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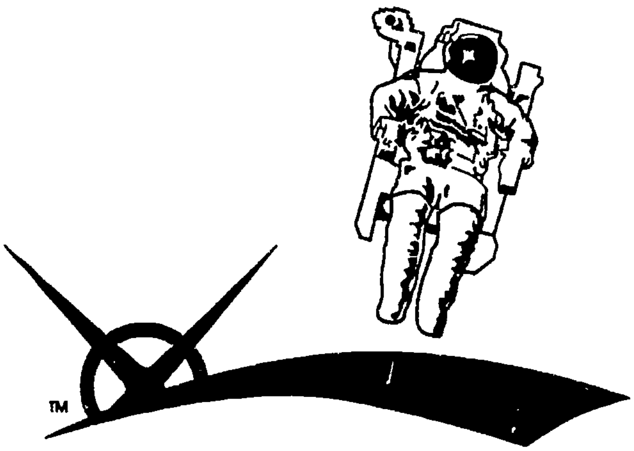
ABSTRACT

This teaching guide for 4th through 6th grade classes integrates science, language arts, and math concepts into ready-to-use space and space technology lessons. Significant learning outcomes for this curriculum are linked to Ohio's educational objectives for science in an at-a-glance curriculum matrix. A summary of the significant 4-H life skills addressed within this curriculum is also provided. This curriculum is organized around three distinct units of study, Forces, Fibers, and Foods, linking space age technology to the everyday interests of students. Activity sheets and a pre/post test are included for these topics. (PR)

4-H LEADER/TEACHER HANDBOOK

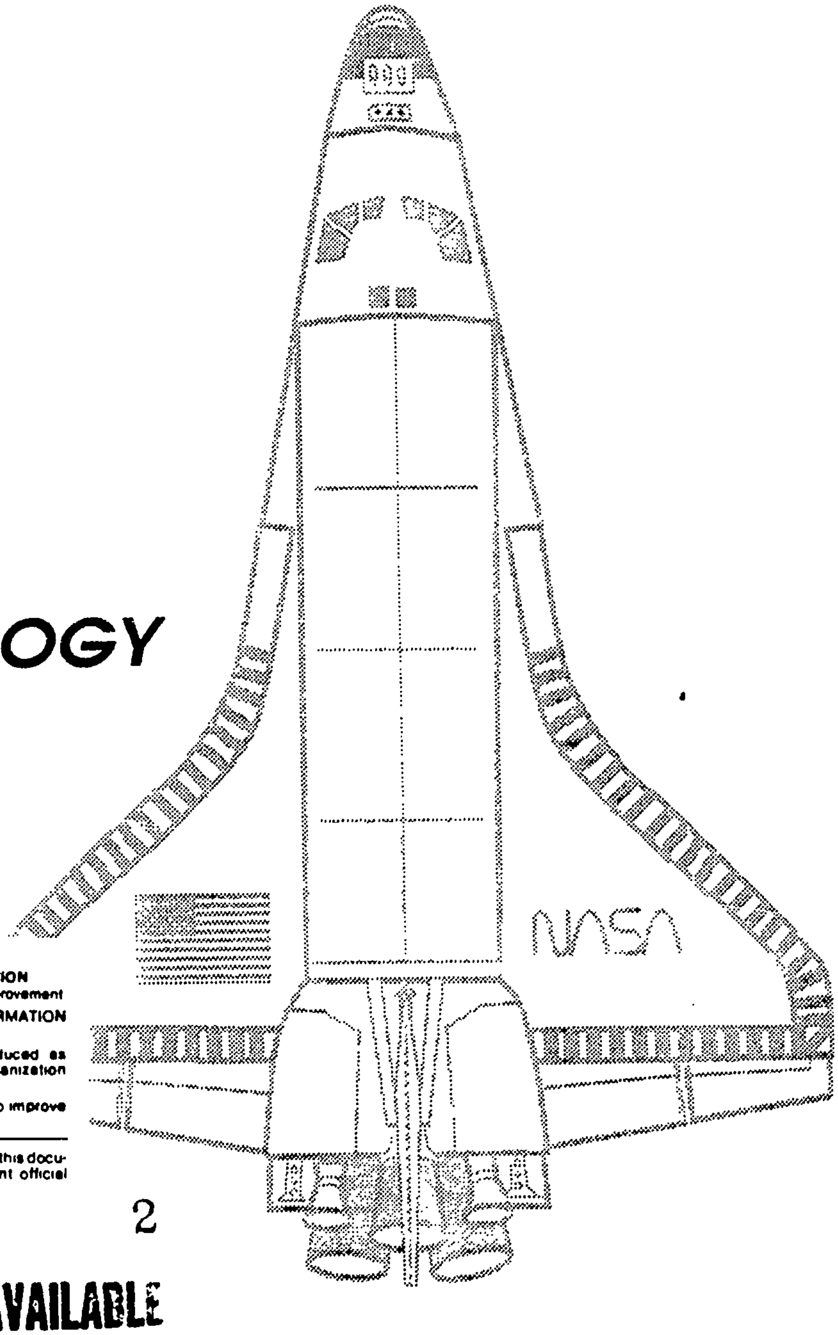
4-H 700



BLUE SKY BELOW MY FEET

ADVENTURES IN SPACE TECHNOLOGY

FORCES, FIBERS, FOODS



THE OHIO STATE UNIVERSITY EXTENSION

4-H 700GPM

Blue Sky Below My Feet

. . . A 4-H Space Science Program

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THE NATIONAL CENTER for SCIENCE TEACHING & LEARNING

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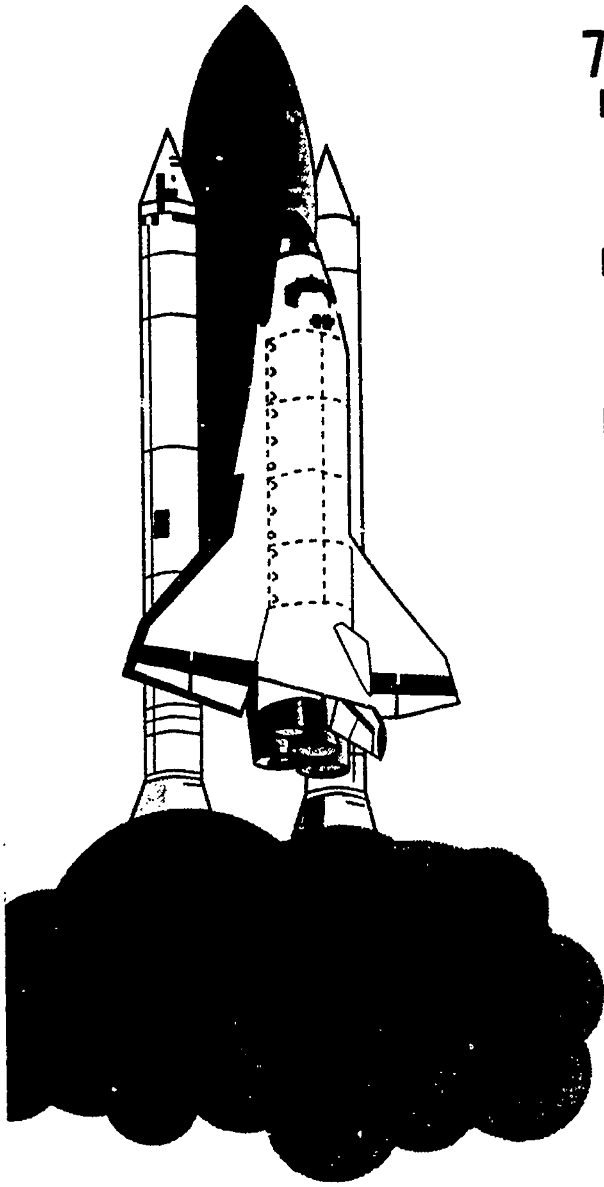


Table of Contents

Introduction

Ohio State University Extension is pleased to share with you a dynamic teaching resource for 4th through 6th grade classes. This unique teaching guide, *Blue Sky Below My Feet*, integrates science, language arts and math concepts into ready-to-use space and space technology lessons. In addition, significant learning outcomes for this curriculum are linked to Ohio's educational objectives for science in an at-a-glance curriculum matrix (as identified in the Ohio Department of Education publication, *New Dimensions in Science Education*, 1988). A summary of the significant 4-H Life Skills addressed within this curriculum is also provided.

The 4-H *Blue Sky* curriculum is organized around three distinct units of study, Forces, Fibers and Foods, linking space age technology to the everyday interests of students. Young people will learn:

- How **forces**, such as gravity, affect our daily lives on earth and astronauts while in space.
- The various roles **fibers** and textile products play on earth and in space
- Similarities between the nutritional requirements (**food**) of our bodies while on earth and in space.

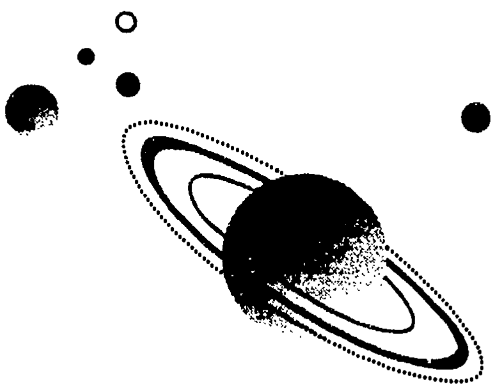
Each unit of study is complemented by a special 20-minute video presentation produced by NASA, USDA and the National 4-H Council. These videos, featuring shuttle astronauts, live shuttle footage and an animated satellite named Impulse, provide an ideal orientation for youth who are unfamiliar with this area of science and technology.

Educational Objectives

The objectives of the 4-H *Blue Sky* curriculum are to:

- Increase appreciation of space technology.
- Increase understanding of the relationship between space science and technology and daily living.
- Improve problem-solving and decision making skills.
- Develop initiative in learning by doing.
- Sharpen consumer skills.
- Promote career exploration.
- Establish positive role models.
- Recognize the relationships between events in this country and the global community.

Specific objectives for each unit are outlined in the individual teacher lesson plans.



About the Lessons

The lessons are designed to be used on a stand alone basis or in sequence as comprehensive unit of study. When preparing your lesson, familiarize yourself with the appropriate video and Blue Sky Fact Sheet. Also, be sure to gather the necessary materials and practice the experiments and activities beforehand.

Next, familiarize yourself with the Discussion Questions at the end of each unit. A proper discussion of an activity beforehand will help group members prepare for the learning that follows. Once an activity is completed allow time for processing. Use the questions provided to help group members relate what they observed and experienced to real life situations. When processing an activity, try not to focus on answers being "right" or "wrong." Rather, accept all answers as possible solutions. Then, help the group see why a particular answer may be more appropriate than others. Especially if the answer you were looking for was not given.

Lessons should last at least one hour and include 2-3 activities. Time permitting, you may wish to explore some of the Digging Deeper activities. Likewise, if you are providing a series of lessons, consider doing some of the Going Beyond activities. They are designed to provide a bridge between lessons.

Teaching Outline

The following is a recommended outline for conducting a series of lessons using the Blue Sky curriculum.

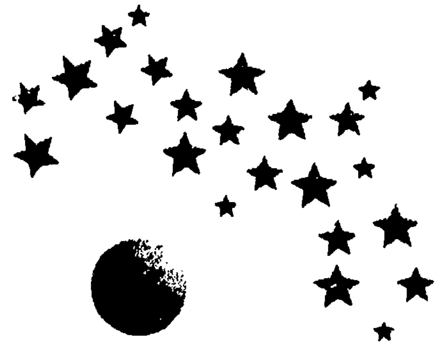
•Review of Last Session - Be sure to review what was learned at the last session. This will help members have a common starting place for the current session and lead into new information.

•Introduce New Knowledge - Rely heavily on showing rather than telling. Refer to the activities in each lesson, or use your own to get your message across. As you teach, focus on improving the learner as a person, as well as helping the group learn new things.

•Summarize Learning - Have the group talk about what they learned and what they liked doing. Focus on the positive, especially things didn't work out like you planned.

•Bring Closure to Session - Be sure to provide an over view of what will be covered during the next session. Try building excitement for what's to come by giving the group a problem to solve or maybe even question to be answered.

Significant 4-H Life Skill Outcomes



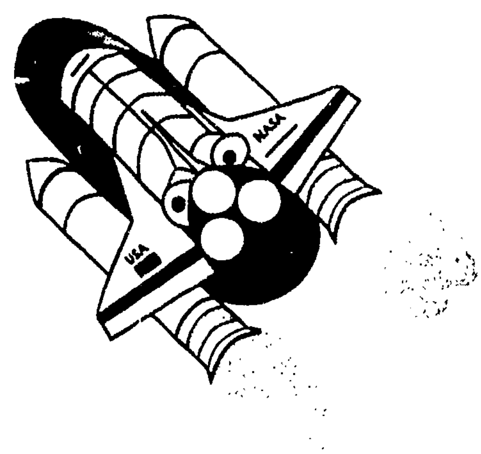
Life Skill Areas	Targeted Units 1 Forces	2 Fibers	3 Foods
Learning to Learn			
• Developing intellectual curiosity.	✔	✔	✔
• Learning by using the five senses.			✔
• Learning through experience.	✔	✔	
• Learning to use things.	✔	✔	
Making Decisions/ Solving Problems			
• Identifying problems.			✔
• Gathering information to solve problems.	✔	✔	✔
• Comparing and selecting alternatives.			✔
Communicating with Self and Others			
• Speaking before a group		✔	
Leading Self and Others			
• Working on a team.	✔	✔	✔
• Identifying one's own competencies.			✔
Planning and Organizing			
• Setting short term goals.	✔	✔	✔

Blue Sky Below My Feet
a 4-H Space Science Program

Planning Format
Grade Levels, 4-6

Goal Cluster or Program Goals	Program Objectives
Unit 1 — Forces 2.1 The students will understand the interactions of science, technology and society.	The students will be able to recognize the parts of the shuttle, their use and reuse.
3.1 The students will develop a knowledge and understanding of scientific principles and concepts.	The students will be able to understand the force of gravity and how it differs on earth and in space.
3.3 The students will learn to think critically, creatively and rationally so they can solve problems and promote lifelong learning.	The students will be able to understand how weightlessness affects objects in space.
Unit 2 Fibers 1.1 The students will understand and use new ideas and scientific information to improve their lives.	The students will be able to recognize the need for protective clothing in space and their application here on earth.
1.2 The students will develop skills to support scientific inquiry.	The students will be able to understand how spacesuits are constructed, the materials used and the various components.

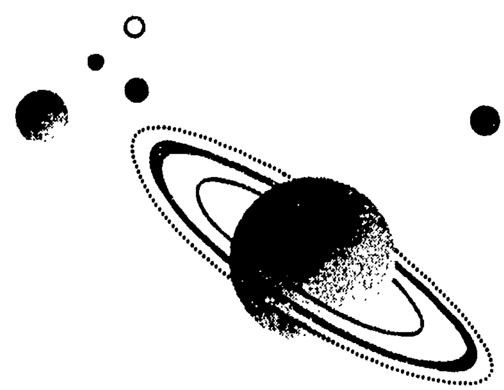
Subject Objectives *Science/Language Arts/Arts*	**Activities**
• Define the parts of the space shuttle. • Tell what each part is used for in space. • Conclude what parts of the shuttle can be reused for another mission.	• Measure the dimensions of the space shuttle. • Experiment with rocket staging. • Experiment with rocket lift-off. • Assemble a model shuttle. • Design a space shuttle bulletin board.
• Define gravity. • Hypothesize how gravity differs on earth versus in space. • Generalize about the effects of gravity on our daily lives.	• Construct a model of the space shuttle. • Demonstrate the effects of orbital movement. • Experiment how gravity effects a person's height. • Experiment how an egg can be modified to overcome gravity. • Identify the effect of gravity on real life objects. • Illustrate the effects of zero gravity.
• Formulate what it means to be weightless in space. • Predict how weightlessness affects objects in space.	• Perform math activity dealing with weightlessness. • Identify the effects of weightlessness on objects in space. • Experiment with the effects of the moon's gravity on a weightless object. • Demonstrate the appearance of weightlessness on earth bound objects.
• Analyze the different kinds of protective clothing worn in space. • Evaluate the space fabrics that are used in protective garments here on earth.	• Experience the insulating effects of an oven mitt. • Experiment whether certain fabrics burn or melt. • Experience how colors affect temperature. • Identify how space-age fabrics are used in our daily lives.
• Analyze how spacesuits are made and their functions. • Evaluate the function of the various fabric layers of a spacesuit.	• Communicate the different parts of a spacesuit. • Identify the parts of a spacesuit. • Simulate the bulkiness of a spacesuit. • Demonstrate the need for flexibility in a spacesuit. • Experiment why spacesuits are white. • Experience the cooling effect of evaporation.



Goal Cluster or Program Goals	Program Objectives
2.1 The students will understand the interactions of science, technology and society.	The students will be able to understand the differences between natural and man-made fibers

Unit 3: Foods

3.1 The students will develop a knowledge and understanding of scientific principles and concepts.	The students will be able to recognize the role of calories in an astronaut's diet as well as the need for physical exercise.
3.3 The students will learn to think critically, creatively and rationally so they can solve problems and promote lifelong learning.	The students will be able to understand how meals are eaten in space.
4.1 The students will realize that science and technology are relevant to the world of work.	The students will be able to understand how food is prepared and packaged for space travel.



