

# MISSION X

TRAIN LIKE AN ASTRONAUT



## A MICROBIAL WORLD

|                     |             |
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### Team Leader Guide

#### MISSION OVERVIEW

Students will investigate the relationship micro-organisms have with many of the products they use every day and then sample, grow, and investigate the micro-organisms around us.

#### LEARNING OBJECTIVES

- Analyse microbial life based on research.
- Investigate the relationship of many everyday products to micro-organisms.
- Examine the impact of micro-organisms on daily life.
- Discover that micro-organisms have the greatest diversity of all living organisms.
- Explain how micro-organisms are beneficial to humans and the environment.
- Formulate and prepare an inquiry-based investigation.
- Grow and study microbial life.

**Skills:** Scientific Methodology, Communication, Teamwork, Problem-solving, Critical thinking, Classifying, Sampling.

We recommend using two lessons for this Mission, spaced a few days apart. Use the first lesson to do Activity 1 allowing students to research and learn about micro-organisms before doing the swabbing and incubation. Use Lesson 2 to answer questions and to observe the microbial colonies in the petri-dishes under a microscope after they have had time to grow.

#### FAST FACTS

**Subject:** Microbiology  
**Age:** 8-14  
**Prep:** 30 mins  
**Lesson Time:** 2 x 1-hour lessons  
**Cost:** 0-10 Euros  
**Location:** Lab required

## SUMMARY OF ACTIVITIES

| Summary of activities |                            |  |  |                          |  |
|-----------------------|----------------------------|--|--|--------------------------|--|
|                       | Title                      | Description  | Learning Outcome   | Requirements             | Time   |
| 1                     | Microbial research         | Formulate a hypothesis about micro-organisms and explore how certain items affect microbial growth.          | <ul style="list-style-type: none"><li>• Creating hypotheses and forming conclusions.</li><li>• Researching information from sources such as the internet, textbooks and other sources.</li><li>• Conveying the information to other students.</li></ul>      | None                     | <b>Preparation:</b><br>10 minutes<br><br><b>Lesson time:</b><br>30 minutes             |
| 2                     | What's in your petri-dish? | Swabbing locations where microbes might be present and then observing microbial colonies under a microscope. | <ul style="list-style-type: none"><li>• Creating hypotheses and forming conclusions.</li><li>• Swabbing locations or items without contamination.</li><li>• Culturing microbial growth.</li><li>• Observing microbial colonies under a microscope.</li></ul> | Completion of activity 1 | <b>Preparation:</b><br>15 minutes<br><br><b>Lesson time:</b><br>30 minutes × 2 lessons |

## INTRODUCTION

Micro-organisms are found almost everywhere on the planet and can even survive in outer space. Whilst some microbes are dangerous, many are useful, for example in the production of medicines such as antibiotics or vaccines, and in the making of food such as cheese and bread.

We recommend reading the introduction about micro-organisms, included in the student worksheets, first, to learn more about them.

You can also use this video, from ESA Astronaut Thomas Pesquet: [ESA - Paxi on the ISS: Microbes](#) to introduce the concept of micro-organisms to your students at the start of the lesson.

## ACTIVITY 1: INFORMATION POSTER

### Preparation

Prepare a set of images of the following items:

- Yoghurt
- Blue cheese
- Slice of bread
- Peanuts
- Coffee beans
- Vinegar
- Sterile, empty container of antibiotics
- Sweaty socks
- Picture of geothermal hot springs or geyser.

You need more than one image of each product to share them with all the students.

**Exercise:** This research task could be given as homework and the results presented in the classroom.

Each student should receive one item or an image of the item. Students can be given a second or third item for an extended task.

The students need to determine if the item is a micro-organism, utilises micro-organisms, or is associated with micro-organisms in some way and filled, in the table sheet, their answer

Back in the classroom, project one by one, the table filled in by each student, onto the board and ask the students to present their data.

