CLOTHING

LIVING IN SPACE

Boots
Concepts
Aboard the spacecraft, astronauts can work in flight suits that resemble the clothes we wear on earth. Flight suits worn on the Space Shuttle must
- be safe
- be functional
- be comfortable
- be good-looking

Appearance of Clothing Worn for Space Travel
Cobalt blue flight suits, consisting of soft cotton pants and a lined zipper jacket, are issued to each crew member. A navy blue cotton knit short-sleeve shirt coordinates with these outfits. These items are stocked in standard sizes, along with underwear, socks, footwear, and gloves. The astronauts are fitted "off the racks" at NASA’s Johnson Space Center near Houston. All clothing, except underwear, is the same for both sexes.

The waist-length jacket is fitted by chest size and sleeve length. Expansion pleats in the shoulders and back make it easier to move and flex while wearing the jacket. The pleats are also needed to compensate for the lack of gravity in space. Without gravity pulling down on an astronaut’s body, an astronaut becomes two to five centimeters taller in space. The pleats provide room for this expansion. Flight suit pants are fitted by waist and inseam measurements.

Functional Clothing
Astronauts wear different clothes at different times during the mission. During liftoff, special communications headgear and helmets are added to their flight suits. They also wear a separate backpack that contains an oxygen supply.

Astronauts also put on special gear for atmospheric entry. In addition to the communications headgear and helmets, antigravity suits are worn. The antigravity suit is really an inflatable pair of pants that is put on over underwear. The suit has a valve that is used to fill the suit with oxygen from a bottle. Without the antigravity suit, blood would pool (collect) in the lower part of an astronaut's body. This is caused by the change from weightlessness to the pull of Earth's gravity. This pooling of blood could cause fainting. The pressure exerted by the inflated antigravity suit on the legs and abdomen prevents the pooling of blood.

Safe and Convenient Clothing
The flight suits have built-in safety features. The material is treated with a chemical soak to make it fireproof. The clothing is designed to be loose enough for comfort, without being sloppy. Clothing that is too loose can accidentally turn critical switches on or off by brushing up against them.

A dozen pockets cover much of the flight suit’s exterior for storing small useful items. The pockets are closed with either Velcro or zippers. Small items are thereby prevented from sailing about dangerously in the weightless environment of space. Stocked in specific pockets before the flight are felt-tip and pressurized ball-point pens, mechanical pencils, data books, sunglasses, a multipurpose Swiss army pocket knife, and standard surgical scissors.

Clothing Inventory
In-flight clothing consists of

- jacket 1 per flight
- trousers 1 pair per seven days
- 1 spare pair per flight
- shirt 1 per 3 days
- underwear 1 set per day
- one-g (gravity) footwear 1 pair per flight
- in-flight footwear 1 pair per flight
- gloves 1 pair per flight

Each astronaut also has a chronograph watch as well as a sleeping mask and earplugs to help block out Shuttle cabin noises.
Objectives
Students will understand the following:
- Astronauts work in flight suits aboard the spacecraft.
- Flight suits are jackets, pants, and shirts made of blue cotton.
- Flight suits are similar to clothes worn on Earth.

Motivation
1. What would you wear inside the Space Shuttle on a trip into space? (Accept any answer that is clothing related. List answers on board.)
2. What type of clothing should an astronaut wear to be comfortable? (Clothing that is lightweight, made of natural fibers, and resembles the clothing we all wear on Earth.)

Vocabulary
Have the students use these words as part of your motivating discussion and in the follow-up Space Lab and Space Countdown activities.
- Space Shuttle (a reusable spacecraft)
- space suit (protective layers of clothing worn outside the spacecraft)
- astronaut
- flight suit

Activity Description
The Student Liftoff page for this lesson contains two activities: Space Lab and Space Countdown.

The Space Lab is a hands-on experiment that allows students to simulate an astronaut's use of a flight suit. The students are asked: Why do astronauts have many pockets on their flight suits? The students place items in different pockets and retrieve them when asked by a friend. This activity may be done at school or at home.

The Space Countdown, a math activity, requires a student to read a graph. This involves counting, subtracting, and comparing.