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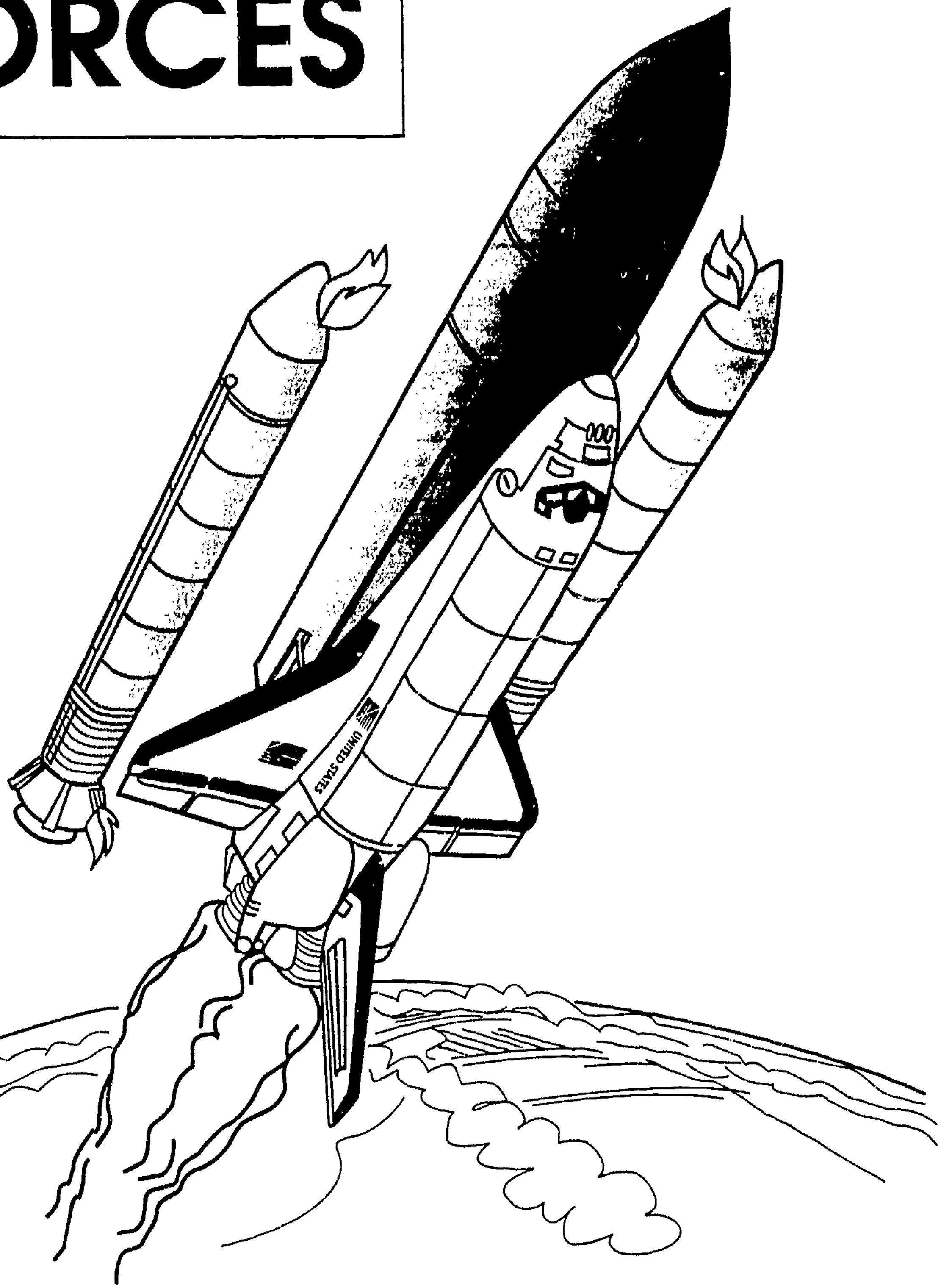
Subject Objectives *Science/Language Arts/Arts*	**Activities**
• Classify fibers and textiles based upon their origins and characteristics. • Analyze differences between natural and man-made fibers.	• Conduct a word search for terms relating to fibers. • Identify fabrics by touch. • Discuss the characteristics of natural and man-made fibers. • Experiment how different fabrics insulate better than others. • Conduct a fabric scavenger hunt.
• Analyze how calories contribute to the health of an astronaut. • Generalize how exercise is used to maintain the physical well being of an astronaut.	• Construct a menu using space-age foods. • Conduct a series of in-flight exercises. • Compare how calories are burned up differently among individuals. • Maintain a record of foods eaten and determine their nutritional value. • Demonstrate activities that burn up calories at different rates.
• Infer how meals are eaten while traveling in space. • Generalize similarities and differences between foods eaten and prepared on earth and in space. • Role play the eating of foods in space. • Conduct word search for foods that are eaten in space.	• Experiment with space-age eating utensils. • Experience what it is like to eat in space. • Construct a space food serving tray.
• Analyze how food is prepared and packaged for space travel. • Evaluate processing methods used to prepare food for space travel. • Communicate similarities between foods used in space and here on earth.	• Conduct food processing activity. • Work in groups to explore how food is prepared for consumption in space. • Perform a math exercise related to space-age foods. • Experiment with fresh and dried foods. • Experiment with the weights of fresh versus dried foods. • Dry foods for demonstration purposes. • Solve food storage problem situations. • Compare the taste of dried foods versus fresh foods.

FORCES



Getting Started

Begin unit by administering the pre-test to students followed by the presentation of the Blue Sky video on *Forces.* Administer the post-test at the conclusion of this unit. You may also wish to extend the learning of students at home by using the Supplemental Fact Sheets and Activity Sheets provided in the Learning resource section of this guide.

Parts of the Shuttle

Activities

- The Space Shuttle is 121 feet long, has a 70 feet wingspan and weighs about 200,000 pounds fully fueled. The payload bay is 60 feet by 15 feet and can carry up to 65,000 pounds. Using a ruler or yardstick, measure the shuttle's dimensions on the ground. Ask students to stand at points where certain parts of the Shuttle would be. For example, have one or two stand where the main engines are located, the crew compartment, payload bay, the top and bottom of the Space Shuttle, etc. If you have a group of 20 or more students, form the outside shape of the Shuttle.

- Play Space Shuttle Jeopardy using **Blue Sky Activity Sheet 2, Forces** page 49. Place students into groups of three to four players. Have one give the answer from the cards. The others must give the correct question. The student who states the correct question will receive the card, which includes a puzzle piece on the back. The students must collect enough puzzle pieces to put together the puzzle. The winner is the one who completes the puzzle first.

Experiments

Experiment 1

Demonstrate rocket staging.

Cut the bottom from the paper cup. Partially inflate the long balloon and pull the open end of the balloon through the top and out the bottom of the cup. Fold the top of the balloon over the edge of the cup to keep the air from escaping as you place the round balloon inside the cup and inflate it. Release the mouth of the round balloon.

Forces

Note To Teachers

Give each student a copy of the **Blue Sky Fact Sheet 1, The Space Shuttle**, page 35 - 36

Give each student a copy of the **Blue Sky Activity Sheet 1, Parts of the Space Shuttle**, page 48, and **Activity Sheets** 2-3

Lesson 1

Goals

- Identify the parts of the Space Shuttle.
- Identify what each part is used for in space.
- Identify what parts of the Shuttle can be reused for another mission.

4-H Life Skills

Working on a Team

Learning Through Experience

Gathering Information to Solve Problems

Developing Intellectual Curiosity

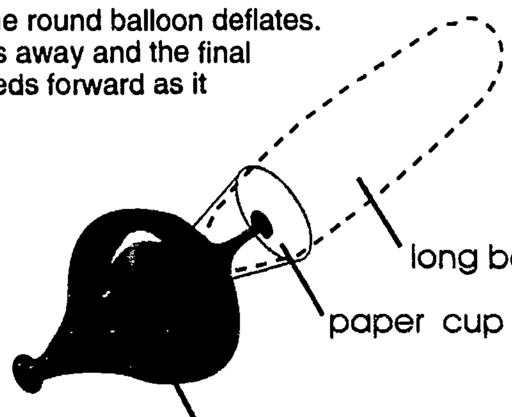
Classroom Key Words

Gravity
Thrusters
Payload
Atmosphere

Materials Needed

- ❑ Balloon, 9-inch, round
- ❑ Paper cup, 5-ounce
- ❑ Balloon, 18-inch, long
- ❑ Scissors

Results: The attached balloons move quickly as the round balloon deflates. The cup falls away and the final balloon speeds forward as it deflates.



Materials Needed

- ❑ Paper clips
- ❑ Tape
- ❑ String
- ❑ Balloons (small round, long or variety)

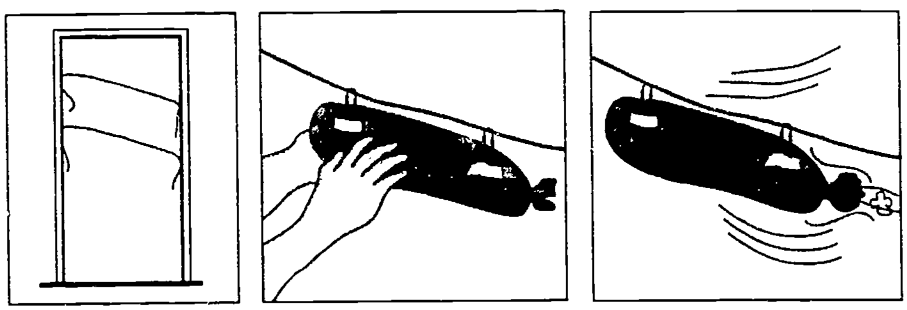
Experiment 2

Does the shape of rockets affect lift-off speed?

To make the rockets, tape two pieces of string beside each other between two walls or backs of chairs. (See illustration below.) One end of the strings should be higher than the other. Put two paper clips over each string so they can move.

Inflate the balloons and hold them closed. Tape the paper clips to the balloons. Have the small round balloon on one string and the long balloon on another string. Release them and see which reaches the top first.

Next use two round balloons taped on one string and one long balloon on the other string. Try other combinations to see if more balloons will reach the top of the string faster.



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Extending the Lesson

Art Activities

- Use **Blue Sky Activity Sheet 3, Assemble a Space Shuttle,** page 51. Have the students color the different parts of the Space Shuttle. Glue the parts together to form the Space Shuttle on a piece of paper.

- Have students or small groups design a bulletin board which can be used as a motivational teaching tool.

Discussion Questions

How big are the rocket boosters on the Space Shuttle and what fuels do they burn?
Rocket boosters are 150 feet high and burn solid fuels.

Why are rocket boosters needed?
On lift-off, they help the Shuttle overcome the initial strongest pull of earth's gravity.

Why are the rocket boosters so large?
To overcome gravity, they develop approximately five million pounds of thrust and push the heavy Shuttle 24 miles up into space.

Why are the three main liquid fuel engines needed on the Shuttle? How similar are they to the rocket boosters?
The main engines and the boosters help propel the Shuttle into space. The liquid fuel engines start burning at the same time as the rocket boosters. The rocket boosters burn for only two minutes before being released from the Shuttle. They eventually drop back to Earth. The liquid fuel engines burn for eight minutes before shutting down, and they stay with the Shuttle throughout its flight.

What parts of the Shuttle are reusable?
All parts except the liquid fuel tank are reusable.

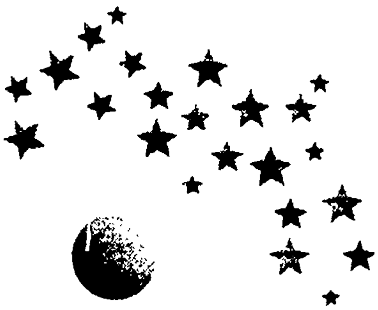
Why does the Space Shuttle have so many different size engines?
Different sizes of engines are required to maneuver in different gravitational situations.

Lesson 2

Gravity and Space

Note To Teachers

Give each student a copy of the **Blue Sky Fact Sheet 2, Gravity and Space**, page 37.
Give Students: Activity Sheet 4, 5, 6.



Goals

- Define gravity and explain how it differs between Earth and space.
- Explore the effects of gravity in our daily lives.

4-H Life Skills

Learning to Usa Things

Setting Short Term Goals

Gathering Information to Solve Problems

Developing Intellectual Curiosity

Classroom Key Words

M P H
Accelerates
Centrifugal
Escape Velocity

Activities

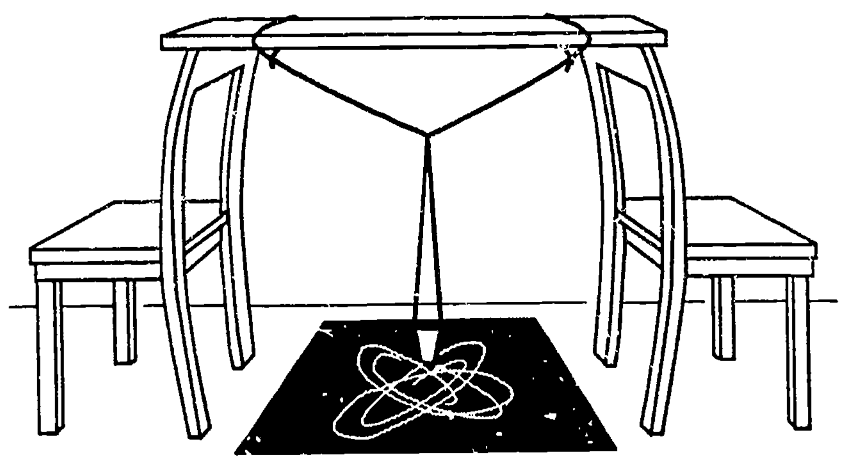
- Give the students a copy of **Blue Sky Activity Sheet 4, Gravity and Space Word Search**, page 52.

- Demonstrate the effect of forces on orbital movement. Separate two chairs and tape the ends of a yardstick to the top edge of each chair's back. Cut two one-yard lengths of string. Attach both ends of one string to the yardstick to form a V-shaped support. Secure the ends with tape. Loop the second string over the V-shaped string and use tape to attach the ends to the top rim of the cup, one on each side of the cup. Tie the string so the cup is about four inches from the floor. Lay black poster board under the hanging cup. Fill the cup with salt. Use the point of a pencil to make a small hole in the bottom of the cup. Pull the cup back and release to allow it to swing forward. The pattern formed by the salt is like the orbits in space.

- Drop objects of different weights to see if they land at the same time. Drop two objects of the same weight at two different heights and see if they land at the same time.

- Language Arts Activity — Write a poem about the Shuttle or space. Experiment with different types of poetry.

- Art Activity — Make a model of the Space Shuttle. See **3lue Sky Activity Sheet 5, Space Shuttle Model**, page 53 for directions.

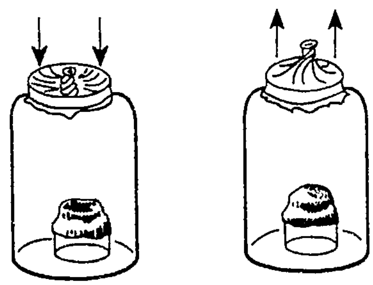


Experiments

Experiment 1
See if gravity affects a person's height.

Materials Needed
- ❑ Baby food jars, two small
- ❑ Balloons, four round, 9-inch
- ❑ Large-mouthed jars, two, one-quart
- ❑ Scissors

Cut the neck from two of the balloons. Stretch the cut balloons over the baby food jars to cover the opening. Place the covered baby food jars inside the larger jar. Cut the tip off the rounded end of the other balloons. Stretch the balloon over the mouth of the large jar with the neck of the balloon centered over the jar's mouth. Push the surface of the stretched balloon down into the jar, allowing air from the inside the jar to escape through the open neck of the balloon. Twist the balloons' neck. Then pull one balloon upward and push the other balloon inward. Observe the effect this has on the balloon which is stretched over the mouth of the baby food jar.



Results: The jars simulate the effect of gravity on the moveable disc in the spinal column. Pulling the balloon upwards represents a low-gravity environment, causing the rubber covering on the baby food jar to bulge upward, thus making a person taller in space. Pushing down on the balloon represents a high-gravity environment, and the rubber covering on the baby food jar sinks, thus pushing the spinal disc together to make a person shorter.

Experiment 2
Egg Drop — landing a safe Space Shuttle.

Materials Needed
- ❑ Raw eggs
- ❑ Plastic bags
- ❑ Newspapers

Give each student a raw egg, a plastic bag and two full pages of newspaper. Students are to place the egg in the bag. The egg should be dropped from a high location, like a second or third story window. Using only the two pages of newspaper to control the descent, drop the eggs. The students may use the paper in any way they wish. After this experiment discuss better ways of packaging their payload.

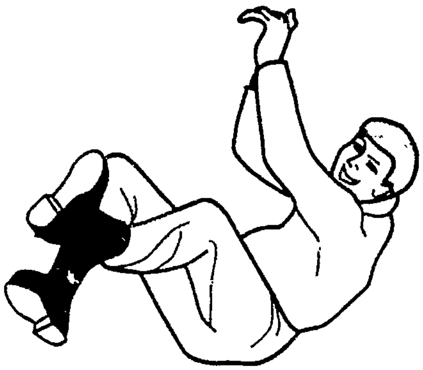
Extending the Lesson

- Find 15 effects of gravity in the picture **Blue Sky Activity Sheet 6, Effects of Gravity**, page 54.
- In groups of two, have students create an advertisement for a Space Shuttle flight.

- Imagine what it would be like to "swim" through a house, school or grocery store if it had near-zero gravity. Ask the students to draw how they imagine it would be, or write about how it would feel.

Discussion Questions

Which forces can prevent the Shuttle from leaving the ground?
Gravity and air resistance.



What effects does gravity have on our daily lives?
The force of gravity pushes down on the Earth and we have to push back to overcome the force of gravity on our daily lives. Gravity makes lifting heavy objects difficult: it holds heavy unfixed objects in place: and causes tides in coastal areas.

What are the effects of gravity on the Space Shuttle? On Earth? In orbit?
Gravity gives the Shuttle weight on Earth and allows it to stand upright on the launch pad. In orbit, gravity's absence causes near-zero weightlessness.

When does earth's gravitational pull completely disappear?
Never! Earth's gravity extends through the solar system but, nearer another planet, for example, its' gravity is counterbalanced by the gravity of the other planet.

Why does the Space Shuttle have so many different size engines?
Different sizes of engines are required to maneuver in different gravitational situations.

What effect does gravity have on the released rocket booster engines? How do parachutes overcome these effects?
Gravity pulls the booster engines back to Earth. Parachutes' wind resistance slows their rate of fall so they do not disintegrate.

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Weightlessness in Space

Lesson 3

Classroom Activities

- Math Activity: Have the students do **Blue Sky Activity Sheet 7, Matching Up The Space Shuttle**, page 55.

- Divide the students into small groups of two or three. Have them do a "weightless check" in the school or classroom. Write the following questions on the chalk board:

  How would you keep food on your cafeteria trays?

  How would you keep books on the shelves in your library?

  How would you keep library shelves on the floor?

  How would you make a basketball go through the hoop?

  How would you keep school busses on the ground?

  How would you keep desks on the floor?

  What would make water go down the bathroom sinks?

- Have the students do **Blue Sky Activity Sheet 8, Weightlessness In Space**, page 56. Circle ten things in the Space Shuttle that show the effect of weightlessness.

Experiments

Experiment 1
Demonstrating Weightlessness

Take a balloon completely filled with water (no air) and tie a 3 ft. piece of string to the end of if. With the balloon attached to the string, lower it into an empty 5 gallon bucket. With your group clustered around, ask what they think will happen to the balloon when it is placed in the same bucket filled with water.

After they have made their guesses, fill up the bucket with water and return the water balloon to the bucket. What they will observe is apparent weightlessness. When the water balloon enters the water it basically stays put, going neither up nor down in the bucket. Use this demonstration to illustrate why astronauts train in "swimming pool" like conditions to experience the weightlessness of space.

Note To Teachers

Give each student a copy of copy of **Blue Sky Fact Sheet 3, Weightlessness in Space,** page 38.
Activity Sheets 7 - 8

Goals

- Define what weightlessness is in space.
- Define how weightlessness affects objects in space.

4-H Life Skills

Working on a Team

Gathering Information to Solve Problems

Setting Short Term Goals

Developing Intellectual Curiosity

Classroom Key Words

Weightlessness
Orbit
Experiments
Environment

Materials Needed

- ❑ Balloon
- ❑ String
- ❑ 5 Gallon Bucket
- ❑ Water
- ❑ Salt
- ❑ Eggs
- ❑ Measuring Cup

Digging Deeper:

If any of you students wish to know why the water balloon appears to float, explain that the density of the water in the balloon is exactly equal to and supported by the bouyant force of the surrounding water. In fact, any object with the same density of water, 64 lbs./cubic foot, will produce the same effect.

Try increasing the density of the water in the bucket by adding salt, 1 cup/gallon. Now submerge the water balloon again and see what happens. Because the salt water in the bucket is denser that the fresh water in the balloon, the balloon should float. You could also continue the experiment with an egg. A fresh egg placed in fresh water sinks, while a fresh egg in salt water floats.

Extending The Lesson

- Have the students sketch a map of the United States. Mark the location of Cape Canaveral or the Kennedy Space Center (Florida) where the Shuttle is usually launched, and the Edwards Air Force Base (California) where it sometimes lands. Where else might the Shuttle land? (Kennedy Space Center) Mark this location, also. The map might be used to give a speech or illustrated talk.

