

Chapter: **Exploring the Universe**

Read each question thoroughly. The Science Coach boxes will help you apply the skills and concepts you need to answer the questions.

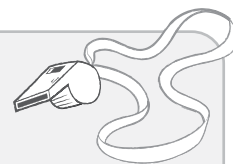
1. Clouds of gas and dust between stars tend to block visible light used for optical telescope observations. Although these clouds are much cooler than stars, they do emit some electromagnetic energy.

Which telescope system would be **best** suited for studying these cooler clouds of dust and gas?

- (A) Chandra X-Ray Observatory
- (B) Fermi Gamma-ray Space Telescope
- (C) GALEX Ultraviolet Telescope
- (D) Greenbank Radio Telescope

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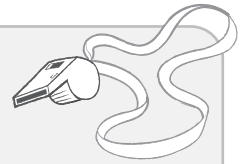
Consider how the energy of an **electromagnetic wave** is related to its frequency. Then think about which telescope system could be best **applied** to gather this kind of data.



2. Why have more space probes been sent to Mars than to Saturn?
- (F) Mars is a more interesting planet than Saturn.
 - (G) Mars has an atmosphere, but Saturn does not.
 - (H) People are not able to live on Saturn, but they can live on Mars.
 - (I) It is easier to send a probe to Mars because it is much closer than Saturn.

Science Coach

Consider the **distance** between objects in the Solar System and the **technology** needed to send probes great distances.



3. Which statement does NOT describe a way that the presence of the Kennedy Space Center has had an impact on Florida?
- (A) It has led to more agricultural activity.
 - (B) It has increased the amount of tourism.
 - (C) It has provided many good jobs for residents.
 - (D) It has led to the development of new industries.

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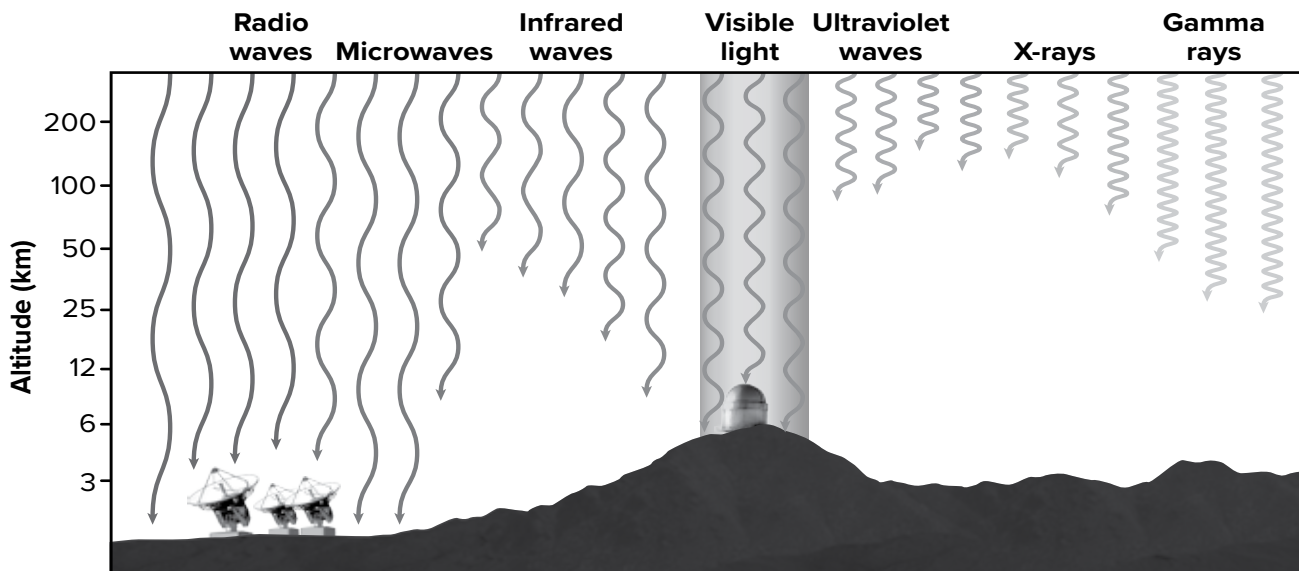
Think about how **space exploration** has an impact on jobs and other aspects of life in **Florida**.

For questions 4, 5, and 6, refer to the following passage and illustration.

In this group of questions, you will use your knowledge about electromagnetic radiation and the technology used to detect it to answer three questions.

