Ages: 8-12
Topic: Bacteria, Classifying, Science Lab Practices
Time: 1-2 class days

Standards
Next Generation Science Standards:
5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment
Common Core State Standards: MP.4 Model with mathematics

Mission X: Train Like an Astronaut

A MICROBIAL BOX

EDUCATOR SECTION (PAGES 1-8)
STUDENT SECTION (PAGES 9-16)

Background

Microbes live everywhere! While many microbes on Earth are harmless, and can even be helpful to humans, some microbes can be unsafe.

Microbes belong to a group all by themselves because they are neither plants nor animals. Because they can multiply extremely quickly, it is normal to find millions of them in the same location.

Some microbes or "germs", such as bacteria and mold, can grow on food, dirty clothes, and garbage that people produce. Microbes live on your skin, in your mouth, nose, hair, and inside your body.

Astronaut Chris Hadfield taking microbe samples on the ISS.

Microbes can also be found aboard the International Space Station (ISS). NASA scientists have reported that some germs on the ISS can increase to a higher number than they do on Earth. Therefore, cleanliness and proper disposal of garbage is an important part of living on the ISS.

Scientists who study microbes are called microbiologists and microbiology is the study of microorganisms or microbes. The root word "micro" comes from Greek and means "small". These microbes are so small that powerful microscopes are needed to be able to see them. At the Johnson Space Center in Houston, TX, NASA microbiologists study the small microbes in the air, water, food, and surfaces of the ISS. Controlling the microbes inside your body is an important part of staying healthy. So, where can you find microbes?

Lesson Objectives. Students will:

- analyze microbial life based on research.
- investigate the relationship of many everyday products to microorganisms.
- examine the impact of microorganisms on daily life.
- discover that microorganisms have the greatest diversity of all living organisms.
- explain how microorganisms are beneficial to humans and the environment.

Teacher Notes / suggestions for implementation:

This activity is designed to accompany Bugs in Space, so completing both activities will give the students both a research and a laboratory experience. It is possible to do the activities in different years or separated by a significant amount of time. Thus, the student reading sections and background information are the same as they are appropriate for either activity.

QUESTION: WHAT DO YOU DO WITH YOUR WET WORKOUT CLOTHES?

Fungi on the ISS, growing on a panel where exercise clothes were hung to dry.

Microbiologists have found that microbes can live just about everywhere, even on us! We have trillions of microbes inside and outside of our bodies. Run your tongue over your teeth—you are licking thousands of microbes that normally live on your teeth. Millions of them live on your tongue, too. A large part of the mass of your body is actually something else: bacteria, viruses, and fungi.

Microbes are in the world around you, too. If you pick up a fistful of garden soil, you are holding hundreds (if not thousands) of different kinds of microbes in your hand. A single teaspoon of that soil contains over 1 billion microbes of bacteria, about 120,000 microbes of fungi and 25,000 microbes of algae.

Microbes have been around for billions of years because they are able to adapt to the ever-changing environment. They can find a home anywhere, and some of them live in places where we once thought nothing could survive.

For example, scientists have discovered microbes living in the boiling waters of hot springs in Yellowstone National Park. Other heat-loving microbes live in volcanic cracks—miles under the ocean surface, where there is no light and the water is a mixture of poisonous chemicals. Other microbes live in the permanently frozen ice of Antarctica. Microbes have also been found living inside the stones that make up the walls of old cathedrals in Europe. Microbes can even survive in space. On April 20, 1967, the unmanned lunar lander Surveyor 3 landed near Oceanus Procellarum on the surface of the Moon. One of the onboard items included a television camera. Two-and-a-half years later, on November 20, 1969, Apollo 12 astronauts Pete Conrad and Alan L. Bean recovered the camera. When NASA scientists examined it back on Earth, they were surprised to find some bacteria called Streptococcus mitis were still alive. Because of the precautions the astronauts had taken, NASA could be sure that the germs were inside the camera when it was retrieved, so they must have been in the camera before the Surveyor 3 was launched. These bacteria had survived for 31 months in the vacuum of the Moon's atmosphere. They may have frozen or dried inside the camera, which are two ways normal bacteria can enter a state of deep sleep.

