

# ScienceNews

## EDUCATOR GUIDE



NASA

**February 12, 2022**

**Meteorite's Organics Aren't Signs of Life**



### About this Guide

In this Guide, based on the online *Science News* article "[Organic molecules in an ancient Mars meteorite formed via geology, not alien life](#)," students will learn about the origin of organic material found inside a meteorite from Mars and discuss how new evidence can be used to reevaluate scientific claims.

#### **This Guide includes:**

**Article-based Comprehension Q&A** — Students will answer questions about the online *Science News* article "[Organic molecules in an ancient Mars meteorite formed via geology, not alien life](#)," which describes new research into the origin of organic material found in a space rock. A version of the article, "Meteorite's organics aren't signs of life," appears in the February 12, 2022 issue of *Science News*. Related standards include NGSS-DCI: HS-LS1; HS-PS1.

**Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

**Cross-curricular Discussion Q&A** — Students will compare two *Science News* articles and analyze how new evidence has revised an initial claim and the reasoning behind that claim. As a bonus, students can answer chemistry questions about abiotic and biotic reactions. Related standards include NGSS-DCI: HS-LS1; HS-PS1.

**Student Discussion Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

**Article-based Comprehension, Q&A**

**Directions for teachers:** Ask students to read the online *Science News* article "[Organic molecules in an ancient Mars meteorite formed via geology, not alien life](#)," which describes new research into the origin of organic material found in a space rock, and answer the following questions. A version of the article, "Meteorite's organics aren't signs of life," appears in the February 12, 2022 issue of *Science News*.

**1. In the 1990s, what did scientists report about a meteorite from Mars that was found in Antarctica?**

The meteorite contained organic molecules.

**2. At the time, what were two theories that scientists came up with to explain the finding?**

Scientists thought that the molecules either were produced by life on Mars or were contaminants from Earth.

**3. Name two ways that organic molecules can form.**

Organic molecules can be formed by living organisms or through nonbiological, or abiotic, processes.

**4. What has recent research revealed about the meteorite's organic molecules?**

A new study suggests that organic molecules in the meteorite resulted from geologic processes on Mars, not alien life.

**5. How and where do scientists now think the molecules formed? Describe the evidence that supports the scientists' claim in your answer.**

Organic molecules in the meteorite probably formed during two chemical reactions — serpentinization and carbonation — on Mars a long time ago. The molecules were found amid by-products of the reactions, which occur when minerals and water meet. The amounts of different types of hydrogen in the organic material suggest that the molecules developed on Mars, not naturally on Earth or as part of laboratory experiments.

**6. What does the new finding and evidence from other Martian meteorites suggest about the formation of organic molecules on Mars? What about the search for life on the planet?**

Abiotic processes probably have been producing organic molecules on Mars for much of the planet's history. Understanding how abiotic processes create organic compounds on Mars could help scientists investigate how life, if present, might impact those reactions.

### Student Comprehension Worksheet

**Directions:** Read the online *Science News* article "[Organic molecules in an ancient Mars meteorite formed via geology, not alien life](#)," which describes new research into the origin of organic material found in a space rock, and answer the following questions. A version of the article, "Meteorite's organics aren't signs of life," appears in the February 12, 2022 issue of *Science News*.

- 1. In the 1990s, what did scientists report about a meteorite from Mars that was found in Antarctica?**
- 2. At the time, what were two theories that scientists came up with to explain the finding?**
- 3. Name two ways that organic molecules can form.**
- 4. What has recent research revealed about the meteorite's organic molecules?**
- 5. How and where do scientists now think the molecules formed? Describe the evidence that supports the scientists' claim in your answer.**
- 6. What does the new finding and evidence from other Martian meteorites suggest about the formation of organic molecules on Mars? What about the search for life on the planet?**

### Cross-curricular Discussion, Q&A

#### Directions for teachers:

Ask students to read the online *Science News* article "[Organic molecules in an ancient Mars meteorite formed via geology, not alien life](#)" and discuss the first set of questions as a class. Then ask students to read the online *Science News* article "[Debate over life in Mars rock rekindles](#)" and answer the second set of questions alone or with a partner. The bonus questions are chemistry-themed; feel free to incorporate them into a discussion if it makes sense for your classroom.

**Want to make it a virtual lesson?** Post the online *Science News* article and video link to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

#### Reasons for research

1. Why do you think the search for life on other planets is such a popular area of research?

*Student answers will vary, but students could discuss people's fascination with aliens, which has been buoyed by media, science fiction, etc. Students could also mention the discovery within the last few decades of exoplanets — planets beyond our solar system — which has bolstered people's desire to better understand life on Earth and their place in the cosmos.*

2. What factors might influence the amount of research done on a specific science topic?

*Student answers will vary, but students may say the level of public excitement around the topic, the amount of funding, the sense of urgency, etc.*

3. How might public interest in a research topic affect scientific progress in the related fields of research? Explain.

*Student answers will vary. Students may say that public interest and awareness could help draw attention to a field that otherwise would go under the radar and perhaps help it get more funding. On the other hand, public attention, through politics or media, could lead to scrutiny and questioning of the research.*

#### Comparing claims based on new evidence and reasoning

4. Read the online *Science News* article "[Debate over life in Mars rock rekindles](#)," which was published in 2001. In your own words, explain the debate described in the article. Who are the key players and what are their arguments?