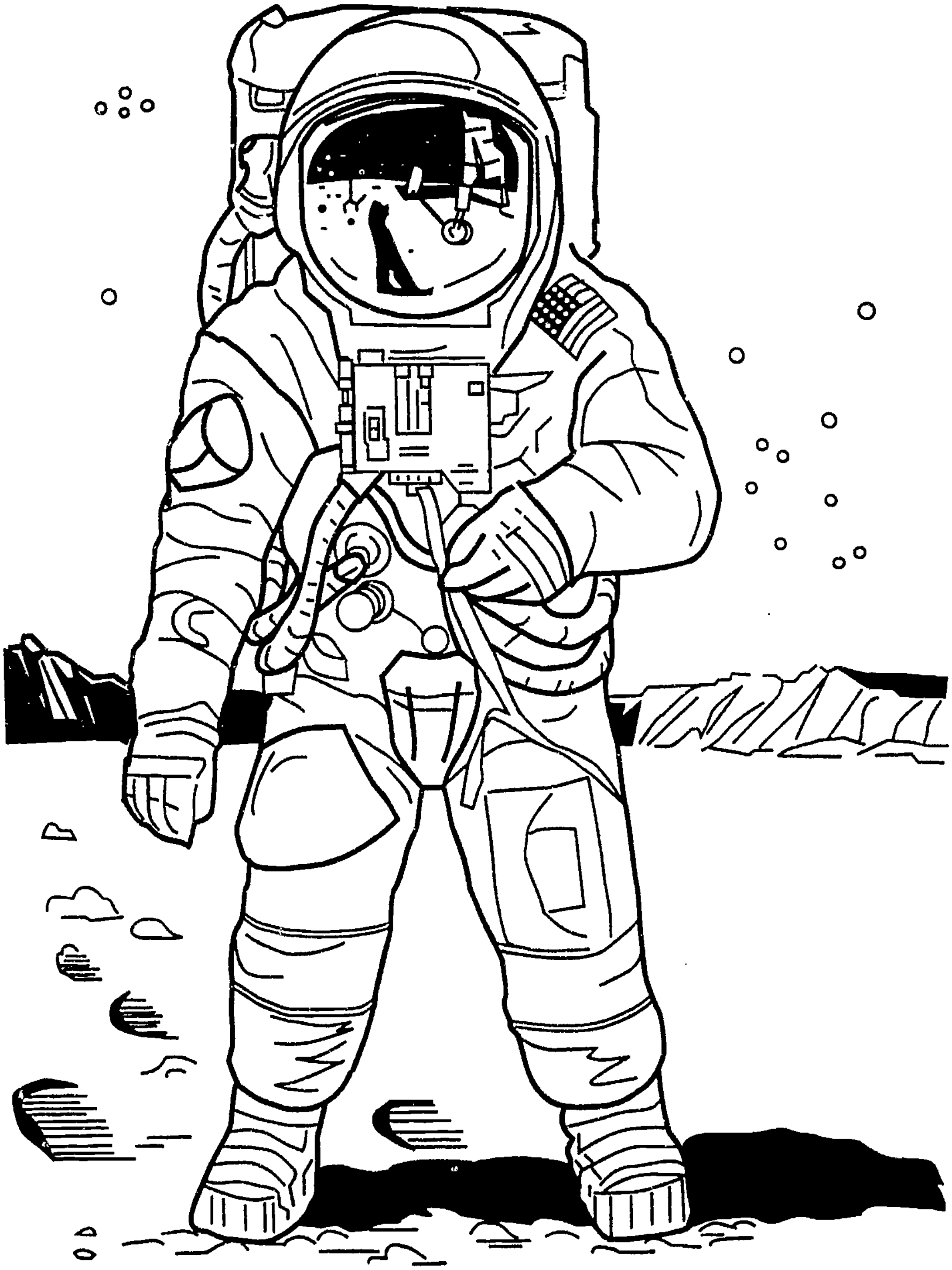
Discussion Questions

What jobs deal almost exclusively with forces such as gravity?
Pilots, elevator engineers, water supply crews, highway engineers, power dam operators and crane operators.

How does weightlessness affect the crew of the Space Shuttle?
Because there is no gravity in space, the crew floats around in the Shuttle.

How does the weightlessness in space help the astronauts in their work?
Because of the weightlessness, the astronauts are able to move large heavy objects with less force. Remember an object in space weighs about $^1/_6$ to $^1/_8$ less then it does on Earth.

FIBERS



Fibers

Lesson 1

Note To Teachers

Bring in squares of fabric to identify. Give each student a copy of the **Blue Sky Fact Sheet 4, Fibers and Textiles**, page 39.
Activity Sheet 9

Goals

- Describe fibers and textiles, their origins and characteristics.
- Identify the difference between man-made and natural fibers.

4-H Life Skills

Speaking Before a Group

Gathering Information to Solve Problems

Learning to Use Things

Developing Intellectual Curiosity

Key Words

Man-made fibers
Natural fibers

Getting Started

Begin unit by giving the pre-test to students followed by the Blue Sky video about Fibers. Administer the post-test at the conclusion of the unit. You may also wish to extend the learning of students at home by using the Supplemental Fact Sheets and Activity Sheets provided in the Learning resource section of this guide.

Fiber and Textiles

Activities

- Do **Blue Sky Activity Sheet 9, Fibers and Textiles Word Search**, page 57.
- Play Blind-Man's Bluff to identify different fabrics by touch. Blindfold each student. Hand them different fabric samples for identification. Keep score to see who can best identify the fabrics by touch.
- On the chalk board, list as many examples of man-made and natural fibers as possible. Refer to **Blue Sky Fact Sheet 4** for ideas.
- Discuss each fiber and how it can be used in everyday life.

  Examples:

  Polyester — Strong and durable

  Nylon — Protect against rain and wind; wind-breaker

  Wool — Keeps one warm in cold weather; sweater or coat

  Cotton — Keeps one cool in hot weather; T-shirt

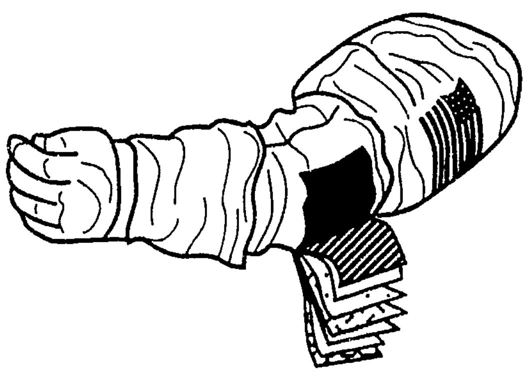
- Discuss how people use special fibers in their work.

  Examples:

  Medical — Disposable paper items, arteries, cloth, bandages

  Fire-fighters — Heat and flame resistant clothing

  Policeman — Protection from weapons and bullets; bullet-proof vest



Experiments

Experiment 1
How different fabrics insulate.

Place a lamp in the center of a table. Do not turn it on. Place both thermometers on the black paper. Lay one thermometer on one end of the table and record the room temperature. Place the other thermometer under the lamp. Turn the lamp on and measure the temperature change in three- to five-minute intervals. Record the changes.

Turn the lamp off and note the drop in temperature.

Place one layer of a given fabric over the bulb of the thermometer and repeat. Try two different layers, then multiple layers of the same fabric. Next, try different fabrics in the same way, such as wool, cotton, polyester, etc.

Materials Needed

- ❑ Two thermometers
- ❑ Various pieces of fabric
- ❑ Lamp or light bulb
- ❑ Two pieces black paper

Extending the Lesson

Have each student conduct a fabric scavenger hunt in the classroom. Look at clothing labels from other students' clothes. Find someone who is wearing the same type of fibers, such as cotton or wool. You may also wish to bring in samples of other different fabrics for discussion.

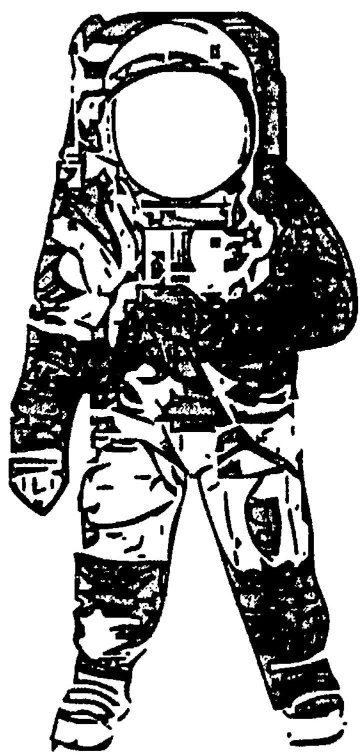
Discussion Questions

What is the major difference between man-made and natural fibers?
Man-made are chemically manufactured; natural fibers come from plants or animals. (Answers may vary)

Name four man-made fibers.
Man-made fibers include acrylic, polyester, aramid and nylon.

Where do natural fibers come from?
Natural fibers come from plants and animals.

What are the differences in clothing needs inside and outside the Space Shuttle?
Inside the Shuttle, comfort, convenience, appearance and fit are important. Outside the Shuttle, temperature, protection, durability and puncture-proof qualities are considered.



Space Suit

Goals
- Identify how space suits are made and their functions.
- Identify the functions of the different layers of fabric in the spacesuit.
- Identify the different parts of a Extravehicular Mobility Unit.

4-H Life Skills
Setting Short Term Goals

Learning Through Experience

Developing Intellectual Curiosity

Gathering Information to Solve Problems

Key Words
Extravehicular Mobility Unit
Evaporation
Astronaut
Wardrobe

Note To Teachers
Give each student a copy of the **Blue Sky Fact Sheet 5, Space Suits**, page 40.
Activity Sheet 10

Materials Needed
- ❑ Three empty jars
- ❑ Three thermometers
- ❑ Black paper
- ❑ White paper
- ❑ Tap water
- ❑ Masking tape

Activities
- Have the students identify the part of the EMU by doing the **Blue Sky Activity Sheet 10, Parts of the EMU**, page 58.
- Simulate the bulkiness of the different layers that make up a space suit. Have the students put on additional layers of clothing (pants, skirts, shirts, sweaters, gloves and coats). Have them try to do regular activities such as write their name, pick up an object off the floor, etc. Have others observe how difficult movement is. Discuss the possible ways to make a space suit more comfortable.
- Demonstrate the need for flexible joints in a spacesuit. Inflate long balloons to simulate the pressurized space suit. Try to bend the balloons as an astronaut might bend an elbow or a knee Observe what happens.

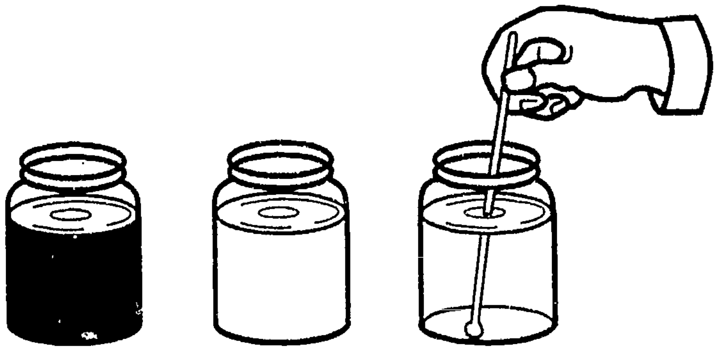
Experiments

Experiment 1
Why are space suits white?
Cut black paper to wrap around one jar. Cut white paper to wrap around the second jar. Leave the third jar as is. Fill each with tap water and place them in the sun or under a light bulb.

Measure and record the temperature of each jar after 10 minutes, 15 minutes and 20 minutes.

What happens to the water in each jar?

How can color be used to control temperature?



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Experiment 2
How does evaporation and moving air decrease temperature?

Dampen the back of your hand with a few drops of water. Turn on the fan. Let it blow across your hand. What do you feel?

Dampen the back of your hand with a few drops of alcohol. Turn on the fan and let it blow across your hand. What do you feel now?

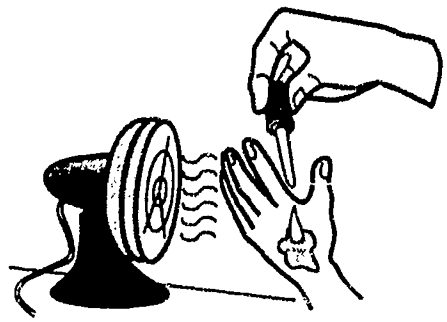
What happens to the water and the alcohol?

How does evaporation decrease temperature? **(Hint: evaporation is a cooling process.)**

How does moving air in the space suit help astronauts?

Materials Needed

- ❑ 1/2 teaspoon water
- ❑ 1/2 teaspoon alcohol
- ❑ Small fan or other source of moving air

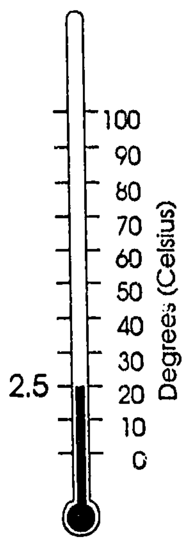


Extending The Lesson

Temperature drops at approximately 6.6° C per kilometer as you go higher in the atmosphere. If the outside temperature is 20° C at 2.5 kilometers, what will it be at 6.5 kilometers? At 8.5 kilometers? At 10 kilometers?

Answers

-6.4 C; -19.6 C; -29.5 C



Discussion Questions

How might space suit fibers be used on Earth?
These fibers provide protection from intense heat and cold, such as from heat for a firefighter or from cold for workers in a freezer plant.

How does the extravehicular space suit protect the body?
It protects against heat, cold and bodily explosion from lack of air pressure and speeding micro meteorites. Why is it needed? It allows astronauts to work in space outside the Shuttle.

Why are the space suits white?
Light colors do not absorb as much heat as dark colors. Light colors reflect the sun's rays away from the astronauts.

Why is it important for gloves to fit the individual astronaut?
Gloves must fit snugly in order to feel and pick up small objects. A good fit allows for manipulation of objects and materials.

Protective Clothing

Goals

- Identify the different kinds of clothing worn for protection.
- Identify space fabrics that are now used in everyday products on Earth.

4-H Life Skills

Comparing and Selecting Alternatives

Learning Through Experience

Gathering Information to Solve Problems

Working on a Team

Key Words

Environment
Protective
Velcro™ Closure

Note To Teachers

Give the students a copy of the **Blue Sky Fact Sheet 6, Protective Clothing**, page 41.

Math activity: Give students a copy of the **Blue Sky Activity Sheet 11, Math Match**, page 59.

Give the students a copy of **Blue Sky Activity Sheet 12, Fibers and Fabrics Find Use On Earth**, page 60.

Activities

- Compare the protection provided by the EMU in space against the various environmental elements. Place an oven mitt next to a heat source (oven, heat lamp, heater). Observe that the outside of the mitt next to the heat source becomes quite warm, while the inside, which is protected from the heat, stays cooler.
- Art Activity: Astronauts wear helmets as part of their space suits. Have the students create space helmets using materials such as an empty cardboard container, small rectangle box, string, cellophane, pipe cleaners and brass fasteners. Cut the cardboard container so it fits over a child's head. Cut a rectangular opening at eye level.

Experiments

Experiment 1

Does fabric burn or melt?

Conduct this experiment outside or in a well-ventilated area.

Place a fabric square in the center of the pan. Ask the students if the fabric is a natural or man-made fiber. Have them decide the content of the fabric (wool, nylon, spandex, etc.).

Light the square with matches.

Does the fabric catch on fire?

Does the fabric burn or melt?

Do natural fibers burn where the man-made fibers melt?

Materials Needed

(Experiment 1)

- ❑ 2 x 2-inch squares of fabric, both natural and man-made (include some fire resistant materials)
- ❑ One plate or pie pan
- ❑ Matches
- ❑ Hot mitts

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Experiment 2

Does color affect temperature?

Have the students place the ice cubes on the paper. Place them on a desk. Observe the rate that the ice melts (every 30 seconds)

Decide if light or dark paper keeps ice from melting as quickly.

The ice that melts faster absorbs the most heat.

Material Needed

(Experiment 2)

- ❑ Four ice cubes (all the same size)
- ❑ Assorted colors of paper

Extending the Lesson

- Invite a person from the local fire department to bring the protective clothing they wear. Ask them to describe how it protects them from injury.
- Discuss the protective clothing made from fibers that is worn by football, baseball or soccer players.

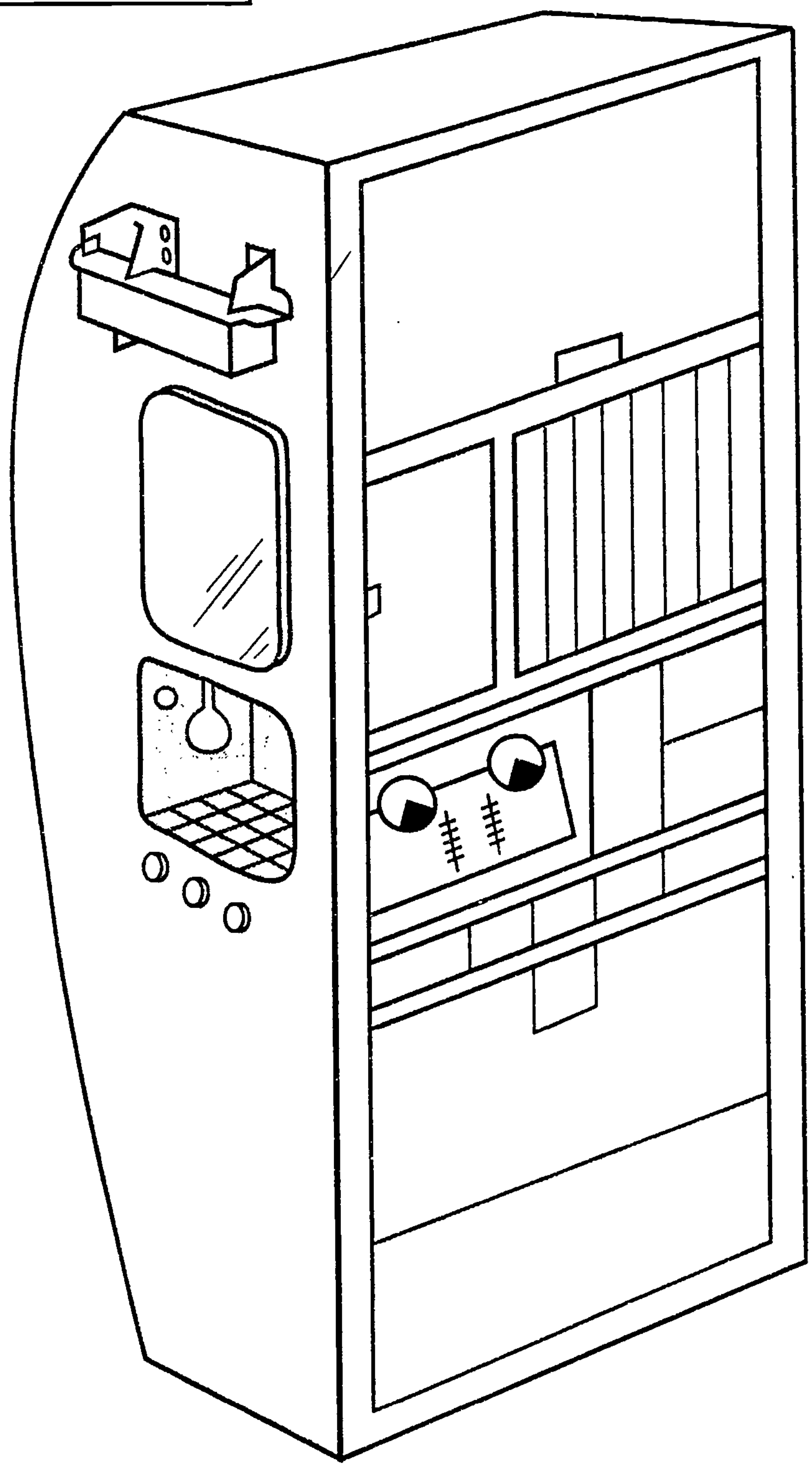
Discussion Questions

Does the thickness of the astronauts' gloves and spacesuit protect them from the environment in space?
No, the spacesuit and gloves must be made out of certain fibers that are specialized in heat and cold resistance.