Electromagnetic Radiation from Space

Objects in space emit radiation in wavelengths of the entire electromagnetic spectrum. Extremely hot objects are the sources of gamma rays and X-rays. Stars emit most of their radiation in the infrared, visible, and ultraviolet ranges. Cooler objects, such as gas clouds and non-luminous bodies, can be observed using radiation in the radio, microwave, and infrared regions. These objects also tend to reflect visible light from other sources.



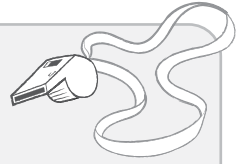
As shown in this illustration, not all of the electromagnetic radiation that reaches Earth from space makes it to the surface. Many high-energy waves are blocked by the planet's magnetic field. Much of the radiation that does reach the atmosphere is absorbed by atoms and molecules.

4. What part of the electromagnetic spectrum can be observed using optical telescopes on the surface of Earth?

- ☐ F radio waves
- ☐ G infrared waves
- ☐ H visible light
- ☐ I ultraviolet waves

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Consider how the information in the illustration relates to the **characteristics of electromagnetic radiation** and the interaction between waves and the atmosphere.



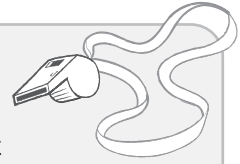
5. The illustration shows that much of the electromagnetic radiation from space cannot be observed from Earth's surface. Space telescopes, satellites, and other types of space technology are required to observe this radiation.

Which of these reasons does NOT describe why governments and other agencies would make the investment to build and use this technology?

- (A) to support industries that provide jobs to people
- (B) to provide scientific knowledge and an understanding of the universe
- (C) to develop new technologies that can be applied to make new materials
- (D) to find ways to prevent harmful solar radiation from reaching Earth's surface

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Consider how science can affect **political, social, and economic concerns.**



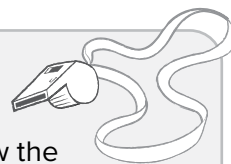
6. The illustration shows that visible light reaches Earth's surface through the atmosphere.

Why are optical telescopes often built at high mountain elevations?

- (F) It is less expensive to buy land and build in remote areas on top of mountains.
- (G) Mountaintops are closer to the source of the light, so they provide better observations.
- (H) Even though the light reaches the surface, it can be affected by gases in the atmosphere.
- (I) More wavelengths of visible light reach the tops of mountains than areas at lower elevations.

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Use the diagram to understand how the atmosphere interacts with **electromagnetic radiation** and the ability to use that radiation to **collect data**.



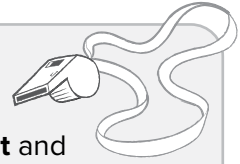
7. Based on information from electromagnetic waves that reach Earth, scientists have determined how long it takes light to travel from various cosmic objects. This table lists some examples.

Table 1: Travel Time of Light From Objects To Earth

Object	Time for Light to Reach Earth
Sun	8.3 minutes
Nearest star	4.2 years
Center of Milky Way galaxy	28,000 years
Nearest large galaxy	26,000,000 years
Most distant large galaxy	13,500,000,000 years

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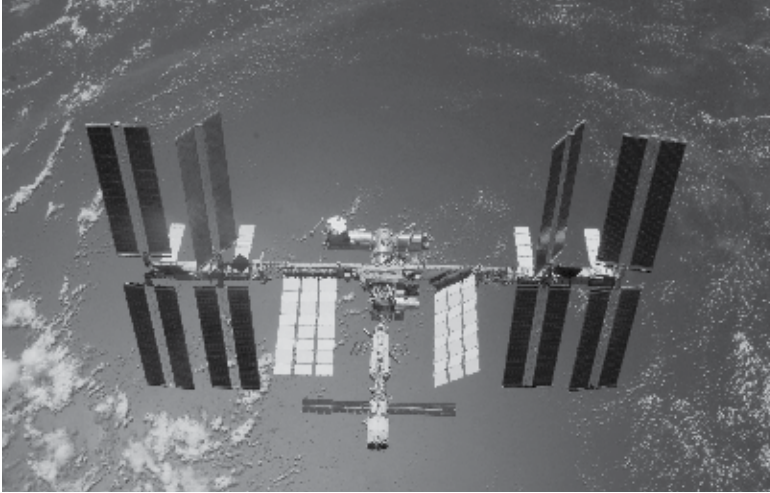
Apply your knowledge of **light** and how it travels to understand **distances** among objects in space.



