MISSION X

TRAIN LIKE AN ASTRONAUT

HYDRATION STATION

Team Leader Guide

MISSION OVERVIEW

Students will learn about the importance of staying hydrated for maintaining good health. They will also learn how to identify the symptoms of dehydration.

FAST FACTS

Subject: Biology and science
Age: 8-12
Prep: 20 mins
Lesson Time: 2 × 45-minute lessons
Cost: 0-10 Euro
Location: Lab recommended

LEARNING OBJECTIVES

- Understand the importance of hydration for human beings.
- Researching and analysing information.
- Assess the reliability of sources.
- Evaluate the healthiness of different beverages.
- Creating a model to simulate reality.
- Understand the effect that drinking more water has on urine colour.

Skills: Researching, Scientific Methodology, Communication, Teamwork, Problem-solving.

RELATION TO OTHER MISSION X MISSIONS

To demonstrate how exercise impacts hydration levels, we suggest accompanying the Hydration Log activity with a physical task. The Mission X activity 'Do a Spacewalk' is a great example ready to use.

SUMMARY OF ACTIVITIES

Summary of activities					
	Title	Description	Learning Outcome	Requirements	Time
1	Information Poster	Researching facts about hydration and creating a poster based on this information.	• Learn the importance of hydration for the human body. • Understand how to research information effectively, including from textbooks and the internet. • Selecting and comparing trustable information sources. • Create a poster that relays information concisely.	None	**Preparation:** 5 minutes **Lesson time:** 20 minutes
2	Healthy hydration	Categorise sources of hydration on whether they are 'healthy', 'unhealthy' or neutral.	• Evaluate the healthiness of different beverages using their prior knowledge and critical thinking.	None	**Preparation:** 1 minute **Lesson time:** 10 minutes
3	Hydrate the astronaut	Labelling the organ or part of the astronaut and write a short paragraph on why hydration is important for that part of the body.	• Understand the importance of hydration for each organ. • Convey and explain information in a concise manner.	Completion of activity 1	**Preparation**: 5 minutes **Lesson time:** 10 minutes
4	Simulating urine	Formulating a hypothesis about urine and dehydration and simulating urine model samples.	• Creating hypotheses. • Simulating a model of urine to represent different levels of dehydration. • Understanding how models represent reality.	Completion of activities 1	**Preparation**: 10 minutes **Lesson time**: 30 minutes
5	Hydration log	Keeping a log of urine colour to determine if the student is drinking enough liquids.	• Developing skills in writing a scientific log for observation purposes. • Learning the importance of maintaining accurate logs during an experiment. • Understanding that drinking enough liquids is important to maintain a healthy urine colour.	None, but completion of activities 1, 2 and 3 are advisable	**Preparation**: 1 minute **Lesson time**: 10 minutes
6	Hydration on the ISS	Exploring the process of water recycling on the ISS.	• Understand how water is recycled on the ISS. • Apply prior knowledge to answer new questions.	None	**Preparation**: 1 minute **Lesson time**: 10 minutes

INTRODUCTION

Staying hydrated is crucial for healthy lifestyle. Drinking enough water is just as important as eating a balanced diet, exercising regularly and getting enough sleep. Dehydration can lead to headaches, confusion and brain fog – and even accelerate the ageing process!

Hydration equally vital for astronauts, as they must be in top physical and mental condition to undertake cutting-edge scientific research and perform space walks. This mission focuses on the importance of staying hydrated in day-to-day life.

At the start of the lesson, we suggest showing your students this video of ESA astronaut Andreas Mogensen drinking orange juice in space to get them engaged with hydration in the context of space: Drinking in space.

ACTIVITY 1: INFORMATION POSTER

In this activity, students will create a poster about hydration. They will need access to the internet so that they can research information about the importance of staying hydrated. Encourage them to use reliable sources – e.g. research papers, well known reliable online websites – rather than unreliable sources (such as a personal blogs).

After they have completed the poster, we suggest you tell them to present the poster to the class or to stick the posters up. This will develop the students' confidence in presenting to a class and they can learn from other groups' research.

