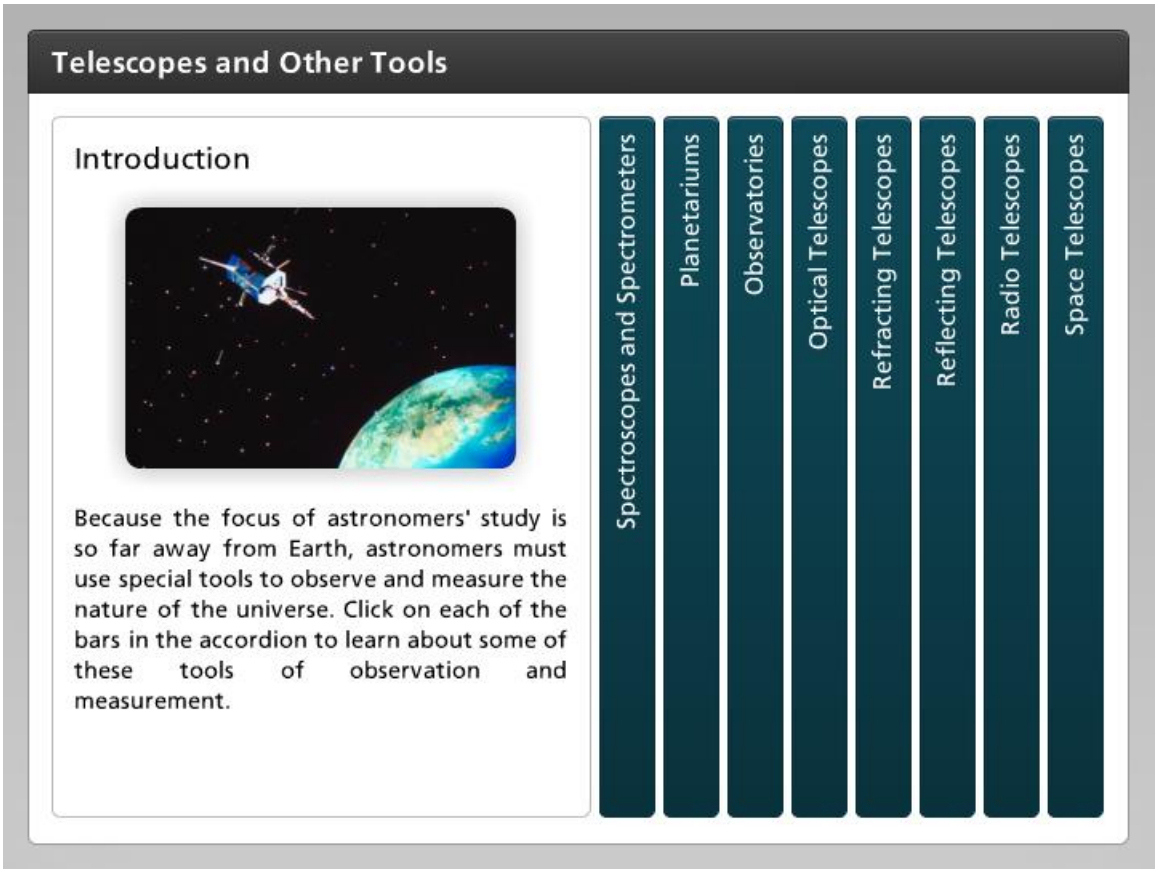
Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

