

# ScienceNews

EDUCATOR GUIDE



NASA, ROSCOSMOS

**September 26, 2020**

**Bacteria Can Survive for Years in Space**



SOCIETY FOR SCIENCE & THE PUBLIC

### About this Guide

In this Guide, based on the online *Science News* "[If bacteria band together, they can survive for years in space](#)," students will learn about research conducted aboard the International Space Station and develop their own research question that could be explored on the space station.

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

**Article-based Comprehension Q&A** — Students will answer questions about the online *Science News* article "[If bacteria band together, they can survive for years in space](#)," which describes an experiment on the International Space Station that suggests microbes are capable of surviving interplanetary travel. A version of the story, "Bacteria can survive for years in space," can be found in the September 26, 2020 issue of *Science News*. Related standards include NGSS-DCI: HS-ESS1; HS-LS1; HS-ETS1.

**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 learn about the International Space Station and research done by astronauts aboard the space station, and come up with their own research question that could be explored in space. Related standards include NGSS-DCI: HS-ESS1; HS-ESS2; HS-ETS1.

**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:** After your students read the online *Science News* article "[If bacteria band together, they can survive for years in space](#)," ask them to answer the following questions. A version of the story, "Bacteria can survive for years in space," can be found in the September 26, 2020 issue of *Science News*.

**1. Why is outer space not friendly to most known life-forms?**

The extreme conditions of outer space, including temperature, pressure and radiation, could damage an organism's DNA and kill the organism.

**2. What type of bacteria did scientists use in an experiment on the International Space Station? Why did scientists choose to study these bacteria?**

Scientists studied *Deinococcus*. It thrives in extreme environments on Earth and is resistant to radiation damage, making it a good test subject for an outer space experiment.

**3. What was the purpose of the experiment? Describe the experimental procedure in your own words.**

Scientists wanted to determine how long *Deinococcus* could survive in outer space, so they sent up dried pellets of the bacteria to the International Space Station. An astronaut attached plates containing the pellets to the exterior of the station, where the pellets were exposed to the harsh environment. Each year, samples were sent back to Earth where scientists rehydrated the samples and monitored them for bacterial growth.

**4. What were the independent and dependent variables of the experiment? Explain how you know.**

The independent variable was the pellet thickness and the dependent variable was the survival rate of the bacteria. The scientists varied the size/thickness of the bacteria pellets that were sent to space to see if it affected the bacteria's rate of survival in space.

**5. What were the results of the experiment? Explain.**

*Deinococcus* in pellets that were at least 500 micrometers thick could survive in outer space for up to three years. Bacteria on the outside of the pellets died, but those dead bacteria protected microbes in the pellets' interiors. About 4 percent of microbes in the pellets survived.

**6. What is the maximum estimated time the bacteria in 1,000-micrometer pellets could survive in outer space, according to the researchers' estimates?**

Eight years.

**7. How might bacteria unintentionally end up in outer space, according to the researchers? Can you think of another way bacteria could end up in outer space?**

Scientists say clumps of bacteria could be launched into space by meteorite impacts or by storm-induced disturbances in Earth's magnetic field. Bacteria also might hitch a ride to outer space on the surface of spacecraft.

**8. What implications do the findings have for life elsewhere in the universe?**

If clumps of microbes can survive in outer space, they may be able to spread from Earth to other planets or space rocks.

**9. Find a word or concept in the story that is new to you. Define it using the context given in the article.**

Panspermia is new to me. It is the concept that life can travel throughout the universe, spreading from place to place.

**10. What makes the experiment an example of a successful collaboration in science, technology, engineering and math (STEM)?**

A scientist designed the experiment and prepared the necessary materials, but had to rely on an astronaut on the space station to conduct part of the experiment. The scientist on Earth and the astronaut had to trust each other to make the collaboration successful.

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- 4. What were the independent and dependent variables of the experiment? Explain how you know.**
- 5. What were the results of the experiment? Explain.**
- 6. What is the maximum estimated time the bacteria in 1,000-micrometer pellets could survive in outer space, according to the researchers' estimates?**
- 7. How might bacteria unintentionally end up in outer space, according to the researchers? Can you think of another way bacteria could end up in outer space?**
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**Cross-curricular Discussion, Q&A**

**Directions for teachers:** Ask students to read the online *Science News* article "[If bacteria band together, they can survive for years in space](#)" and answer the following questions. Another version of the article, "Bacteria can survive for years in space," appears in the Sept. 26, 2020 print issue. Each section includes a linked video about the International Space Station that students should watch before answering the questions. Questions in the first section should be answered as a class — the additional resources provided can help you guide the discussion. The final prompt asks students to come up with a research question that could be done in space. Have students pair up to share their research question with their partner.

