



## REDUCED GRAVITY, LOW-FAT

### Educator Section

#### Introduction

As astronauts travel to the moon, Mars, and beyond, the need for nutritionally balanced meals becomes even more important for space missions. The amount of fat inside food packaged for spaceflight is analyzed by researchers before the food is sent into space. Fat content of food is monitored before consumption by dietitians and food scientists at NASA.

#### Lesson Objective

Students will discover the fat content of a meal, and formulate a balanced meal by applying the information on fat content of food. They will also observe an Astronauts mission menu and determine if they are eating a balanced diet.

#### Problem

How can I visualize hidden fat? How can I formulate a balanced meal?

#### Learning Objectives

Students will:

- Make an emulsification from a fast food meal (cheeseburger and French fries).
- Evaluate the invisible fat content of the fast food meal.
- Make observations of NASA Astronaut menus to determine if they are having a balanced meal in space.

#### Materials

Per group (4-5 students per group):

- food guide pyramid
- beaker
- stirring spoon
- water
- marker
- fast food cheeseburger
- fast food French fries
- nutrition label of a cheeseburger and fresh fries
- pan (if you use a cooker)

**Teacher Preparation Time:** 1 hour

**Lesson Duration:** approx 2 hours over 2 days

**Prerequisite:** Knowledge of the Food Guide Pyramid found at [www.mypyramid.gov](http://www.mypyramid.gov)

**Methodology:** to help students make the connections between what they already know and new information, we suggest to follow the 5E instructional model: Engage, Explore, Explain, Elaborate and Evaluate.

---

#### Materials Required

blender  
fast food cheeseburgers  
fast food French fries  
water, refrigerator and freezer  
transparent beakers or other clear containers that will withstand heat and cold capacity about 2 liters, diameter about 10-15 cm  
pan (if you use a cooker)  
cooker or microwave oven  
large stirring spoons  
markers  
food guide pyramids

Per class:

- cooker (or microwave oven)
- freezer
- blender

## **Pre-lesson Preparation**

The day before lesson delivery:

- Secure an appropriate number of cheeseburger and french fries from a fast food restaurant.
- Secure the use of a microwave or cooker, refrigerator and freezer.
- Copy enough food guide pyramids for one per group.
- You may find a nutrition facts label on the fast food meal packaging or by searching the web with the key words “cheeseburger nutrition facts” and “French fries nutrition facts”.

The day of lesson delivery:

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

## **Lesson Development**

### **Observation Engage**

Fat is sometimes hidden inside food. The fat you see on pork, chicken, or beef is visible fat. This type of fat is plain to see, and is solid at room temperature. You can reduce your fat intake by trimming the visible fat from the meat before cooking. Vegetable oil, margarine and butter are all visible fat.

The fat found in snack foods such as cookies, candy, nuts and chips is labeled as invisible fat. Invisible fat cannot be seen, but adds extra calories to your diet.

An appropriate amount of fat is part of a balanced diet, but when we eat too much fat, the body cannot use it all and it turns the extra into body fat. Some body fat is good, but when the body starts making too much fat it starts to store the fat. . That is not good for space explorers or for us! Astronauts want to stay healthy and full of energy.

Knowing the fat content of food allows the space researchers to make healthier decisions about how much and what kinds of food to package for the astronauts to eat.

### **To engage your students:**

1. As a class, discuss briefly
  - What is fat?
  - What happens if you eat too many fatty foods?
  - What type of food contains fat?
  - Is fat always visible on food?
2. As a class, discuss briefly
  - Why do astronauts need to stay healthy and be careful about fat intake?
  - The astronauts’ diet. Astronaut menus are available for each crew who travels into space. Go to crew profiles section of this NASA page to find menus. Students can discuss what astronauts on a mission will be eating and if the fat content is low or a reduced fat menu. What are the students to do with the menus?  
[http://www.nasa.gov/mission\\_pages/shuttle/shuttlemissions/sts131/index.html](http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts131/index.html)
3. As a class, discuss briefly
  - What foods contain large amount of fat?

