

# MISSION X

TRAIN LIKE AN ASTRONAUT



## REDUCED GRAVITY, LOW-FAT

|                     |             |
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### Team Leader Guide

#### MISSION OVERVIEW

Students will learn about nutrition and which foods contain 'healthier' fat and which foods contain more 'unhealthy' fat. Then, they will discover the fat content of a fast-food meal and formulate a balanced and healthy meal for life on Earth and for astronauts in space.

#### LEARNING OBJECTIVES

- Identifying that there are different types of fat, and most types of food contain fat.
- Understand that 'healthy' fat is an important nutrient in balanced diets.
- Make an emulsification from a cheeseburger to evaluate the fat content of a cheeseburger.
- Calculate volume and proportion in an experiment setting.
- Formulate a meal plan for a balanced diet.

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

#### RELATION TO OTHER MISSION X MISSIONS

This resource would work well with the resource '[Planet you go, Gravity you Find](#)' to explore the importance of combining a healthy diet with good exercise.

#### FAST FACTS

**Subject:** Biology and science  
**Age:** 8-14  
**Prep:** 30 mins  
**Lesson Time:** 2 × 30 min lesson  
**Cost:** 0-10 Euros (per group)  
**Location:** Lab required

## SUMMARY OF ACTIVITIES

| Summary of activities |                           |                                                                                                                                                   |                                                                                                                                                                                                                                                |                                  |                                                                                                |
|-----------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------|
|                       | Title                     | Description                                                                                                                                       | Outcome                                                                                                                                                                                                                                        | Requirements                     | Time                                                                                           |
| 1                     | Good fat vs bad fat       | Students will divide the foods into those containing mainly 'good fat' and 'bad fat'.                                                             | <ul style="list-style-type: none"> <li>Understand that most foods contain fat, and that some types of fat are healthy in our diets, and that some are unhealthy.</li> <li>Using critical thinking and prior knowledge to sort food.</li> </ul> | None                             | <b>Prep:</b> None (except print off student worksheets).<br><br><b>Lesson time:</b> 10 minutes |
| 2                     | Blend a burger            | Running an experiment about the fat content of a cheeseburger by blending the cheeseburger into a soup, cooking this 'soup' and then freezing it. | <ul style="list-style-type: none"> <li>Understand how to create healthy, balanced diets.</li> <li>Creating hypotheses and testing the hypotheses by performing an experiment.</li> </ul>                                                       | Completion of activity 1         | <b>Prep:</b> 30 minutes<br><br><b>Lesson time:</b> 2 × 20 minutes                              |
| 3                     | Measure and calculate     | Measuring the layer of fat in the burger soup and calculating the volume of fat.                                                                  | <ul style="list-style-type: none"> <li>Measuring correctly and accurately.</li> <li>Calculating volumes and proportions.</li> <li>Using mathematics in a new context.</li> </ul>                                                               | Completion of activity 1 and 2   | <b>Prep:</b> none<br><br><b>Lesson time:</b> 30 minutes                                        |
| 4                     | Formulate a balanced diet | Using knowledge of a balance diet, formulate a meal plan for a day.                                                                               | <ul style="list-style-type: none"> <li>Amalgamating prior knowledge to solve a problem.</li> <li>Creating a set of balanced meals for a day.</li> </ul>                                                                                        | Completion of activities 1 and 2 | <b>Prep:</b> none<br><br><b>Lesson time:</b> 15 minutes                                        |

## INTRODUCTION

Maintaining a balanced diet is crucial for a healthy lifestyle for everyone. Astronaut meals are carefully formulated by specialists to offer the best nutrition possible.

Fat plays a vital role in a nutritious diet, but there are different types of fat. Some foods contain higher amounts of 'healthy' fats, while others contain more 'unhealthy' fats.