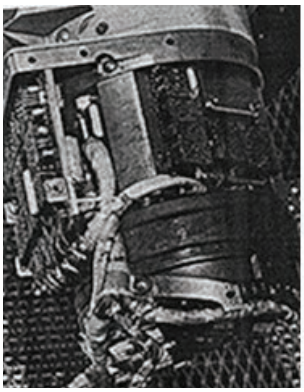


Figure 2: Television camera from Surveyor 3.

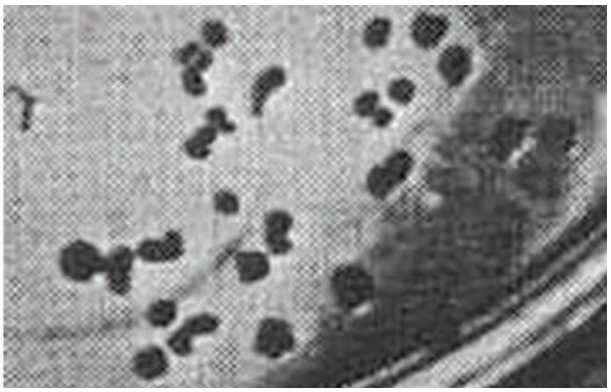


Figure 3: Bacteria found on the television camera of Surveyor 3.

Figure 4: Close-up of bacteria that survived for almost 3 years on the moon.

Some scientists even believe there is a possibility that bacteria may have once lived on Mars. The photograph on the right (taken through a microscope) shows what some scientists believe may be the fossils of tiny bacteria in a rock that formed on Mars about 4.5 billion years ago. The rock crash-landed on Earth as a meteorite thousands of years ago.

Problem: How can I categorize life around me that cannot be seen?

SAFETY!!

- Remind students about the importance of classroom and lab safety.
- Students should not consume any food products in the laboratory.

Part 1 - Explore

Researching the microorganisms around us!

RESEARCH

In this part of the activity, students will investigate the relationship microorganisms have with many of the products they use every day. In addition, students will grow and study microbial life.

Additional research can be done on the following related topics:

- influenza
- common cold
- athlete's foot
- cavities
- pink eye
- strep throat

Pre-lesson Preparation: At least three days prior to the activity.

(Students should work in groups of four.)

Prepare research information.

- Have students watch the video A Microbial Box here http://trainlikeanastronaut.org/media
- Students can use computers to research information. Create bookmarks or "URL hot sheets" on student computers, or print web pages for student use (using resources available on the web site and in Appendix B).
- E-mail resources (available on the web site and in Appendix B) to your technology teacher so that s/he can bookmark web sites prior to your class using a computer. This will facilitate the students' research.
- If computers are not available, the technology instructor can provide print-out information such as internet articles for students that are appropriate to their grade level.
- Provide a copy of the resources (available on the web site) to your librarian to facilitate prior book selection. This will provide students with more resources to help them complete their task.
- Facilitate questioning throughout the activity.

Teacher Notes / suggestions for student engagement:

To help with the student engage section, ask some questions such as: If you drop a piece of candy on the gym floor, would you still eat it? What are some cleaning products you use at home? Why do you clean your hands before eating? What are some ways to clean a wound if you get a cut in your skin? What are some ways to prevent getting sick?