- Is fat always visible? How can I recognize hidden fat in food? (e.g Fat sticking on fingers when handling foods (i.e. doughnuts etc.)
- Discuss the nutrition facts label on a cheeseburger meal (cheeseburger and french fries).
- Introduce the concept of emulsification (or emulsion): a mixture of two liquids which do not mix as oil and water. In this case the two liquids of the emulsions are the liquefied fat from the meal and water.

### **Instructional Procedure Day 1 Explore**

- Ask students to read the introduction in their student guide
- With your students' help place the fast food cheeseburger meal into the blender with your students.
- Give 1 smashed meal to each group in the beaker or container
- Ask them to add 2 parts of water (final result will be 1/3 smashed burger meal 2/3 water)
- Put the beakers in the microwave low intensity to make it simmering for about 15 minutes
  - Or put it in a pan and simmer it for 10 minutes
- Put a lid on the beaker or container
  - Or pour the emulsion from the pan back in the beaker and put a lid on it
- Let the emulsion cool down
- Put the emulsion in the freezer for 1 day
- Ask students to complete their data sheet

### **Conclusion Day 1 Explain**

- 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.*

### **Instructional Procedure Day 2 Explore**

- Ask students to observe the frozen emulsion and mark the layer of fat.
- How thick is it? Ask students to complete their data sheet

### **Conclusion Day 2 Explain**

- Why did we cool down/freeze the emulsion?
 

*In order to make the fat solid again, separate it from water and the rest of the burger and thus become visible.*
- What happened to the fat? Is it now visible?
- Discuss the answers to the Reduced Gravity, Low Fat Student Section study data questions.
- Ask students to compare their group data to the class data. What patterns can be found?
- Do you think that astronauts have burgers on the ISS? Why?
- Starting from the nutritional facts on the cheeseburger meal and the food guide pyramid, formulate a balanced meal according to your own taste preference.

## Curriculum Explorations *Elaborate*

To extend the concepts in this activity, the following explorations can be conducted:

- Mathematics explorations  
Ask your students to 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 cylinder volume. If you measure beforehand the volume of your burger, you can estimate the percentage of fat.
- Actuality explorations  
Give your students obesity rates in different countries all over the world and discuss with your students possible reasons for that and possible countermeasures.

## Assessment *Evaluate*

- Discuss the answers to the Study Data questions in the Reduced Gravity, Low Fat student guide.
  1. If you eat too much fat, how does your body deal with the extra fat?
  2. List one food which contains visible fat and one which contains invisible fat.
  3. Why is it necessary to heat the emulsion? And to cool it down?

## Acknowledgements

David Cañada López  
Facultad de Ciencias de la Actividad Física y del Deporte-INEF  
Universidad Politécnica de Madrid  
<http://www.inef.upm.es/>

Benny Elmann-Larsen  
Life Sciences Unit, Directorate of Human Spaceflight  
European Space Agency  
<http://www.esa.int/esaHS/research.html>

Prof. Dr. Marcela Gonzalez-Gross  
Facultad de Ciencias de la Actividad Física y del Deporte-INEF  
Universidad Politécnica de Madrid  
<http://www.inef.upm.es/>

Dr. Martina Heer  
Nutritional Health Department  
Profil  
<http://www.profil.com/scientific-profile/dr-martina-heer.html>

Nora Petersen  
Crew Medical Support Office, Directorate of Human Spaceflight  
European Space Agency  
[http://www.esa.int/esaHS/ESA5XZ0VMOC\\_astronauts\\_0.html](http://www.esa.int/esaHS/ESA5XZ0VMOC_astronauts_0.html)

## **Educators and Students resources**

The European Food Information Council

<http://www.eufic.org/>

World Health Organization

<http://www.who.int/moveforhealth/en/>

HELENA: Healthy Lifestyle in Europe by Nutrition in Adolescence

<http://www.helenastudy.com/>

Health(a)ware

<http://www2.hu-berlin.de/health-a-ware/>

## Reduced Gravity, Low-Fat Glossary

<b>Emulsion</b>	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.
<b>Balanced Diet</b>	Contains sufficient amounts of 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.
<b>Nutrition Facts label</b>	The label required on most pre-packaged foods.