Examples of reliable websites

- European Space Agency
- World Health Organisation
- European Public Health Association
- National Health Service
- European Commission
- European Centre for Disease Prevention and Control

ACTIVITY 2: HEALTHY HYDRATION

In this activity, students will evaluate and categorise beverages and foods into ‘healthy’ and 'unhealthy' sources of hydration. Here are the answers:

‘Healthy’ sources of hydration	‘Unhealthy’ sources of hydration
Bottled water	Sports drinks
Tap water	Energy drinks
Sparkling water	Alcoholic beverages
Tea	Milkshakes
Milk	Flavoured milk
Cucumber	Coke
Strawberries	Pepsi max
Oranges	Sugary drinks
Vegetable soup	Gravy
Fruit juice	
Coffee	

Fruit juice, coffee, and sports drinks have both healthy and unhealthy aspects due to their nutritional content and effects on the body. While fruit juice contains vitamins, it also contains a lot of natural sugar. Coffee is low in fat, sugar and salt if you consume it pure, but contains caffeine that has different effects on the body. Sport drinks often contain a lot of sugar and sodium – so are not recommended for children – but can be beneficial to athletes to compensate electrolyte loss.

ACTIVITY 3: HEALTHY HYDRATION

In this activity, students will label the organ or body part of the astronaut. For older students or more advanced students, you can encourage them to write a short explanation of why hydration is important for that part of the body.

- **Brain**: Dehydration can impair your ability to concentrate. It may also affect your brain’s processing and abilities as well as impair your short-term memory.
- **Heart**: Fluids play a role in keeping your blood pressure normal. Dehydration can decrease cardiac output which may lead to increased heart rate and reduce your blood pressure.
- **Kidneys**: Hydration is essential for Kidneys; water helps remove waste, toxins and excess nutrients from the body. A healthy hydrated kidney filters approximately 180L of water each day. Kidneys expel waste substances using water, creating urine in the process. Thus being dehydrated means that kidneys must work harder to expel waste substances using less water.
- **Digestive System**: Water aids in the digestion of food; it’s found everywhere in your digestive track from your saliva to the solution of enzymes of your lower intestine. Water helps dissolve nutrients that are absorbed into your bloodstream and delivered to your cells.
- **Cells**: Hydration is critical for transporting carbohydrates, vitamins and minerals to your cells. Cells are made up of approximately 70% water.
- **Muscles and Joints**: Water is important for your muscles and joints; it helps cushion joints and keeps muscles working properly. Your muscles are made up of approximately 76% water.
- **Skin**: Staying well hydrated will help preserve your skin’s elasticity, softness and colouring.

ACTIVITY 4: SIMULATING URINE

In this activity, students will be creating simulated urine using food colouring and water. Prepare the materials for each group prior to the lesson. A full list of all equipment and instructions can be found on page 11, which is page 5 of the student worksheets.

ACTIVITY 5: HYDRATION LOG

In this activity, students will keep a log of their urine colour to determine if they are drinking enough water. Before the lesson, print out the hydration log table, one per student.

We suggest using one of the Mission X physical resources so that the students can see how exercise affects their urine colour and thus their level of hydration.

Questions

Questions 1, 2, 3, 4 are based on the students' own hydration log, so each student will have individualised answers. Here are sample answers for questions 3 and 5:

Question 3: What circumstances do you think made your urine a darker colour at this time of day?

Sample answer: **At this time of day, I hadn't drunk any water for a few hours, which meant I was slightly dehydrated and had dark yellow urine.**

Sample answer: **I had been asleep all night, not drinking any water, so I woke up dehydrated and my urine was a dark colour.**

Sample answer: **Earlier today I ate some beetroot and this might have changed the colour of my urine.**

Question 5: Explain why hydration is important to stay healthy.

This question can have a multitude of answers that they might have picked up from their own research for the hydration poster, or from the introduction.

Sample answer: **Hydration is important to stay healthy because many of our organs depend on sufficient water in our body. For example, kidney stones can form over time if you are often not drinking enough water. Dehydration can lead to headaches and dizziness, so drinking enough water is important to stay healthy.**

ACTIVITY 5: HYDRATION ON THE ISS

We suggest you show this video of ESA astronaut Samantha Cristoforetti as she explains how the toilets work on the ISS and that urine is recycled: International Space Station toilet tour.