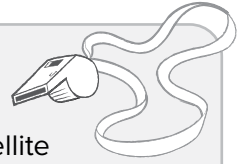
Which conclusion is **most** supported by this data?

- (A) We can send space probes to nearby stars but not to other galaxies.
- (B) The speed of light is not a useful measure for the distance of other galaxies.
- (C) We cannot learn very much about most galaxies because they are so far away.
- (D) When we observe very distant objects, we see them as they appeared long ago.

8. Why is the International Space Station shown in the picture considered to be a satellite of Earth?

**Science Coach**

Consider the definition of a satellite and how it relates to **technology**.



- ☐ F It orbits Earth.
- ☐ G It has a crew.
- ☐ H It uses communication technology.
- ☐ I It is naturally occurring.

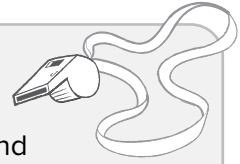
9. Space telescopes are very expensive to build and place into orbit.

Why do space agencies **most likely** need many different space telescopes?

- (A) The telescopes can only be used at night, so they need to be located in many places.
- (B) Each telescope obtains information from specific parts of the electromagnetic spectrum.
- (C) Because of conditions in space, they do not last very long, and they have to be replaced frequently.
- (D) A large network of space telescopes is needed in order to transmit data from space to receivers on Earth.

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Think about how the **wavelength** and frequency of **electromagnetic radiation** are related to data that can be obtained from the observation of waves.

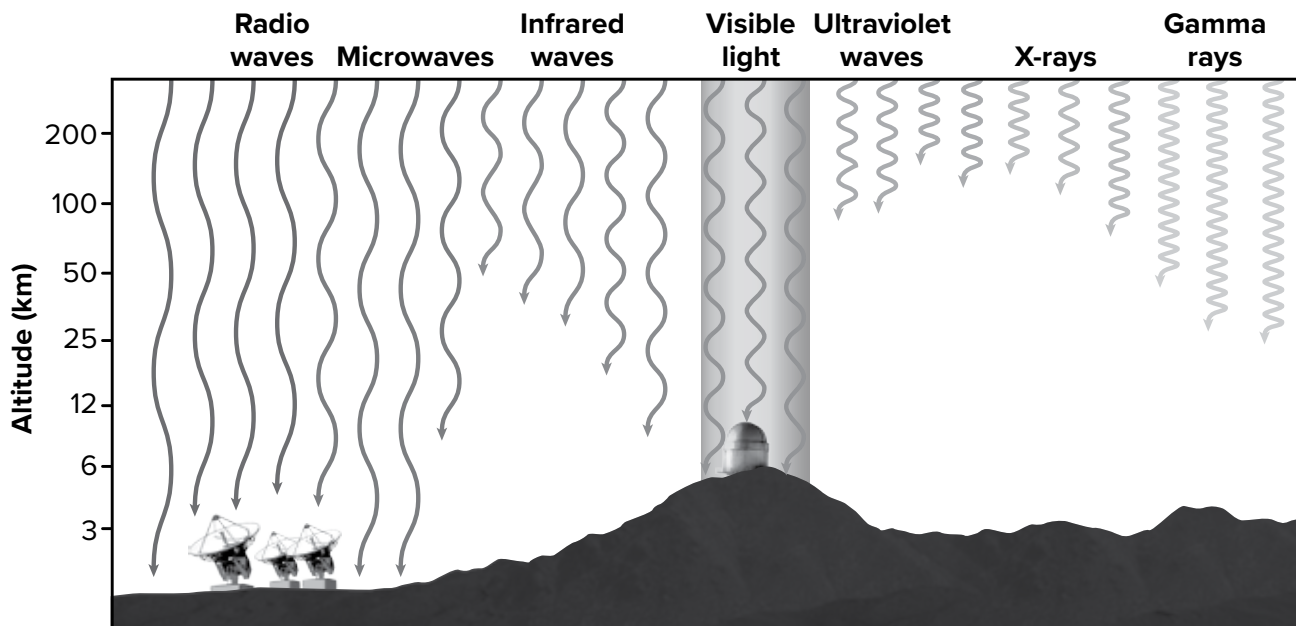


Chapter: **Exploring the Universe**

Answer the questions that follow.

