

Signals From Space

Analyze evidence that supports a theory of the early universe.

8.9.C "research and analyze scientific data used as evidence to develop scientific theories that describe the origin of the universe."

NAME _____ DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each measurement or observation, then circle the words that explain what scientists infer from it.

Evidence for an Expanding Universe

- ① In the 1920s, astronomers measured light from galaxies at different distances. When spectral lines shift toward red wavelengths, a galaxy is moving away. The measurements in the table show that galaxies farther from Earth generally recede faster. This pattern is called the distance-redshift relationship. It provides measurable evidence that space is expanding.

REPRESENTATIVE GALAXY MEASUREMENTS

Galaxy	Distance from Earth, million light-years	Recession speed, km/s
A	65	1,400
B	160	3,500
C	325	7,000
D	490	10,500

- ② A second line of evidence comes from the cosmic microwave background, or CMB. In every direction, instruments detect faint microwave radiation with nearly the same temperature. Scientists interpret this glow as cooled energy left from a much hotter, denser early universe. Small temperature differences also show where matter later gathered.
- ③ Scientists also measure the amounts of light elements in ancient gas clouds. The observed abundance of hydrogen and helium closely matches calculations for a hot early universe. Together, expansion, the CMB, and light-element evidence support the Big Bang theory: the observable universe was once much hotter and denser and has expanded. The theory describes early development, but it does not identify what caused the universe to begin. Scientists continue testing it as new data improve.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 Compare Galaxy B and Galaxy C in the table. How do their distance and recession speed change?

2 How does the distance-redshift relationship support the claim that space is expanding?

3 What observation do scientists make about the CMB, and what do they infer from that observation?

4 What does the passage say the Big Bang theory does not identify?

3 YOUR TURN _____ Your own words

Complete the table using the three kinds of evidence in the passage. For each row, state the observation and explain how it supports the Big Bang theory of a hot, dense early universe.

EVIDENCE SOURCE	WHAT SCIENTISTS OBSERVE	HOW IT SUPPORTS THE THEORY

PART 1 • READ AND MARK

Underline each measurement or observation, then circle the words that explain what scientists infer from it. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	Compare Galaxy B and Galaxy C in the table. How do their distance and recession speed change?	From B to C, the distance increases from 160 to 325 million light-years, about double, and the recession speed increases from 3,500 to 7,000 km/s, double.
2	How does the distance-redshift relationship support the claim that space is expanding?	Galaxies are moving away, and more distant galaxies generally move away faster. This pattern is evidence that space is expanding.
3	What observation do scientists make about the CMB, and what do they infer from that observation?	They detect faint microwave radiation in every direction with nearly the same temperature. They infer that it is cooled energy from a hotter, denser early universe.
4	What does the passage say the Big Bang theory does not identify?	It does not identify what caused the universe to begin.

PART 3 • YOUR TURN (SAMPLE ANSWER)

EVIDENCE SOURCE	WHAT SCIENTISTS OBSERVE	HOW IT SUPPORTS THE THEORY
Galaxy redshift data	Farther galaxies generally recede faster.	It supports the idea that the universe has expanded.
Cosmic microwave background	Faint microwave radiation appears in every direction at nearly the same temperature.	It is interpreted as cooled energy from a hotter, denser early universe.
Light elements	Hydrogen and helium amounts in ancient gas clouds match calculations.	It supports calculations for a hot early universe.

Accept equivalent descriptions that accurately distinguish an observation from the inference made from it. For the open table, students should connect all three evidence sources to expansion or to a hotter, denser early universe.