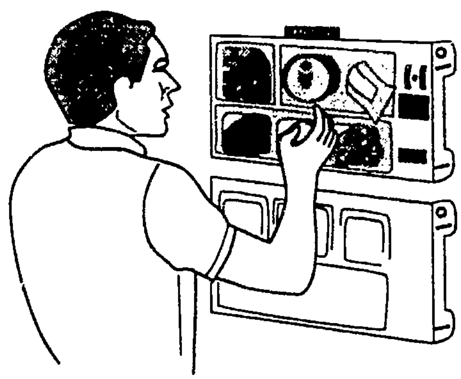
How would space suit fibers be used on Earth?
These fibers can be used as protection from intense heat and cold and in underwater applications for divers.

Name some sports that require special shoes and/or boots.
Hockey, football, soccer, roller skating and figure skating.

FOODS



Getting Started



Begin unit by giving the pre-test to students followed by the Blue Sky video about Foods. Administer the post-test at the conclusion of the unit. You may also wish to extend the learning of students at home by using the Supplemental Fact Sheets and Activity Sheets provided in the Learning Resource section of this guide.

Food For Space

Activities

- Math Activity: **Blue Sky Activity Sheet 14, Math Fractions**, page 62.

  If your students can not do fractions the numbers can be changed to percentages.

  $^{1}/_{3}$ = 33 percent $\quad$ $^{7}/_{24}$ = 30 percent

  $^{1}/_{24}$ = 4 percent $\quad$ $^{1}/_{12}$ = 8 percent

  $^{1}/_{6}$ = 17 percent

- Describe how each of the following methods of food processing works. (See **Blue Sky Fact Sheet 7, Food For Space.**)

  ✔ **Thermostabilization** — preserving food with heat and sealing the container, as in canning tuna fish, fruits, pudding, and applesauce.

  ✔ **Dehydration** — removing all water from food, such as soup mix.

  ✔ **Freeze-drying** — removing ice from frozen food by vaporization, a method often used on vegetables

  ✔ **Natural form** — taken as is, such as candy, banana, cookies.

  ✔ **Irradiation** — subjecting food to high energy rays to prevent decay, as in preserving bread and meat so they don't need refrigeration.

  ✔ **Intermediate moisture** — removing part of the moisture from foods, such as drying grapes into raisins.

Foods

Note To Teachers

Give each student a copy of the **Blue Sky Fact Sheet 7, Food for Space**, page 42.

Give each student **Blue Sky Activity Sheet 13, Processing and Packing**, page 61.
Activity Sheet 14

Lesson 1

Goals

- Identify how food is prepared and packaged for space travel.
- Identify processing methods used to prepare food for space travel.
- Identify foods in the grocery store that are packaged similar to foods for space travel.

4-H Life Skills

Working on a Team

Developing Intellectual Curiosity

Learning by Using the Five Senses

Setting Short Term Goals

Key Words

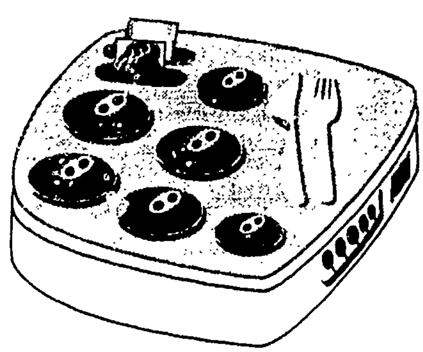
Dehydrated
Intermediate Moisture
Freeze Dried
Natural Form
Thermostabilization
Irradiation

Materials Needed

- ❑ Dried apricot (intermediate moisture) and fresh apricot
- ❑ Other foods may be used as long as one is dried and the other is fresh.

Materials Needed

- ❑ Single serving of canned peaches or apricots (thermostabilized)
- ❑ Single serving of dried peaches or apricots (intermediate moisture)
- ❑ Single serving of dehydrated peaches or apricots (freeze dried)
- ❑ Scale, ounce or gram



Experiments

Experiment 1
Fresh vs. Dried

Place each piece of fruit in a separate plastic bag. Place them in the warm air or sunlight for two to three days.

Watch for changes in the fruit.

Does mold appear? If so, on which fruit?

Which fruit could be taken on a space mission?

Experiment 2
Which weighs more?

Weight and volume are a primary consideration when taking food aboard the Space Shuttle. Weight allowed for food is limited to 3.4 pounds per person per day, which includes one pound of packaging.

Weigh one serving of each food. Which one weighs the most?

Rehydrate the dehydrated food.

How much did a dehydrated food weigh before and after the water was added?

Extending the Lesson

- Dry fresh food for space travel. Slice bananas thin and place them on a cookie sheet. Sprinkle with sugar. Place them in a 150° F to 200° F oven for 1 to 2 hours dry. Cool and eat.
- Art Activity: Allow students the opportunity to discover how NASA attempted to solve the problem of storage space. Experiment in groups with paper, plastic and other materials, to design food containers that hold food in a small space. Ask the students to share their results with the class and tell how they made the container.
- Eat the same food that is processed in different ways. Describe why one is more appealing than another, such as grapes and raisins

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Discussion Questions

What two methods do astronauts use most in food preparation in space?
Rehydration and heating.

What challenges do a lack of refrigeration present to the Space Shuttle astronauts?
Many foods we eat fresh from the refrigerator or freezer must be processed and prepared in different forms to provide balanced diets.

On Earth, where do you take food to eat that has similar conditions to the Shuttle?
These would be situations where there is no refrigeration, a limited amount of water, no kitchen sink and no stove. Answers would include picnics, camping, backpacking, biking, hiking.

What items would not be appropriate for space travel? Why would they not be appropriate?

- ✔ *Container holds more than one serving.*
- ✔ *Package is too bulky and is hard to hold.*
- ✔ *Food required refrigeration.*
- ✔ *Container is hard to open.*
- ✔ *Food required preparation not available in the Space Shuttle.*

Eating In Space

Note To Teachers

Give each student a copy of **Blue Sky Fact Sheet 8, Foods Eaten in Space**, page 44.
Activity Sheets 15-16

Activities

- Have students do **Blue Sky Activity Sheet 15, Foods Eaten in Space**, page 63 to learn what types of foods and drinks are taken on a space mission.
- Have students imagine they are going on a space mission. Students can bring in items for either a breakfast, lunch, dinner or snack in the form that it would be taken into space. Have them compare the food to a meal they eat on Earth.

Experiments

Materials Needed

- ❑ Several servings of pudding
- ❑ One teaspoon
- ❑ Spoon (less than one teaspoon)
- ❑ Clock with second hand

Experiment 1

How does using a small spoon help an astronaut eat slowly and carefully?

Eat a serving of pudding with the regular spoon. Time how long it takes to finish the pudding. Eat slowly and carefully the way an astronaut would.

Eat a second serving of pudding the same way but use the small spoon.

How long did it take to eat the pudding with the regular spoon?

With the small spoon?

Which spoon made you a more careful and slower eater?

Why would smaller spoons be used in the Space Shuttle?

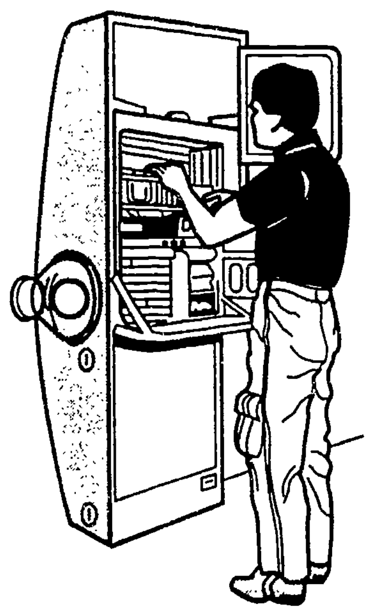
Materials Needed

- ❑ Paper bowls
- ❑ String
- ❑ Instant Oatmeal
- ❑ Hot water
- ❑ Small plastic utensils

Experiment 2

What is it like to eat in space?

Place three or four holes in the top rim of the bowl. Tie the string to the bowls. Make the string long enough so the bowls will dangle from it. Have one student hold the string in the air while the other student tries to eat dry oatmeal from the bowl using the small utensils. Reverse roles. Then add the water to the oatmeal. Again have the student try to eat the oatmeal. The bowls will swing back and forth.



Extending The Lesson

- Art Activity: Have the students design their own meal tray out of boxes, paper, foil, rubber bands, string and miscellaneous objects. The small food containers should stay in the tray while the students eat on their backs, side-ways and at different angles. See **Blue Sky Activity Sheet 16, Space Food Tray.**

Discussion Questions

What is eating in space like?
The process of eating is somewhat more difficult because of the weightless or near-zero gravity. Foods are packaged in special containers and fastened down to keep them from floating in space.

How do the astronauts eat in space?
They can eat comfortably while sitting down, lying down, floating or in almost any position due to the weightless environment.

What kinds of teamwork does it take to develop new foods and food products for space use?
Scientific knowledge, packaging and engineering skills, and environmental information all can play a role.

How much do you think foods will change in the future? Will most of the changes be in new methods of processing?
Foods will change very slowly in the future. Most of the changes will be in new methods of processing. There will be some new food products but not many because development of a new product proceeds very slowly.

What are some of factors to be considered when making food choices?

✔ *Taste — How good does it taste?*

✔ *Enjoyment — Do you like eating it?*

✔ *Cost — Is it a good food value for the nutrients it provided?*

✔ *Ease of preparation — Is easy to prepare?*

✔ *Quantity needed — How much will you need?*

Goals

- Describe how meals are eaten while traveling in space.
- Identify similarities and differences in foods, meal preparation and dining space available.

4-H Life Skills

Developing Intellectual Curiosity

Identify Problems

Working on a Team

Identifying One's Own Competencies

Key Words

Gravity
Velcro™
Utensils
Condiments

Food and Energy

Note To Teachers

- Give each student a copy of the **Blue Sky Fact Sheet 9, Food and Energy**, page 45.
- Math Activity: Give each student a copy of **Blue Sky Activity Sheet 17, Space Lunch Menu**, page 65.
  Activity Sheet 18

Goals

- Describe how calories contribute to good health and weight control.
- Describe what types of physical exercise are done while in space.

4-H Life Skills

Developing Intellectual Curiosity

Setting Short Term Goals

Working on a Team

Gathering Information to Solve Problems

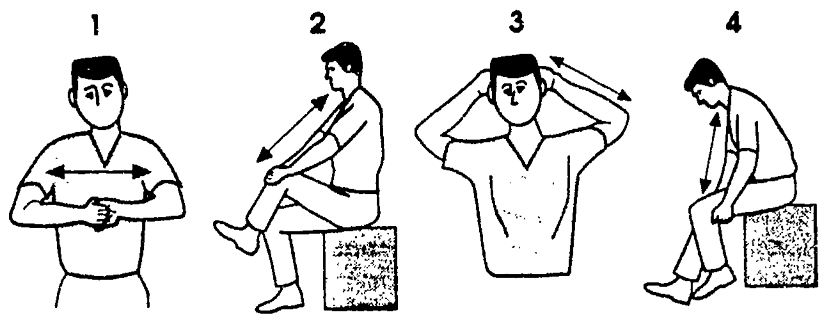
Key Words

Exercise
Energy
Resistance
Calorie
Nutrients

Activities

- Exercise for space flight. To simulate exercise done by the astronauts while in flight, try the following basic isometrics:

  1. Grasp right hand in left and pull in opposite directions while hands are held together for five seconds, 10 seconds and 20 seconds.
  2. Grasp left leg at the knee with clasped hands. Pull leg toward chest 10 times. Repeat procedure with other leg.



  3. Clasp hands behind head. Pull in opposite directions.
  4. In a seated position, clasp hands under legs. Pull in opposite direction.

- How do you burn calories? Give each person in the group a copy of **Blue Sky Activity Sheet 18, Keeping Fi**, page 66. Ask them to recall what they did in the last 24 hours and complete the worksheet. Ask if they were surprised to see the number of calories needed for one day.

Extending The Lesson

- Ask students to keep a record of the foods eaten for two days. Using a calorie counter and food labeling information, calculate calorie and nutritional intake. Ask them: Are you surprised at what you found? What can you do about what you discovered?
- Invite a sports coach to discuss the importance of physical fitness and suggest some activities for the class.
- Form physical fitness teams of three or four members. Ask one to design and lead the group in a quiet activity; another to lead the group in a light activity; and the third to lead everyone in an exercise activity. Each team should identify the number of calories burned for their activity.

Discussion Questions

How many calories an hour do you burn in various activities?
Sleeping — 80 calories
Studying — 150 calories
Walking — 250 calories
Working hard — 360 calories

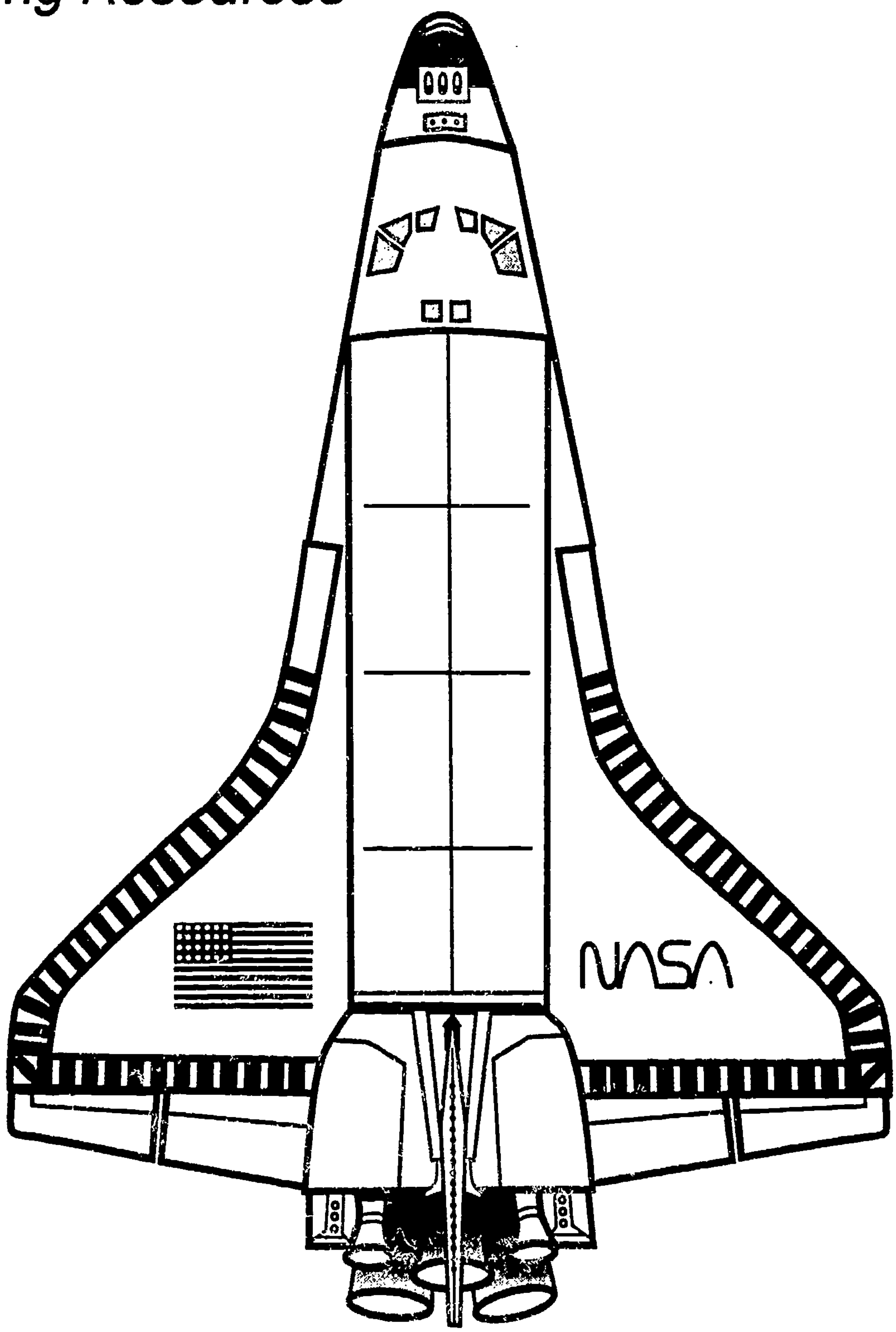
Why do we need calories from food?
Our bodies require energy for maintenance, functions and growth.

Why do astronauts eat the same balanced diets that you eat on Earth?
Astronauts are human beings and they have the same physiological needs for energy and adequate nutrition while in space as they do on Earth.

What's the relationship between exercise and nutrition?
Exercise builds strong bodies and burns calories; it also helps the body absorb nutrients.

Does exercise help you to burn calories? What else does it do?
It also helps you to maintain your weight, good physical condition, and general feeling of wellness.

Blue Sky Below My Feet Learning Resources



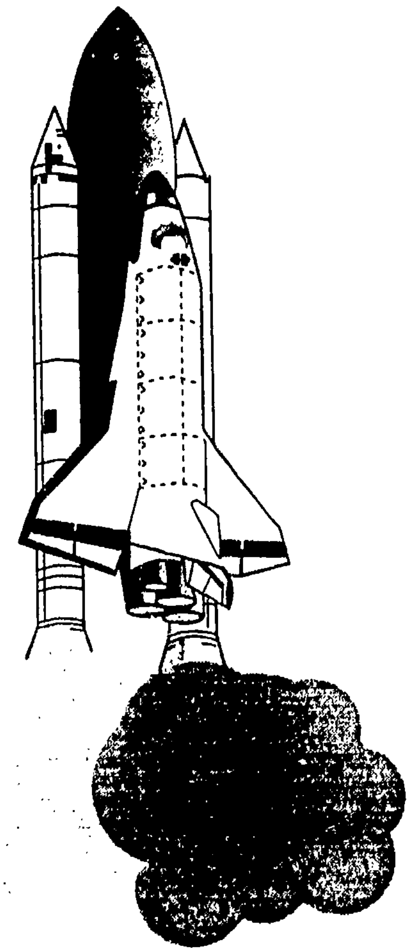
FACT SHEET

The Space Shuttle

The Space Shuttle as we know it today, is the result of more than 30 years of space technology development. From the early "Dyna-Soar" test of a gliding spacecraft to the Apollo spacecraft which went to the moon, space technology has sought a re-useable spacecraft.

The Space Shuttle is in three main parts: the Shuttle or orbiter, the external liquid fuel tank and two solid rocket boosters.

The orbiter is 121 feet long, has a 79-foot wingspan and weighs about 150,000 pounds without fuel (200,000 pounds with payload). It's about the size of a DC-9 airplane. The payload bay is 60 feet long by 15 feet wide.



To push the Shuttle away from Earth's pull requires a lot of power. Engineers provide the power by having five huge power plants, three engines on the Shuttle plus two solid rocket boosters. These power plants burn a large amount of fuel very quickly, which provides forces that push the Shuttle into orbit.

The Shuttle is propelled into space by three main liquid engines (fed super-cooled oxygen and hydrogen from the 500,000-gallon fuel tank) and by two 150-foot-high *solid-fuel rocket boosters* (SRB). Each booster carries more than one million pounds of fuel. The fuel is mainly a mixture of aluminum powder fuel and a oxidizer, ammonium perchlorate.