Questions

1. State the substance that all life needs to thrive. **Water**

2. Explain why astronauts need to be even more careful about staying hydrated, compared to people on Earth.

   It is important to mention the dangers of being dehydrated in space, and to explain that – in weightlessness – the human body thinks it is overhydrated and tries to compensate, which makes the astronaut dehydrated, so the astronaut has to be careful to continuously drink enough fluids.

   Sample answer: **It is important for astronauts to stay hydrated because they are in the harsh and dangerous environment of space. Dehydration can make the astronaut confused, which would be dangerous. Also, astronauts carry out lots of research, and dehydration can impair their ability to undertake their tasks. In weightlessness, there is no gravity pulling blood down away from the head, which means that blood pools in the head. The body detects this as the astronaut being too hydrated, so the body will urinate more often to get rid of excess water. This leads to the astronaut being dehydrated without realising, so the astronaut must continuously drink enough liquid to stay hydrated.**

3. Suggest why ESA and the other space agencies try to recycle as much water as possible, instead of sending fresh water up from Earth and disposing wastewater with the rubbish?

   Sample answer: **Sending supplies to the International Space Station (ISS) is costly and demands extensive planning and time. As a result, it's crucial to recycle as much water as possible in space to minimize the amount that needs to be transported. The knowledge we gain from recycling in space can also help improve recycling methods and waste reduction on Earth, offering valuable benefits to our everyday lives.**

STUDENT WORKSHEET

HYDRATION STATION

Student Worksheet

MISSION OVERVIEW

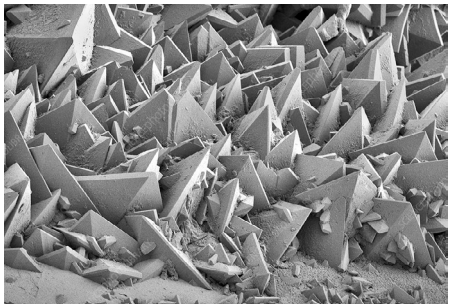
You will explore the importance of staying hydrated here on Earth and in space. You will also learn to identify the signs of dehydration.

INTRODUCTION

Staying hydrated is crucial for living a healthy lifestyle. Drinking enough water is just as important as eating a balanced diet, doing enough exercise and getting enough sleep.

Credits: Adobe Stock Photo

Many tissues and organs can't function properly without enough water. For example, your lips and skin can become dry and cracked if you don't drink enough water throughout the day.



Electron micrograph of kidney stones.
Credits: Thomas Deerinck, NCMIR / Science Photo Library

Dehydration can cause headaches, make you feel lightheaded or dizzy and confused. Being dehydrated often can lead to kidney stones developing, which can be very painful.

Astronauts need to stay properly hydrated whilst on mission to the International Space Station (ISS). Gravity on Earth pulls blood down, away from our head, and our bodies have evolved to cope with this.

In weightlessness on the ISS, there is no gravity to pull blood downwards and so it pools in the head. This makes the astronaut's face look puffy. The body thinks it has too much liquid, so it tries to get rid of the extra fluids, which can cause the astronaut to become dehydrated.

Samantha Cristoforetti drinking water on the ISS
Credits: ESA/NASA

Did you know?

If you feel thirsty, that means you are already dehydrated and not drinking enough water.

Credit: ESA

Astronauts must drink lots of liquids to stay hydrated. This is especially important because dehydration can cause you to feel dizzy and confused, which can be very dangerous for an astronaut in space.

Did you know?

If you are older than 8 years old, you should aim to drink about 2 litres of liquid per day, or more if you are participating in sport or it is a hot day. Sweat is mainly water, so anything that causes you to sweat will mean you must drink more water.

ACTIVITY 1: POSTER

In this activity, you will create a poster about hydration.

Discuss the importance of staying hydrated, the risks of dehydration and the best methods to keep hydrated. Do some research about the topic and collect information from different sources for your poster.