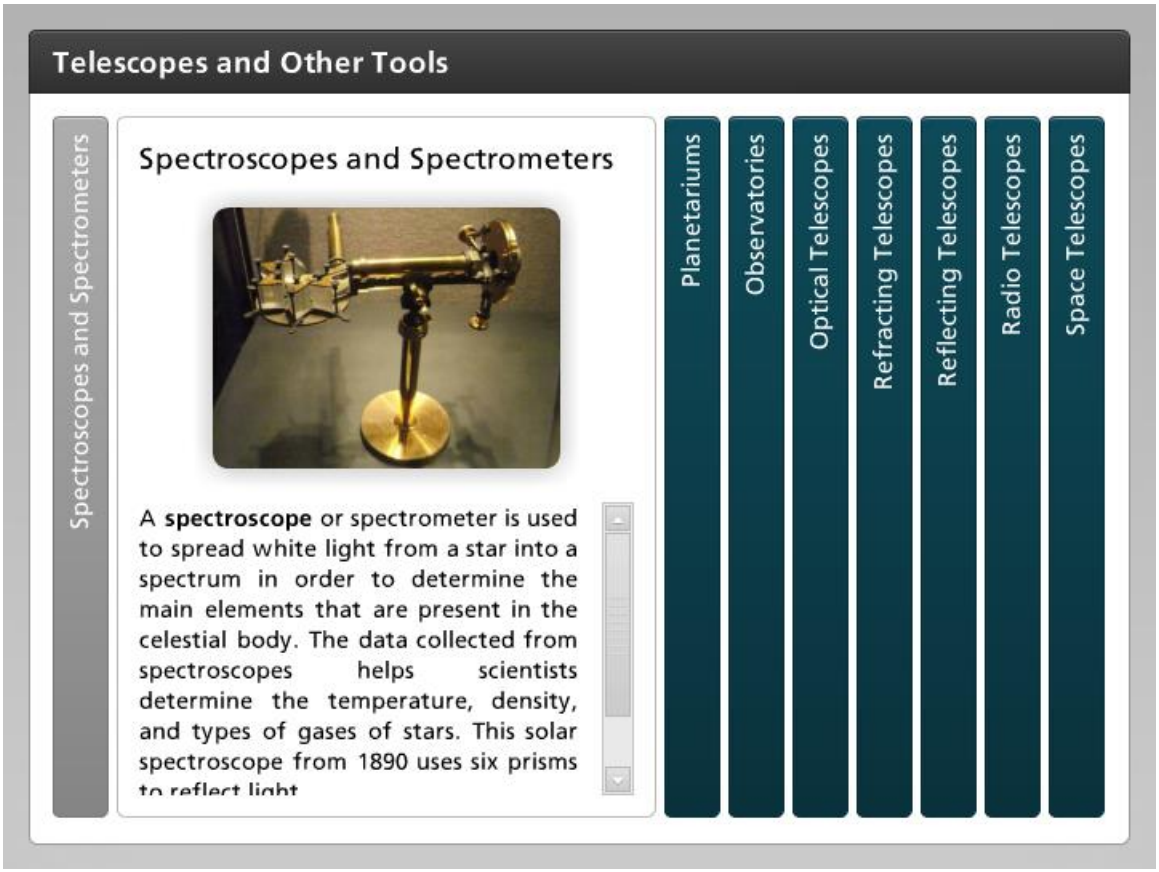
Introduction



Because the focus of astronomers' study is so far away from Earth, astronomers must use special tools to observe and measure the nature of the universe. Click on each of the bars in the accordion to learn about some of these tools of observation and measurement.