1. Which of these explanations is NOT an example of how the space industry has had a direct effect on society in Florida?
 - (A) Space-related research has led to the development of many new technologies used in homes.
 - (B) Many new companies have started to develop technologies for use by space programs.
 - (C) There has been a significant increase in population in certain areas, such as Brevard County, as a result of the number of jobs in the industry.
 - (D) Agricultural production has increased in the last fifty years leading to an increase in exports of farm products to the rest of the country.

2. This illustration shows relative wavelengths (not to scale) of how electromagnetic radiation interacts with the atmosphere.



Based on the illustration, what can be inferred about telescopes that are used to observe distant objects in space?

- (F) Visible light telescopes must be located on mountaintops to receive data from space.
- (G) Gamma ray telescopes must be placed in orbit around Earth to collect data from space.
- (H) X-ray telescopes must be very large because they need very large antennas to collect data.
- (I) Radio wave telescopes must be installed on the surface instead of in space because radio waves have so much energy.

3. Thousands of planets have been located outside the solar system. For many of these planets, scientists have been able to determine size, composition, and whether they have atmospheres.

Why have no probes been sent to any of these planets?

- (A) A space probe is not able to obtain useful information about planets.
- (B) Distant planets are not useful to humans, so there is no reason to obtain more information about them.
- (C) A space probe to one of these planets would be so expensive that no one is willing to provide funding.
- (D) Current technologies are not able to develop a probe that could travel far enough and send data back to Earth.

For questions 4, 5, and 6, refer to the following passage and picture.

In this group of questions, you will use your knowledge about technology that uses the electromagnetic spectrum to study distant objects to answer three questions.

Radioastronomy

Radio telescopes collect radio waves from distant objects in space. They have a dish shape, similar to a satellite dish, which is used for communication or receiving TV signals, but they are much larger. A number of similar telescopes are often combined in a group. The photo shows part of the Very Large Array in New Mexico. These telescopes act as if they are a single unit with a 36 km diameter.



A telescope system like this is extremely sensitive to radio waves. It could detect a cell phone signal on one of the moons of Saturn! Therefore, they are usually located in remote areas where there is limited interference from other devices.

4. Which of these statements does NOT provide a reason that explains why radio telescopes are so large compared to optical telescopes?
- (F) Radio waves have a much longer wavelength than visible light waves.
 - (G) Radio signals from space have very little energy, so a large antenna is needed.
 - (H) Stray signals from devices on Earth are less likely to interfere with large antennas.
 - (I) It is much easier to build a large radio telescope framework than it is to build a large mirror or lens.

5. Which of these objects will **most likely** be observed using a radio telescope?

- Ⓐ gas clouds between stars in a galaxy
- Ⓑ large, hot stars
- Ⓒ high energy pulsars
- Ⓓ the core of a distant galaxy

6. Radio telescopes have been used to study the electromagnetic radiation of the cosmic microwave background. This radiation was produced by the most distant sources in the universe.

Approximately how long has this radiation traveled before being detected by a telescope?

- ☐ F thousands of years
- ☐ G millions of years
- ☐ H billions of years
- ☐ I trillions of years

7. Which of these human activities has the **least** reliance on satellite technology?

- Ⓐ communication
- Ⓑ medical treatment
- Ⓒ navigation
- Ⓓ weather forecasting

8. There are several types of missions that could be launched toward Mars in the future.

Which statement about Mars exploration is **most** accurate?

- (F) Space probes are the best choice of mission to study the soil composition of Mars.
- (G) A crewed mission to the planet requires significantly more resources than a Mars probe.
- (H) Mars landers are generally used to take samples from the surface and return them to Earth.
- (I) A Mars orbiter would not be able to collect useful information because it does not land on the surface.

9. This table shows the relationship between the distance to an object in space and the time required for light to travel from that object to Earth.

Table 1: Distances In Space

Object	Average Distance (km)	Time Required for Light to Travel from Object(s)
International Space Station	4.1×10^2	0.001
Moon	3.8×10^5	1
Sun	1.5×10^8	5.0×10^2
Nearest star	4.0×10^{14}	1.4×10^8

When Pluto is farthest from Earth, it takes about 2.5×10^4 seconds for light from Pluto to reach Earth.

Based on this data, what can be concluded about Pluto's location?

- (A) Pluto is much closer to the ISS than it is to Earth.
- (B) Pluto is about 50 times as far from the Sun as Earth.
- (C) Pluto is about ten times as far from Earth as the Moon.
- (D) Pluto is about half as far from Earth as the nearest star, other than the Sun.