Prepare:

Per class

- A Microbial Box Research Sheet transparency (viewed using an overhead projector), a copy of the Microbial Box table on a chart tablet, or an image on the wall using a document camera.
- Bookmarked web sites, printed web resources, and/or book resources (available on the web site and in Appendix B)
- Microbial Box (see pre-lesson instructions section below)

Per Student:

- Copy of *A Microbial Box* Student Section

Materials:
- Shoe box or container
- Zipper seal bag
- Images or the following items
- yogurt
- Blue cheese
- Swiss cheese
- Slice of bread
- Split peas or peanuts
- Coffee beans
- Picture of hot springs or geyser
- Sterile, empty container of antibiotics
- Sweaty socks
- Vinegar
- Plastic nose or image of nose

The day prior to the activity:

1. Create a Microbial Box
   - Obtain any size shoe box or container (and decorate if desired)
   - Print and cut corresponding images to go inside the box or container. You may need more than one of each item, depending on the class size. Optional: Instead of using images, you may use clean containers, clean packaging, or the actual items themselves. If using this method, the following items will be needed (explanation of items provided in Appendix B):
     - clean, empty yogurt container with label or yogurt in a zipper seal bag
     - blue cheese or its label in a zipper seal bag
     - swiss cheese or its label in a zipper seal bag
     - slice of bread in a zipper seal bag
     - split peas or peanuts in a zipper seal bag
     - coffee beans in a zipper seal bag
     - picture of a hot springs, such as Old Faithful
     - empty container of antibiotics
     - sweaty sock inside a zipper seal bag
     - vinegar in a zipper seal bag or picture of vinegar
     - plastic nose or picture of a human nose
2. Make a Microbial Box Research Sheet (Appendix A) transparency or a copy of the Microbial Box table on chart tablet, or you may project an image on the wall using a document camera.
3. Make a copy of the *A Microbial Box* Student Section for each student.

Procedures:

A Microbial Box (taken from the *A Microbial Box* Student Section)

This activity should highlight the role microbes play and contribute to our lives and environment on Earth, as well as in space.

1. Each student will fill in the KWL chart for what they already KNOW about microbes. Discuss as a class.
2. Discuss as a group then each student will fill in the section for what they WANT to learn about microbes.
3. Each student will receive one item from the Microbial Box. *(These items may come directly from microorganisms [or microbes], utilize microbes, or in some way be associated with microorganisms.)*

Teacher notes: *Challenge students to determine if the item comes directly from microorganisms, utilizes microorganisms, or is associated with microorganisms in some way.*

4. Investigate with your group to determine what your items have to do with microbes.

Teacher notes:
- *Students can use computers to research information (resources are available on the internet and in English in Appendix C). If the lesson will be performed in languages other than English, prepare before the lesson by finding resources in appropriate languages for the students.*
- *Remind students to use guiding questions located at the top of their Microbial Box.*
- *Have the students use the Research Sheet (Appendix A) to help in their research.*

5. **Record your data** on the Microbial Box Research Sheet.
6. With your group, identify which of the items might be found on a spaceflight mission.

7. **Record your data** on the Microbial Box Research Sheet. *(Use Appendix A as a reference key.)*
8. Present your data to the class. As other students present, record all the data on your Microbial Box Research Sheet.

Teacher notes: *As students present their data, write data on chart paper or make a transparency of a blank Microbial Box Research Sheet so that the information may be viewed by the whole class. Use Appendix A as a reference key.*

If the students perform the follow up activity, Bugs in Space, they will **research** and **test** their hypothesis' following the procedure of the **experiment**.

Explain:

The following are the student explain questions from the *A Microbial Box* Student Section.
When you have completed your research, study your data and answer the following questions.

1. How many microbes were bad for humans and the environment? [Answers will vary]

2. How many microbes were good for humans and the environment? [Answers will vary]

3. Based on your data, are microbes good, bad, or both? Why? [Answers will vary and will most likely include both good and bad microbes]

4. Give examples of how microbes are used. [Answers will vary, but may include microbe use in digestion, medicines, agriculture, etc]

5. Which items could be found in a spaceflight mission? [Plastic bags, peanuts, coffee, antibiotics, sweaty socks]

6. Where are microbes found? [Answers will vary and will likely include inside the human body, on the skin, and on surfaces around us]

Teacher notes: *The Student Reading Section can be read either at the beginning of the activity, or following the microbial box research section.*

Evaluate:

1. Choose three objects in your microbial box that are similar to each other. How are they similar? [Answers will vary]

2. What is a different object that you might add to your microbial box that would be an example of something containing microbes? [Answers will vary]

3. Microbes are too small to see without a microscope. How might you know if you ate microbes in your food? [Answers will vary, but may include feeling healthier or sicker.]