Once each booster is ignited it can not be shut off. It must burn until it uses all the fuel. The solid rocket boosters burn for about two minutes with five million pounds of thrust before being released from the Shuttle. The boosters then parachute into the ocean and are picked up by ships for reuse.

The main Shuttle engines burn for about eight minutes generating more than one million pounds of thrust before shutting down. Engine exhaust approaches 6,000° F. The engine nozzles can be turned to steer the craft and their power can be varied to control the Shuttle's speed. The three main engines are only used during take-off. The engines shut down and remain part of the Shuttle rather than separating from the craft and falling to the ocean.

The half million gallons of super-cooled fuel for the three engines is stored in a giant 150-foot-high fuel tank called the liquid fuel tank, (fuels are chilled to below -290°F). The liquid fuel tank is the only part of the Shuttle that is not reusable. It drops off and burns up in the atmosphere.

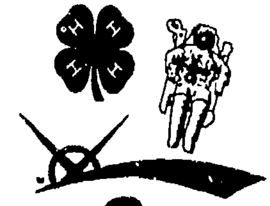
Once in space, the Shuttle pilot uses two small engines to reach orbit, about 175 miles above Earth. The pilot can also move from one orbit to another by using these engines. (These two engines are found in the tail section of the Shuttle.) With another set of very small engines (44 in all), the Shuttle can change speed or altitude.

The Shuttle's nose and tail also contain many rockets, called thrusters. The thrusters are used to make small changes in the Shuttle's position. The Shuttle wings have movable flaps called elevons. These, with the body flap beneath the engines and the rudder, help the Shuttle maneuver when it re-enters the atmosphere before landing.

The Shuttle has a large storage area called the payload bay, measuring 60 feet long by 15 feet wide for carrying cargo. When the payload bay doors are opened, radiators inside them help to cool the Shuttle by allowing heat to flow from them into space. The payload bay carries equipment, satellites, etc. to and from space. The payload bay may also contain a robot arm used to move objects into or out of the payload bay. The robot arm is not used during every mission. In front of this bay is the crew compartment, where the astronauts live and work while in space.

Thermal protection is given to the Shuttle during exit from Earth's atmosphere and reentry. This thermal protection protects it from surface temperatures of up to 3,600° F. The most notable feature of this protection is a set of 20,000 heat-absorbent tiles on the lower surface of the Shuttle. Another 7,000 tiles are located on the upper wing and fuselage. Protective tiles cover approximately 70 percent of the Shuttle's surface.

FACT SHEET 2



Gravity and Space

Gravity is a force that has always affected humans. It works for you and against you. It was only some 300 years ago that the Englishman, Isaac Newton, discovered the principles of gravity.

Once in orbit the Shuttle can stay there because of its speed (17,500 miles per hour). When the Shuttle's speed and the Earth's gravitational pull are balanced, centrifugal force allows the Shuttle to orbit around the Earth every 90 minutes. It is at this point that the astronauts begin to experience near zero gravity or weightlessness.

The force of gravity holds people to the Earth. We say that this force has a strength of 1 g. (The letter g stands for gravity.)

For the first few minutes after lift-off, a large force (approximately 3 g's) jams the astronauts down in their seats. You may experience this same force on a rollercoaster ride. At the bottom of the first hill, you will experience the force up to 3 g's.

The Earth's gravity is the force that pulls objects towards the center of Earth. A spacecraft leaving the Earth must travel fast enough to overcome the Earth's gravity. As an object gets farther away from the Earth, the pull of gravity weakens.

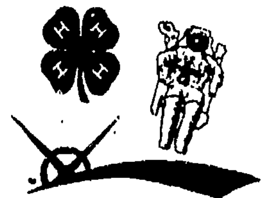
The speed needed to overcome the gravity is called escape velocity. This speed is about seven miles a second, or 25,000 miles an hour. Reaching escape velocity does not mean that a spacecraft has freed itself completely of the Earth's pull. It also does not mean that the spacecraft will not fall back to Earth, even if no more power is used. The spacecraft will continue on its course away from Earth until the gravity of the Earth no longer affects it.

A spacecraft can also travel at a lower speed which will cause it to go into orbit around the Earth. This craft then becomes a satellite of the Earth.

Since gravity affects the astronauts during launching and landing, many experiments have been done to see how gravity affects them. Great care has been taken to prevent the large force of gravity from causing injury. Experiments have shown that astronauts can withstand up to about two minutes without harm if they are lying down. They must be facing in the direction in which the Shuttle is moving and their bodies must have been previously trained to withstand the strain.

At the end of the flight, using the Shuttle's smaller engines, the pilot slows the craft. Gravity then takes over, pulling the Shuttle towards the Earth. Without using engine power, it is drawn into the atmosphere, where it lands like a glider at about 200 miles per hour.

FACT SHEET 3



Weightlessness in Space

By the time the Space Shuttle reaches orbit there are no more great g-forces. Even the Earth's 1 g-force is gone. There is gravity in space but the orbital motion of the Shuttle around the Earth counteracts this force.

People in a state of weightlessness, or zero gravity, are free from the effect of the Earth's gravity. They feel lighter than a feather, because they weigh nothing.

Imagine yourself in a spacecraft in which there is no pull of gravity. There is no up or down. You can walk on the walls, the ceiling, or the floor. Or you can drift around the cabin instead of walking. If you touch the wall, your whole body moves away in the opposite direction. If you take your lunch out of its container, the food may drift out of your hand. You may have to catch it before it goes out of reach. You can not drink from a glass because the liquid will not pour. You must use a drinking straw or squeeze the liquid from a plastic bottle.

Lines or ropes are set up in the Shuttle's cabin so the crew members can pull themselves in the directions they want to go. This enables the crew to move about the cabin when they are weightless, rather than wearing special shoes.

Astronauts learn to work in this weightless environment. Some training is done in a large swimming pool which simulates the type of effort required to work in space. This pool is approximately 70 feet long by 25 feet deep and large enough for the payload bay of the Shuttle to fit inside. A fully-suited astronaut is placed under the water and weighted so as to be neutrally buoyant. Under the water the astronauts practice work that will have to be done while in space. Some training, such as using the manipulator arm to move large but weightless objects, is very hard to simulate.

Once in orbit, astronauts conduct experiments in the Shuttle to see what happens when the sense of Earth's gravity force is almost gone. For instance a book that weighs two pounds on Earth does so because the Earth's gravity exerts a two-pound pull on the book. On the Moon, which has a surface gravity about 1/6 that of the Earth, the same book would weigh about one-third of a pound. Other experiments include: How perfectly can honeybees make combs in weightless conditions? Do roots of plants sense in space which way the Earth's gravity would be pulling them so they will grow away from their stalks? Can men, animals, insects and plants adapt to the weightlessness of space without danger or physical harm and remain productive on long space voyages?

FACT SHEET 4

Fibers and Textiles

Fibers are individual strands from which yarns and threads are made. They are either natural or man-made. Natural fibers come from things in nature. These are natural fibers:

Cotton Linen Wool Silk Specialty hair

Man-made fibers are derived from a chemical manufacturing process and not provided by nature.

These are man-made fibers:

Acrylic Aramid Nylon Polyester

Man-made fibers are manufactured from coal, gas, water, glass, metal, cellulose, rubber and other substances.

Each fiber has built-in characteristics that influence the properties of the textile product it makes. Often fibers are blended before being made into yarns. Cotton fabric can be made stronger by adding amounts of polyester. Stretch and recovery can be added to by mixing man-made fibers such as spandex or rubber. Special effects can be achieved by adding metallic or luster yarns.

There are many other uses for fiber than just clothing. Industrial fiber and textiles are used in drains under pavement, river bank protection, linings for water reservoirs, ponds, erosion control, sea blankets and forms for concrete. Other uses for industrial fibers include rockets, cables ten times stronger than steel, boat hulls, airplane shells and artificial arteries.

In fact, it is difficult to think of a moment that is not touched in some way by fibers or textile products. Items such as a business suit, a fire-fighter's hat, doctor's coat, a ski jacket or a race car driver's suit are all a variety of man-made or natural fibers.

Needs on Earth are similar to those in space. The focus inside the Space Shuttle is on comfort, fit and useability. The astronauts live in an atmosphere similar to indoor life on Earth. Needs outside the Shuttle are more specific and life-threatening. Outside the astronauts need protection from temperatures ranging from 250° F to -250° F. Lack of oxygen and danger from meteoroids also require specialized protective fibers.

Fiber	Characteristics
Cotton	Soft Durable, different weights
Wool	Warm and comfortable Naturally absorbent Naturally water-repellent
Aramid	Low absorbency Resistant to high temperatures (heat and flames) Very strong and puncture resistent
Nylon	Very strong and durable Melts at high temperatures Accumulates static electricity
Polyester	Heat sensitive Strong and durable Easy to care for

FACT SHEET 5

Space Suits

Astronauts of the Space Shuttle era have more than one wardrobe for space flight, and what they wear depends on the job they are doing. During ascent and entry, each crew member wears special equipment consisting of a partial-pressure suit, a parachute harness assembly and a parachute pack. While doing experiments within the Shuttle, resting or just floating around, the astronauts can wear normal clothes like people on Earth. A special space suit called *extravehicular mobility unit* (EMU) is required if an activity is planned outside of the Shuttle. The EMUs come in three sizes — small, medium and large. They are designed to be worn by both male and female astronauts. Before the Space Shuttle each astronaut had their own tailor-made space suit. Those suits could only be used for one mission. The new EMUs can be used for more missions. Each astronaut still has their own custom-made gloves for working outside the Shuttle. The Space Shuttle now normally carries only two extravehicular mobility units aboard.

The EMU is made in a series of layers. The basic layer is an inflatable bladder (tube) which is filled with oxygen to create a steady ring of pressure around the body. This pressure prevents the astronaut's blood from boiling in space. A restraint layer of dacron-polyester over the bladder stops it from ballooning (swelling up with air). Next are several layers of fireproof fabric and flexible metal to provide insulation against radiation and temperature variations. The temperature variations in space can range from -250° F to +250° F in a short time.

The astronauts change into an EMU suit in the airlock compartment of the Shuttle. First thing they put on a pair of "long-johns" and a urine-collection device. The "long-johns" have water-cooling tubes to help keep the astronaut comfortable. Next, the astronauts rise into the upper torso section, and then climb into the lower torso section. These sections are connected by a layer of hard metal. The helmet and gloves are both then locked securely in place. The smallest exposure of the body when outside the spacecraft would be fatal to the astronaut.

The space suit has a built-in backpack called *Primary Life Support System* (PLSS) in the upper section which contains a miniature life support system. It contains oxygen for circulation through the helmet and the inside layer of the suit. It also carries a fan to move air, a small lithium hydroxide canister with a layer of charcoal to remove carbon dioxide and other unwanted gasses, water and a pump to dispatch it into the tubes in the "long-johns," a unit to cool the water and get rid of heat from the astronaut's body, and batteries to power it. There is even a water purifier, so drinking water can be sipped inside the helmet. The maximum total weight of the largest size space suit assembly, including the "long-johns," urine-collection device, helmet and visor assembly, communication assembly, in-suit drink bag and instrument system is 275 pounds.

FACT SHEET 6

Protective Clothing

Do you wear protective clothing? Protective clothing is worn by almost everyone in the world. The astronauts wear the EMU to protect them from the environment when working outside of the Shuttle.

Astronauts are not the only people who wear protective clothing, special gloves or boots. Football players wear special padding and equipment to protect their bodies from injuries. Special gloves are worn by hockey players to protect their hands from the cold temperatures of the ice. Hockey, roller skating, figure skating and football all require special boots or shoes. Like the astronauts, athletes must also wear special boots. All of these items are made from some type of fabric.

Since the 1969 splashdown of Apollo 11, textiles developed for the space program have became an important part of our textiles on Earth. The same material used in the EMU, which is resistant to heat and flame, is now being used in the coveralls for race car drivers. Since crashes and fires frequently occur during races, drivers needed something to protect their body from the heat and flames.

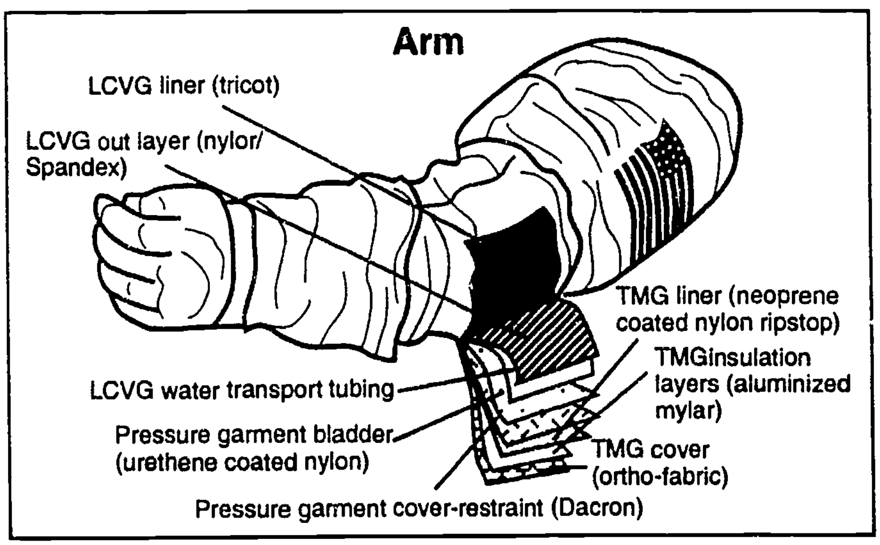
The EMU is made of different layers of fabric. The majority of the layers contain some type of nylon. Nylon is one of the stronger and more durable fibers. After NASA used nylon in the space missions, the military developed other uses for nylon. These included parachutes, tents and gloves. Nylon today can still be found in clothing, carpeting, surgical sutures and women's hose.

The fabric of the in-flight coveralls and the inner layers of the space suit is used for fire-retardant pajamas in hospitals. Hospitals are also using a modified suit (like the liquid cooling garment astronauts wear under the space suit) to treat patients in shock. The same modified suit is sometimes used to keep doctors cool during long operations.

The space program developed the Velcro™ closure for space clothing so the astronauts could get out of it quickly. This same closure is now being used in items here on Earth from clothing to shoes.

Aluminumized mylar, or the insulation layer of the space suit, is the same fabric used in ski jackets. Fabric is now coated with aluminum to use as a insulator in winter outdoor clothing.

The same fabrics used in the space suit have become valuable for use on Earth. Can you think of other items that are made from the same fibers and textiles used in the space program?



FACT SHEET 7

Foods for Space

Astronauts on a space flight for more than a few hours will require food and liquid. Their meals must have a minimum of roughage but items that are not hard to digest. Space Shuttle food must have a shelf life of six months or it will not be taken into space. However, the astronauts do take fresh fruit aboard the Shuttle.

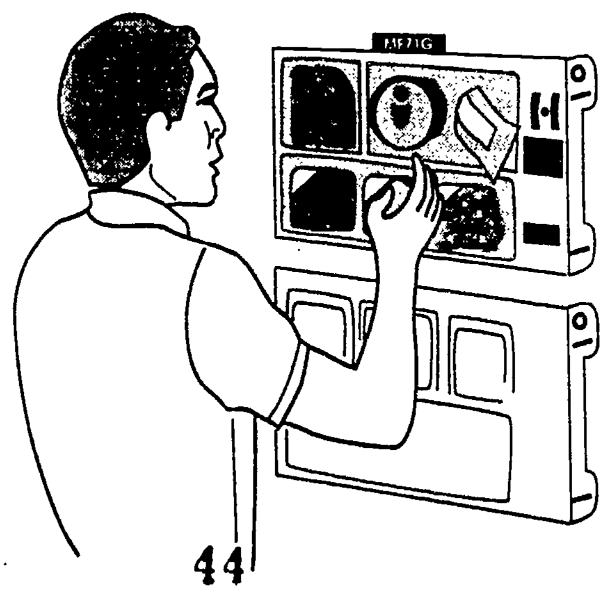
Space nutritionists remember early missions when astronauts had to "suck" their meals out of plastic bags. Unable to see or smell the food, astronauts had little interest in eating. Today, endless experiments and testing go into making food as mouth-watering as possible. The astronauts can also now see the food and smell the aroma.

Meals in space are both tasty and nutritious. The menu includes more than 70 food items and 20 beverages. With so many different choices available, astronauts can have a varied menu every day for five days. The variety of drinks includes tea and coffee, which are also dehydrated. The list does not include pure orange juice, grapefruit juice or whole milk. When water is added to the orange crystals, there is no mixture, only orange rocks in the water. That is why TANG was invented as an orange juice substitute. If whole milk is rehydrated, the milk floats around in lumps and has a disagreeable taste. Skimmed milk and synthetic orange and grapefruit juice are also used.

The Shuttle does not normally carry a refrigerator because of the weight. If one is needed for biomedical experiments, and extra room is available, foods such as ice cream and frozen steaks may be added to the astronauts' menu. The Shuttle menu is designed to provide nutritional requirements essential for good health and effective performance with safe, heathy and acceptable food. Meals center around a galley on the deck of the Shuttle's cabin. It features hot and cold water dispensers, pantry, oven, food serving trays, personal hygiene station, water heater and auxiliary equipment storage area. It also can be removed for special missions that require extra interior space.

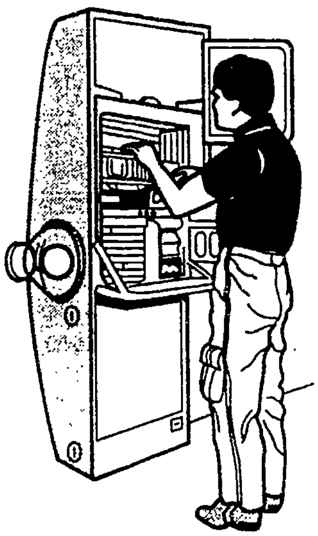
Food preparation starts 30 to 60 minutes before mealtime. Heating and reconstitution of the food takes an additional 20 to 30 minutes. To meet weight and storage restrictions, food is packaged in a variety of forms.

Foods that need no preparation such as nuts, candy or cookies are contained in plastic pouches. Each rehydratable package is inserted into a holder on the galley and shoved into a water dispenser. A large hollow needle is automatically inserted into the package. According to printed instructions on the package the cook dials the proper amount of water on a control panel and presses either hot or cold water to fill the package. The flexible plastic lid expands with the increasing volume. The package is then shaken to mix the water with the food. The package can then be heated in the oven or inserted into a slot on the trays.



Water for rehydration comes for the Shuttle's fuel cells that produce electricity by combining hydrogen and oxygen gas. Water is a by-product.

Eating utensils consist of a knife, fork, spoon and a pair of scissors for cutting open packages. Food can be seasoned with serving-sized packets of mustard, catsup, mayonnaise, hot sauce and liquified salt and pepper. Following the meal, food containers are discarded within the Shuttle and the utensils and serving trays are cleaned with "wet wipes."



Food Processing Methods and Definitions

Dehydration — Complete removal of water or moisture from the food. For example, instant oatmeal, soup mix, scrambled eggs.

Freeze Dried — Foods are prepared, then instantly frozen and placed in a vacuum chamber to remove all moisture. For example, peaches, peas, corn and chili beans.

Thermostabilization — Foods are heated and sealed in aluminum cans or flexible packages. For example, tuna, applesauce, pudding, fruit and beef stew.

