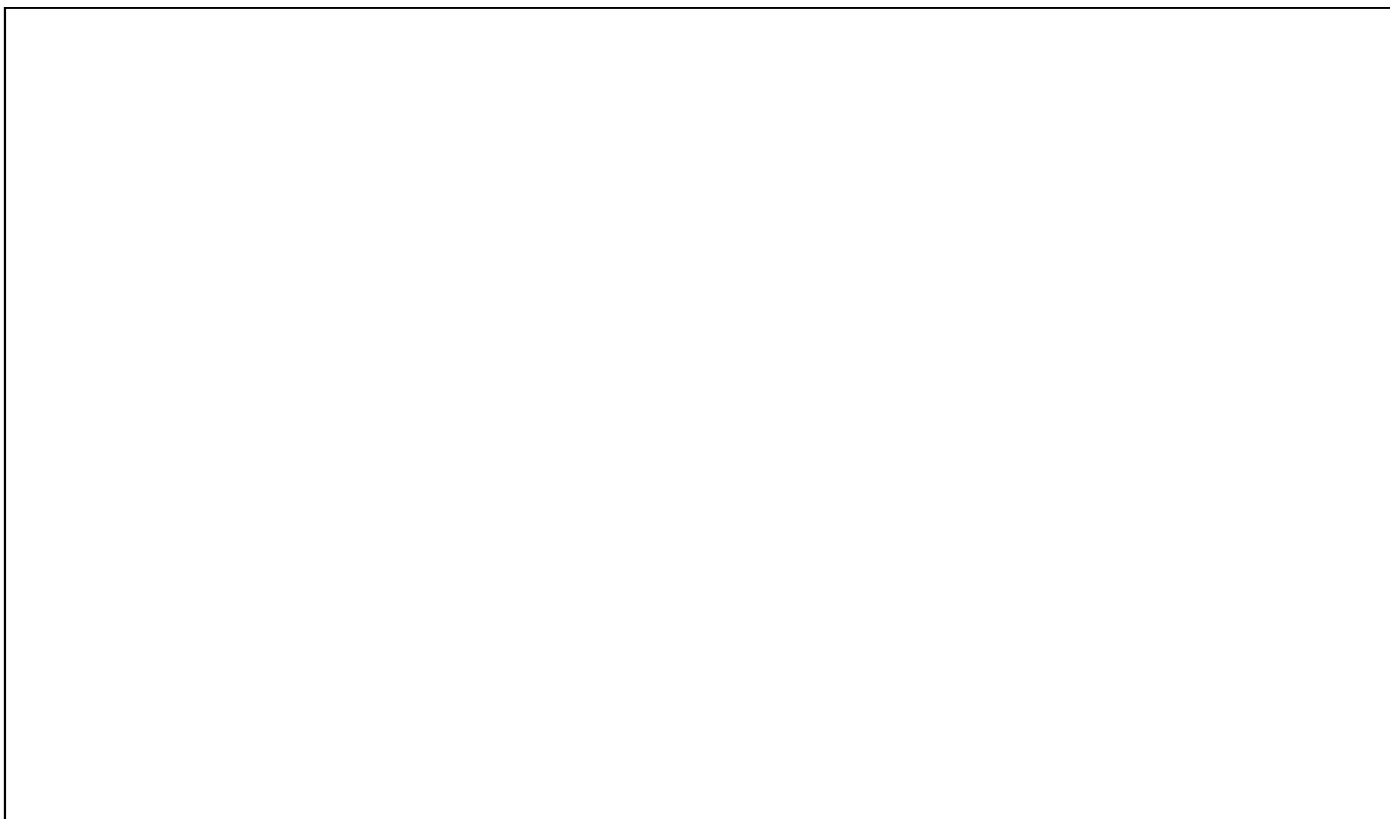
9. What is the ***Hubble Space Telescope***

10. What is a ***spectroscope*** and what is it used for?

11. Draw and label a **Refracting Telescope**. Show at least two light rays passing through the telescope.



12. Draw and label a **Reflecting Telescope**. Show at least two light rays passing through the telescope.



13. Label the **colors** of the light spectrum at the bottom of the diagram below (use colored pencils to color different colors)