4. Which microbes would you find in your school as well as in your home? [Answers will vary, but may include foods or similar surfaces.]

5. Where else do you think you would be able to find a large amount of microbes? [Answers will vary]

Elaborate:

1. How can you observe life around you that cannot be seen? [Using tools such as microscopes or telescopes, or letting things grow until they are big enough to see.]

2. Which objects in your school do you think would have high amounts of microbes? [Answers will vary]

3. As a group, develop a plan as to how you help maintain a clean and microbe-free school. How could you do this at home?[Answers will vary]

4. Imagine you are a microbiologist concerned about astronaut safety. Please make recommendations to NASA to reduce the microbial level aboard spaceflight missions.[Answers will vary]

Extend:

1. Read the “Did you know?” graphic. Why do you think astronauts are kept away from other people for a week before launching into space. How does this keep them from getting sick in space? [Answers will vary]

2. Look at your microbial box again. Where on the ISS would you expect more microbes to be found? Where would you expect the least amount of microbes? [Answers will vary]

3. Create a diary or story from the perspective of the microbes inside your microbial box. For example, if you were one of the microbes in the box, what would be your life story? [Answers will vary]

Educator resources

Useful Websites for Further Information

Microbes living on the ISS before humans ever lived there
http://science.nasa.gov/science-news/science-at-nasa/2000/ast26nov_1/

To read more about the ISS Environmental Control and Life Support System
http://www.nasa.gov/sites/default/files/104840main_eclss.pdf

To learn more about microbes and health
https://www.niaid.nih.gov/topics/microbes/Documents/microbesbook.pdf

NASA eClips about life on other planets
http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000

Some lesson plans from the UK
http://www.schoolscience.co.uk/partners/chilled-food-association

http://www.nationalstemcentre.org.uk/elibrary/collection/991/chilled-food-association

Appendix A

Microbial Box Research Sheet Solution Key

Item	How is this item related to microbes?	Are these microbes good or bad for humans and the environment? Why?	If this item is a body PART, should this PART of the body be tested on an astronaut?	Can this item be found on a spaceflight mission?
Yogurt	See Appendix B	Good - Appendix B	N/A	No—it spoils, no refrigerator in space
Blue Cheese	See Appendix B	Good - Appendix B	N/A	No—it spoils, no refrigerator in space
Swiss Cheese	See Appendix B	Good - Appendix B	N/A	No—it spoils, no refrigerator in space
Antibiotics	See Appendix B	Good - Appendix B	N/A	Yes—antibiotics are taken into space in case of illness
Bread	See Appendix B	Good - Appendix B	N/A	Yes—bread is eaten in space
Split peas or peanuts	See Appendix B	Good - Appendix B	N/A	Yes—peanuts are eaten in space
Vinegar	See Appendix B	Good - Appendix B	N/A	No—vinegar is not taken into space
Coffee beans	See Appendix B	Good - Appendix B	N/A	No—astronauts take coffee into space, but not coffee beans
Sweaty socks	See Appendix B	Bad - Appendix B	N/A	Yes—astronauts wear socks in space
Hot Springs (Old Faithful)	See Appendix B	Good - Appendix B	N/A	No—Hot springs are only found on Earth
Nose	See Appendix B	Good - Appendix B	No — There is no need to test unless an astronaut is sick.	Yes—all astronauts have a nose!

