Teacher Guide

Topic: *An Introduction to Weightlessness*

Audience: grades 6-12, general science

Time: 50 minutes

Materials: student handouts, teacher scissors, internet and projector (optional)

Carla Savage can usually be found floating around the Chemistry lab at Auburndale High School in Central Florida. Here, she's seen floating in NASA's "Weightless Wonder".

Print free copies of this lesson by visiting **carlasavage.com** .

Worksheet definition and terms in handout:

"Spaced-Out" in Weightlessness!

Define

Weightlessness— a phenomenon experienced during free-fall; the force of gravity still acts upon the body, but a person feels no apparent weight due to an absence of other forces

List terms commonly used to describe *weightlessness*:

zero gravity, microgravity, µg, reduced gravity, zero-g

(Note: Terms can be misleading due to the fact that gravity is still acting on an object, even if the force of gravity is not felt by the object due to its motion.)

Teacher Procedure:

1. Introduce the topic. Show the internet video of water in weightlessness (optional— see references) .
2. Distribute the handout, "*Spaced-Out" in Weightlessness!* (side 1) and *Experiments in Weightlessness* (side 2).
3. Explain instructions:
    A.) Students are to form teams of 3. Each member will receive one topic from the description handout.
    B.) Each team member is to read and explain their assigned topic to the group. On side 1, students are to complete drawings and descriptions on their individual handouts.
    C.) Turn to side 2. Teams are to brainstorm experiment ideas. To answer the Analysis Questions, the entire class is to make new teams of 3.
4. Collect all the handouts upon completion.

References:

video.google.com Search: "Water spheres in microgravity"
(Result: video.google.com/videoplay?docid=-1493589576538490331)
Teasing water in weightlessness!

spaceflorida.gov
An agency promoting and developing Florida's aerospace industry.

Attenuation:

Any large mass naturally exerts the force of gravity on nearby objects. The larger the mass, the larger the force.

The term 'attenuation' describes how weightlessness is achieved by an object traveling so far out into space that the force of gravity can no longer act upon the object.

This is a simple idea, however, it's not practical for humans because we do not yet have the technology to sustain life that far away from Earth.

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Free-fall:

M*icrogravity*, or *μg*, can be achieved in an airplane following a parabolic flight path. NASA's Reduced Gravity Aircraft, the "Weightless Wonder", is used to train astronauts and conduct experiments in *reduced gravity*.

The pilot flies in arc. As the plane goes "up-and-over the hump", it enters a powered dive, causing the people inside to float for about 30 seconds. Gravity is still acting on their bodies, but it is not felt because they are suspended in space.

As the plane pulls out of the parabola, the occupants feel twice their normal weight, or 2 g acceleration.

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In Orbit:

When a large object exerts the force of gravity on a spacecraft orbiting around it, the gravitational acceleration does not change the spacecraft's speed, only its direction. In other words, the spacecraft is constantly pulled towards the object, causing the spacecraft's direction to follow the curved path of the object's horizon. If the spacecraft's direction did not change, its velocity would take it out into space in a straight line away from the object.

The International Space Station orbits the Earth. The astronauts experience a feeling of *zero-g* because of this curved, freefall-like motion.

Name: _____
Date: _____
Period: _____

"Spaced-Out" in Weightlessness!

Define
Weightlessness—_____

_____

List terms commonly used to describe *weightlessness*: _____

_____

Draw a **DIAGRAM**	Write a **DESCRIPTION**
Attenuation	_____ _____ _____ _____ _____ _____
Free-fall	_____ _____ _____ _____ _____ _____
In Orbit	_____ _____ _____ _____ _____ _____

Experiments in Weightlessness

Purpose:

Scientist may be able to create and improve products made in weightlessness. Systems often behave differently in zero-g. For example, water in microgravity is very strange compared to water in its normal Earth environment!

Procedure:

Brainstorming with your group, list as many ideas as you can about experiments that you would like to perform in space. Predict what you think might happen in each experiment.

You may attach notebook paper for more space.

Experiment Ideas	**Predictions**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Analysis Questions: *Switch group partners.*

1. Based on a vote in your new group, which three ideas do you think are best?

_____

_____

2. Which experiment do you think would be the most difficult to perform? Why?

_____

_____

3. Which of these experiments do you think would most benefit mankind? Why?

_____

_____