Intermediated Moisture — Removes some moisture, leaves food soft. For example, dried peaches, raisins or apricots

Natural Form — Food taken just as they are. For example, cookies, gum, candy, apples and bananas,

Irradiation — Foods receive high energy rays to prevent spoilage. They do not need refrigeration. For example, meat, hot dogs, bread and ham.

Space Shuttle Food List

Applesauce (T)	Apricots, dried (IM)	Granola Bar (NF)
BBQ Beef (D)	Beef patty (IR)	Beef Steak (IR)
Bran Flakes (D)	Breakfast Roll (NF)	Bread (IR)
Brownies (NF)	Butter Cookies (NF)	Cashews (NF)
Cauliflower w/cheese (R)	Chicken a la King (T)	Corn, Green Beans (D)
Chocolate Pudding (T)	Dried Beef (IM)	Eggs, Scrambled (D)
Frankfurters (IR)	Fruit Bars (IM)	Fruit Cocktail (T)
Graham Crackers (NF)	Green Beans w/ Mushroom (D)	Jam/ Jelly (IM)
Lemon Pudding (T)	Macaroni and Cheese (D)	Mushroom Soup (D)
Oatmeal w/ Raisins (R)	Peaches, Diced (T)	Peanuts (NF)
Raisins (IM)	Salmon (IR)	Spaghetti w/ Meat Sauce (D)
Tuna Salad Spread (T)	Turkey and Gravy (T)	Trail Mix (NF)

Beverage List

Apple Drink	Grape Drink	Cocoa
Instant Breakfast	Lemonade	Coffee / Tea
Orange Drink	Milk Shake	

This is only a part on the foods that astronauts can take on a space mission.

Abbreviations

T Thermostabilized	IM Intermediate Moisture	D Dehydratable
FD Freeze-Dried	NF Natural Form	IR Irradiation

FACT SHEET 8

Foods Eaten In Space

What is it like to eat in space? In many ways it's the same as eating here on Earth. We will notice some differences in the amount of space for food preparation, the weightless environment versus gravity and the conveniences available.

The one, two and three-person crews in earlier missions ate their meals out of containers or pouches, most commonly prepared by adding water and kneading the mixture by hand. The food was nutritious but not very appetizing. After a long work day in space, astronauts like nothing better than a good dinner. Meals are as important in space as they are on Earth for both good health and relaxation. However, in space all objects — astronauts, food and utensils float freely about. A bump of an elbow can send spaghetti and meatballs flying in all directions. Eating in space is a challenge, but it also can be fun.

What are meals like in space? The menu for a typical day might start with orange drink, peaches, scrambled eggs, sausage, cocoa and a sweet roll for breakfast; cream of mushroom soup, ham and cheese sandwich, stewed tomatoes, banana and cookies for lunch; and shrimp cocktail, beefsteak, broccoli au gratin, strawberries, pudding and cocoa for dinner.

The Space Shuttle has a special food preparation area, called a galley, where meals are prepared mostly by adding water (rehydrating) and heating. The mid-galley includes special serving trays that hold the different food containers in place in microgravity. It also has a convection-type oven where packages of food are warmed before going into the trays. A small dining area, consisting of a table and several foot loops, is optional on each mission. The foot loops are floor restraints that help the astronauts steady themselves and remain in place while eating.

When the food has been prepared and packages have been placed in the tray's slots, crew members take their tray to some convenient spot to eat on the mid-deck. To keep trays from floating away, a Velcro™ strap on the tray can be wrapped around the astronaut's leg. The eating utensils, knife, spoon, fork and scissors are held by magnetic strips on the tray. The scissors is used for cutting open plastic lids on the dehydrated packages and plastic pouches that hold other food. The trays also have spring clips for holding condiments such as mustard, ketchup etc.

In the weightlessness of space, gravy and sauces cling to the side of food containers and to the utensils. Too much food clinging to the top and bottom of regular-size utensils makes eating messy. With a regular teaspoon the astronauts get too large a portion of food. They could knock off the excess food against the inside of the bowl, but the better solution is to use smaller utensils. The silverware the astronauts use is 3/4 the normal size (about the size of small plastic silverware). Because sudden moves causes food to float away, astronauts must eat slowly and carefully.

After the meal, all utensils are wiped clean with pre-moistened towelettes and packed with the food trays. Used food containers are sealed in a plastic bag and stuffed into a waste container. Once back on Earth, the trash will be properly disposed.

FACT SHEET

Food and Energy

Nutritious food, exercise and rest are important in keeping healthy on Earth and in space. Just as the Shuttle burns fuel to lift off, the body burns food energy to go and grow. Food contributes energy (measured in calories) and nutrients which bodies need for good health.

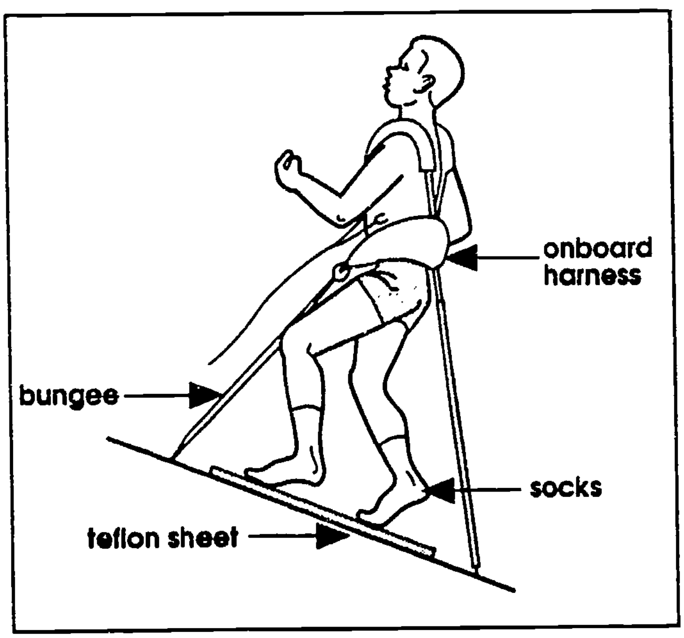
Astronauts use a lot of energy working in a weightless environment in Shuttle orbit. In space astronauts eat basically the same nutritious diets they eat on Earth, but because of the extra effort needed in the Shuttle, they simply eat more. The daily food supply of the Shuttle takes into account extra use of energy. Astronauts eat a total of 3,000 calories, plus snacks, while in space. Meals try to keep the astronauts from losing needed minerals in microgravity. Loss of potassium, calcium, nitrogen and other minerals can affect muscle tone, bone mass and ability to concentrate and work, so the food must contain ample amounts of these minerals.

Daily activity and exercise is important for good health. It strengthens body muscles, helps us feel good and helps control weight. If you take in the same number of calories that you use, you will maintain your body weight. If you take in more calories than you use, you will gain weight. In order to lose one pound you must take in 3,500 fewer calories than you use.

The best way to maintain the desired weight is through balancing the number of calories you take in with the number of calories you use through exercises and activity.

The astronauts exercise in space while on their missions. Resistance exercise is as necessary as proper food and sleep to maintain good health in microgravity. On past missions, astronauts have suffered some bone and muscle deterioration despite their physical work in space, because their bodies were not getting the resistance they were accustomed to in gravity.

The astronauts take a treadmill on the Shuttle for exercise. Flight physicians recommend at least 15 minutes daily on the treadmill for missions lasting 7 to 14 days, and 30 minutes for mission up to 30 days. The use of the treadmill will help their bones and muscles re-adjust quicker to the Earth's gravity on their return home.



When not in use the treadmill is kept in a locker. When the astronauts are using it, straps come from its base to tie or buckle around the waist of the astronaut. The tighter the straps the greater the resistance encountered during the workout. Other straps attach from a bar in front of the astronaut to their waist. This lets the astronauts exercise their arms by pushing upward on the bar as they walk.

When you perspire in microgravity, perspiration will cling to your skin. It does not drip off like on Earth, but only grows thicker. It can be taken off in "sheets." The astronauts use a vacuum cleaner to suck it out of the air.

FACT SHEET

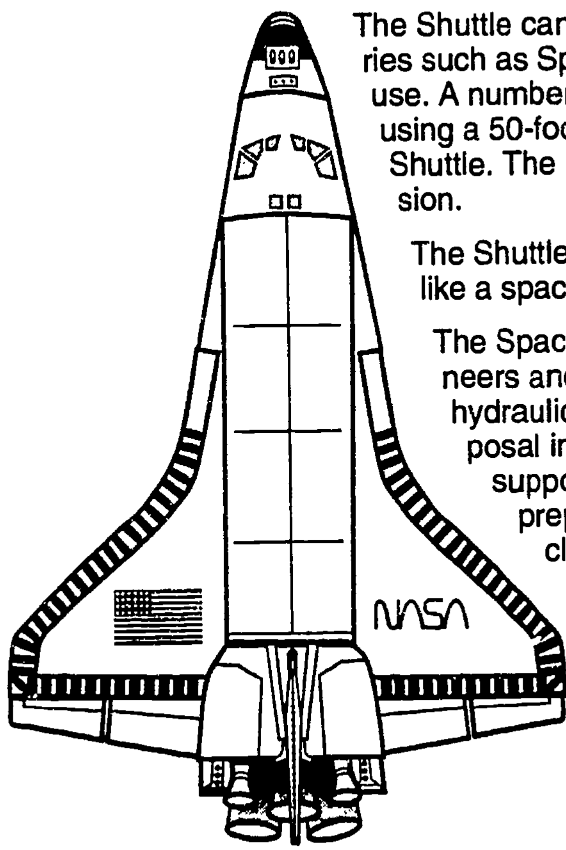
Basic Information About the Space Shuttle

Supplement

Originally conceived in the late 1960's, a Space Shuttle is an aircraft designed to carry astronauts into space to explore and conduct research. Four Shuttle vehicles are in operation: Columbia, Discovery, Endeavor and Atlantis. Each is designed to be reused more than 100 times, and technicians can prepare them for new flights within weeks after a mission. A typical mission lasts from three to six days. In a typical orbit, the Shuttle operates about 175 miles above Earth, at an orbiting speed of five miles per second or 17,500 MPH. In its 90-minute Earth orbit, crew members experience near-zero gravity or weightlessness.

Weighing more than 150,000 pounds and controlled by the commander and pilot, a Shuttle is designed to carry up to 65,000 pounds of payload into space. This payload can be experimental equipment or satellites. A variety of experiments can be performed by crew scientists aboard the Space Shuttle.

The crew of the Shuttle can place satellites in orbit and retrieve them for repair either in space or upon return to Earth. Specially-designed space suits and powered *mobility maneuvering units* (MMUs) permit the astronauts to move about and work for about six hours in space outside the Shuttle.



The Shuttle can also carry into orbit experimental space laboratories such as Space Lab or large solar power stations for future use. A number of operations in the payload bay are conducted using a 50-foot remote manipulator arm directed from inside the Shuttle. The remote manipulator arm is not used in every mission.

The Shuttle takes off like a rocket, maneuvers in Earth orbit like a spacecraft, and lands like a glider at about 200 MPH.

The Space Shuttle is an amazing aircraft. Teams of engineers and designers also had to design power generators, hydraulic systems, environmental controls and waste disposal into the Shuttle to provide operations, control and life support systems for the astronauts. Compact food preparation and sleeping accommodations are included. More than 2,020 separate displays and controls are located on the flight deck.

A set of extremely complex computer guidance, monitoring and control systems protects and guides the Shuttle. A world-wide communications system with hundreds of computers provides two-way Shuttle and crew-to-Earth communications. Special NASA ships are utilized to retrieve the reusable rocket boosters from the ocean.

The Space Shuttle is moved from the *vehicle assembly building* (VAB) at Cape Canaveral three miles to the launch pad, on a gravel road 130 feet wide by a six-million-pound crawler transporter.

Launch, back-up, support, control and retrieval facilities are located mainly at the Johnson Space Center (Houston, Tex.), Kennedy Space Center, Cape Canaveral (Fla.), and Edwards Air Force Base (Calif.).

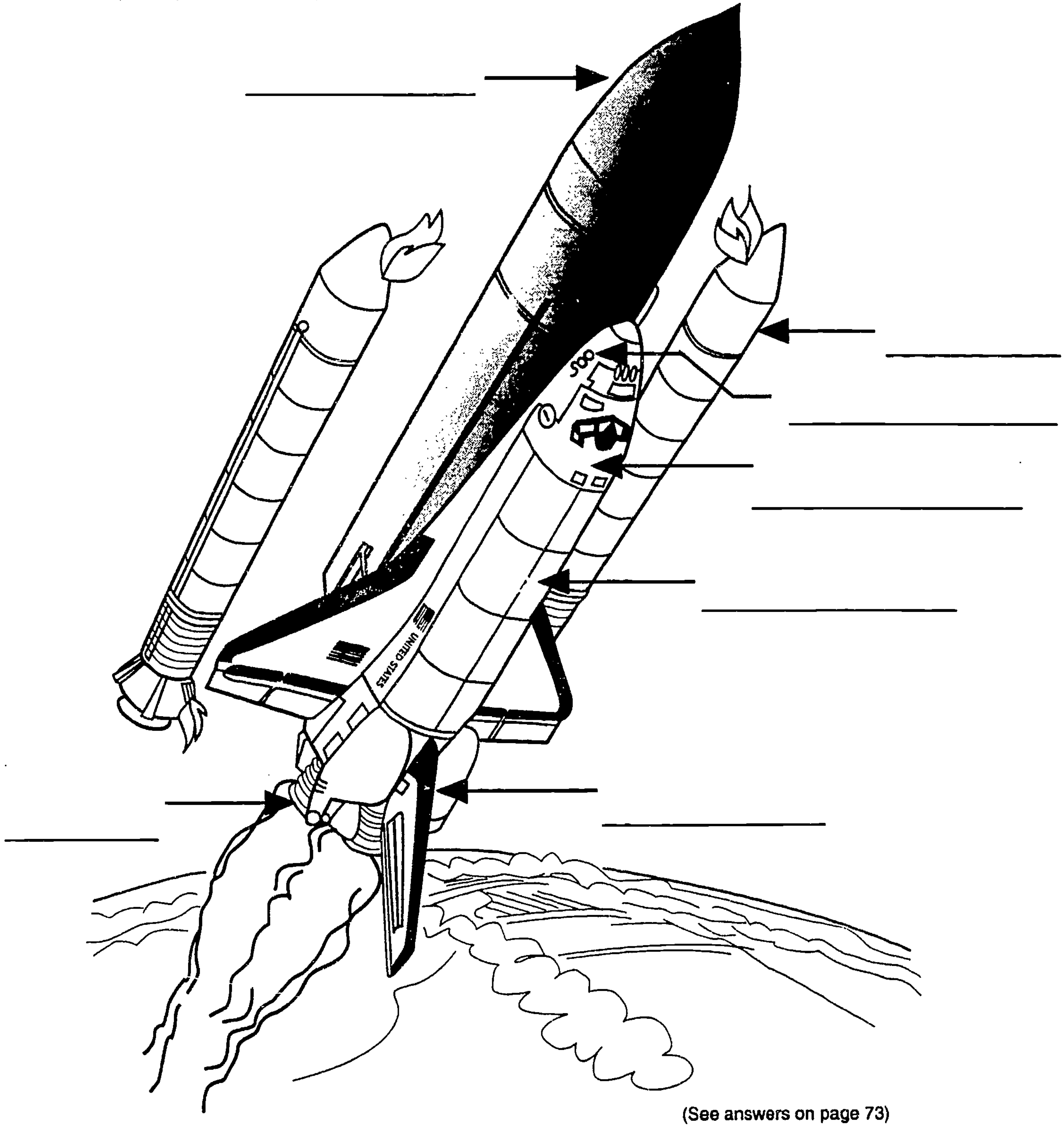
The Space Shuttle launch is controlled by the Kennedy Space Center. When it rises above the lauch tower, less than seven seconds after lift-off, Mission Control at the Johnson Space Center in Texas takes over. It keeps constant links with the astronauts.

Parts of the Space Shuttle

ACTIVITIES 1

Name ______________________

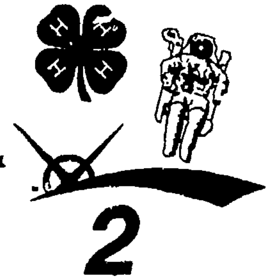
Identify the parts of the Space Shuttle.



(See answers on page 73)

Space Shuttle Jeopardy

ACTIVITIES



Name ______________________________

Answer:
I am 121 feet long with a 70 feet wingspan.

Question:
What is the Space Shuttle?

Answer:
We are picked up by ships in the ocean.

Question:
What are the solid rocket boosters?

Answer:
I am the only part of the Shuttle not reused.

Question:
What is the liquid fuel tanks?

Answer:
I keep people and objects from falling off the Earth.

Question:
What is gravity?

Answer:
Once started we can not be shut off.

Question:
What are the solid rocket boosters?

Answer:
The Shuttle, liquid fuel tank and solid rocket boosters.

Question:
What are the main parts of the Shuttle?

Answer:
I am the part that can hold the equipment when traveling.

Question:
What is the payload bay?

Answer:
We only burn for eight minutes during the flight.

Question:
What are the three main engines?

Answer:
I am 60 feet long by 15 feet wide.

Question:
What is the payload bay?

Answer:
Astronauts travel through it to reach the Moon.

Question:
What is the atmosphere?

Answer:
I burn up in the atmosphere when released from the Shuttle.

Question:
What is the liquid fuel tank?

Answer:
Super-cooled oxygen and hydrogen.

Question:
What is the fuel for the Space Shuttle?

Answer:
We are 150 feet tall and burn solid fuels.

Question:
What are solid rocket boosters?

Answer:
I can travel 175 miles above the Earth.

Question:
What is the Space Shuttle?

Answer:
Solid rocket booster.

Question:
What carries one million pounds of fuel?

Answer:
We burn for only two minutes.

Question:
What are solid rocket boosters?

Answer:
I am used to move heavy objects around in space.

Question:
What is the robot arm?

Answer:
I take off like a rocket but, land like a airplane.

Question:
What is the Space Shuttle?

Answer:
We do not separate from the Shuttle.

Question:
What are the main Shuttle engines?

Answer:
We are used to protect the Shuttle from high heat temperatures.

Question:
What are thermal protection tiles?

Answer:
We store the satellites during the space trip.

Question:
What is the payload bay?

Answer:
I am the only part of the Shuttle that is not reusable.

Question:
What is the liquid fuel tanks?

Answer:
We are used to change speed or attitude.

Question:
What are 44 small engines?