*Scientists debated whether the organic matter found in the Martian meteorite ALH84001 was produced by organisms on Mars. Scientists that argued for a biological origin cited the similarity of the meteorite's crystals to crystals on Earth that are produced by bacteria. These scientists also cited the fact that such*

*crystals on Earth had never before been detected in the absence of life. On the other side of the debate, scientists argued that the similarity between the crystals does not prove that the space rock's crystals were created by living organisms. The crystals could have formed through an unknown inorganic process instead.*

5. In the online *Science News* article "[Organic molecules in an ancient Mars meteorite formed via geology, not alien life](#)," which was published in 2022, what claim do the scientists make about the origin of organics in the meteorite? Based on the claim, what side of the debate are the scientists on?

*The scientists argue that the organic matter in the Martian meteorite was not produced by life, but instead arose from the geologic processes serpentinization and carbonation. The scientists are firmly in the abiotic camp.*

6. What evidence do the scientists use to support their claim? How does this relate to the evidence described in the 2001 *Science News* article to support the same claim?

*New microscopic and spectroscopic images of the meteorite revealed complex organic molecules amid by-products of two abiotic chemical reactions. These reactions — carbonation and serpentinization — occur when minerals and water interact. The amounts of different types of hydrogen in the organic molecules indicated that the material formed while on Mars not while on Earth. In 2001, a scientist argued that an "unknown inorganic process" could have formed the crystals in the space rock. The 2022 *Science News* article describes evidence that carbonation and serpentinization are those inorganic processes.*

7. How do the scientists described in the 2022 *Science News* article use the new evidence as reasoning to support their claim?

*The scientists reasoned that the organic molecules found in the meteorite were formed during the abiotic chemical reactions (serpentinization and carbonation) and therefore were not formed by living organisms.*

8. Does the new finding settle the debate? Why or why not?

*This new finding does not settle the debate, but it does provide more evidence for the claim that the organic matter inside the space rock does not necessarily indicate life on Mars.*

9. What additional evidence is needed to bolster the scientists new claim?

*More evidence of organic compounds being generated by abiotic processes, and the details of how those compounds are generated, is needed.*

### **Bonus: Chemistry corner**

1. How would you define biotic and abiotic chemical reactions?

*Biotic reactions occur when a chemical is created within or by a living organism. Abiotic reactions occur when a chemical is created from the interaction of nonliving substances.*

2. What abiotic chemical reactions are mentioned in the 2022 article? Why are they considered abiotic, according to your definition above?

*Serpentinization and carbonation are geologic processes that occur between water and minerals. The water and minerals physically interact and react over time without the involvement of living organisms.*

3. Give an example of a biotic chemical reaction that you've learned about. What is a benefit of the reaction for life?

*Biotic reactions can support the longevity of organisms. Photosynthesis is considered a biotic reaction. Plants and other organisms use photosynthesis to produce glucose and oxygen from light, water and carbon dioxide.*

4. Organic compounds can be produced both biotically and abiotically. What defines an organic compound, and how might one organic compound be produced in both ways?

*Organic compounds are primarily composed of carbon covalently bonded to hydrogen. Student examples of organic compounds that can be produced both biotically and abiotically will vary and could include methane or carboxylic acids. Methane can be produced by microbes or through various geologic processes. For example, when water reacts with a mineral called olivine in certain types of rocks, the reaction releases hydrogen gas that then reacts with carbon dioxide to form methane. Carboxylic acids can form during the metabolism of carbon-fixing microorganisms. The acids also can form under hydrothermal conditions via the reduction of  $\text{CO}_2$ ,  $\text{CO}$ , or  $\text{HCO}_3^-$  with  $\text{H}_2$  in the presence of transition metal catalysts.*



### Student Discussion Worksheet

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#### Reasons for research

1. Why do you think the search for life on other planets is such a popular area of research?
2. What factors might influence the amount of research done on a specific science topic?
3. How might public interest in a research topic affect scientific progress in the related fields of research? Explain.

#### Comparing claims based on new evidence and reasoning

4. Read the online *Science News* article "[Debate over life in Mars rock rekindles](#)," which was published in 2001. In your own words, explain the debate described in the article. Who are the key players and what are their arguments?
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6. What evidence do the scientists use to support their claim? How does this relate to the evidence described in the 2001 *Science News* article to support the same claim?
7. How do the scientists described in the 2022 *Science News* article use the new evidence as reasoning to support their claim?



8. Does the new finding settle the debate? Why or why not? Is there more evidence that is needed?

9. What additional evidence is needed to bolster the scientists new claim?

**Bonus: Chemistry corner**

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