The tables with the correct filled-in answers can be found below. The first table has more detailed answers:

| Item    | How is this related to micro-organisms?   | Are these microbes good or bad for humans and the environment? Why?  | Can this item be found on a spaceflight mission?   |
|---------|---|--|--|
| Yoghurt | Yogurt is made from milk using special bacteria. These bacteria grow in the milk and convert milk into yoghurt. Some types of yoghurts still contain living bacteria.   | Good, because yoghurt can be a good source of calcium and vitamin D, and the living bacteria can be healthy for your gut.      | Yes, yoghurts are a good source of calcium and vitamin D, that astronauts need for maintaining strong bones. |
| Cheese  | Most cheeses have bacteria or fungi added to them. The type of bacteria/fungus determines the flavour of the cheese. For example, Cheddar cheese is made from bacteria that produce lactic acid (such as <i>Lactococcus</i> species). | Good, because cheese can also be a good source of calcium and protein. However, cheese can also contain lots of saturated fat. | Yes, because astronauts have a diminished sense of taste in space, cheese can be a good food to eat.         |

|                    |   |   |   |
|--------------------|---|---|---|
| Bread              | Most breads are made with yeast, which is a type of fungus. The yeast ( <i>Saccharomyces cerevisiae</i> ) ferments, producing carbon dioxide gas as a by-product which results in the bread rising.   | Good, because bread is a common and cheap food.   | Astronauts tend to eat flatbreads and tortillas so that the crumbs don't float around and mess up equipment.  |
| Peanuts            | Peanuts are part of the legume family. Like many other legumes, they have small nodules on their roots that contain nitrogen-fixing bacteria. These bacteria take nitrogen from the air to convert it into forms that plants can use to grow and make proteins. The bacteria that live in Peanut root nodules belong mainly to the group of <i>Rhizobium</i> and <i>Bradyrhizobium</i> .  | Good, because leguminous plants are a good source of plant-based proteins and the nitrogen-fixing bacteria mean less fertilisers are required.  | Yes, peanuts are eaten by astronauts in space, but they need to be careful if a crewmember is allergic.   |
| Coffee cherries    | When coffee cherries are picked, the beans inside are covered by a soft, sticky layer. Tiny helpers called yeasts come in to do a special job. They eat the sugars in the sticky layer and make it disappear. This helps the coffee beans get clean and dry before they are roasted.  | Good, because the coffee cherries are more easily cleaned and dried.  | Astronauts use straws in a coffee pouch or a special space cup to drink their coffee, to prevent hot coffee liquid from coming out and floating around, potentially damaging equipment!                   |
| Vinegar            | Vinegar is made when a type of bacteria ( <i>Acetobacter spp.</i> ) ferments ethanol (alcohol) into ethanoic acid (acetic acid), which makes up vinegar. Even though bacteria produce ethanoic acid, it can kill bacteria.  | Good, because vinegar is a useful ingredient in dishes and a cleaning product because ethanoic acid has antibacterial effects, which means it kills bacteria or acts against them.  | Vinegar is used as a condiment on the ISS to improve the taste for some astronauts.   |
| Antibiotics        | Antibiotics are used to treat bacterial infections. Also, most antibiotics are derived from natural products of fungi or bacteria that are used by these organisms to kill their competitors. An example is the antibiotic, Streptomycin, produced by the bacteria <i>Streptomyces griseus</i> . Many plant species produce substances with antibiotic effects. Some ant species produce antibiotics in their saliva, which helps them kill bacteria that would infect the fungus they farm as food | Both. Antibiotics are good because they are vital in stopping bacterial infections. However, antibiotics can have negative effects on the microbiome by killing your beneficial bacteria, and over-use of antibiotics can lead to bacteria becoming resistant to antibiotics, which can make them very dangerous. | Yes, there are antibiotics onboard the ISS in case an astronaut becomes ill or injured.   |
| Sweaty socks       | Sweaty feet are likely to have an offensive odour, 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 proliferate in the dark, damp environment of a sweaty sock, growing and metabolising the sweat. The bacterial by-products are responsible for the odour.  | Bad, because they can be dangerous bacteria like <i>Staphylococcus epidermis</i> . However, over-cleaning your skin can be harmful because bacteria on human skin is normal and help to protect the skin.   | Yes, sweaty socks can be found onboard the ISS, especially after exercise. Since water is a scarce resource on the ISS, clothes are simply thrown away with other waste to burn up in Earth's atmosphere. |
| Geo-thermal spring | Scientists have found bacteria and archaea that can live at very hot temperatures. Organisms that can live in extreme environments are called extremophiles, and organisms that can survive in extreme heat are called thermophiles.  | Good, because scientists use enzymes from these microbes to perform experiments that would not otherwise be possible.   | Astronauts have sent extremophiles to live temporarily in space   |

