Two Views of Light

Use experimental evidence to choose a useful model.

AR.PS4.3 "Develop an argument for how scientific evidence supports the explanation that electromagnetic radiation can be described either by a wave model or the particle model, and in some situations one model is more useful than the other."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two observations that support the wave model and circle two that support the particle model. Write W or P beside the explanation that matches each observation.

What Does the Evidence Show?

1. At a science museum, a laser shines through two narrow slits onto a screen. The screen shows alternating bright and dark bands, not just two bright streaks. A wave model predicts this pattern: light waves spreading from the slits overlap, reinforcing one another in some places and canceling in others. When the slits are moved farther apart, the bands move closer together, as the wave model predicts. This evidence makes waves useful for predicting where light will land after passing through openings. It does not mean light is only a wave. A different experiment can reveal behavior that this model alone does not explain.

2. Across the room, ultraviolet light shines on a clean metal plate and releases electrons. Bright red light on the same plate releases none, even when its intensity is increased. The wave model by itself does not explain why adding more red light fails. In the particle model, light arrives in packets called photons. A photon's energy depends on its frequency, not on the beam's brightness. Each electron needs a minimum amount of energy to escape this metal. Ultraviolet photons have enough energy; red photons do not. Making red light brighter adds photons, but each still lacks the needed energy.

3. These experiments do not ask scientists to vote for one picture of light. They ask which model best predicts a particular result. For the slit pattern, overlap and band spacing are easier to explain with waves. For electrons leaving the metal, photon energy and the frequency threshold are easier to explain with particles. This choice matters when designing tools. An engineer can use wave behavior to plan how light spreads through an optical device, then use photon energy to choose light for a detector. An argument about either model should name an observation, explain its cause, and state why that model fits the task.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why do the bright and dark bands support the wave model? Use the observation and the model's explanation.

2. How does moving the slits farther apart strengthen the argument for the wave model?

3. Why does the bright red light's failure to release electrons support the particle model?

4. An engineer must predict both a slit pattern and whether light will release electrons from the metal plate. Which model is more useful for each prediction, and what evidence supports each choice?

3 YOUR TURN

Your own words

An engineer finds that microwaves spread around a hallway corner. A separate sensor releases electrons with dim violet light but not with bright red light. Write a five-sentence argument naming the more useful model for each result, using both observations as evidence, and explaining why greater red brightness does not make the sensor work.

ANSWER KEY

Two Views of Light

HIGH SCHOOL · AR.PS4.3

PART 1 · READ AND MARK

Underline two observations that support the wave model and circle two that support the particle model. Write W or P beside the explanation that matches each observation. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why do the bright and dark bands support the wave model? Use the observation and the model's explanation.	**The alternating bands support the wave model because overlapping light waves reinforce one another at bright bands and cancel at dark bands.**
2	How does moving the slits farther apart strengthen the argument for the wave model?	**The bands move closer together when the slits move farther apart, matching a prediction of the wave model.**
3	Why does the bright red light's failure to release electrons support the particle model?	**Each red photon lacks the energy needed to release an electron. Increasing brightness adds photons but does not raise each photon's energy.**
4	An engineer must predict both a slit pattern and whether light will release electrons from the metal plate. Which model is more useful for each prediction, and what evidence supports each choice?	**The wave model is more useful for the slit pattern because it predicts the bright and dark bands and their changing spacing. The particle model is more useful for electron release because photon energy explains why ultraviolet light works and brighter red light does not.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The wave model best explains the microwaves spreading around the hallway corner. Waves can spread around obstacles, so the corner result fits wave behavior. The particle model best explains why the sensor responds to dim violet light but not to bright red light. Violet photons have enough energy to release electrons from this sensor, while red photons do not. Brighter red light sends more photons, but it does not increase the energy of each photon.

Accept explanations that connect the slit observations to wave overlap and the metal-plate results to photon energy. For Your Turn, students should apply wave spreading and the photon-energy threshold to the new situations, not claim that one model is always correct.