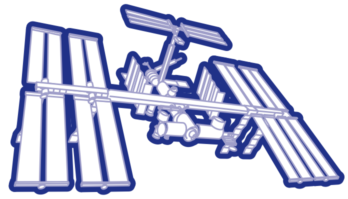
Educational Product	
Educators	Grades K-3

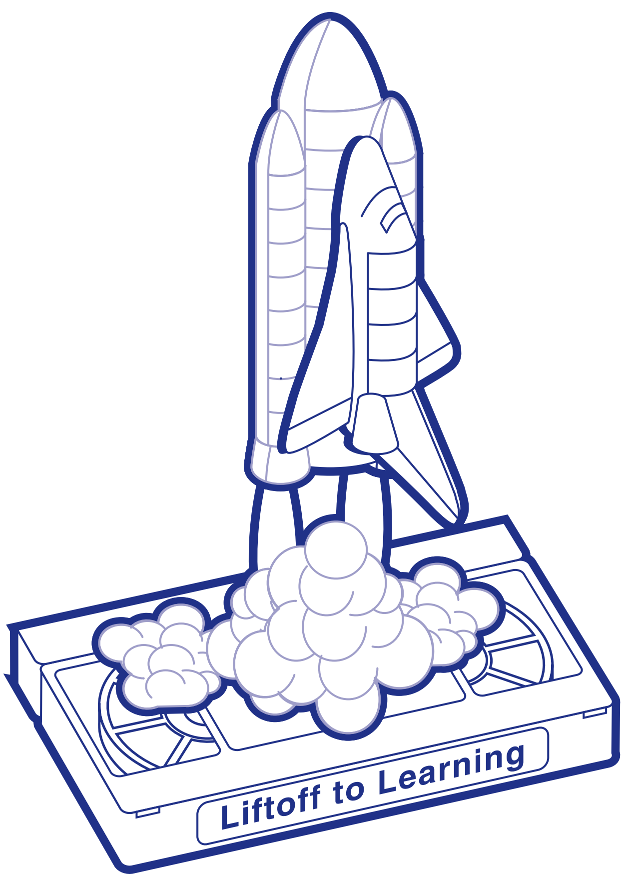
National Aeronautics and
Space Administration

Liftoff to Learning



Living In Space

A Videotape for Life Science and Physical Science



Video Resource Guide

EV-1997-07-007-HQ

Video Synopsis

Title: Living In Space

Length: 10:00

Subjects: Living in space.

Description:
This program discusses the similarities and differences between living on Earth and living in space.

Science Standards:
Physical Science
- Position and motion of objects

Life Science
- Organisms and environments

Science Process Skills:
Observing
Making Models
Investigating

Mathematics Standards:
Problem Solving
Geometry

Background

In many ways, living in space is not very different from living on Earth. In other ways, it is quite different. Astronauts in orbit above Earth must do the same things inside their spacecraft to live as we do on Earth. They have to eat, work as a part of a team, exercise, relax, maintain hygiene, and sleep. The only significant differences from living on Earth are that they operate in the confined space of the Space Shuttle orbiter cabin and that they, and all objects inside the cabin, float. Actually, floating is not quite the correct word to use because in order to float, astronauts have to have something to float on. The floating effect is called *microgravity*.

Microgravity refers to an environment in which the local effects of gravity have virtually been eliminated by free-fall. For example, imagine that you and a friend are riding in an elevator car when the elevator cables break. As you plummet down the elevator shaft, you and your friend experience microgravity. In other words, you are falling together inside the car. This makes both of you appear to float.

Of course, gravity has not really gone away when you fall, but its effects inside the elevator car have. For example, what would the dial on a bathroom scale read if you could stand on it as you fall?