Appendix B - Microbial Box Items (Internet links are in English)

- **Yogurt:** Formation of yogurt from milk relies on actively growing cultures of specific bacteria. The bacteria converts pasteurized milk to yogurt during fermentation. Students should be able to find the label on the package that says "live and active cultures". The bacteria used are *Lactobacillus* spp. and *Streptococcus thermophilus*. http://aboutyogurt.com/index.asp?sid=5
- **Blue cheese:** Most cheeses that are aged have bacteria or fungi added to them. The type of bacteria/fungus determines the flavor of the cheese. In the case of blue cheeses, you can explain that the blue vein is actually made of blue mold (fungus) which is particular Penicillium spp. http://www.ehow.com/how-does_5194628_blue-cheese-mold-it.html
- **Swiss cheese:** The holes in this cheese are the result of fermentation by bacteria (*Propionibacterium shermanii*) which produces a lot of gas as a by-product, and therefore creates holes in the final product. The bacteria also give the cheese its characteristic flavor. http://www.inspirationline.com/Brainteaser/cheese.htm
- **Antibiotic:** Most kids will tell you this is what is used to treat bacterial infections. That certainly is true. But more importantly, most antibiotics are derived from natural products of fungi or bacteria that are used by these organisms to kill their competitors. A perfect example is the antibiotic, streptomycin, produced by the bacteria, *Streptomyces griseus*. http://www.infoplease.com/ce6/sci/A0846951.html
- **Bread:** Most breads are made with yeast, which is a type of fungus. The yeast (*Saccharomyces cerevisiae*) ferments, producing gas as a by-product which results in the bread rising. http://microbezoo.commtechlab.msu.edu/zoo/zqq0221.html#top
- **Split peas or peanuts:** These plants are members of the legume family. Legumes rely on bacteria in the soil. The bacteria attach to their roots and help the plants grow by fixing nitrogen gas so the plant can use the nitrogen. These bacteria are called *Rhizobium*. http://microbezoo.commtechlab.msu.edu/zoo/zdrmain.html
- **Vinegar:** Vinegar is made when a type of bacteria (*Acetobacter* spp.) where ferment ethanol (alcohol) turns into acetic acid (vinegar). http://www.versatilevinegar.org/faqs.html
- **Coffee beans:** When these beans come off the plant, they are coated with a pulp and surrounded by a thin skin. Yeasts are used to ferment and help destroy the pulp, so the beans can be more easily cleaned and dried. http://www.coffeereview.com/glossary.cfm?alpha=F
  Images of how coffee is made: http://www.flickr.com/photos/counterculturecoffee/5430967023/in/photostream/
- **Sweaty socks:** Sweaty feet are more likely to have an offensive odor, but it isn't the sweat (which is mostly salt and water) that causes the distinctive smell. Rather, it is the bacteria that live on the feet that lead to the smell. The bacteria enjoy the dark, damp environment of a sweaty sock, and have a feast, growing and metabolizing the sweat. When you remove the sock, the bacterial by-products are responsible for the odor. http://health.howstuffworks.com/question514.htm
- **Hot springs, such as Old Faithful:** Scientists have found bacteria that can live at very hot temperatures. They are using enzymes made from these bacteria to help them do experiments that would not otherwise be possible. http://mms.nps.gov/yell/ofvec/exhibits/ecology/microbes/alkaline.htm
- **Nose:** Nitric Oxide (NO) is commonly found in the nose and nasal passages, and is meant to protect people against disease-causing microbes. Staph aureus is a bacteria commonly found in the nose. When Staph aureus is exposed to Nitric Oxide (NO), it produces an enzyme, responsible for lactic acid production. http://www.textbookofbacteriology.net/staph.html

Mission X: Train Like an Astronaut

A MICROBIAL BOX

Did you know?
NASA sends microbes to the International Space Station with every mission. Some are in the food, some are in the air, and some are even inside the astronauts! To keep the crew from getting sick from bad microbes, before they fly to space the astronauts are kept away from people who feel ill and as many people as possible; even spouses and family!

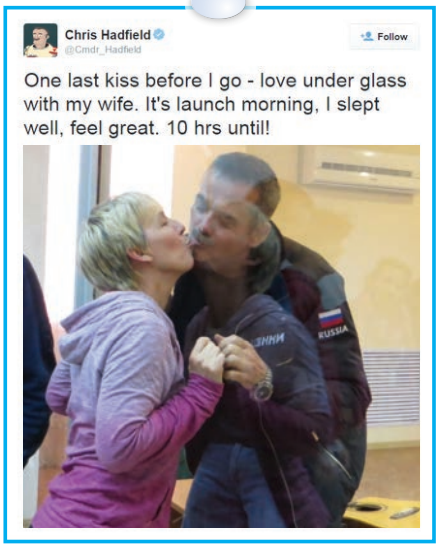
Student Section

Problem: How can I categorize life around me that cannot be seen?