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

Spectroscopes and Spectrometers

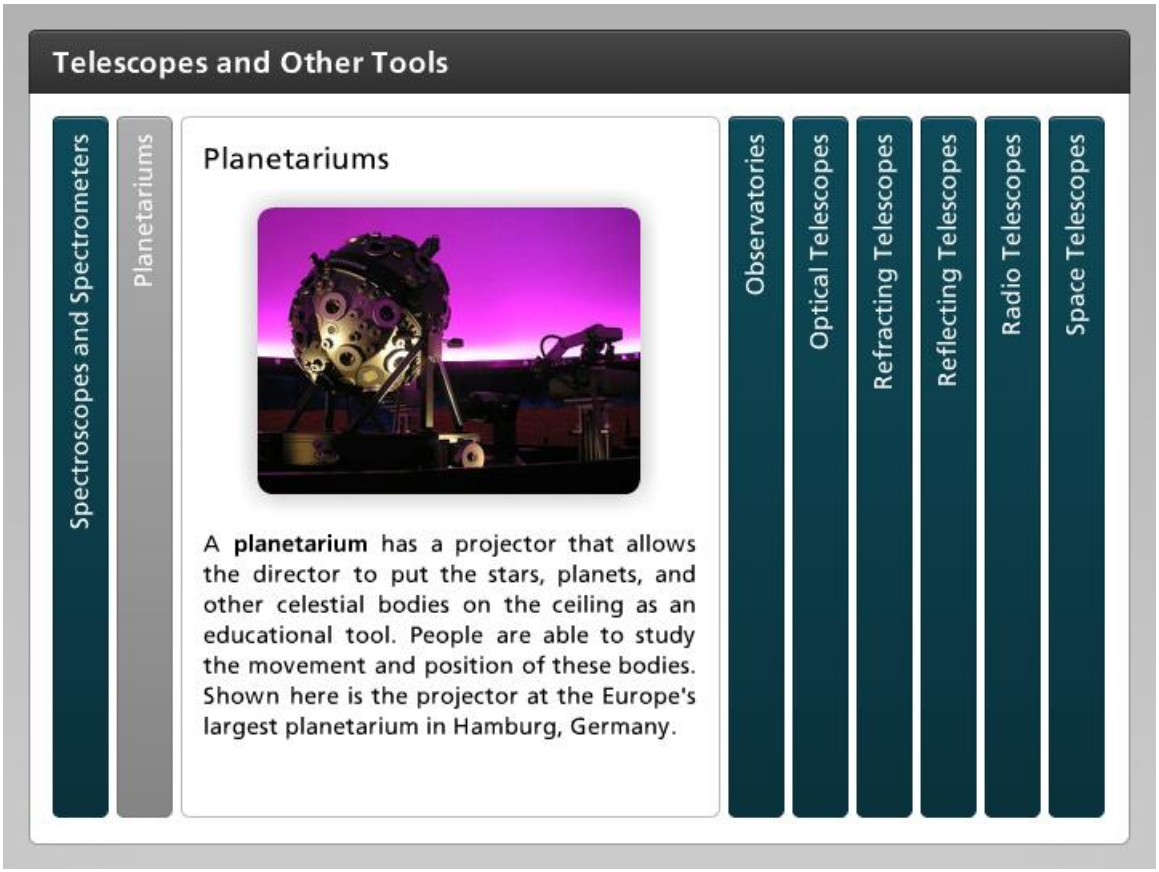


A **spectroscope** or spectrometer is used to spread white light from a star into a spectrum in order to determine the main elements that are present in the celestial body. The data collected from spectroscopes helps scientists determine the temperature, density, and types of gases of stars. This solar spectroscope from 1890 uses six prisms to reflect light.