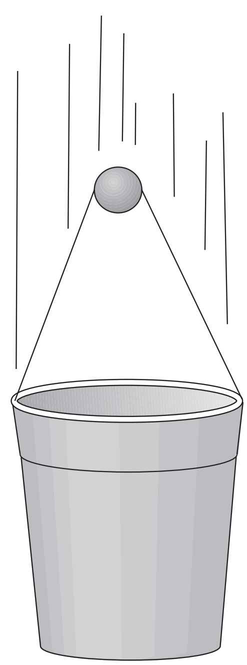
Because of microgravity on the Space Shuttle, some jobs become a little more difficult, like handling tools and fluids. If you are not careful, things will float away. Eating is also more of a challenge and so is going to the lavatory. Other jobs, however, become easier. Moving about is very easy and so is reaching the top shelf. Moving massive objects is very easy because they feel like they do not have any weight. But, once you get a massive object moving, you have to be able to stop it too. Otherwise, it will collide with the inside walls of your spacecraft with the same force you used to get it moving.

Classroom Activities

Microgravity Through Falling

Materials
Paper cup
Thread
Colorful wooden bead (1-2 cm in diameter)
Several paper clips
Cellophane tape

Procedure
You can show how objects appear to float by tying a wooden bead to a paper cup with thread and dropping them together. Assemble the demonstration as shown in the illustration below. Because of air friction, it may be necessary to add a few paper clips to the bottom of the cup to make it fall as fast as the bead. Hold the cup high in the air by the bead and drop it to the floor. Observe the bead and cup as they fall. Try letting go of the bead again, but this time hold on to the bottom of the cup. How does this demonstration show that free-fall creates microgravity?



Tight Working Spaces

Materials
Four tables
Art supplies
Building blocks
Action toys such as construction sets

Procedure
Demonstrate the importance of teamwork and cooperation by creating a small work space in the classroom with four tables arranged in a square so that there is a small working space in the middle about large enough to fit a small couch. Place art supplies, building blocks, and other items around the tables. Make up several jobs, such as drawing a picture of the Space Shuttle, folding a paper airplane, or building a tower of blocks. The jobs should involve sharing tools and supplies. Select seven children to work inside the space at a time. Give them a time limit for completing all the jobs. Have other students observe the activity and take notes of problems they see and more efficient ways of doing things. After other students have tried the tasks, hold a group discussion to talk about what was learned. How does this activity relate to working on the Space Shuttle?

Space Food

Materials
Instant chocolate pudding (several packages)
Plastic self-sealing bags (sandwich size)
Water
Spoons

Procedure
Show how space foods are prepared in space by making chocolate pudding. Add about one quarter of a box of instant pudding mix to a plastic bag. Add water to the bag according to directions. Seal the bag and begin kneading it until it is ready to eat. This activity shows how astronauts prepare dry-mix, and freeze-dried foods in space. Preparing the food inside plastic bags prevents water from escaping inside the Space Shuttle cabin. Other kinds of food used in space include fresh fruits, dried fruits, nuts, and pre-cooked foods in foil/plastic pouches.

Relaxing In Space

Materials
Various items such as balls, paper, coins, tape, pencils, etc.

Procedure
Ask your students to try to invent games and other forms of relaxation that could be used on the Space Shuttle during periods of free time. Point out to them that games requiring small pieces could be a problem if the pieces drift away. Test the games to see how much fun they are and how well they would work in space.

Terms

Atmosphere - The envelope of air surrounding Earth to an approximate distance of 160 kilometers.

Convection Oven - A small compartment in the Shuttle's kitchen in which prepackaged foods are heated with forced hot air.

Gravity - The attraction of all objects to one another due to their mass.

Microgravity - An environment, produced by free-fall, that alters the local effects of gravity and makes objects seem weightless.

Satellite - (Artificial) A spacecraft that orbits around Earth or some other large body in space.

Space Shuttle - The reusable space vehicle, consisting of an orbiter, external tank, and two solid rocket boosters, that carry humans and other payloads into Earth orbit.

Waste Collection System - The name for the toilet on the Space Shuttle.

References

NASA On-line Resources for Educators provide current educational information and instructional resource materials to teachers, faculty, and students. A wide range of information is available, including science, mathematics, engineering, and technology education lesson plans, historical information related to the aeronautics and space program, current status reports on NASA projects, news releases, information on NASA educational programs, useful software and graphics files. Educators and students can also use NASA resources as learning tools to explore the Internet, access information about educational grants, interact with other schools, and participate in on-line interactive projects, communicating with NASA scientists, engineers, and other team members to experience the excitement of real NASA projects.