Engage:

What are microbes, and which microbes are good for the human body? Are living things inside us? Do we eat living things? Are some of these living things good, and some bad, for our health? Which surfaces around school may have some living things on them which are too small to see? Can you imagine all the microbes floating around your school or the International Space Station?

In this activity, your group will investigate the relationship microorganisms have with many of the products we use every day. If your class completes part 2 of this activity, "Bugs in Space", your group will actually grow and study microbial life!



Commander Chris Hadfield, who flew to space three times.

Part 1 - Explore

Researching the microorganisms around us!

Use the first column of this KWL chart to organize what you already know about microbial growth. Brainstorm with your group what you want to know about microbial growth, then list in the second column of this KWL chart.

KNOW	WANT TO KNOW	LEARNED

Hypothesis:

Based on your observations, answer the "problem question" with your idea about answering the question, "How can I categorize life around me that cannot be seen?"

My answer: _____

_____

Safety

No safety concerns in this section. Do not eat any food items in this activity or science lab!

Procedures

1. Investigate with your group to determine what your items have to do with microbes.
2. ***Record your data*** on the Bugs in Space Microbial Box Research Sheet.
3. With your group, identify which of the items might be found on a spaceflight mission.
4. ***Record your data*** on the Bugs in Space Microbial Box Research Sheet. *Use Appendix A as a reference key.*
5. Present your data to the class. As other students present, ***record all the data*** on your Bugs in Space Microbial Box Research Sheet.

EXPLAIN

Microbial Box Research Sheet Solution Key

Item	How is this item related to microbes?	Are these microbes good or bad for humans and the environment? Why?	If this item is a body PART, should this PART of the body be tested on an astronaut?	Can this item be found on a spaceflight mission?
Yogurt				
Blue Cheese				
Swiss Cheese				
Antibiotics				
Bread				
Split peas or peanuts				
Vinegar				
Coffee beans				
Sweaty socks				
Hot Springs (Old Faithful)				
Nose				

EXPLAIN: Study Data

When you have completed your research, study your data and answer the following questions.

1. How many microbes were bad for humans and the environment?

2. How many microbes were good for humans and the environment?

3. Based on your data, are microbes good, bad, or both? Why?

4. Give examples of how microbes are used.

5. Which items could be found in a spaceflight mission?

6. Where are microbes found?

Student reading section:

Microbes live everywhere! While many microbes on Earth are harmless, and can even be helpful to humans, some microbes can be unsafe.

Microbes belong to a group all by themselves because they are neither plants nor animals. Because they can multiply extremely quickly, it is normal to find millions of them in the same location.

Figure 1: Inside a mouth where microbes cultivate (courtesy of Hardin MD/ University of Iowa and The Centers for Disease Control and Prevention)

Some microbes or "germs", such as bacteria and mold, can grow on food, dirty clothes, and garbage that people produce. Microbes live on your skin, in your mouth, nose, hair, and inside your body.

Microbes can also be found aboard the International Space Station (ISS). NASA scientists have reported that some germs on the ISS can increase to a higher number than they do on Earth. Therefore, cleanliness and proper disposal of garbage is an important part of living on the ISS.

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Geyser in Yellowstone National Park.

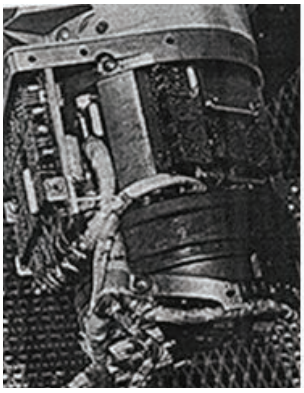


Figure 2: Television camera from Surveyor 3.