Additional Activities for School or Home
- Collect different kinds of bags, such as paper lunch bags, paper supermarket bags, plastic sandwich bags, plastic shopping bags, canvas carrying bags. Have the students predict which bags will tear most easily, which will be the strongest. List the different kinds of bags in order from weakest to strongest. Experiment with tearing each different kind of bag. Observe what happens. Compare the results with the earlier predictions. Correlate the results of this activity with the kind of testing scientists must do to develop strong, tear-proof materials for astronaut flight suits.
- Have students pretend they are a pen inside an astronaut's pocket. How can they help the astronaut? When will the astronaut use the pen? What might the astronaut write about in a logbook (a book that is used to record events on a flight)? Brainstorm words and ideas with the students. List all suggestions on the board. Accept all suggestions as valid. Use their ideas to create a class experience chart story.
What does an astronaut wear inside the Space Shuttle?
An astronaut wears a flight suit.
A flight suit is a light blue jacket and pants.
The jacket closes with a zipper.
The jacket and pants have many pockets that hold small tools.
The suit also has a navy blue cotton knit short-sleeve shirt.
Flight suits are comfortable and look nice.
They look like your clothes.

Space Lab

Why do astronauts have many pockets on their flight suits?

You need: a pen, a pencil, eyeglasses, scissors,
1 pair of jeans or overalls with 4 or more pockets.

Step 1. Put on jeans.

Step 2. Fill each pocket with one thing, such as a pen.
Think about where each thing is.

Step 3. As a friend calls out each thing, take it out of its pocket.

Repeat steps 2 and 3.
Can you find things faster each time you try? Why?
How do astronauts use the pockets on their flight suits?

Space Countdown

Some children like the flight suit to be blue.
Other children want the suit to be red.
Look at the graph. Answer the questions.

1. How many children like the blue flight suit?
2. How many children want a red flight suit?
3. How many more children like blue than red?
Objectives

Students will understand the following:
- Flight suits are designed with safety features.
- Flight suits consist of a soft blue cotton jacket, pants, and shirt.
- Flight suits are fireproof.
- Flight suits have many pockets for holding small items.

Motivation

1. What makes clothing safe?
(Materials can be treated with flame-retardant chemicals. Relate answers to the flame-retardant materials used in children's pajamas. Clothes should fit properly; for example, children would not wear loose-fitting pants when they ride a bicycle. The pants could become tangled in the gears or wheels.)

2. Why must astronauts wear safe clothing?
(To prevent accidents and to be able to do their work. You might want to compare an astronaut's clothing with a firefighter's hat and boots or a telephone lineman's insulated boots and gloves and hard hat.)

Vocabulary

Have the students use these words as part of your motivating discussion and in the follow-up Space Lab and Space Countdown activities.
- fireproof (treated with chemicals to retard flames)
- Velcro (self-tightening fastener with meshing plastic ridges)
- flight suit
- switch
- accident
- astronaut
- comfortable
- graph

Activity Description

The Student Liftoff page for this lesson contains two activities: Space Lab and Space Countdown.

The Space Lab is a hands-on experiment that allows the student to use a jacket pocket like the pockets on an astronaut's flight suit. The students are asked: How does Velcro work on an astronaut's flight suit? The experiment demonstrates how Velcro closures keep objects inside pockets. This activity may be done at school or at home.

The Space Countdown, a math activity, uses deductive thinking to solve a problem. It also provides practice in using a step-by-step approach to problem solving.

Teacher Guide for solving the Space Countdown: Read one clue at a time. Use the information given to fill in the chart with no or yes in the appropriate boxes. When a yes is indicated, the rest of the vertical or horizontal line must be no. Complete clue by clue.

Additional Activities for School or Home

- Buy a strip of Velcro wherever sewing supplies are sold. Cut off two pieces that are three centimeters long. Glue one piece to the eraser end of a pencil. Glue the other piece to the cover of a notebook. Attach one piece of Velcro to the other piece of Velcro. What happens? Why? Explain that Velcro strips are found inside some pockets of an astronaut's flight suit. They are used to hold pens, pencils, small flashlights, and other objects and prevent the objects from flying around the cabin in the weightless environment.
- Have children imagine they are clothing designers. Have each student design and draw a flight suit that
  - is made of protective material
  - is comfortable to wear
  - is suitable for astronaut activities
  - demonstrates creativity
How is an astronaut’s flight suit special? The flight suit must keep the astronaut safe and comfortable. The shirt, jacket, and pants, made of soft blue cotton, are fireproof. The flight suit fits close to the body to help stop accidents. Loose clothing might catch on switches. The flight suit has many pockets for pens, sunglasses, scissors, and small tools. All the pockets have zippers or Velcro strips to keep the small items from floating out of the pockets.

**Space Lab**

**How does Velcro work on an astronaut’s flight suit?**

**You need:** a jacket with Velcro on a pocket, a pencil, a small notepad.

**Step 1.** Put the pencil and notepad into the pocket. Using the Velcro, close the pocket.

**Step 2.** Shake the jacket upside down. What happens? What keeps the pencil and pad in the pocket? How is the pocket on the jacket like the pocket on an astronaut’s flight suit?