Image courtesy of Reptonix

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

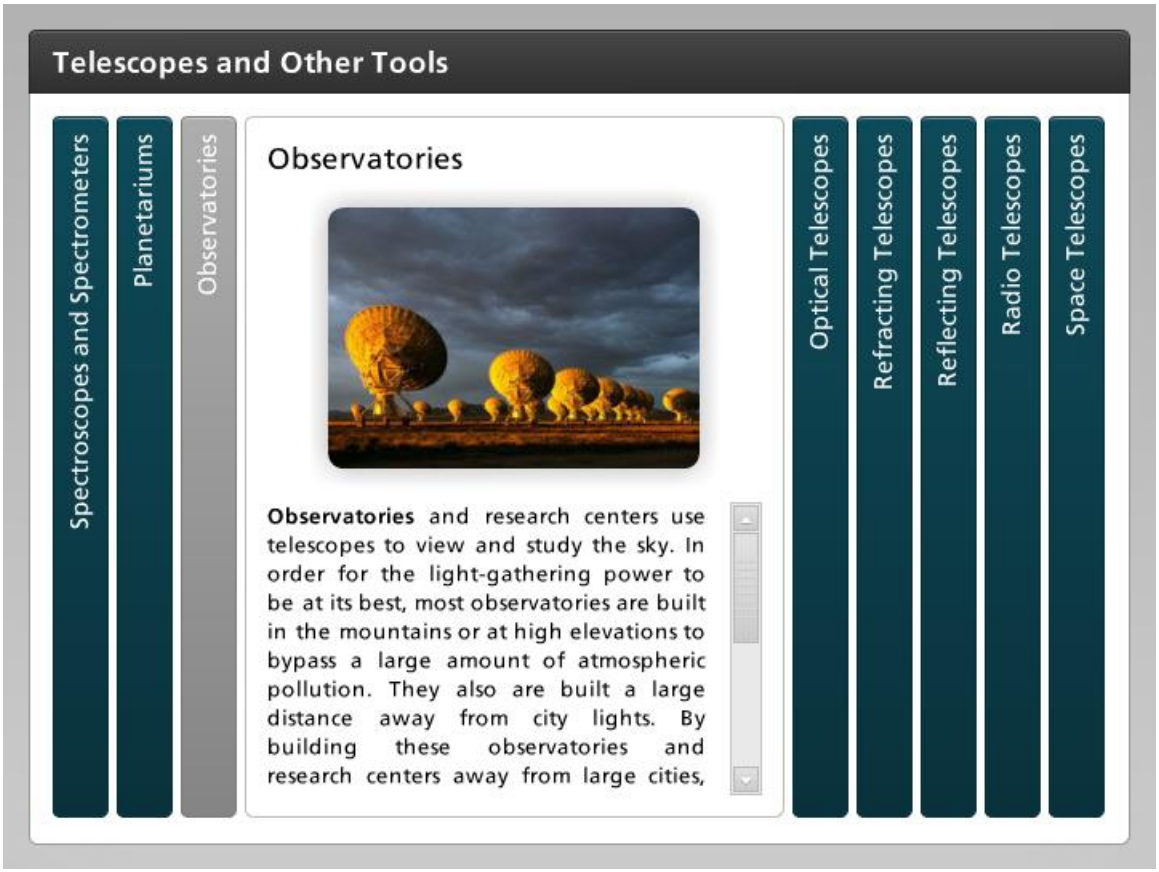
Planetariums



A **planetarium** has a projector that allows the director to put the stars, planets, and other celestial bodies on the ceiling as an educational tool. People are able to study the movement and position of these bodies. Shown here is the projector at the Europe's largest planetarium in Hamburg, Germany.