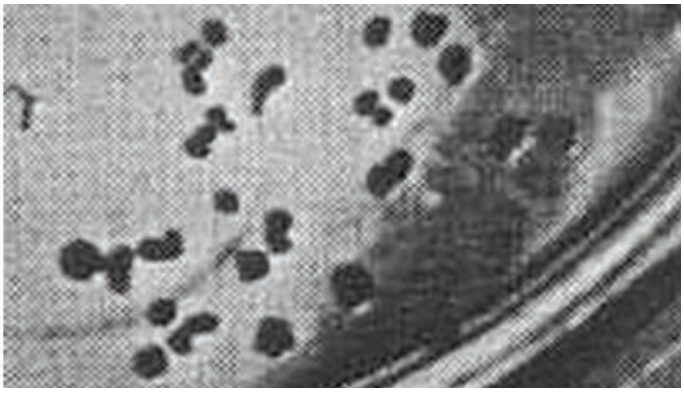
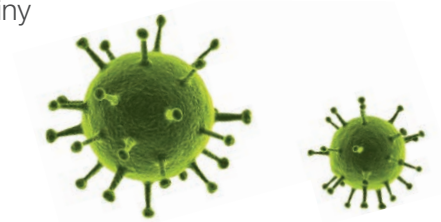


Figure 3: Bacteria found on the television camera of Surveyor 3.

Microbes can even survive in space. On April 20, 1967, the unmanned lunar lander Surveyor 3 landed near Oceanus Procellarum on the surface of the Moon. One of the onboard items included a television camera. Two-and-a-half years later, on November 20, 1969, Apollo 12 astronauts Pete Conrad and Alan L. Bean recovered the camera. When NASA scientists examined it back on Earth, they were surprised to find some bacteria called Streptococcus mitis were still alive. Because of the precautions the astronauts had taken, NASA could be sure that the germs were inside the camera when it was retrieved, so they must have been in the camera before the Surveyor 3 was launched. These bacteria had survived for 31 months in the vacuum of the Moon's atmosphere. They may have frozen or dried inside the camera, which are two ways normal bacteria can enter a state of deep sleep.

Figure 4: Close-up of bacteria that survived for almost 3 years on the moon.

Some scientists even believe there is a possibility that bacteria may have once lived on Mars. The photograph to the left (taken through a microscope) shows what some scientists believe may be the fossils of tiny bacteria in a rock that formed on Mars about 4.5 billion years ago. The rock crash-landed on Earth as a meteorite thousands of years ago.



Evaluate:

Update the LEARNED column in your KWL chart and answer the following questions:

1. Choose three objects in your microbial box that are similar to each other. How are they similar?

2. What is a different object that you might add to your microbial box that would be an example of something containing microbes?

3. Microbes are too small to see without a microscope. How might you know if you ate microbes in your food?

4. Which microbes would you find in your school as well as in your home?

5. Where else do you think you would be able to find a large amount of microbes?

Elaborate

1. How can you observe life around you that cannot be seen?

2. Which objects in your school do you think would have high amounts of microbes?

3. As a group, develop a plan as to how you help maintain a clean and microbe-free school. How could you do this at home?

4. Imagine you are a microbiologist concerned about astronaut safety. Please make recommendations to NASA to reduce the microbial level aboard spaceflight missions.

