

INTRODUCTION

Prerequisite Knowledge

- Know that electromagnetic radiation can have a large range of possible wavelengths.
- Know that visible light is a type of electromagnetic radiation.

Goals

- Understand that different wavelengths of light are absorbed differently by Earth's atmosphere.
- Be able to reason about how the observing wavelength determines telescope location.

Pre-activity Question

Which of the following wavelengths can be observed easily by a telescope located on Earth's surface?

- a) gamma ray
- b) X-ray
- c) ultraviolet
- d) **radio**
- e) all of the above wavelengths
- f) none of the above wavelengths

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Figure Discussion

The figure is a schematic representation of atmospheric absorption for different wavelengths. The different bands of shading in the diagram suggest different atmospheric layers, but the diagram does not attempt to portray a complete map of atmospheric structure.

1) [Visible and Radio]

Some students will incorrectly interpret questions 1, 2 and 3 as asking about depth of atmospheric penetration. Some students incorrectly argue that UV, Visible, IR, and Radio entirely reach the surface. Other students interpret the figure to mean that more X-ray than gamma reaches Earth's surface.

2) [Ultraviolet and Infrared]

3) [Gamma and X-ray]

- 4) [a. Project Theta] Gamma rays do not reach Earth's surface.
[b. Project Alpha] X-rays do not reach Earth's surface.

[c. Project Rho] The additional cost of the space-based telescope is not justified.

The criteria do not include consideration of improved seeing that is achieved with space-based missions, although some students will use this line of reasoning.

[d. Project Zeta] This project is less expensive and utilizes all of the incident radiation in the observing waveband.

Part d is intentionally more difficult to answer than the other pairs of project proposals. Students who choose Project Epsilon over Project Zeta and provide thoughtful explanations should not be discouraged for their response.

ADDITIONAL QUESTIONS

- 1) Which of the following wavelengths of light emitted by the Sun is most effectively blocked by Earth's atmosphere?
 - a) visible
 - b) radio
 - c) infrared
 - d) **gamma**
- 2) Imagine that you are the head of a funding agency that can afford to build one telescope. Which of the following proposed telescopes would be best to support?
 - a) a radio telescope in orbit around Earth
 - b) **an ultraviolet telescope in orbit around Earth**
 - c) an X-ray telescope located in New Mexico
- 3) Some telescopes are placed in space above Earth's atmosphere primarily for which of the following reasons?
 - a) The light being sent out from the telescopes can be blocked by Earth's atmosphere.
 - b) **The light from stars can be blocked by Earth's atmosphere.**
 - c) Astronomers want to observe continuous spectra from stars rather than absorption spectra.
 - d) Astronomers want to observe continuous spectra from the stars rather than emission spectra.
 - e) Like any special interest group, astronomers want to have their pet projects funded regardless of the cost to taxpayers.