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

Observatories

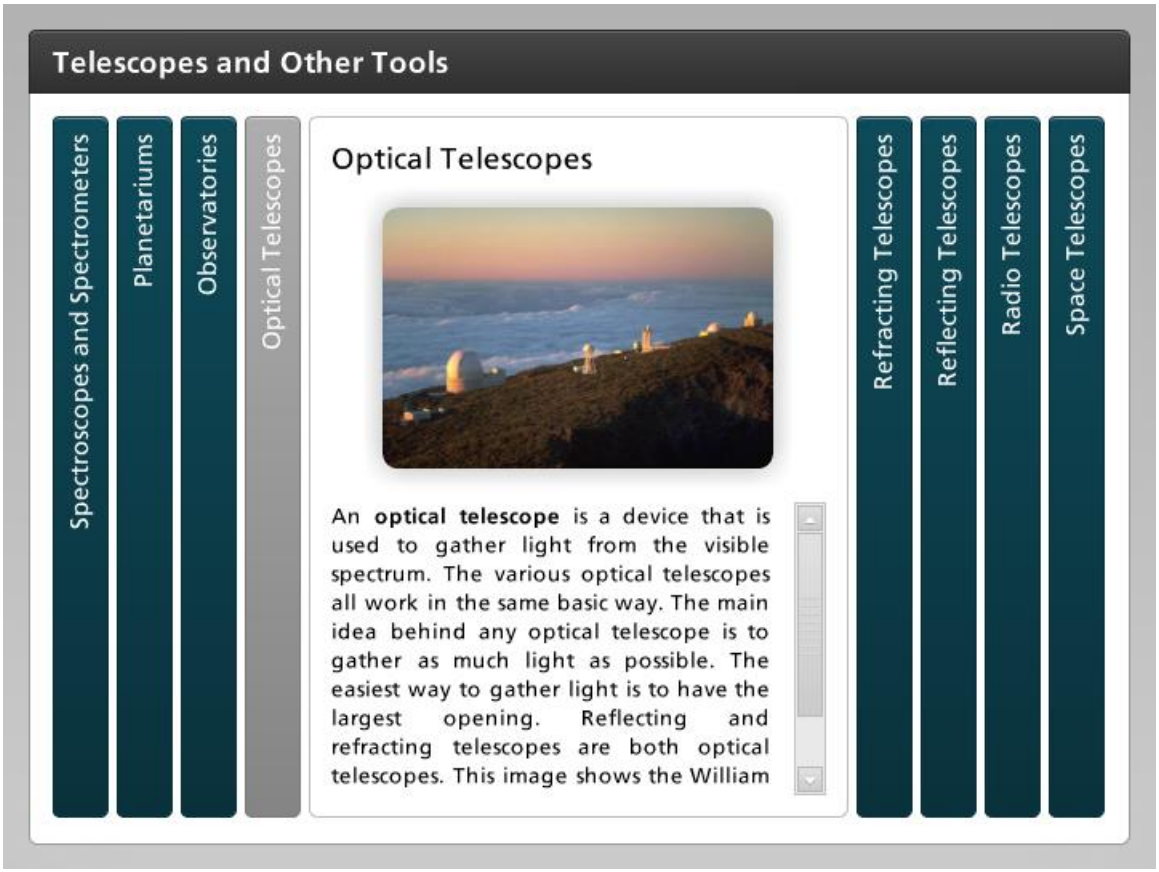


Observatories and research centers use telescopes to view and study the sky. In order for the light-gathering power to be at its best, most observatories are built in the mountains or at high elevations to bypass a large amount of atmospheric pollution. They also are built a large distance away from city lights. By building these observatories and research centers away from large cities, there is a restriction on light pollution in the area. Light pollution is any type of light that does not come from the sky. The Lick Observatory in California, the Keck Peak Observatory in Hawaii, and the Kitt Peak Observatory in Arizona are just a few observatories where astronomers use telescopes to explore space.