Fat in food is a source of essential fatty acids, which the body cannot produce on its own. Fatty acids are essential for the absorption of vitamins A, D and E, for the repair of cells, for brain development, for a healthy immune system, and as an energy source. Whilst body fat is a way for the body to store extra calories, having too much body fat can lead to health problems.

## ACTIVITY 1: GOOD FAT VS BAD FAT

### ESA Astronaut meals in space

This video shows Samantha Cristoforetti, who is an ESA Astronaut, as she eats a healthy, balanced diet on the ISS. It can be used to explain how an astronaut eats a healthy meal to stay fit and healthy whilst on mission in space: [Healthy food in the International Space Station | Minerva Mission](#).

### Exercise

The aim of this activity is to help students recognise that fat is present in most food and to understand that some fats are classified as 'healthy', whilst others are considered 'unhealthy'. **Students will then decide which foods contains more 'healthy' fat and which foods contain more 'unhealthy' fat.**

As a class, discuss briefly:

- What is fat? Fat in food is a source of essential fatty acids, which the body cannot make itself. Fatty acids are essential for the absorption of vitamins A, D and E, and for the repair of cells. Body fat is a way for the body to store excess calories, but too much body fat can cause health issues.
- What happens if you eat too many fatty foods?
- What type of food contains fat?
- Is fat always visible on food?
- How can I recognise hidden fat in food? *For example: Fat sticking on fingers when handling foods (e.g. doughnuts).*
- That the fat content of food can change when the food is cooked. E.g. grilled or boiled chicken is relatively healthy, but fried chicken can have very 'unhealthy' fat.
- Why do astronauts need to stay healthy and be careful about fat intake?
- The astronauts' diet: After watching the video from Samantha Cristoforetti, the students should have an idea of what astronauts eat onboard the ISS.

Here are the answers to Activity 1:

| Foods that contain more 'healthy fat' | Foods that contain more 'unhealthy fat' |
|---------------------------------------|-----------------------------------------|
| Olive oil                             | Cheeseburger                            |
| Avocados                              | Fries/chips                             |
| Tuna                                  | Crisps                                  |
| Olives                                | Butter                                  |
| Nuts                                  | Chocolate                               |
| Eggs                                  | Bacon                                   |
| Chicken                               | Lard                                    |
| Seeds                                 | Cakes                                   |
| Soybeans                              | Biscuits                                |
| Salmon                                | Cheese                                  |
| Tofu                                  | Milk                                    |

## ACTIVITY 2: BLEND A BURGER

### Non-blender option

If you have no access to a blender, then you can provide blotting sheets (oil absorbing paper) for the students to dab the cheeseburger to identify that the burger contains fat.

### Preparation

A full list of materials can be found in the student section on [pages 8 - 9](#). Make sure to:

- Gather cheeseburgers (one per group).
- Secure the use of a microwave or cooker or Bunsen burner, and refrigerator or freezer, and a blender.
- Find the nutrition information label on the fast-food meal packaging or by searching the web with the key words “cheeseburger nutrition facts”. **The nutrition information label should contain all the important nutrients and their quantities per 100g of the food.**

### Part 1

Divide class into groups of 4-5 students and distribute group material.

- 1). Read the introduction as a class and discuss the nutrition information label for a cheeseburger.
- 2). Introduce the concept of emulsification (or emulsion): **a mixture of two liquids that do not mix, such as oil and water.**
- 3). Measure the diameter of the cheeseburger and weigh its mass.
- 4). Blend the cheeseburger (per group) and instruct them to add two parts water (final result will be 1/3 smashed cheeseburger 2/3 water)
- 5). Put the beakers in the microwave, on low intensity, to make it simmer for about 15 minutes and then place a lid on the beaker.  
**Or put the cheeseburger emulsion in a pan and simmer for 10 minutes.**
- 6). Let the emulsion cool down and then put the emulsion in the freezer for 1 day.
- 7). Instruct students to complete their table of data.