Reliability of sources

The best places to find trustworthy information are books, scientific researches, news from well-known newspapers, and websites from schools or big organisations. You shouldn't believe everything you read on a website without checking it with better sources. For example, a website from a university or school is usually more trustworthy than someone's personal blog

Reliability of sources

Whilst creating your group poster keep the following questions in mind:

- What is dehydration?
- What are the causes of dehydration?
- What are the signs of dehydration?
- How can dehydration be prevented?
- Why is it important to keep your body hydrated?
- What are the best beverages to stay hydrated?
- Do you think hydration is important to astronauts while they are in space?
- When should an astronaut be concerned about hydration in space?

Did you know?

Dehydration can affect an athletic performance and increase the risk of a medical emergency. Elderly people are more susceptible to dehydration due to less fluid content in the body, and they also have a reduced sense of thirst and loss of appetite that can trigger dehydration. Hence, dehydration is a major cause for hospitalisation among the elderly.

Be prepared to present your group poster to the class.

ACTIVITY 2: HEALTHY HYDRATION

There are many ways in which you can stay hydrated. And not just by drinking! Some types of food contain enough water to help you hydrate. Here is a list of some sources of hydration; your task is to categorise them into 'healthy' or 'unhealthy' sources of hydration. Two of the options have been classed as both 'healthy' and 'unhealthy', do you know why?

- Bottled water
- Sports drinks
- Alcoholic beverages
- Tap water
- Energy drinks
- Sparkling water
- Fruit juice
- Coffee
- Tea
- Milk
- Flavoured milk
- Coke
- Pepsi max
- Cucumbers
- Strawberries
- Oranges
- Sugary drinks
- Gravy
- Vegetable soup

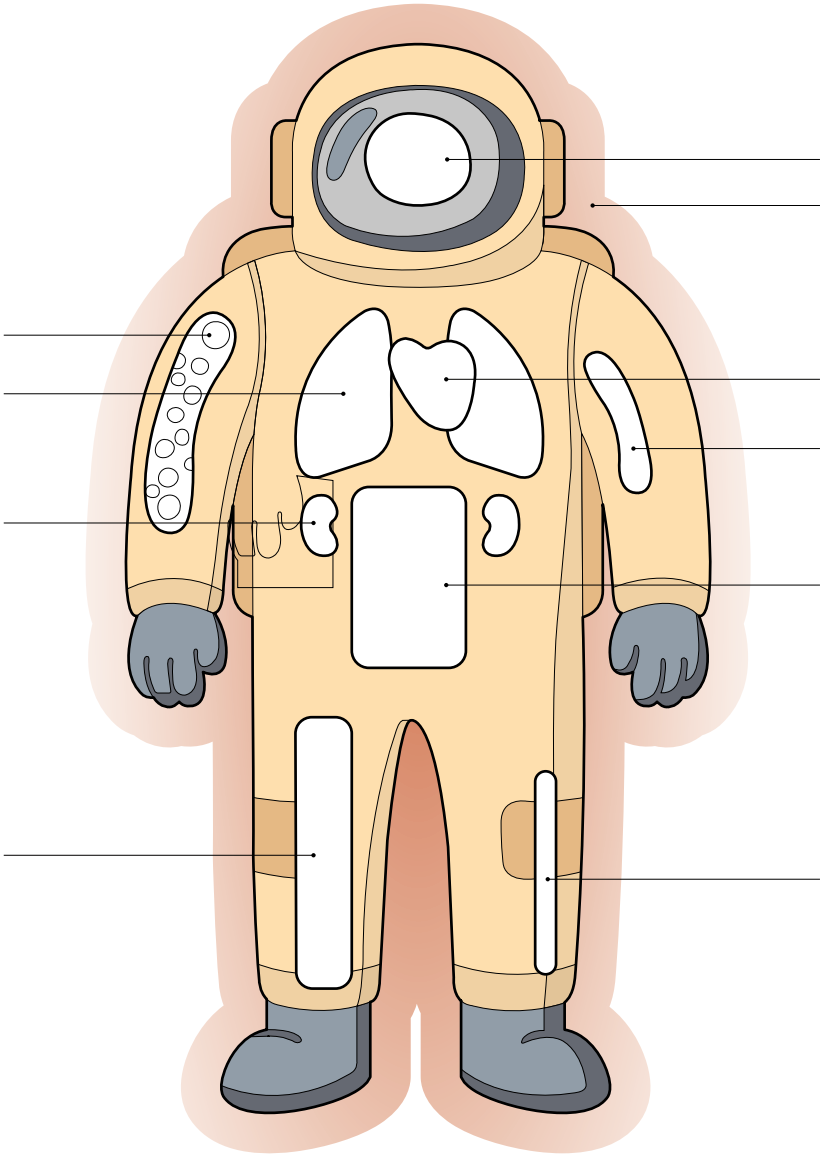
'Healthy' sources of hydration	'Unhealthy' sources of hydration
Bottled water	