Access these resources through the NASA Education Home Page:
http://education.nasa.gov

Other web sites of interest:
http://www.jsc.nasa.gov

STS-56 Crew Biographies

Commander: Kenneth D. Cameron (COL, USMC)
Kenneth Cameron was born in Cleveland, Ohio. He earned bachelor of science and master of science degrees in aeronautics and astronautics from the Massachusetts Institute of Technology. He served in the Vietnam War as a Platoon Commander with the 1st Battalion, 5th Marine Regiment and later with the Marine Security Guards at the U.S. Embassy, Saigon. Following his return to the U.S., he was assigned to the Marine Corps Air Station, Yuma, Arizona, where he flew A-4M Skyhawks. He flew with the Marine Aircraft Group 12 in Iwakuni, Japan, and attended the U.S. Navy Test Pilot School, Patuxent River, Maryland. Following graduation, he served as project officer and test pilot in the F/A-18, A-4 and OV-10 aircraft. Cameron has logged over 3,400 flying hours in 46 different types of aircraft. He became an astronaut in 1985 and was the pilot on STS-37.

Pilot: Stephen S. Oswald
Stephen Oswald was born in Seattle, Washington, but considers Bellingham, Washington, his hometown. Oswald graduated from the U.S. Naval Academy. He became a naval aviator and flew the Corsair II aboard the USS *Midway*. Oswald then attended the U.S. Naval Test Pilot School and conducted flying quality, performance, and propulsion studies on the A-7 and F/A-18 Hornet. He then became an F/A-18 instructor and later a catapult officer aboard the USS *Coral Sea*. Oswald resigned from active duty and joined Westinghouse Electric Corporation as a civilian test pilot. He has logged over 5,000 hours of flying time in 40 different kinds of aircraft. Oswald joined NASA as an aerospace engineer and research pilot. He was pilot of the STS-42 mission.

Mission Specialist: C. Michael Foale (Ph.D.)
Michael Foale was born in Louth, England, but considers Cambridge, England, to be his hometown. He attended the University of Cambridge, Queens' College, receiving a bachelor of arts degree in physics, and National Sciences Tripos, with first class honors. While at Queens' College, he completed a doctorate in laboratory astrophysics. As a postgraduate at Cambridge University, Foale participated in the organization and execution of scientific scuba diving projects, including surveying under-

water antiquities in Greece. Foale joined NASA Johnson Space Center in 1983 in the payload operations area of the Mission Operations Directorate. He was selected as an astronaut candidate in 1987. Foale was a mission specialist aboard STS-45.

Mission Specialist: Kenneth D. Cockrell
Kenneth Cockrell was born in Austin, Texas. He received a bachelor of science degree in mechanical engineering from the University of Texas and a master of science degree in aeronautical systems from the University of West Florida. After designation as a naval aviator, he flew the Corsair II aboard the USS *Midway* in the Western Pacific and Indian Oceans. Following graduation from the U.S. Navy Test Pilot School in Maryland, he conducted flight tests on the A-4, A-7, F-4 and F/A-18 aircraft. He was assigned as a pilot in an operational F/A-18 squadron and made two cruises on the USS *Constellation*. Cockrell resigned his commission to work as a research pilot at NASA's Johnson Space Center. Selected as a pilot astronaut in 1990, he has logged over 5,700 flying hours and 650 carrier landings. This was his first spaceflight.

Mission Specialist: Ellen Ochoa (Ph.D.)
Ellen Ochoa was born in Los Angeles, California, but considers La Mesa, California, to be her hometown. She received a bachelor of science degree in physics from San Diego State University and master of science and doctorate degrees in electrical engineering from Stanford University. Her doctoral dissertation on photorefractive crystals resulted in a patent for a system to detect defects in periodic objects. She is also co-inventor on two additional patents in the field of optics. After joining the NASA Ames Research Center, she was selected as Chief of the Intelligent Systems Technology Branch, serving as technical and administrative head of 35 engineers and scientists researching and developing computational systems for aerospace missions. Ochoa was named an astronaut in 1990. This was her first spaceflight.

NASA Liftoff to Learning
Living in Space

EDUCATOR REPLY CARD
Video Resource Guide

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http://ehb2.gsfc.nasa.gov/edcats/educational_videotape

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