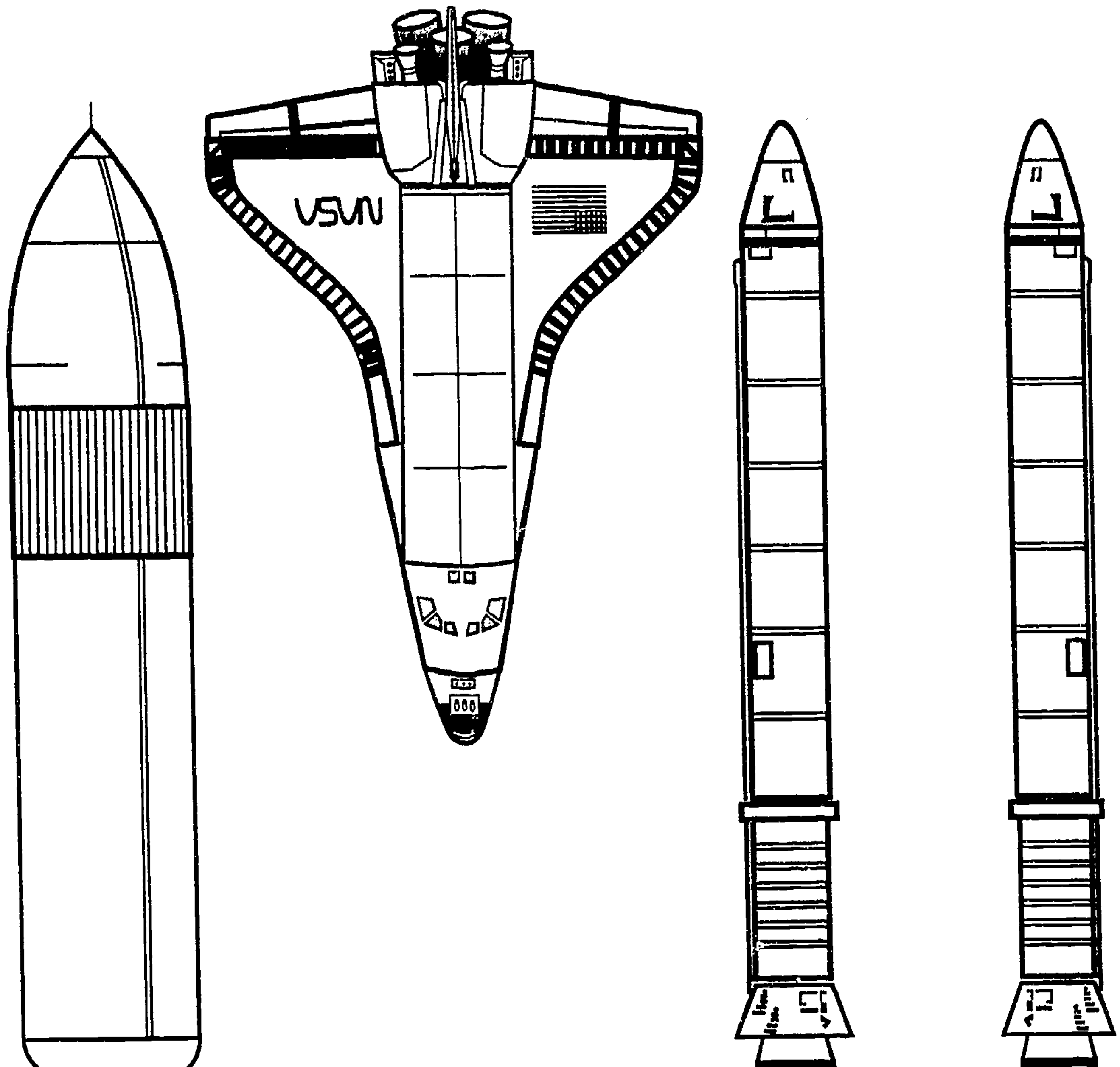
Answer:
We can not be shut off after ignition.

Question:
What are solid rocket boosters?

Assemble a Space Shuttle

ACTIVITIES 3

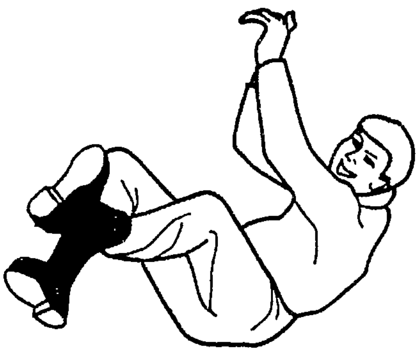
Color each piece of the Space Shuttle on this page. Carefully cut out the pieces. Put together the pieces to show how the Space Shuttle is assembled for take-off. Glue them on a piece of paper.



Gravity and Space Word Search

ACTIVITIES 4

Name ______________________________



Find the following words below.

weightlessness	manipulator arm
g-force	Shuttle
zero gravity	Moon
experiments	astronauts
environment	launch
orbit	payload

O	R	E	Z	A	I	Z	M	J	F	G	A	B	V
W	A	F	E	K	E	Y	C	O	G	H	V	W	Y
M	E	B	R	M	A	N	O	D	H	A	S	R	R
R	Z	I	O	J	S	H	R	D	O	I	T	Y	I
A	H	H	G	Z	A	O	B	Y	H	N	N	L	A
R	D	W	R	H	S	X	I	Q	E	P	E	M	U
O	A	G	A	F	T	O	T	E	N	A	M	Z	B
T	O	V	V	E	R	L	R	S	T	J	I	R	I
A	L	I	I	K	O	Y	E	K	A	L	R	C	L
L	Y	U	T	I	N	H	J	S	N	A	E	I	L
U	A	K	Y	K	A	M	H	M	S	U	P	O	J
P	P	L	J	I	U	U	O	F	I	N	X	C	X
I	E	G	A	V	T	G	F	O	R	C	E	S	Z
N	C	O	M	T	S	L	L	O	N	H	N	S	D
A	U	G	L	I	H	M	P	G	P	D	Q	A	S
M	Z	E	N	V	I	R	O	N	M	E	N	T	C

(See answers on page 73.)

Space Shuttle Model

ACTIVITIES 5

Materials and Tools Needed

1 2-liter plastic pop bottle

2 egg cartons

1 6-ounce paper cup

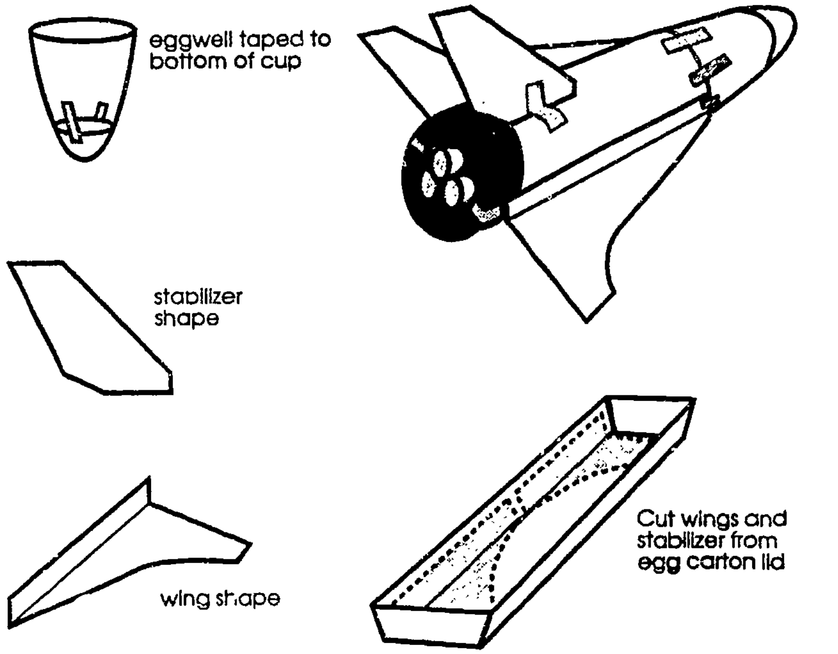
masking tape

newspaper

glue for paper mache

white glue

scissors



Procedure

Cut two wings from the top of an egg carton as shown in the diagrams. Tape the wings, as shown, to the bottle.

Cut an "egg well" from the carton and tape to the bottom of the cup to round off the flat surface. Tape the cup over the neck of the bottle. If the neck is too long to permit a good fit, take a sharp knife and trim.

Cut a vertical tail for the model from the egg carton and tape on to the bottle.

Cover the model with paper mache. Narrow strips of newspaper are easiest to work with. Let the paper mache dry and add additional layers for strength.

Cut three egg wells to make engines for the orbiter. Cover each well with paper mache and let dry.

When the body of the orbiter and the engines are dry, glue the engines to the tail end of the model as shown.

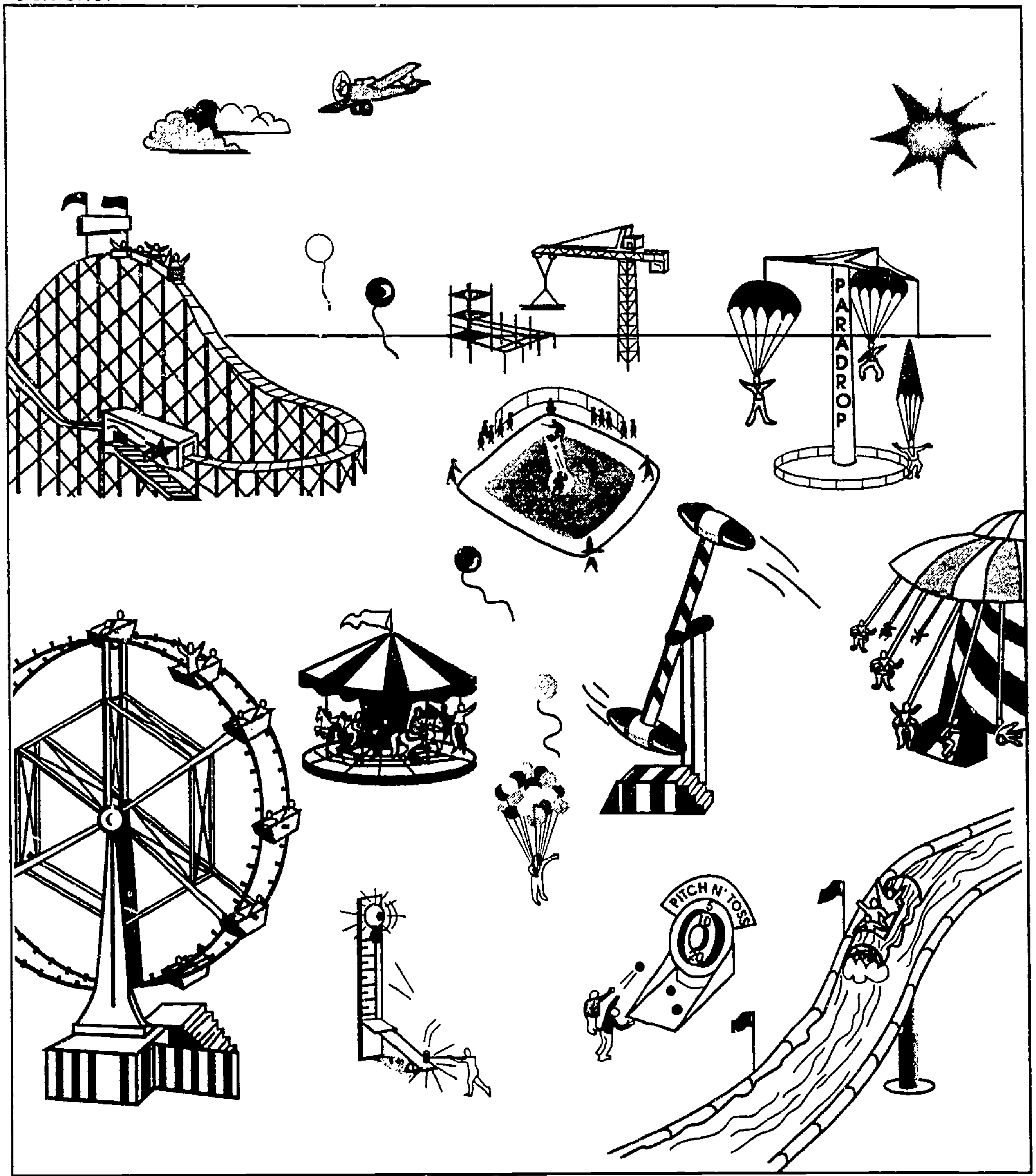
Paint the model. When dry, add decals, stars and other decorations.

Effects of Gravity

ACTIVITIES 6

Name ______________________________

Can you find 15 effects of gravity in this picture? Place a number (from 1 to 15) beside each one.



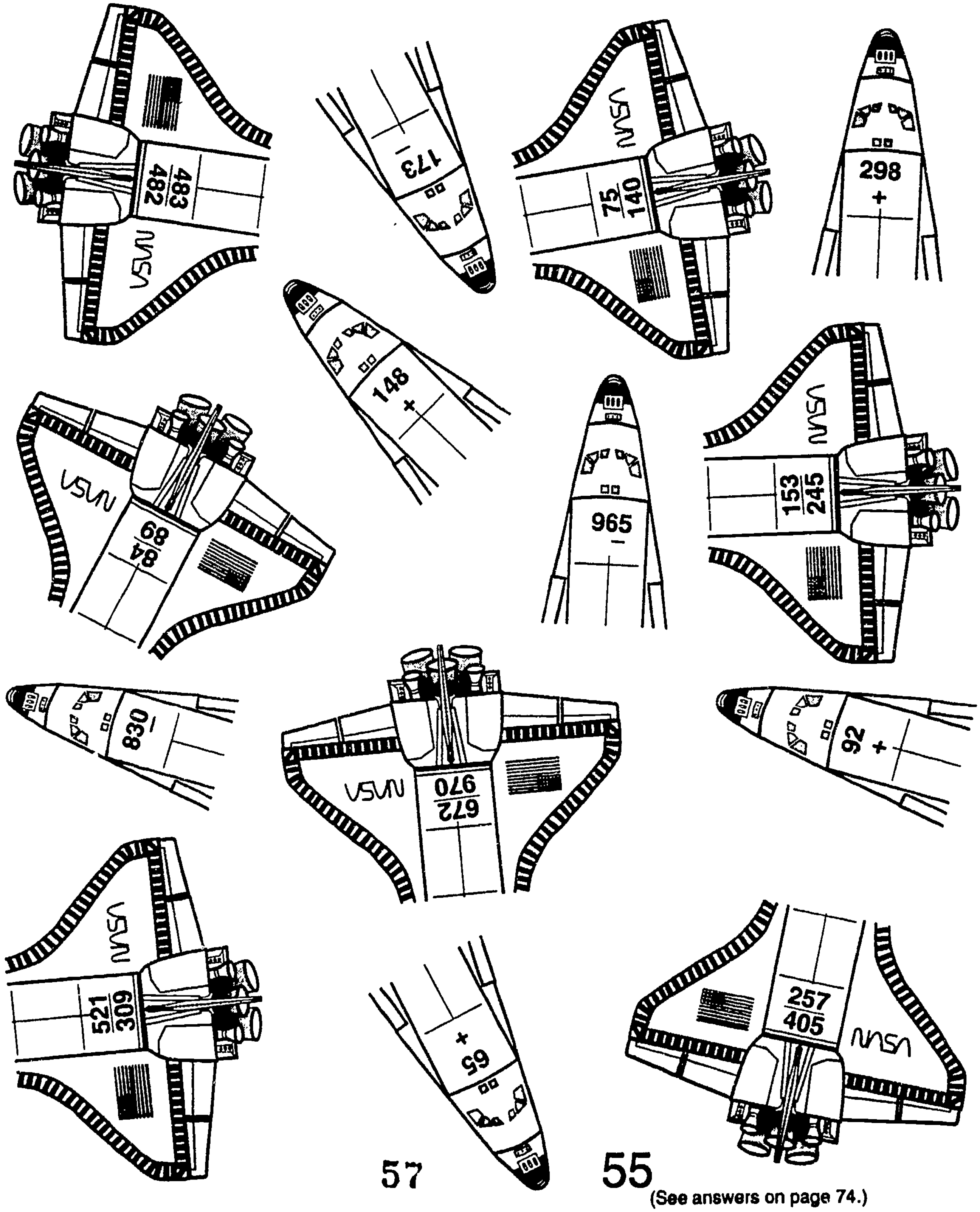
(See answers on page 74.)

Matching Up the Space Shuttle

ACTIVITIES 7

Name ______________________________

Cut out all the pieces of the Space Shuttles. Match the top half of the Shuttle to the bottom half to make a correct math problem.



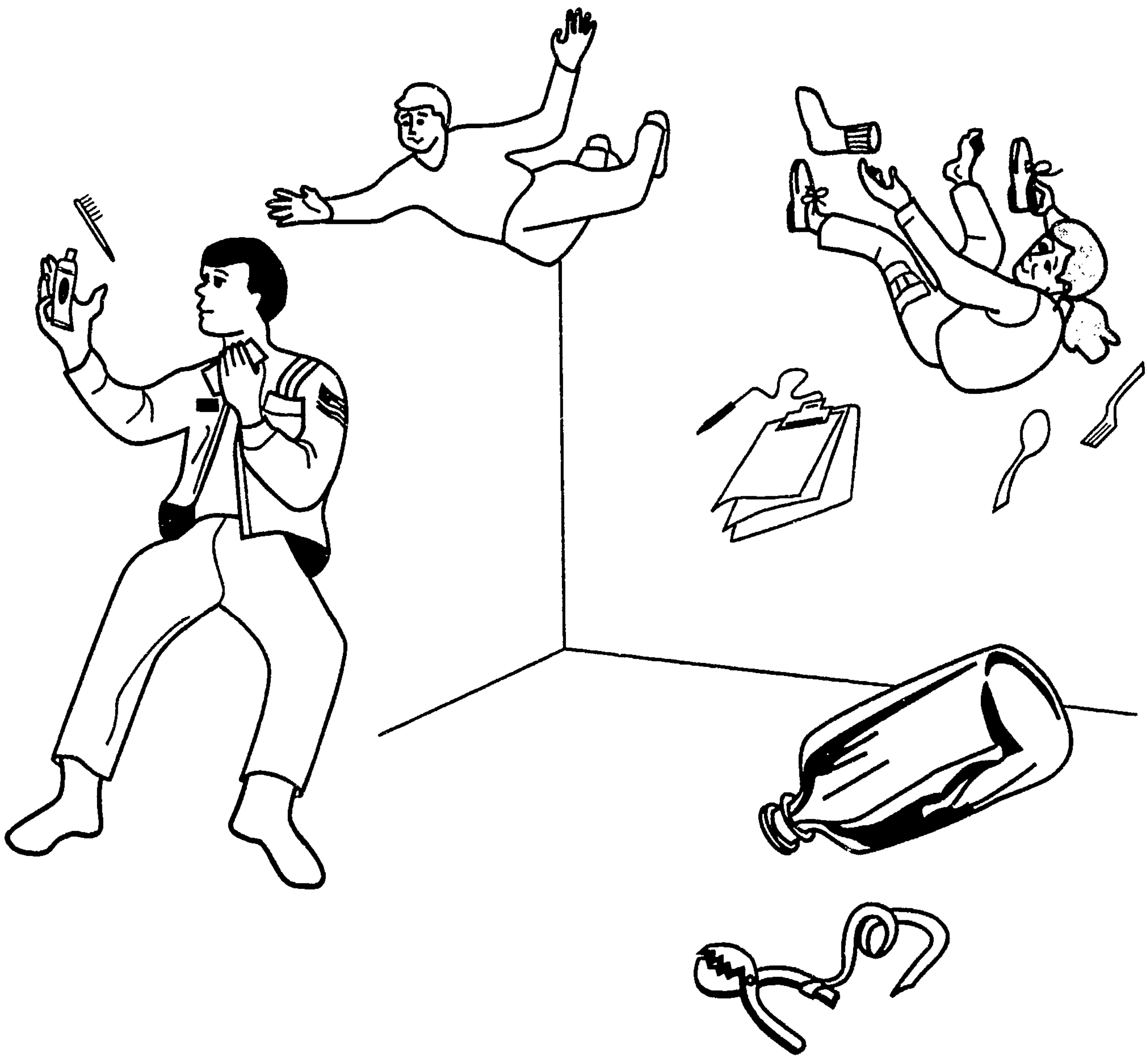
(See answers on page 74.)

Weightlessness in Space

ACTIVITIES 8

Name ______________________________

Circle ten things in the Space Shuttle that show the effects of weightlessness.



Fibers and Textiles Word Search

ACTIVITIES 9

Name ______________________

Can you find these words?