Discuss these questions:

- Why did we blend the burger? Why did we add water? **Introduce the concept of emulsion and that the fat is released into water.**
- Why did we boil it? **The solid fat becomes liquid at higher temperatures and moves from the food to the water.**

### Part 2

Instruct students to observe the frozen emulsion and mark the layer of fat. How thick is it? Instruct students to complete the table in their worksheet.

Discuss these questions:

- Why did we cool down/freeze the emulsion? **To make the fat solid again. As the fat separates from the water and the rest of the burger, it becomes visible.**
- Discuss the answers to the [Reduced Gravity, Low-Fat student worksheet questions.](#)
- Ask students to compare their group data to the class data. What patterns can be found?
- Ask: Do you think that astronauts should eat burgers on the ISS? Why?

### ACTIVITY 3: MEASURE AND CALCULATE

The student worksheets contain two data tables. Page 10 contains the simplified data table for younger students. Page 11 contains the more complex data table for older students. Please print only the table you want your students to complete. This activity aims to enhance your students' mathematical competences through hands-on work and observation.

#### Exercise

For younger students, get them to measure the height of the fat layer, and the height of the 'cheeseburger soup' layer, and get them to compare the two different heights.

For older students, compare the volume of fat, using the instructions below:

Calculate the volume of solidified fat by measuring the diameter of the beaker, the height of the fat layer and then using the formula for calculating the volume of a cylinder.

Note: Radius is half the diameter:  $r = \frac{\text{diameter}}{2}$     Volume of a cylinder:  $V = \pi r^2 h$   
Where  $r$  is the radius and  $h$  is the height

Hence, for our layer of fat:

$$\text{Volume of fat} = \pi \times \text{radius of the fat layer squared} \times \text{height of fat layer}$$

Students can then compare the volume of fat with the volume of the cheeseburger, and compare the mass of fat with the mass of the cheeseburger.

### ACTIVITY 3: MEASURE AND CALCULATE

#### Exercise

Discuss what makes a balanced meal: eating plenty of vegetables, fruit, protein, fibre, healthy fats and whole-grain carbohydrates. Using Samantha Christoforetti's video as a guide, and the 'healthy' fat column of Activity 1, they will formulate a balanced meal according to their own taste preferences.

# MISSION X

TRAIN LIKE AN ASTRONAUT



## REDUCED GRAVITY, LOW-FAT

### Student Worksheet

#### MISSION OVERVIEW

You will explore nutrition and be able to identify which foods contain a higher amount of 'healthy' fats and which foods contain more 'unhealthy' fats. Next, you will examine the content of fat in a fast-food meal and create a balanced, healthy meal suitable both for people on Earth and for astronauts in space.

#### INTRODUCTION

As astronauts travel to space, the need for nutritionally balanced meals becomes even more important. Nutrient content in food is monitored by dietitians and food scientists at ESA prior to consumption.



Credit: ESA



Credit: ESA/NASA

Healthy diets are also crucial for life on Earth. Eating lots of vegetables, low-sugar fruit, lean protein sources, 'healthy' fats and wholegrain carbohydrates are the cornerstone to any balanced diet. Therefore, it is important to reduce the amount of sugar and 'unhealthy' fat that we eat.

Fat in food is a source of essential fatty acids, which the body cannot make itself. Fatty acids are essential for the absorption of vitamins A, D and E, for the repair of cells, for brain development, for a healthy immune system, and as an energy source. Body fat is a natural way for the body to store excess calories, but too much body fat can cause health issues.

As always, healthy diet should be combined with lots of exercise so you can stay healthy and be prepared to be like an astronaut to visit the Moon or Mars!



Credit: ESA/NASA

## Did you know?

Astronauts lose muscle and bone mass in space, so they must exercise and eat lots of vitamins, protein and calcium to maintain healthy muscles and bones. Complete the Mission '[Living Bones](#), [Strong Bones](#)' to find out more about how astronauts maintain healthy bones in space.