Did you know?

Your body's water helps dissipate heat, regulating your overall body temperature. When you get too hot your body releases water by sweating to cool you down. If you do not replace the water you lose through sweating, your body can become dangerously dehydrated.

ACTIVITY 3: HYDRATE THE ASTRONAUT

Label the organ or part of the astronaut. Your teacher will tell you if they want you to do anything else in this activity.



WORD BANK
Cells
Heart
Muscles
Brain
Kidneys
Temperature
Digestive System
Skin
Lungs

ACTIVITY 4: SIMULATING URINE

Urine changes colour depending on how much water you drink throughout the day. In this activity, you will be simulating urine by making a model using water and food colouring.

HYPOTHESIS

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

Question: How can I identify if I am drinking enough water to be hydrated, by using simulated urine?

Hypothesis:

_____

_____

_____

MATERIALS

Per group:

- Safety glasses or goggles
- Yellow, red and green food colouring
- A permanent marker pen
- Water
- Urine colour chart

Per student:

- Safety glasses or goggles

Safety
Review your classroom and lab safety rules. You should wear eye protection during this activity.

TEST PROCEDURE

With your group:

1.) Label the cups 1 – 4
2.) Fill each cup with approximately 60 mL of water
3.) In cup 1 use a toothpick to add 1 dab of yellow food colouring
4.) In cup 2 use a toothpick to add 2 dabs of yellow food colouring
5.) In cup 3 add 1 drop of yellow food colouring
6.) In cup 4 add 1 drop of red food colouring, 2 drops of yellow food colouring, and 1 drop of green food colouring
7.) Compare your simulated urine to the Urine colour chart
8.) Arrange your simulated samples into the four hydration levels:
    a.) Optimal
    b.) Well Hydrated
    c.) Dehydrated
    d.) Seek Medical Aid
9.) Identify each sample of hydration levels by placing the hydration card next to the appropriate simulated urine

ACTIVITY 4: SIMULATING URINE

- You will keep a 12-hour hydration log to determine your own hydration levels. You will determine if you are drinking enough liquids to maintain healthy hydration.
- Make observations of your own urine to determine what category your urine would fall under. Is your urine Optimal, Well Hydrated, Dehydrated or do you need to See Medical Aid? Use your Hydration colour chart to help you determine your hydration levels

! **Never bring an actual urine sample into the classroom.** !

Bathroom time (hr)	Urine Colour	Urine category	What I drank	How much I drank	Physical activity (none, low, moderate, high)	Notes (e.g. today it is very hot outside, I ate a lot of beetroot)

QUESTIONS

These questions may help you to form a conclusion.

1. From your data, are you drinking enough water? Explain your reasoning.

2. After observing your hydration levels for 12 hours, what time of the day did you find you were dehydrated the most?

3. What circumstances do you think made your urine a darker colour at this time of day?

4. What actions did you take to change your hydration levels?

5. Explain why hydration is important to stay healthy?

CONCLUSION

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

Problem: How can I identify if I am drinking enough water to be healthy?

Conclusion:

ACTIVITY: HYDRATION ON THE INTERNATIONAL SPACE STATION

Astronauts living and working 400 km above our planet might prefer not to think about it, but the water they drink is recycled from their colleagues' urine, sweat, and exhaled breath – collected as condensation on the Space Station's walls.

