CONCEPT 1

We have invented telescopes and other devices that extend and enhance our sense of sight.

Our exploration of the universe began with and depends on our sense of sight. As new technologies such as telescopes were invented, people began to use these tools to explore in new ways. By the time of Galileo Galilei in the early 1600s, the telescope had been invented. Galileo improved and turned this new instrument to the night sky and became the first person to observe moons around Jupiter and the rings of Saturn.

Telescopes of the type that Galileo used are called optical telescopes. They collect visible light from over a large area and concentrate it to form a brighter image. However, visible light is only one form of electromagnetic radiation that is given off by stars and other objects in space.

The ideal telescope would be able to detect not only visible light, but also radio waves and other forms of electromagnetic radiation. Such a device does not yet exist, but engineers have designed distinct telescopes that can detect non-visible radiation. One example is a radio telescope such as the one shown in **Figure 4.17**. Radio telescopes detect radio waves. Long-wavelength radio waves can penetrate clouds, so an advantage of using radio telescopes over optical devices is that they can be used on cloudy days as well as at night.

Figure 4.17 This 26 m radio telescope is part of the Dominion Astrophysical Observatory near Penticton. The observatory is owned and operated by Canada's National Research Council.

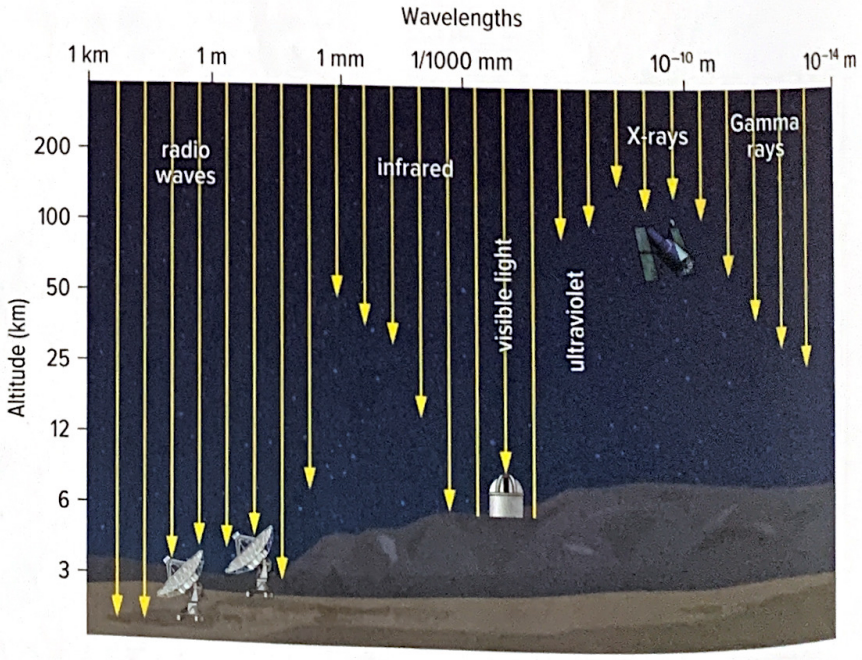

Figure 4.18 Only a fraction of electromagnetic radiation from space reaches Earth's surface. Therefore, some telescopes must be placed in orbit above the atmosphere to take advantage of the wealth of information the whole spectrum of this radiation provides.

Telescopes in Space

Much of the radiation that reaches Earth from space is absorbed by the atmosphere and does not reach the surface (Figure 4.18). For example, infrared radiation with a wavelength of 1 mm is absorbed about 50 km above Earth's surface. In order to observe space in more detail, some telescopes need to be placed above Earth's atmosphere. Some examples are the Chandra X-ray Observatory, the Spitzer Space Telescope (which detected infrared), and the Hubble Space Telescope. Hubble detects visible light as well as infrared and ultraviolet.

Studying Objects in Different Wavelengths

A range of telescopes can reveal different types of information about an object. For example, Figure 4.19 shows the planet Saturn in four different wavelengths. Comparing photo **A** and **B** reveals that Saturn has auroras (the glowing regions at the poles in **B**), just as Earth does. The infrared view in **C** shows detailed features in Saturn's atmosphere. The different colours represent different heights and compositions of the planet's clouds. Photo **D** shows that the planet gives off radio waves (the red portion) and that the rings (the blue) absorb this radiation.

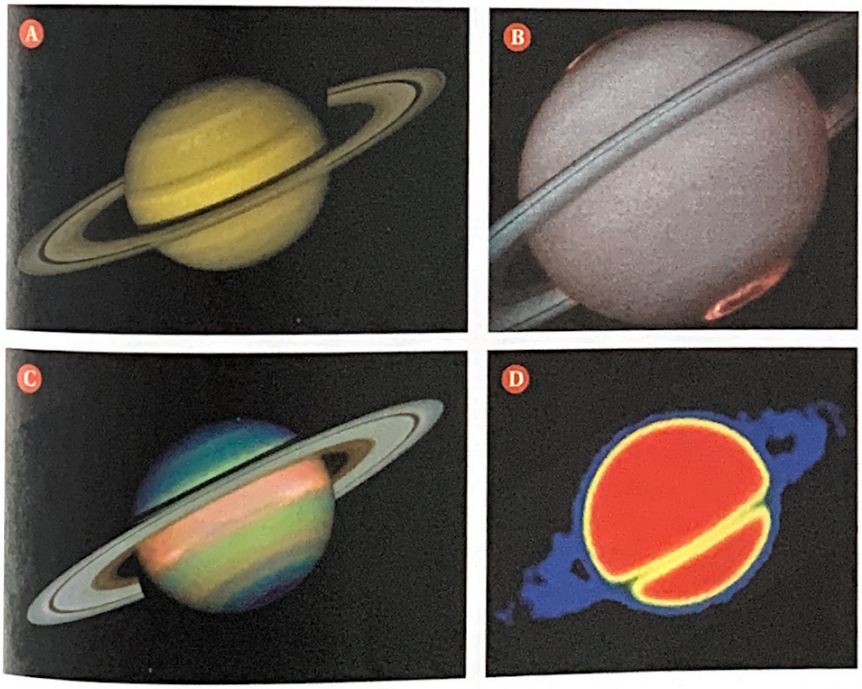

Figure 4.19 Saturn as viewed in visible light A, ultraviolet B, infrared C, and radio waves D. The colours in B, C, and D are false. They are added to highlight different features. **Applying: How does viewing the same object with different wavelengths affect our ability to understand it?**

Before you leave this page . . .

1. How did an optical telescope change the way that we can observe and explore space?
2. How do telescopes that detect non-optical radiation contribute to our understanding of space?