Reading Distant Air

How better measurements change what scientists can infer

ESS.3.a "Obtain and evaluate scientific information that explains how the application of new knowledge and technological advances has improved human understanding of the universe."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two ways instruments measured starlight, circle the evidence for carbon dioxide, and draw an arrow from that evidence to the conclusion it supports.

What Starlight Revealed About WASP-39 b

1 Imagine trying to learn what a planet is made of without ever seeing its surface. WASP-39 b, a giant planet about 700 light-years away, sometimes passes in front of its star from Earth's viewpoint. During a *transit*, the star looks slightly dimmer because the planet blocks some light. Astronomers can measure these dips to estimate the planet's size, but a dip alone does not identify gases in its atmosphere. Earlier telescopes found evidence of water vapor in this planet's atmosphere. To investigate more gases, scientists needed instruments that could separate very faint starlight into many wavelengths.

2 In 2022, the James Webb Space Telescope measured starlight passing through the outer layers of WASP-39 b's atmosphere during a transit. Its sensitive infrared instrument recorded how much light was missing at different wavelengths. Carbon dioxide absorbs infrared light at a recognizable set of wavelengths, so the pattern in Webb's data provided strong evidence for carbon dioxide. Webb's position in space helped it collect infrared measurements without interference from Earth's atmosphere. Compared with measuring only a transit dip, this technique linked a specific pattern in the light to a specific gas. Scientists could now investigate the planet's chemistry in greater detail.

3 That result changed more than a list of ingredients. The amount of carbon dioxide, considered with other atmospheric evidence, helps scientists test models of how giant planets form and change over time. Yet a spectral pattern is not a photograph of the atmosphere, and its interpretation depends on how gases and clouds affect light. Researchers compare measurements with models and check whether the pattern appears across the observed wavelengths. A headline saying that Webb found life on WASP-39 b would go beyond the evidence: carbon dioxide is not a sign of life by itself, and this giant planet is extremely hot.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why could measuring a transit dip estimate WASP-39 b's size but not identify its atmospheric gases?

2. What pattern did Webb measure, and how did it lead scientists to identify carbon dioxide?

3. How did Webb's location in space improve the measurements used to study the planet's atmosphere?

4. A headline claims that Webb found life on WASP-39 b. Evaluate that claim using the passage's evidence and a limit of that evidence.

3 YOUR TURN

Your own words

Unlike older instruments, a future telescope can measure infrared heat from the day and night sides of a distant planet separately. Write three sentences explaining what comparison this advance makes possible, what it could reveal about heat movement, and one conclusion it cannot justify.

ANSWER KEY

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HIGH SCHOOL · ESS.3.a

PART 1 · READ AND MARK

Underline two ways instruments measured starlight, circle the evidence for carbon dioxide, and draw an arrow from that evidence to the conclusion it supports. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why could measuring a transit dip estimate WASP-39 b's size but not identify its atmospheric gases?	**The dip shows how much starlight the planet blocks, which helps estimate its size. It does not show which wavelengths atmospheric gases absorb.**
2	What pattern did Webb measure, and how did it lead scientists to identify carbon dioxide?	**Webb measured missing infrared light at different wavelengths. The pattern matched wavelengths that carbon dioxide absorbs.**
3	How did Webb's location in space improve the measurements used to study the planet's atmosphere?	**In space, Webb could measure infrared light without interference from Earth's atmosphere, helping it detect the faint pattern in the starlight.**
4	A headline claims that Webb found life on WASP-39 b. Evaluate that claim using the passage's evidence and a limit of that evidence.	**The claim goes beyond the evidence. Webb found a pattern supporting the presence of carbon dioxide, but carbon dioxide alone is not a sign of life.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The new telescope could compare heat measured from the planet's day side with heat measured from its night side. A small difference could suggest that heat moves efficiently between the two sides. This comparison alone could not prove that the planet supports life because a temperature pattern does not show that living things exist.

Accept answers that connect a measurement to an inference and distinguish evidence for a gas from evidence for life. For Part 3, students may describe either a small or a large temperature difference if their explanation of heat movement is consistent.