Extend

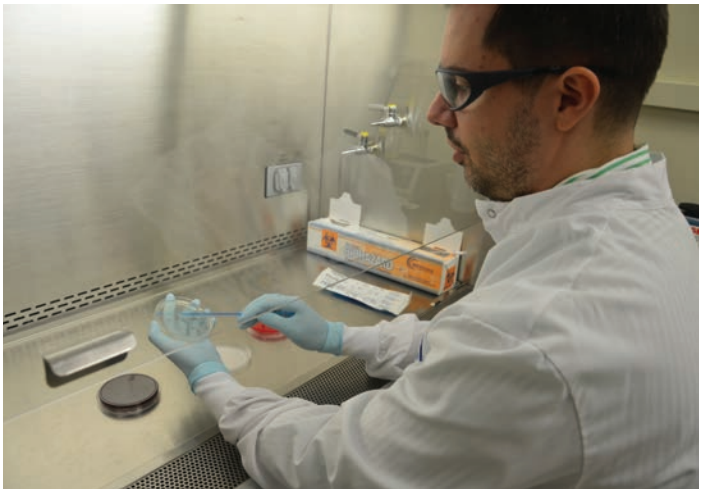
1. Read the “Did you know?” graphic. Why do you think astronauts are kept away from other people for a week before launching into space. How does this keep them from getting sick in space?

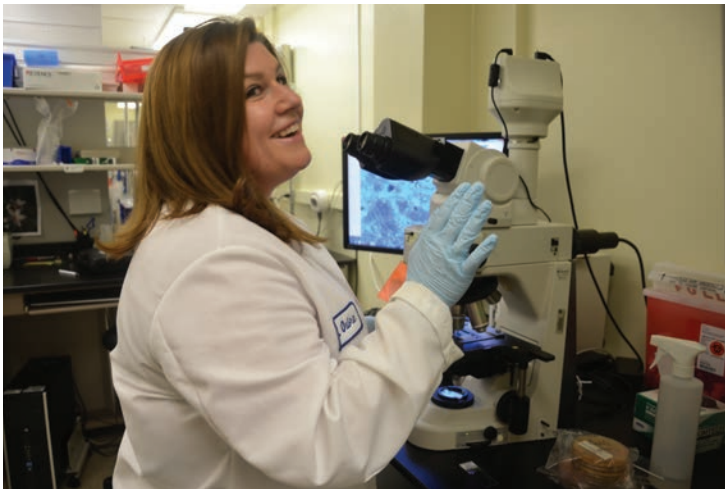
2. Look at your microbial box again. Where on the ISS would you expect more microbes to be found? Where would you expect the least amount of microbes?

3. Create a diary or story from the perspective of the microbes inside your microbial box. For example, if you were one of the microbes in the box, what would be your life story?

Thank you to our Contributors:

Thanks to subject matter experts Dr. Cherie Oubre, Rebekah Bruce, and Dr. Mark Ott for their contributions to the development of this education material. These scientists work in the Microbiology Laboratory at the NASA Johnson Space Center (JSC) in Houston, Texas.





Are you interested in working with microbes that are too small to see, yet are critical in the health and well-being of others? You, too, can continue to study microbiology and maybe one day you can work in the NASA Microbiology Laboratory with the highly skilled interdisciplinary team at the Johnson Space Center. The Microbiology Laboratory serves as a NASA-wide resource for microbial issues associated with living and working in closed environments specializing in spaceflight operations, including requirements development, environmental monitoring (including enumeration, microbial characterization and identification), potable water analysis, crew diagnostics, food analysis, crew training, biosafety review of payloads, and flight hardware and technology development. When a microbe is sampled on the ISS, chances are very good that the JSC Microbiology Laboratory has already studied it. The wonderful scientists in this lab devote their careers to studying these very small organisms that are too small to see, but are necessary to maintain a healthy life in space as well as on Earth.

This lesson was developed with the support of Sylvia Sáenz, a Bilingual Educator at Tinsley Elementary in Houston ISD. She has been teaching for nine years and currently works as a 3rd grade bilingual educator.

This lesson was beta-tested with the support of the following teachers: ***Ellen Hutto*** *has taught 6th, 7th, and 8th grade for the past four years. She currently teaches 5th grade science and has a true passion for space science. She is also the founder and director of Saltgrass Science Programs.* ***Jami Conner*** *has taught 5th grade for five years. She currently teaches math and science, and spends any spare time she has reading and spending time with her 19-month old son, Travis. Both teachers are proud to be Ross Roadrunners at James H. Ross Elementary in League City, Texas.*

Lesson development by the NASA Johnson Space Center Human Research Program Education Outreach team.