The second table has simplified answers:

| Item               | How is this related to micro-organisms?   | Are these microbes good or bad for humans and the environment? Why?   | Can this item be found on a spaceflight mission?  |
|--------------------|---|---|---|
| Yoghurt            | Yoghurt is made from milk using special bacteria. These bacteria grow in the milk and convert milk into yoghurt. Some types of yoghurts still contain living bacteria.  | Good, because yoghurt can be a good source of calcium and vitamin D, and the living bacteria can be healthy for your gut.   | Yes, yoghurts are a good source of calcium and vitamin D, that astronauts need for maintaining strong bones.  |
| Cheese             | Most cheeses have bacteria or fungi added to them. The type of bacteria/fungus determines the flavour of the cheese. For example, Cheddar cheese is made from bacteria that produce lactic acid (such as <i>Lactococcus</i> species).   | Good, because cheese can also be a good source of calcium and protein. However, cheese can also contain lots of saturated fat.  | Yes, because astronauts have a weaker sense of taste in space, cheese can be a good food to eat.  |
| Bread              | Most breads are made with yeast, which is a type of fungus. The yeast ( <i>Saccharomyces cerevisiae</i> ) produces carbon dioxide gas, which results in the bread rising.   | Good, because bread is a common and cheap food.   | Astronauts tend to eat flatbreads and tortillas so that the crumbs don't float around and mess up equipment.  |
| Peanuts            | Peanuts have small nodules on their roots that contain nitrogen-fixing bacteria. These bacteria take nitrogen from the air to convert it into forms that plants can use to grow and make proteins.  | Good, because peanuts are a good source of plant-based proteins and the nitrogen-fixing bacteria mean less fertilisers are required.  | Yes, peanuts are eaten by astronauts in space, but they need to be careful if a crewmember is allergic.   |
| Coffee cherries    | When coffee cherries are picked, the beans inside are covered by a soft, sticky layer. Tiny helpers called yeasts come in to do a special job. They eat the sugars in the sticky layer and make it disappear. This helps the coffee beans get clean and dry before they are roasted.  | Good, because the coffee cherries are more easily cleaned and dried.  | Astronauts use straws in a coffee pouch or a special space cup to drink their coffee, to prevent hot coffee liquid from coming out and floating around, potentially damaging equipment!                   |
| Vinegar            | Vinegar is made when a type of bacteria ( <i>Acetobacter spp.</i> ) ferments alcohol into ethanoic acid, which makes up vinegar. Even though bacteria produce ethanoic acid, it can kill bacteria.  | Good, because vinegar is a useful ingredient in dishes and a cleaning product because ethanoic acid can kill bacteria.  | Vinegar is used as a condiment on the ISS to improve the taste for some astronauts.   |
| Anti-biotics       | Antibiotics are a medicine used to treat infections caused by bacteria. Also, most antibiotics are made from natural products of fungi or bacteria that are used to kill other bacteria. Many plants produce substances with antibiotic effects. Some ant species produce antibiotics in their saliva, which helps them kill bacteria that would infect the fungus they farm as food. | Both. Antibiotics are good because they help to stop bacterial infections. However, antibiotics can have negative effects by killing good bacteria in your body. Also, using antibiotics too much can lead to bacteria becoming resistant to antibiotics, which can make them very dangerous. | Yes, there are antibiotics onboard the ISS in case an astronaut becomes ill or injured.   |
| Sweaty socks       | Sweaty feet are likely to smell bad due to the bacteria that live on the feet. The bacteria grow in the dark, damp environment of a sweaty sock and produce the bad smells.   | Bad, because they can be dangerous bacteria like <i>Staphylococcus epidermis</i> . However, over-cleaning your skin can be harmful because bacteria on human skin is normal and helps to protect the skin.  | Yes, sweaty socks can be found onboard the ISS, especially after exercise. Since water is a scarce resource on the ISS, clothes are simply thrown away with other waste to burn up in Earth's atmosphere. |
| Geo-thermal spring | Scientists have found bacteria that can live at very hot temperatures. Organisms that can live in extreme environments are called extremophiles, and organisms that can survive in extreme heat are called thermophiles.  | Good, because scientists use enzymes from these microbes to perform experiments that would not otherwise be possible.   | Astronauts have sent extremophiles to live temporarily in space.  |