Image courtesy of Andrew Clegg, NSF

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

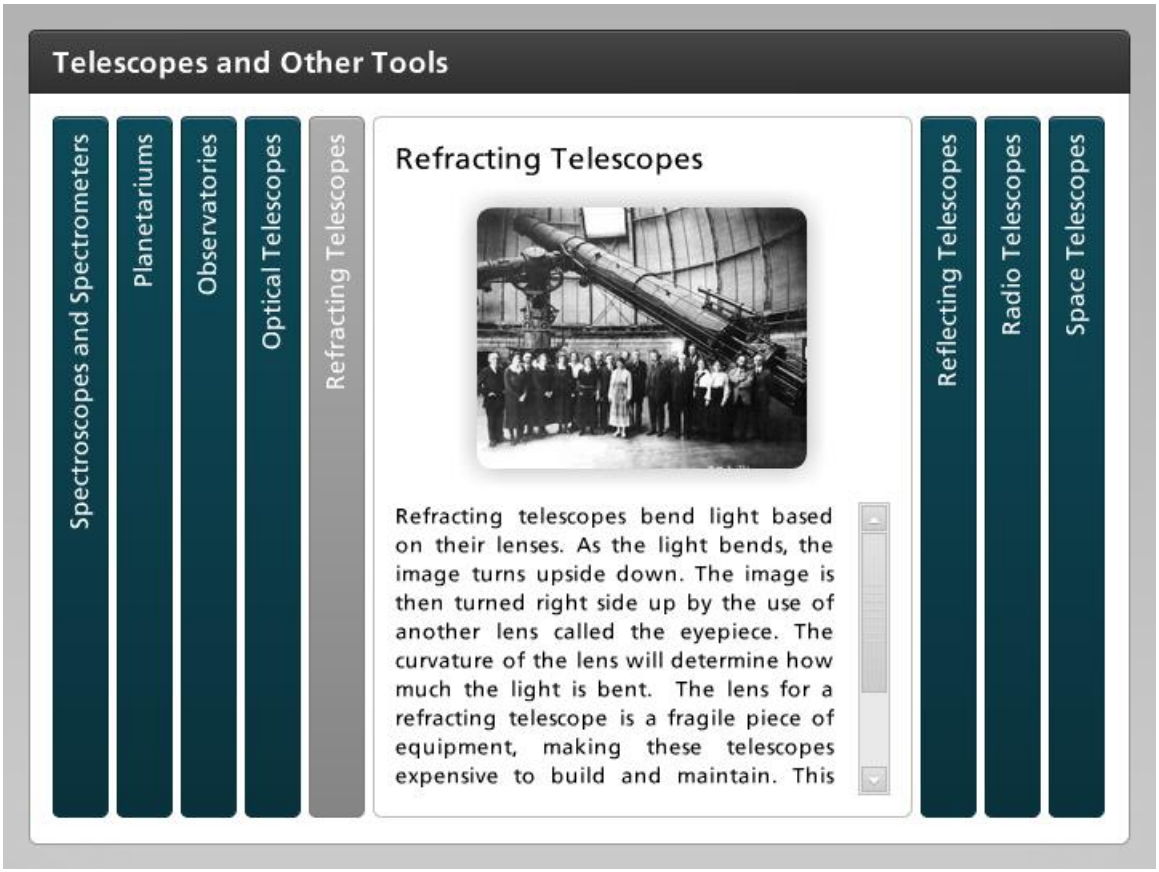
Optical Telescopes



An **optical telescope** is a device that is used to gather light from the visible spectrum. The various optical telescopes all work in the same basic way. The main idea behind any optical telescope is to gather as much light as possible. The easiest way to gather light is to have the largest opening. Reflecting and refracting telescopes are both optical telescopes. This image shows the William Herschel Telescope (WHT) in the Canary Islands of Spain.

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

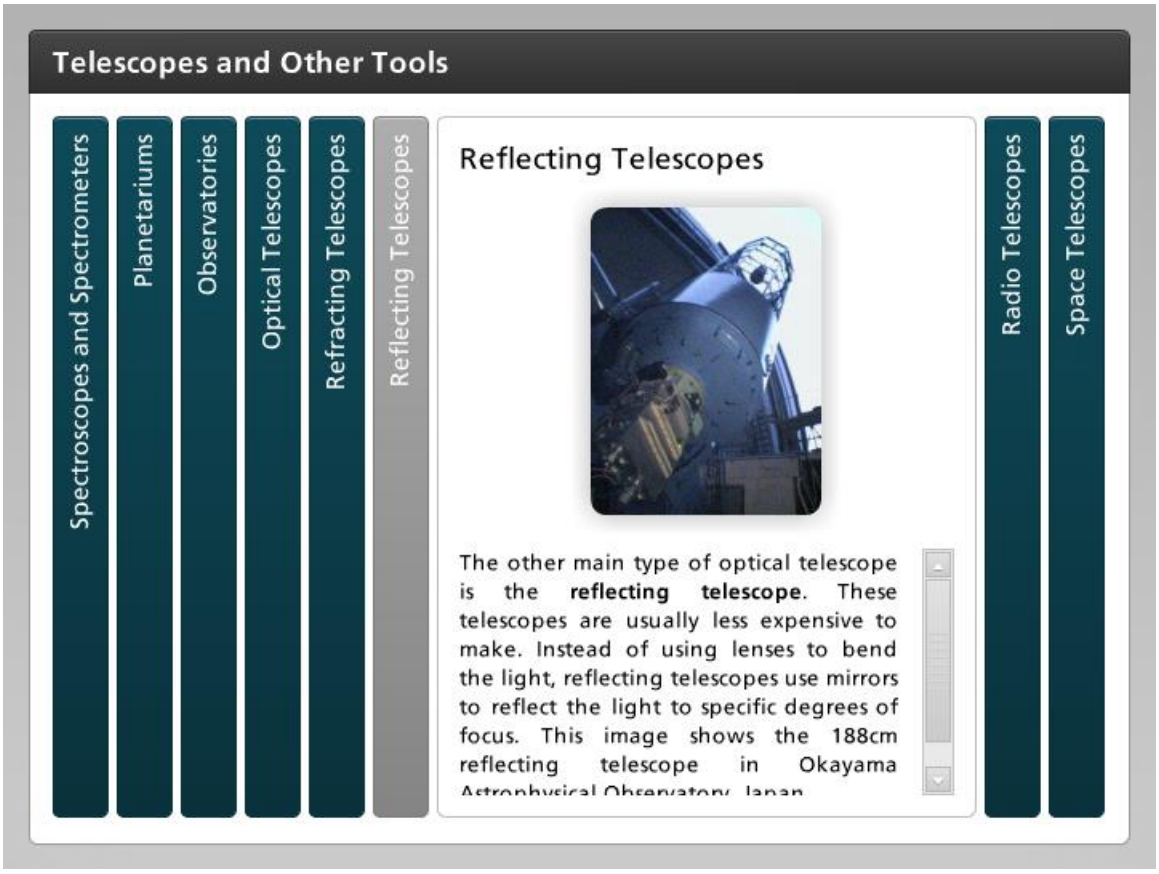
Refracting Telescopes



Refracting telescopes bend light based on their lenses. As the light bends, the image turns upside down. The image is then turned right side up by the use of another lens called the eyepiece. The curvature of the lens will determine how much the light is bent. The lens for a refracting telescope is a fragile piece of equipment, making these telescopes expensive to build and maintain. This image shows the 1,000-millimeter (40 in) refractor, at Yerkes Observatory, the largest achromatic refractor ever put into astronomical use.