### ACTIVITY 1: GOOD FAT VS BAD FAT

Some fats are known as 'healthy fats' – we need these in our diets to stay healthy. Often, people eat far too much 'unhealthy' fat and not enough 'healthy' fat. In this mission, we will be discussing unhealthy fats and reducing their consumption.

Don't forget, food that contains 'healthy' fat can contain lots of 'unhealthy' fat if they are cooked in an unhealthy way – for example, frying chicken, or eating chicken nuggets instead of chicken breast.

In the table below, decide whether you think each food contains mainly 'healthy' fat or 'unhealthy' fat.

- Cheeseburger
- Olive oil
- Avocados
- Fries/chips
- Crisps
- Tuna
- Butter
- Chocolate
- Olives
- Nuts
- Bacon
- Eggs
- Lard
- Chicken
- Cakes
- Seeds
- Biscuits
- Soybeans
- Cheese
- Milk
- Salmon
- Tofu

| Foods that contain more 'healthy fat' | Foods that contain more 'unhealthy fat' |
|---------------------------------------|-----------------------------------------|
|                                       |                                         |
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## ACTIVITY 2: BLEND A BURGER

### MATERIALS

#### Per class:

- Cooker (or microwave oven)
- Freezer
- Blender
- Weighing scales

#### Per student:

- Safety glasses or goggles

#### Per group:

- Ruler
- Water
- Cylindrical beaker (or other container)
- Stirring spoon
- Pan (if using a cooker or Bunsen burner)
- Cheeseburger
- Nutrition information label of a cheeseburger
- Bunsen burner (if no access to a microwave oven or a cooker)

#### Safety:

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

### HYPOTHESIS

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

**Question:** How can I discover the fat content of a cheeseburger? How can I formulate a balanced meal?

#### Hypothesis:

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## TEST PROCEDURE

With your group:

### Session 1

1. Record the height or volume, and mass, of the cheeseburger in your table of data.
2. With your teacher: place the cheeseburger into the blender.
3. Once blended, put it in the beaker or container and add twice as much water.
  - Two parts water for one part blended cheeseburger.
  - $\frac{2}{3}$  water,  $\frac{1}{3}$  cheeseburger.
4. With your teacher: put in the microwave, for 15 minutes on low intensity, to make it simmer.
  - Or with your teacher: put it in a pan and simmer for 10 minutes on the Bunsen burner or cooker.
5. Put a lid on the beaker or container and let the emulsion cool down.
  - Or pour the emulsion from the pan back in the beaker and put a lid on it
6. Put it in the freezer (or refrigerator) for 1 day
7. Record data in the table.

### Session 2

1. Remove the cold emulsion from the refrigerator/freezer and mark the layer of fat with a marker pen
2. Measure the width and thickness of the fat layer.
  - Calculate the volume of fat if your teacher asks you to.
3. Record the data in your table of data.
4. Scoop out the fat layer and record its mass in your table of data.
5. Calculate the proportion of the volume of fat to the volume of the cheeseburger, and the mass of fat to the mass of the cheeseburger.

**DATA TABLE**

| Data                                                                                           | Your data |
|------------------------------------------------------------------------------------------------|-----------|
| Time ( <i>minutes</i> ) that the 'cheeseburger soup' simmered                                  |           |
| Time ( <i>hours</i> ) for cooling                                                              |           |
| Thickness of the fat layer ( <i>mm</i> )                                                       |           |
| Height of burger ( <i>mm</i> )                                                                 |           |
| Proportion ( $\frac{\text{thickness of fat}(\text{mm})}{\text{height of burger}(\text{mm})}$ ) |           |
| Mass of fat ( <i>g</i> )                                                                       |           |
| Mass of burger ( <i>g</i> )                                                                    |           |
| Proportion ( $\frac{\text{mass of fat}(\text{g})}{\text{mass of burger}(\text{g})}$ )          |           |