## Did you know?

The type of bacteria/fungus determines the flavour of the cheese. For example, Cheddar cheese is made from bacteria that produce lactic acid (such as *Lactococcus* species) whilst the white surface mould of Brie or Camembert is made from at least four different microbial species – *Penicillium camemberti*, *Geotrichum candidum*, *Kluyveromyces lactis*, and *Debaryomyces hansenii*.

## ACTIVITY 2: WHAT'S IN YOUR PETRI-DISH?

### Pre-lesson preparation

Prepare the equipment for each group before the lesson. Your school might have the equipment in the science lab room or you can purchase the equipment beforehand. A full list of equipment and instructions can be found in the student section on page 12.

For the Petri-dishes, it is important to use an agar formulation that does not preferentially grow one kind of bacteria over another. Although other agar formulations might work, it is recommended that you purchase nutrient agar for this activity as it will grow the widest range of bacteria. You can purchase nutrient agar from any science supply and material company.

Prepared Petri dishes should be refrigerated until used and always stored upside down (media in upper dish and cover on the bottom). This keeps condensation, which forms on the lid, from dropping onto (and disrupting) the microbe growing surface.

### Exercise

Divide the class into groups of 2 – 4 students. Each group should prepare one control Petri-dish by swabbing it with a sterile cotton swab without sampling any surface; they should label this dish as the 'control'. Each student should have their own Petri-dish and a sterile cotton swab to collect a sample from a chosen location.

After the Petri-dishes have been swabbed, they should be left for around 5 days to allow the microbial cultures to grow. The exact number of days does not matter, as long as all Petri-dishes from the same class group are analysed on the same day so that the variable of time is kept consistent.

### Sterilisation

After the Petri-dishes have been analysed, they need to be autoclaved at 121°C for 15 minutes to sterilise any dangerous micro-organisms. If there is no autoclave available, 1% Virkon solution can be used, or a domestic pressure cooker. Bleach should only be used if these solutions are not available.

### Questions

Most of the questions can be answered using the data the students collected, but the following one requires instead background knowledge:

1. Micro-organisms are too small to see without a microscope. How did you observe and measure microbial growth without seeing each individual microbe? **Suggested answer: Even though an individual microbe is too small to be seen without a microscope, a whole microbial colony is large enough to see with the naked eye, so we counted the number of colonies.**

# MISSION X

TRAIN LIKE AN ASTRONAUT



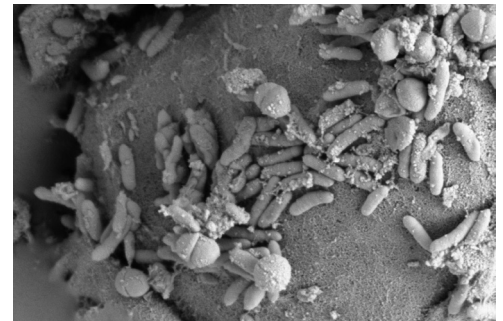
## A MICROBIAL WORLD

### Student Worksheet

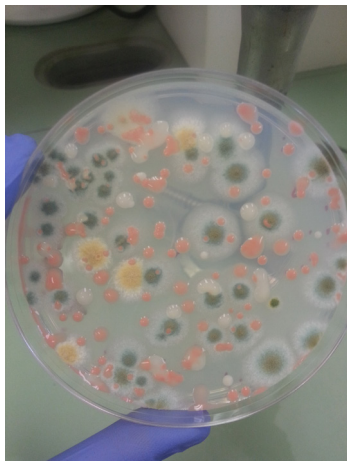
#### MISSION OVERVIEW

You will investigate how micro-organisms are involved in many everyday products and then you will collect, grow, and study the micro-organisms found in our surrounding.