The International Space Station (ISS).
Credits: NASA/ESA–T. Pesquet

Did you know?

Up to 80% of the water on the International Space Station is recycled!

Challenge questions:

1. State the substance that all life needs to thrive.

_____
_____

2. Explain why astronauts need to be even more careful about staying hydrated, compared to people on Earth.

_____
_____
_____
_____

3. Suggest why ESA and the other space agencies try to recycle as much water as possible, instead of sending fresh water up from Earth and disposing wastewater with the rubbish.

_____
_____
_____
_____

RESOURCES AND LINKS

ESA Resources

- This website has information about the recycling of water on the ISS: ESA - Water in space
- This video shows ESA astronaut Andreas Mogensen drinking orange juice in space: How to drink orange juice in space (Fun way)
- This video is of ESA astronaut Samantha Cristoforetti as she explains how the toilets work on the ISS and that urine is recycled: International Space Station toilet tour.

Extra information

- This webpage is the advice from the European Food Safety Authority on the amount of water different ages of children should drink: Dietary reference values for water | EFSA
- This is a webpage from the World Health Organisation about the safety of drinking water worldwide: Drinking-water
- This is a webpage from the World Health Organisation about the staying hydrated in the heat: Staying hydrated in the heat: what the public can learn from professional athletes
- This is a webpage from the NHS about fluid intake: Water, drinks and hydration - NHS
- This paper talks about whether sports drinks are classed as healthy or unhealthy drinks: Healthy Behavior and Sports Drinks: A Systematic Review - PMC

APPENDIX

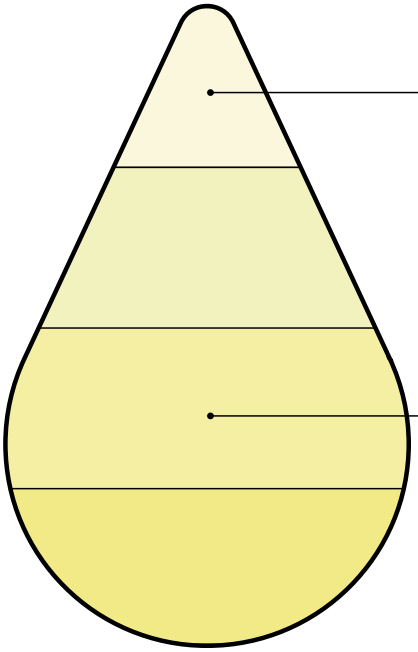
Acknowledgements

This resource has been adapted in 2025 from NASA's "Reduced Gravity, Low-Fat" 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 (David Cañada López, Benny Elmann-Larsen, Nora Petersen, Prof. Dr. Marcela Gonzalez-Gross, Dr. Martina Heer and others at NASA and ESA) who contributed their time and knowledge to this resource.

URINE COLOUR TEST

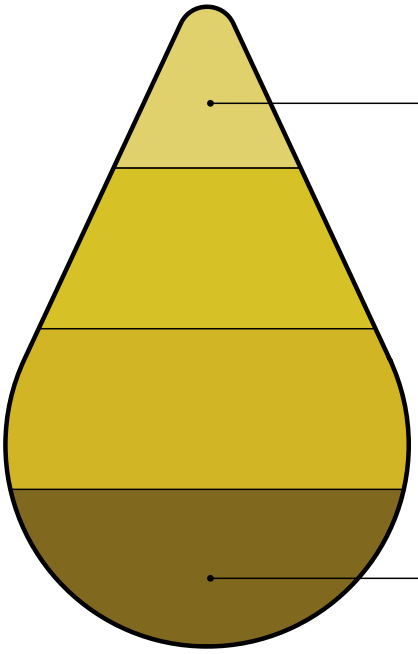
HYDRATED



Optimal Level

Well Hydrated Level

DEHYDRATED



Dehydrated Level

Drink more water

Seek Medical Attention Level

May indicate blood urine or kidney disease

This chart is a representation. Do not use for clinical purposes.