**DATA TABLE**

| Data                                                                                              | Your data |
|---------------------------------------------------------------------------------------------------|-----------|
| Proportion of water and burger meal                                                               |           |
| Time (minutes) that the 'cheeseburger soup' simmered                                              |           |
| Time (hours) for cooling                                                                          |           |
| Thickness of the fat layer (mm)                                                                   |           |
| Diameter of the fat (mm)                                                                          |           |
| Radius of the fat (mm)                                                                            |           |
| Volume of fat (mm <sup>3</sup> )                                                                  |           |
| Volume of burger (mm <sup>3</sup> )                                                               |           |
| Proportion ( $\frac{\text{volume of fat (mm}^3\text{)}}{\text{volume of burger (mm}^3\text{)}}$ ) |           |
| Mass of fat (g)                                                                                   |           |
| Mass of burger (g)                                                                                |           |
| Proportion ( $\frac{\text{mass of fat (g)}}{\text{mass of burger (g)}}$ )                         |           |

## QUESTIONS

These questions may help you to form a conclusion.

1. State three food items that contain more healthy fats and three that contain more unhealthy fats.

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2. State what happens to your body if you eat too much unhealthy fat.

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3. Why is it necessary to heat the emulsion? And to cool it down?

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4. Does the data you collected support your hypothesis? Why or why not?

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5. How do your group results compare to class results?

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## CONCLUSION

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

**Question:** How can I discover the fat content of a cheeseburger? How can I formulate a balanced meal?

**Conclusion:**

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**ACTIVITY: FORMULATE A BALANCED MEAL****Scenario:**

You have been selected as an astronaut for a mission to the International Space Station (ISS). The dietitians are seeking your help in creating a meal plan for your time in space. Using your understanding of healthy eating, design a balanced meal plan that incorporates your personal food preferences.

**MY SPACE MISSION MEAL PLAN FOR A DAY**

|                         |                      |
|-------------------------|----------------------|
| <b><u>Breakfast</u></b> | <b><u>Lunch</u></b>  |
| <b><u>Dinner</u></b>    | <b><u>Snacks</u></b> |

## RESOURCES AND LINKS

### ESA Resources

This video shows Samantha Cristoforetti, who is an ESA Astronaut, as she eats a healthy, balanced diet on the ISS: [Healthy food in the International Space Station | Minerva Mission](#)

This article talks about French chef Anne-Sophie Pic developing a menu for ESA Astronaut Sophie Adenot for her epsilon mission to the International Space Station: [ESA - A pinch of France in space](#)

This document describes the nutrition that astronauts need on the International Space Station: [Space food astronaut nutrition.pdf](#)

### Extra information

The WHO website gives more information about eating a healthy, balanced diet: [Healthy diet](#)

The European Public Health Association gives information about eating healthy, sustainable diets. [EUPHA report on healthy and sustainable diets 20-05-2017.pdf](#)

## APPENDIX

### Glossary

|                             |                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Emulsion                    | A suspension of two liquids within each other that normally would not mix (like oil and water). Picture a cup with vinegar. If you pour oil into the vinegar, the oil will float on top of the vinegar because it is less dense. The liquids start to mix together, and tiny droplets of each liquid become suspended within each other. When they are evenly mixed in each other then you have an emulsion. |
| Balanced Diet               | Contains sufficient fibre and the various nutrients (carbohydrates, fats, proteins, vitamins, and minerals) to ensure good health. Food should also provide the appropriate amount of energy and adequate amounts of water.                                                                                                                                                                                  |
| Nutrition information label | The label required on most pre-packaged foods that has a list of nutrition contained in the food and their amounts in grams per 100g.                                                                                                                                                                                                                                                                        |
| Resistive exercise          | A type of exercise in which the body's muscles move (or try to move) against a force or weight; usually created using a type of equipment.                                                                                                                                                                                                                                                                   |

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