Microbes live everywhere! Whilst many micro-organisms are harmless, and can even be beneficial to humans, some can be unsafe.



*Diverse population of bacteria from the Corona lava tube in Lanzarote, Spain. Credit: Ana Miller*



*Microbial samples from the ISS. Credits: NASA/JPL*

Micro-organisms are organisms of microscopic size, so they can't be seen with the naked eye. Powerful microscopes are needed to see them. Microbes are a large and diverse group, which include bacteria, algae, fungi, protozoa and archaea.

Some microbes or 'germs', especially bacteria and mould, can grow on food, dirty clothes, and rubbish that people produce. Trillions of microbes live on your skin, in your mouth, nose, hair, and inside your body.

#### Did you know?

Some microbes, especially many strains of bacteria, can multiply extremely quickly. The fastest multiplying species can double in population every 20 minutes! Because they can multiply extremely quickly, it is normal to find millions of them in the same location.

Microbes can also be found on board the International Space Station (ISS). The photo on the right is of fungi growing on the ISS where an astronaut hung their clothes to dry after sweaty exercise. Therefore, cleanliness and proper disposal of rubbish is an important part of living on the ISS.



Credit: NASA/ESA

**Did you know?**

Micro-organisms found inside your body are known as the ‘microbiome’. The microbiome is essential to help you live. Beneficial microbes in your gut break down nutrients so you can digest them, and beneficial microbes on your skin stop the growth of dangerous microbes. Astronauts are given prebiotic pills to support their microbiome.

**Did you know?**

Eating plenty of fibre and eating a balanced diet helps you to develop a healthy microbiome. Microbial cells outnumber your own cells by 10x in your own body! Learn more about healthy diets in the Mission X missions [‘Reduced Gravity, Low-Fat’](#) and [‘Energy of an Astronaut’](#).

**ACTIVITY 1: MICROBIAL BOX**

**HYPOTHESIS**

Your hypothesis should be a statement to answer the problem based on your observations, predictions and the materials available.

**Problem:** Can microbes be beneficial or are they always harmful?

**Hypothesis:**

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## Did you know?

If you pick up a fistful of garden soil in Europe, you are holding thousands of different kinds of microbes in your hand. A single teaspoon of soil contains over a billion individual microbes of 10,000 different species!

## PROCEDURE

In your group, based on the items your teacher gave you, research and investigate the questions found in the table below. Your teacher will ask you to present data to the class. As other students will be presenting, we recommend you to record all the data in the table below:

| Item               | How is this related to micro-organisms? | Are these microbes good or bad for humans and the environment? Why? | Can this item be found on a spaceflight mission? |
|--------------------|---|---|--|
| Yoghurt            |   |   |  |
| Cheese             |   |   |  |
| Bread              |   |   |  |
| Peanuts            |   |   |  |
| Coffee cherries    |   |   |  |
| Vinegar            |   |   |  |
| Anti-biotics       |   |   |  |
| Sweaty socks       |   |   |  |
| Geo-thermal spring |   |   |  |

## Did you know?

ESA astronaut Matthias Maurer has even made his own yoghurt onboard the ISS, using milk that he allowed to ferment using prebiotic pills. On Earth, the gas produced by microbes rises to the top of the yoghurt pot but, in weightlessness in space, gases can't rise and so pockets of gas appear in the yoghurt – making the yoghurt more like a mousse!

## QUESTIONS

These questions will help you to form a conclusion.

1. State and explain three examples of how micro-organisms are used for the benefit of humans.

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2. Micro-organisms are too small to see without a microscope. Could you guess how would you feel in case you ate food that was contaminated by dangerous microbes.

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3. In the items you were given, name the examples of items that were related to microbes that were harmful for humans and the environment.

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4. In the items you were given, name the examples of items that were related to microbes that were beneficial for humans and the environment. Explain your reasoning.

