Light as Evidence

Evaluate spectral evidence and the sources behind astronomy claims

CHE.2.4 "Research appropriate sources to evaluate the way absorption and emission spectra are used to study astronomy and the formation of the universe."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each kind of spectrum described in the passage. Circle the sources scientists use to check spectral claims, and number two limits on what a spectrum can prove.

Reading the Light from Space

1. At an observatory, a spectrograph spreads starlight into wavelengths, much as a prism separates colors. A star's hot interior produces a broad range of light. Cooler gas in its outer layers absorbs certain wavelengths, leaving dark absorption lines. Each element has a pattern of lines measured in laboratories, so a researcher compares the star's pattern with laboratory measurements rather than trusting a color photograph. An observatory's published spectrum should also report the instrument and its calibration, which checks where lines fall. Without that information, an apparent line could be an instrument error instead of evidence about the star.

2. When energetic stars illuminate a thin cloud of gas, atoms in the cloud can emit light at particular wavelengths, producing bright emission lines. Researchers compare those lines with laboratory spectra to identify elements, but overlapping lines can make an identification uncertain. Light from distant galaxies can also have familiar patterns shifted toward longer wavelengths. Comparing several lines with reference wavelengths helps scientists measure redshift more reliably than using one line. A redshift can support an inference that space has expanded while the light traveled. It does not, by itself, reveal the age of a particular star or prove what caused the expansion.

3. To investigate the early universe, astronomers study spectra from galaxies at different distances. More distant light generally left its source earlier, so its spectrum offers evidence about an earlier cosmic era. Scientists also compare predicted amounts of hydrogen and helium from early-universe models with measurements; no single spectrum settles the model. A peer-reviewed paper should describe its data, comparison spectra, uncertainty, and alternative explanations. An observatory archive can supply the original measurements, while a laboratory database supplies reference wavelengths. A headline without these links may summarize a claim, but it cannot show whether the evidence actually supports it.

2 ANSWER WITH EVIDENCE

Use the passage

1. A website identifies an element in a star from a color photograph. What two kinds of evidence would make its claim more testable, and how would they help?

2. An archive shows one bright line from a cloud of gas. What should a researcher compare before naming an element, and why is one line uncertain?

3. A report says one shifted line from a galaxy proves the age of a particular star. What comparison would strengthen its redshift measurement, and what part of the claim still does not follow?

4. Two reports about the early universe disagree. One links original measurements and lists uncertainty; the other offers only a headline. Which is better evidence, and what further comparison would you seek?

3 YOUR TURN

Your own words

A museum label claims that one faint galaxy's spectrum proves the first stars were made mostly of iron. In four sentences, evaluate the claim: name two appropriate types of sources, explain what you would check in each, and identify one limit on the conclusion.

ANSWER KEY

Light as Evidence

PART 1 · READ AND MARK

Underline each kind of spectrum described in the passage. Circle the sources scientists use to check spectral claims, and number two limits on what a spectrum can prove. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A website identifies an element in a star from a color photograph. What two kinds of evidence would make its claim more testable, and how would they help?	**An instrument-calibrated spectrum would show the star's absorption lines. Laboratory measurements would let researchers check whether the pattern matches the element.**
2	An archive shows one bright line from a cloud of gas. What should a researcher compare before naming an element, and why is one line uncertain?	**Compare the line with laboratory emission spectra. Lines from different elements can overlap, so one line may not identify an element reliably.**
3	A report says one shifted line from a galaxy proves the age of a particular star. What comparison would strengthen its redshift measurement, and what part of the claim still does not follow?	**Compare several galaxy lines with reference wavelengths to measure redshift. Redshift alone does not reveal the age of a particular star.**
4	Two reports about the early universe disagree. One links original measurements and lists uncertainty; the other offers only a headline. Which is better evidence, and what further comparison would you seek?	**The report linking measurements and uncertainty is better evidence. Compare measured hydrogen and helium amounts with predictions from early-universe models.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would find the galaxy's spectrum in an observatory archive and check its calibration and whether several lines support the identification. I would compare those lines with reference wavelengths in a laboratory database, allowing for redshift. A faint galaxy is not necessarily a first star, and its spectrum alone cannot establish what all first stars contained. The label's conclusion goes beyond the evidence it cites.

Accept other appropriate sources, such as a peer-reviewed study, if students explain what evidence they would examine. Responses should distinguish identifying spectral lines from making claims about all first stars.