**Space Countdown**

Astronauts Joe, Sally, and Bob each put something different in their top jacket pocket. One astronaut had a pen, one had a Swiss army knife, and one had a pair of sunglasses.

**Use the clues to solve the problem. Put a yes or no in each box.**

<table>
<thead>
<tr>
<th></th>
<th>Pen</th>
<th>Sunglasses</th>
<th>Knife</th>
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</thead>
<tbody>
<tr>
<td>Joe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bob</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Clue 1.** Joe did not put a pen or sunglasses in his pocket.
**Clue 2.** Sally did not put a pen in her pocket.

What did each astronaut put in each pocket?
Objectives

Students will understand the following:
- Flight suits are designed for work.
- Antigravity suits are worn during reentry to protect the astronauts.

Motivation

1. What do you wear to go swimming? To school? To sleep?
(Bathing suits, trunks; jeans, skirts, pants, blouses, shirts; pajamas, nightgowns. Accept any suitable answers as they relate to each part of the question.)

2. Why do we need different kinds of clothing?
(Different activities require different clothes. Close-fitting suits make it easier to swim. Loose-fitting clothes are better for sleeping. Comfortable clothes are used for work and school.)

Vocabulary

Have the students use these words as part of your motivating discussion and in the follow-up Space Lab and Space Countdown activities.
- reentry (returning from space into Earth’s atmosphere)
- antigravity suit (an inflatable pair of pants with a valve that allows the pants to be filled with oxygen from a bottle)
- flight suit
- ready-to-wear
- cobalt blue
- liftoff
- headgear

Activity Description

The Student Liftoff page for this lesson contains two activities: Space Lab and Space Countdown.

The Space Lab is a hands-on experiment to help students understand how pleated clothing allows astronauts greater flexibility. The students are asked: How do pleats give you extra room in your clothes? The experiment compares the flexibility of an expanding folder with the flexibility of pleats in an astronaut’s flight suit jacket. This activity may be done at school or at home.

The Space Countdown, a math activity, helps the student make calculations using addition and multiplication and provides practice in reading a chart.

Additional Activities for School or Home

- Astronauts on every Space Shuttle mission design their own patches. Have students work in small groups to design patches to be used in their future Space Shuttle missions. Each patch should include a mission number (STS is the official prefix and stands for Space Transportation System), the date, the astronauts’ names, and highlights of the mission.

  Example: STS 2 11/12-11/14, 1981
  Engle, Truly
  tested mechanical “robot arm”

- The material used in astronauts’ clothing is soaked with a fireproofing chemical. Discuss the need for special treatment of clothing, depending on how the clothing is to be used. After a rainfall, have two children do the following: One child wears sneakers, one child wears waterproof boots. Have both children walk across wet grass or through puddles. Compare what happens to the sneakers and boots. What are the differences? Why? Have children summarize the need for specially treated clothing.
Choosing a flight suit is easy at a NASA space center. Both men and women pick ready-to-wear cobalt blue jackets and pants along with navy blue cotton knit shirts. The jackets have pleats up the back and over the shoulders. The pleats open up to let the astronauts move easily. The outside of the flight suit has many pockets, which are used to hold tools.

At liftoff, the astronauts wear flight suits, communications headgear, and helmets. During reentry, they wear antigravity suits that protect them. Astronauts wear different uniforms at different times during the mission.

Space Lab

How do pleats give you extra room?
You need: an 8½ by 11 expanding folder, a ruler, papers, and books.

Step 1. With the folder closed, measure the width of its side at top and bottom.

Step 2. Open the folder. Add papers and books until the folder has expanded to its full size. Measure the width of the side at top and bottom again. What is the purpose of the pleats?

Step 3. Remove the papers and books. What happens? How are the pleats in the folder like the pleats in an astronaut’s jacket?

Space Countdown

This chart shows the clothing astronauts wear on a six-day Shuttle trip.

Use the chart to answer the questions.

On a Shuttle trip:
1. How many sets of underwear for 1 astronaut? for 2 astronauts?
2. How many shirts for 1 astronaut? for 3 astronauts?
3. How many jackets for a crew of 7 astronauts?

<table>
<thead>
<tr>
<th>CLOTHING</th>
<th>HOW MANY?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underwear</td>
<td>1 set for each day</td>
</tr>
<tr>
<td>Shirts</td>
<td>1 for each day</td>
</tr>
<tr>
<td>Trousers</td>
<td>1 pair for 6 days</td>
</tr>
<tr>
<td>Jackets</td>
<td>1 for 6 days</td>
</tr>
</tbody>
</table>