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5. Suggest a different item to research that would be an example of something containing microbes.

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6. Based on your data, are microbes good, bad, or both? Explain your reasoning.

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7. Does this data support your hypothesis in the beginning? Why or why not?

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## CONCLUSION

Restate your hypothesis, then explain what happened during testing, including your results.

**Problem:** Can microbes be beneficial or are they always harmful?

**Conclusion:**

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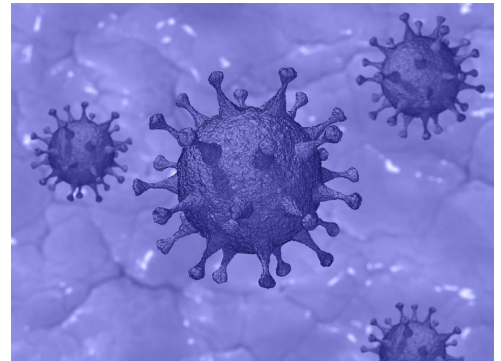


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## INFECTION AND VACCINES

When you get an infection, it means harmful microbes might have entered your body and are making you feel unwell. Your immune system fights back, but the immune response can also be dangerous and can sometimes last a long time.

Your immune system fighting back against microbes can be what causes you to have a runny nose, sore throat, feel exhausted and other symptoms when you are ill. Sometimes, the microbes themselves can cause these bad symptoms. Luckily, the immune system can remember a disease for years, giving you immunity to fight that disease much quicker in the future. This is exactly as vaccines are working, too.



*Credit: ESA*

Vaccines train your immune system to recognise dangerous microbes and how to fight them, which gives you immunity so that you are much less likely to catch the disease in future and have less strong symptoms. This is why routine vaccinations are important to keeping yourself and society healthy.

### Did you know?

Before astronauts fly to space, they are kept in quarantine to prevent them from getting ill from dangerous microbes. The astronauts are kept away from people who feel ill and from as many people as possible, even spouses and family!

## ACTIVITY 2: WHAT'S IN YOUR PETRI-DISH?

### Problem

Micro-organisms are all around us yet are too small to be seen with the naked eye. How can you develop an experiment to test where the most microbes are found?

## MATERIALS

### Per student:

- Safety glasses or goggles
- Disposable gloves
- Petri-dish with agar
- Sterile cotton swab

### Per group:

- Microscope
- An extra Petri-dish with agar
- Extra sterile cotton swab
- Permanent marker pens
- Large zip-sealed bag



### Safety:

Micro-organisms can be dangerous. You should **wear eye protection** during this activity. You should **wear hand protection** during this activity. Always **wash your hands** before and after touching any of the equipment, the surfaces and anything else, and wash your hands again after finishing the activity. **Do not touch your face or skin with your disposable gloves.** Review your classroom and lab safety rules.

## HYPOTHESIS

Your hypothesis should be a statement to answer the problem based on your observations, predictions and the materials available.

**Problem:** Which locations contain the most micro-organisms?

**Hypothesis:**

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## PROCEDURE

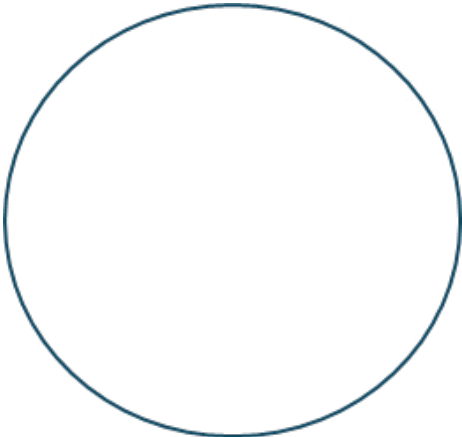
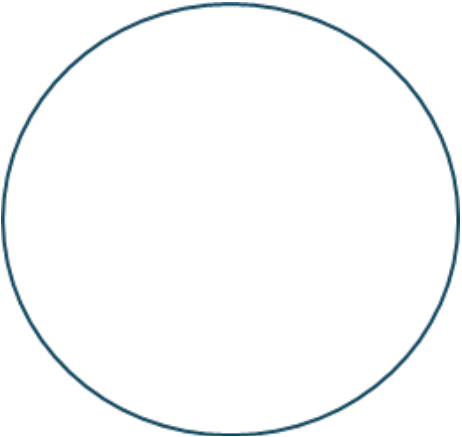
### Session 1