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

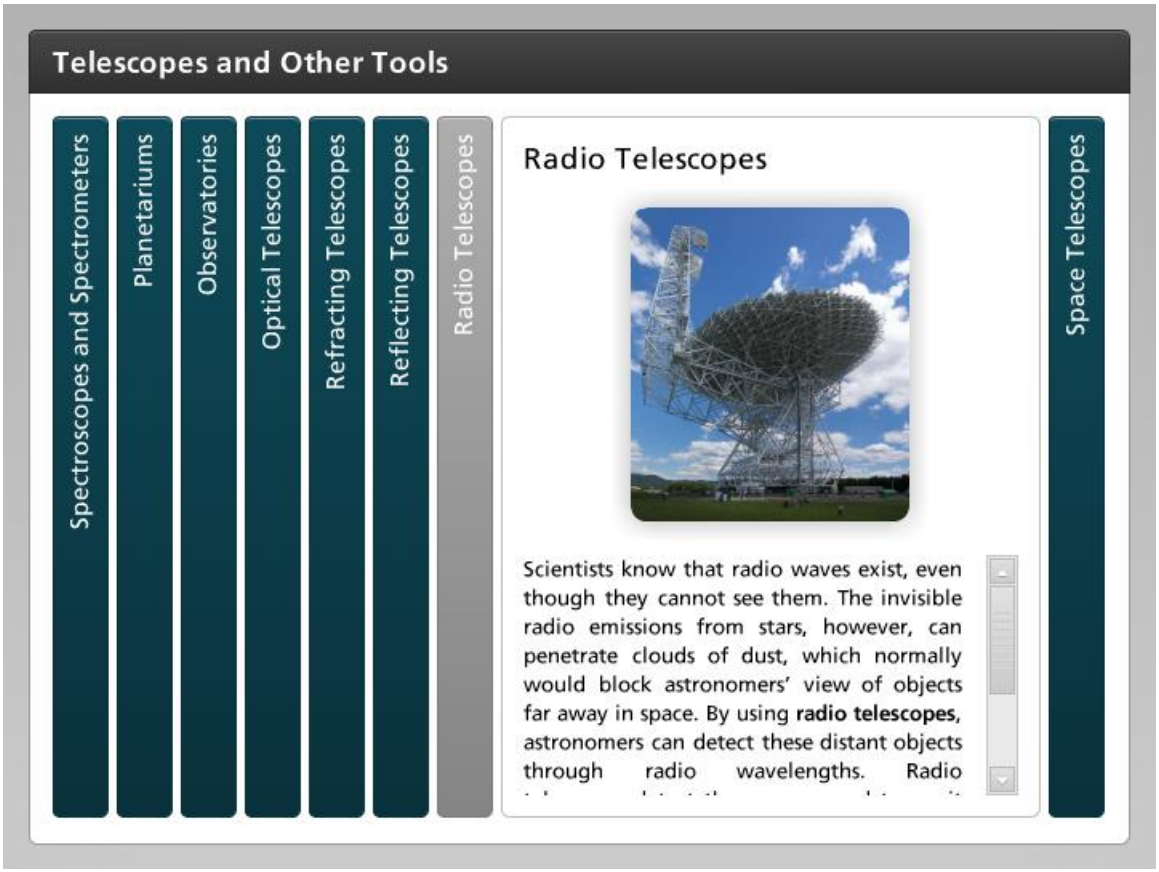
Reflecting Telescopes



The other main type of optical telescope is the **reflecting telescope**. These telescopes are usually less expensive to make. Instead of using lenses to bend the light, reflecting telescopes use mirrors to reflect the light to specific degrees of focus. This image shows the 188cm reflecting telescope in Okayama Astrophysical Observatory, Japan.