Additional resources:

NASA article "[What Is the International Space Station?](#)"

NASA Johnson video "[Everything About Living in Space](#)"

Did you know that students can develop their ideas and submit research projects to the International Space Station? Check out the [Student Spaceflight Experiments Program](#) for more information.

Want to make it a virtual lesson? Post the online *Science News* article "[If bacteria band together, they can survive for years in space](#)" and the additional resources to your virtual classroom. Ask students to answer the questions individually and post their research question to your online discussion board. Finally, have students give feedback on each other's responses on the discussion board.

**Onboard the International Space Station**

Watch the video "[A Bridge Above: 20 Years of the International Space Station](#)" and answer the following questions as a class.

1. What is the purpose of the International Space Station, or ISS? Why is the ISS important?

*The purpose of the ISS is to have an ongoing human presence in space to do research and report findings. The station is important because it allows nations to combine resources and ideas to do research that provides lessons for future space exploration and benefits humans on Earth.*

2. Based on the *Science News* article and the video, what are some countries that are involved in the ISS collaboration?

*Japan, the United States and Russia are a few of the countries involved in the collaboration. According to the video, astronauts from more than 100 nations have lived on the station.*

3. Brainstorm some challenges and opportunities that astronauts living on the ISS face.

*Astronauts living on the ISS get to be on the front lines of new discoveries. But it can be challenging to live away from their families. Astronauts might struggle with sleeping, since the station doesn't have the same light and dark cues that people do on Earth. Astronauts also might struggle to keep their bodies strong and healthy in microgravity over long periods of time.*

### **Science on the ISS**

After watching the video "[Fruit Punch and Foam: Managing Liquids in Space](#)," answer the following questions on your own.

4. What research were scientists doing in the video? Why is the research important?

*Scientists were studying how to manage the flow of fluids in space without using any electricity. Based on this research, the scientists innovated a foam to collect liquid that works in microgravity conditions. The foam could be used as a backup system for toilets on the ISS or possibly as a wastewater processing system on future crewed missions to the moon and Mars.*

5. How did the ISS play a key role in the experiment described in the *Science News* article? What about in the fluidics research featured in the video?

*The exterior of the ISS housed Deinococcus bacteria that scientists used in an experiment to see how long the bacteria could survive in outer space. The ISS was crucial in providing a controlled microgravity environment for the fluidics research.*

6. How can doing an experiment on board the ISS differ from doing the experiment on Earth? What can scientists learn from doing the same experiment in both places?

*Doing an experiment on the ISS is different from doing an experiment on Earth mostly because of the extreme conditions of outer space, including radiation and low gravity. There also are greater physical space and resource constraints on the ISS. People other than the scientists who develop experiments may be the ones to perform the experiments on the ISS, and those people might not be as well versed as the original scientists are in the various fields of research. Doing experiments both on the ISS and on Earth can allow scientists to study the effects gravity can have on various phenomena, for instance.*

7. Use a keyword to search the [Space Station Research Explorer](#) website for an ongoing experiment that relates to a concept you are studying or a topic that interests you. Summarize the research. Some possible keyword searches include: bacteria, force, nutrition, combustion, etc.

*Student answers will vary.*



8. How does the experiment you found compare with the experiment described in the *Science News* article? Name one similarity and one difference.

*Student answers will vary, but they could highlight the field of research, aspects of experimental design, speed of gathering data, etc.*

### **Get involved**

After watching the video [Space Station Live: Student Experiments Fly to Station](#), answer the following question. Share and discuss your answer with a partner.

9. Come up with a research question you would like to explore in space. What would be some advantages and challenges of doing your experiment in space?

*Student answers will vary.*

Did you know that you can develop a research project and submit it to the International Space Station? Ask your teacher for more information if you're interested!

**Student Discussion Worksheet**

**Directions:** After you have read the online *Science News* article "[If bacteria band together, they can survive for years in space](#)," or the print version of the article, answer the questions below. In each section, watch the linked video before answering the questions. For the last prompt, come up with a research question that you would like to explore in space. Pair up and share your research question with your partner.

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