1. With your group, decide what places or items to swab with the sterile cotton swab. **Make sure your teacher approves them.**
2. Record the places or items your group will test on your Microbial Life Analysis Sheet. **Use one Microbial Life Analysis Sheet per place or item tested.**
3. Put on your safety goggles and disposable gloves. **Do not touch your face, eyes, skin or any body part whilst you have your gloves on.**
4. Watch as your teacher models the correct procedure to swab the Petri-dish without tearing the agar surface.
5. Swab your place or item using a sterile cotton swab. Without tearing the agar surface, very gently rub the swab over the agar in a few strokes and put on the lid. **Each of you should swab a different location or item.**
6. Dispose of the used cotton swabs in the container that your teacher tells you to.
7. With a permanent marker, label your Petri-dish with your name, the name of the item to be tested and the date.
8. To help prevent condensation from dropping onto and disrupting the microbe growing surface, place the Petri-dish upside-down in the incubator.
9. Wash your hands with anti-septic soap and water.
10. Predict what will happen in 1 hours and 48 hours and record your predictions on the Microbial Life Analysis Sheet. **Include physical properties such as shape, colour and the number of colonies.**

### Session 2

1. Put on your safety goggles and disposable gloves.
2. Observe the microbial colonies and record the information on your Sheet. **How many colonies are there? What colour do they have? What shape? Do they look furry or slimy?**
3. With your group, place the Petri-dish under the microscope. Observe the bacterial colonies in greater detail. **Use the coarse focus to adjust the focus of the image to see the microbial colonies. After you can see them, use the fine focus to finely adjust the focus of the image to see the microbial colonies in greater clarity.**

**MICROBIAL LIDE ANALYSIS SHEET**

| Incubation period | Key information   | Description of the microbial culture      | Sketch of the microbial culture  |
|-------------------|---|---|--|
| 0 hours           | Location/item tested: _____<br>Date: _____<br>Time: _____<br>Temperature: _____ | Predict what you think it will look like: |   |
| 5 days            | Location/item tested: _____<br>Date: _____<br>Time: _____<br>Temperature: _____ | Actual:                                   |  |

**QUESTIONS**

These questions will help you to form a conclusion.

1. Micro-organisms are too small to see without a microscope. How did you observe and measure microbial growth without seeing each microbe?

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2. Explain why you decided to swab that specific location or item.

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3. Does the sample growth lead you to believe that there are few or many micro-organisms in that location or on that item? Explain your reasoning.

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4. Explain how your results do, or do not, support your hypothesis.

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5. Suggest other locations that you might find a large number of microbes. Explain your reasoning.

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**CONCLUSION**

Restate your hypothesis, then explain what happened during testing, including your results.

**Problem:** Which locations contain the most micro-organisms?

**Conclusion:**

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## RESOURCES AND LINKS

### ESA Resources

- In this video, ESA Astronaut Thomas Pesquet talks about micro-organisms: [ESA - Paxi on the ISS: Microbes](#)
- This ESA website explains more about microbes: [ESA - Space for Kids - Microbes](#)
- This ESA website explains about self-cleaning surfaces on spacecraft: [ESA - Self-cleaning spacecraft surfaces to combat microbes.](#)

### Extra information

- This document explains the safest way to dispose of Petri-dishes with microbial cultures: [Handling.](#)
- This website contains information about microbes in soil: [Why do soil microbes matter? | UK Centre for Ecology & Hydrology.](#)

## APPENDIX

### Acknowledgements

This resource has been adapted in 2025 from NASA's 'A Microbial Box' and 'What's in your Petri' by the ESA Education Office.

Original Credits: Lesson development by the NASA Johnson Space Center Human Research Program Education and Outreach team, with thanks to subject matter experts who contributed their time and knowledge to this resource.