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

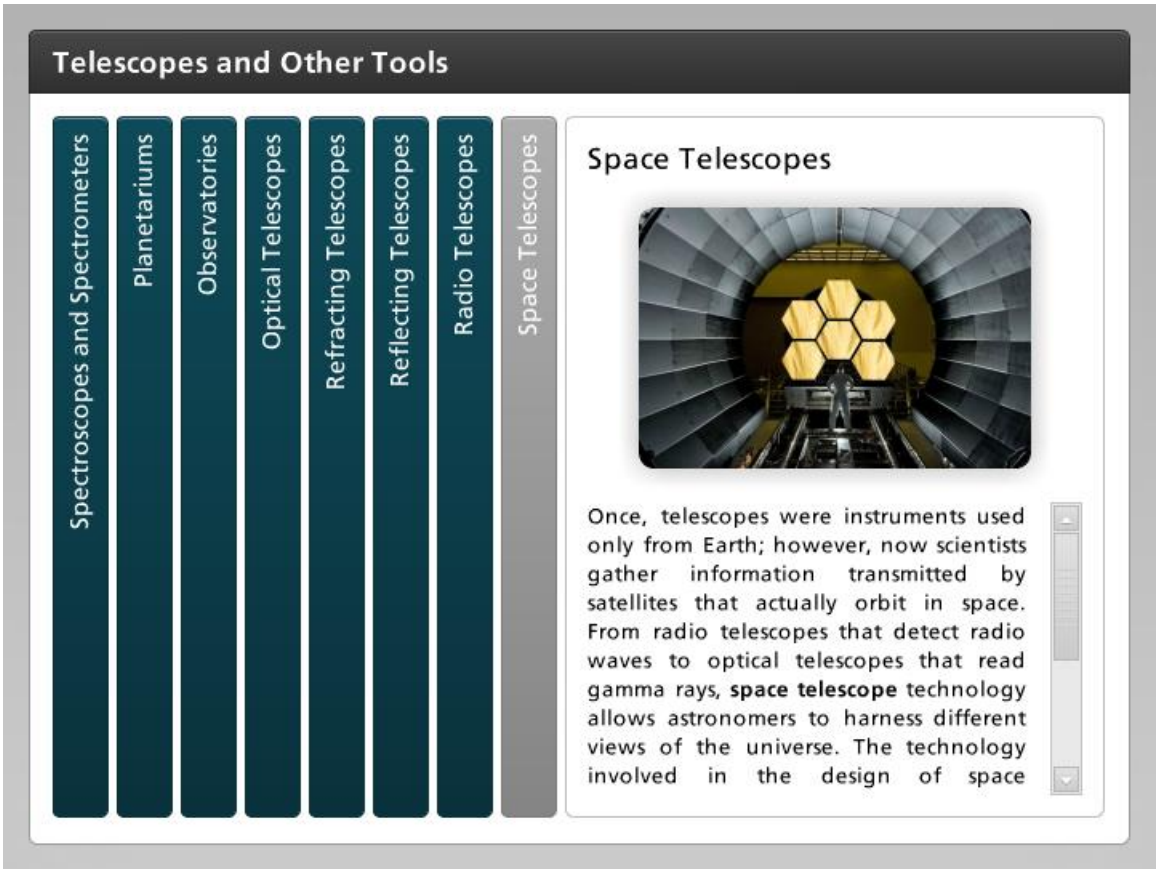
Radio Telescopes



Scientists know that radio waves exist, even though they cannot see them. The invisible radio emissions from stars, however, can penetrate clouds of dust, which normally would block astronomers' view of objects far away in space. By using **radio telescopes**, astronomers can detect these distant objects through radio wavelengths. Radio telescopes detect these waves and transmit images of them so that astronomers can observe, study, and measure them. This image shows a radio telescope from the Green Bank Observatory in West Virginia.

Module 3: Astronomy – The Universe
Topic 5 Content: Telescopes and Other Tools Notes

Space Telescopes



Once, telescopes were instruments used only from Earth; however, now scientists gather information transmitted by satellites that actually orbit in space. From radio telescopes that detect radio waves to optical telescopes that read gamma rays, **space telescope** technology allows astronomers to harness different views of the universe. The technology involved in the design of space telescopes equips scientists with the tools to observe space throughout a range of wavelengths. This image shows the primary mirror of the James Webb Space Telescope, which is currently under construction.

Image courtesy of NASA