They can be found vertical, horizonal, diagonally and in reverse.

extravehicular
mobility unit
polyester
acrylic
fabric
fiber
linen
wool
silk
textiles
man-made fibers
astronauts
spandex
aramid
cotton
nylon
natural fibers
NASA
space suit

Y	F	R	D	J	M	V	V	J	A	Y	O	L	P	H	C	V	F	S	W	N
M	B	Y	J	N	T	U	O	R	K	M	K	D	V	Y	P	M	P	W	E	D
P	C	D	O	R	I	O	T	K	B	D	K	W	M	M	C	Z	Y	M	H	Q
C	Q	R	K	Q	N	M	N	E	N	I	L	H	J	K	K	Q	F	T	O	L
R	J	T	L	S	U	A	E	Z	M	M	I	C	D	Q	P	J	D	C	C	B
G	A	S	Q	Y	Y	G	P	W	T	A	S	S	T	X	M	O	L	N	P	U
N	C	L	P	R	T	H	O	E	Z	R	P	A	G	L	U	B	M	M	S	T
Q	Q	Q	U	O	I	O	X	E	I	A	M	H	K	L	T	V	C	R	C	Q
M	E	D	T	C	L	T	D	N	N	D	S	R	V	B	N	Y	E	I	T	N
L	P	E	J	E	I	Y	Q	D	Y	K	T	Q	I	O	A	B	H	I	O	D
F	B	B	C	L	B	H	E	D	Z	F	U	Z	L	A	I	X	U	T	U	V
R	N	C	E	L	O	X	E	S	T	J	A	Y	N	F	H	S	T	Z	E	F
R	Q	S	I	J	M	Q	Q	V	T	F	N	G	L	U	E	O	V	P	D	H
W	O	Q	S	L	H	N	A	S	A	E	O	A	L	C	C	Q	M	L	N	Y
K	Y	R	N	X	Y	F	I	B	E	R	R	F	A	B	R	I	C	U	B	U
Z	C	L	A	R	D	R	E	F	A	U	T	P	A	D	F	T	R	R	J	Y
B	M	S	K	E	Q	F	C	W	T	H	S	X	P	F	X	L	C	M	I	M
S	G	X	G	T	M	X	M	A	N	M	A	D	E	F	I	B	E	R	S	F
Y	J	D	B	J	E	Q	N	H	V	Q	X	F	B	V	O	T	N	O	V	O

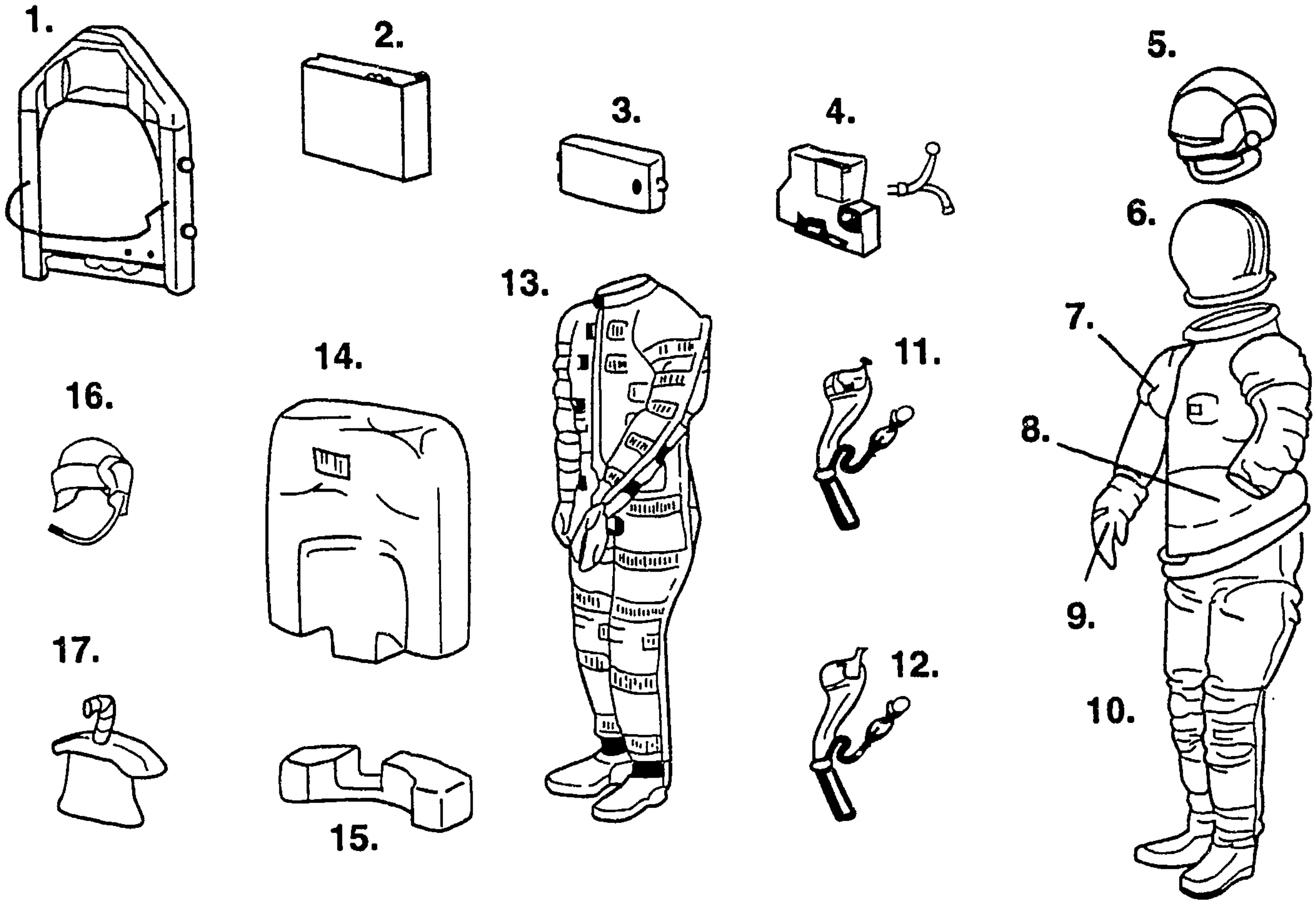
(See answers on page 75.)

Parts of the EMU

ACTIVITIES 10

Name ______________________________

Identify the parts of the EMU.



1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________
15. ______________________
16. ______________________
17. ______________________

(See answers on page 75.)

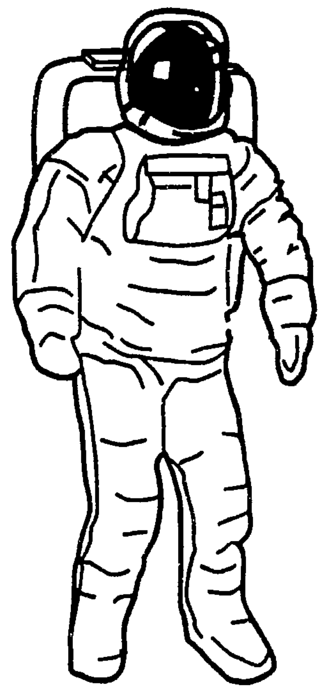
Math Match

ACTIVITIES 11

Name ______________________________

Do the problems below. Then match your answer to the letters below. Write that letter in the box to find the secret message.

A	X	P	O	B	D	H	Y	T	L	M	W	U
17	49	16	2	36	64	16	90	5	56	10	35	54
C	**R**	**E**	**G**	**Z**	**F**	**I**	**N**	**Q**	**J**	**S**	**K**	**V**
18	30	21	78	24	31	40	62	6	73	20	82	27



7 +10	2 x10	67 -62	17 +13	0 +2	95 -33	6 +11	73 -19	43 -38	5 x4

5 x7	4 +17	19 -2	15 +15		62 -45

15 +5	2 x8	87 -70	9 +9	16 +5	2 x10	41 +13	62 -22 ,	5 x1

2 x9	37 -20	41 +15	32 +24	3 x7	37 +27		28 -11

13 +8	49 +0	7 -2	50 -20	12 +5	3 x9	71 -50	4 x4	20 +20	3 x6	27 +27	32 +24	19 -2	3 x10

10 -0	2 x1	6 x6	64 -24	7 x8	46 -6	5 +0	100 -10		2 +52	80 -18	32 +8	5 x1

(See answers on page 76.)

Fibers and Fabrics Find Use On Earth

ACTIVITIES 12

Name____

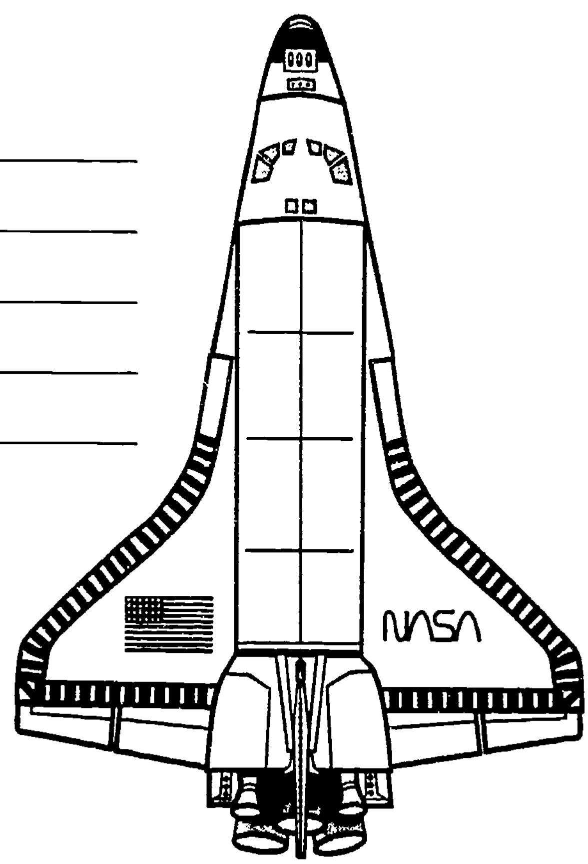
After the Apollo 11 mission in 1969, the space program emphasized the fact that the textiles developed for the space have valuable uses on Earth.

1. The fabric used in space suits is now used in coveralls for race car drivers.
2. The fabric in flotation bags is expected to be standard in safety air bags in automobiles.
3. The fabric in flight coveralls and the inner layer of space-suits is being used for fire-retardant pajamas in hospitals and for protective clothing in certain high risk occupations.
4. The yarn used for tie-downs in spacecraft is used in straps.
5. The Velcro™ closure developed for space suits in used for safety applications where the wearer has to get out of clothing quickly.
6. The air-conditioned suit, based on the development of water-cooled garments, is modified and used in hospitals to treat patients in shock and to keep doctors cool during long operations.
7. The process of aluminumizing is used in ski jackets and fabrics coated with aluminum.

Activity

Make your own list of space-age products used today.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________



Processing and Packing ACTIVITIES 13

Name ______________________________

Activity 1

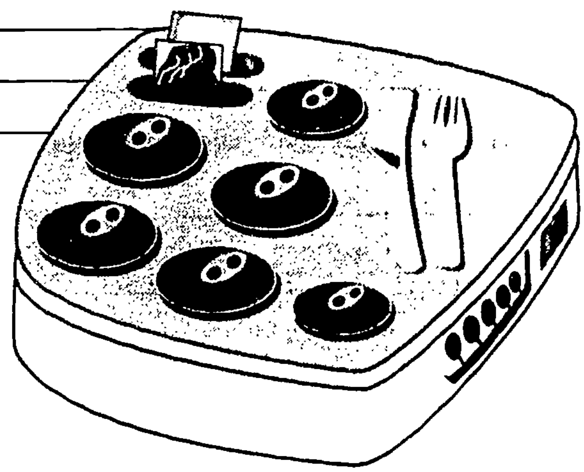
Review food processing and packing methods. Draw lines to match the food processing method on the left with the correct meaning on the right.

A. Dehydration	Cooking and sealing in cans
B. Freeze Drying	Using rays to preserve
C. Thermostabilization	Removing part of water from food
D. Irradiation	Adding water to food or beverages
E. Rehydration	Turning ice into vapor
F. Intermediate Moisture	Removing all the water from food

Activity 2

You are planning a Space Shuttle menu. Given the choices above, how would you package the following foods to take into space?

Food	Processed Form
A. Chocolate Peanuts	____________
B. M & M's	____________
C. Grapes	____________
D. Applesauce	____________
E. Corn	____________
F. Hot Dogs	____________
G. Coffee	____________
H. Soup	____________
I. Ham	____________
J. Lemonade	____________
K. Cookies	____________



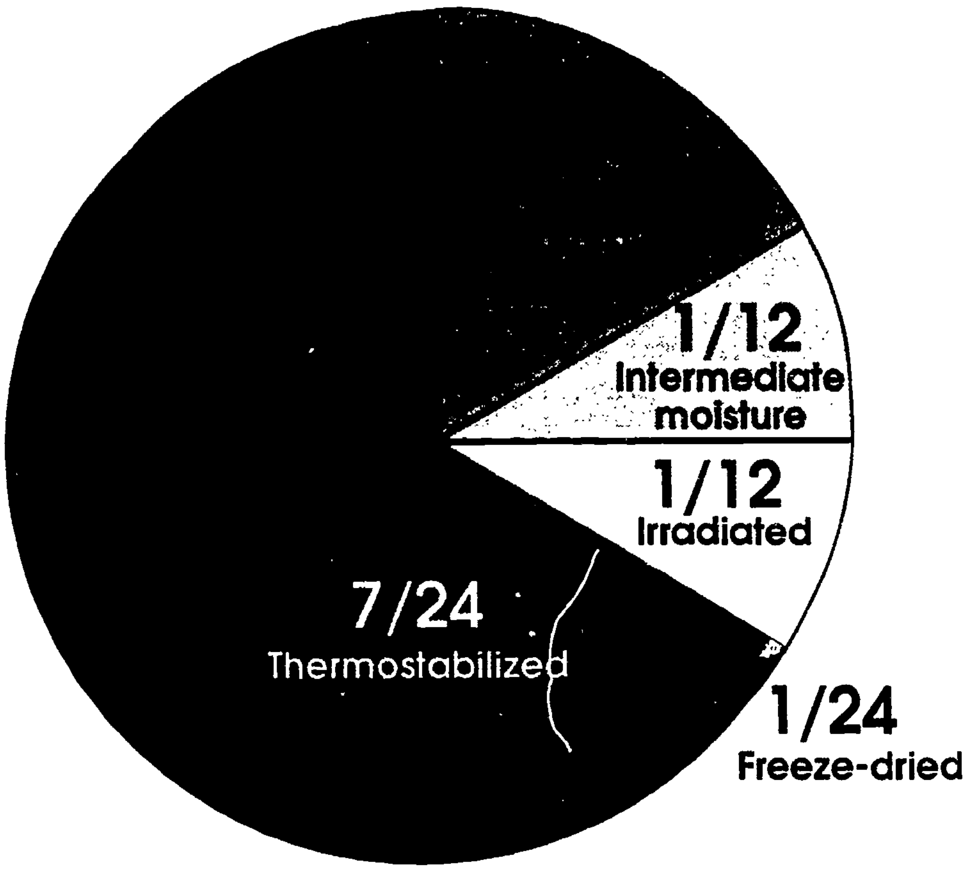
(See answers on page 77.)

Math Fractions

ACTIVITIES 14

Name ______________________________

Study the graph. Change each fraction to a common denominator, then answer the questions.



1. What food form is used most often? ______________________________
2. What two food forms are used half of the time? ______________________________
3. What two food forms are used as much as natural forms? ______________________________

(See answers on page 77.)

Foods Eaten in Space

ACTIVITIES 15

Name ____________________

Can you find these words?

Au Graten Potato
Chicken A La King
Frankfurter
Orange Drink
Grape Drink
Tuna Salad
Lemonade
Cookies
Coffee
Bacon
Rice

Shrimp Cocktail
Scrambled Eggs
Turkey Salad
Green Beans
Roastbeef
Beefsteak
Mustard
Sausage
Banana
Jelly
Peas

Beef and Noodles
Mac and Cheese
Peanut Butter
Sweet Rolls
Spaghetti
Brownies
Pudding
Apricot
Candy
Apple
Corn

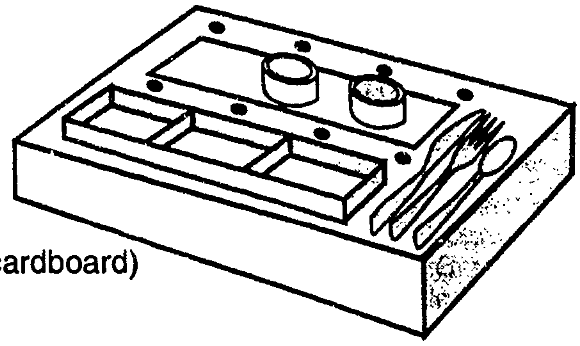
K	S	B	A	G	R	O	A	S	T	B	E	E	F	B	Z	C	S	C	S	S
B	A	C	O	N	M	I	R	K	C	A	K	W	L	E	M	O	N	A	D	E
E	E	A	U	C	Z	S	F	A	N	R	G	I	M	E	R	R	F	N	Q	J
E	I	L	P	C	H	I	C	K	E	N	A	L	A	K	I	N	G	D	D	A
F	V	H	G	R	I	C	E	B	I	T	U	M	F	J	C	H	Y	Y	J	S
A	P	F	R	E	I	K	C	D	P	O	G	A	B	E	Z	C	N	V	G	H
N	H	R	A	W	R	C	D	C	S	E	R	C	S	L	T	C	P	O	U	X
D	J	A	P	W	F	U	O	N	P	D	A	A	P	L	E	R	W	X	X	N
N	Z	N	E	U	P	C	Q	T	A	B	T	N	N	Y	A	D	G	B	H	L
O	F	K	D	S	P	S	S	L	G	R	E	D	U	G	W	F	E	M	U	F
O	W	F	R	M	Q	X	A	M	H	O	N	C	D	T	E	A	T	G	S	W
D	U	U	I	T	S	S	U	A	E	W	P	H	N	E	B	D	Q	B	G	U
L	V	R	N	A	Y	D	S	P	T	N	O	E	Y	Z	C	U	R	T	H	S
E	H	T	K	E	R	Z	A	P	T	I	T	E	D	N	O	O	T	I	R	W
S	J	E	K	A	G	N	G	L	I	E	A	S	U	D	O	D	F	T	N	O
Y	B	R	T	D	A	B	E	E	F	S	T	E	A	K	K	V	S	F	E	K
F	U	S	H	N	S	W	E	E	T	R	O	L	L	S	I	A	K	J	E	R
T	U	N	A	S	A	L	A	D	G	R	E	E	N	B	E	A	N	S	Z	E
M	I	B	M	A	G	Y	E	K	N	D	J	S	N	P	S	V	I	X	S	G

(See answers on page 77.)

Space Food Tray

ACTIVITIES 16

Make a working replica of the Space Shuttle food tray and food packages are made from a cardboard box and plastic freezer containers.



Materials

Cardboard box 18 x 12 x 3 inches in dimensions)
Plastic canvas 13 x 6 inches (for needlepoint)
Silver foil wrapping paper (enough to cover the box)
8 brass paper fasteners
Plastic foam sheet 18 x 12 x 2 inches
Liquid nail (or other glue that will bond styrofoam to cardboard)
Rubber cement
6 cloth fastening patches (such as Velcro™)
3 one-pint plastic freezer boxes
Cellophane tape
Plastic flatware (knife, fork and spoon)
Assorted dry foods
Pudding or fruit cups (commercial food product in aluminum cans with pull-back lids)
Water

Procedure

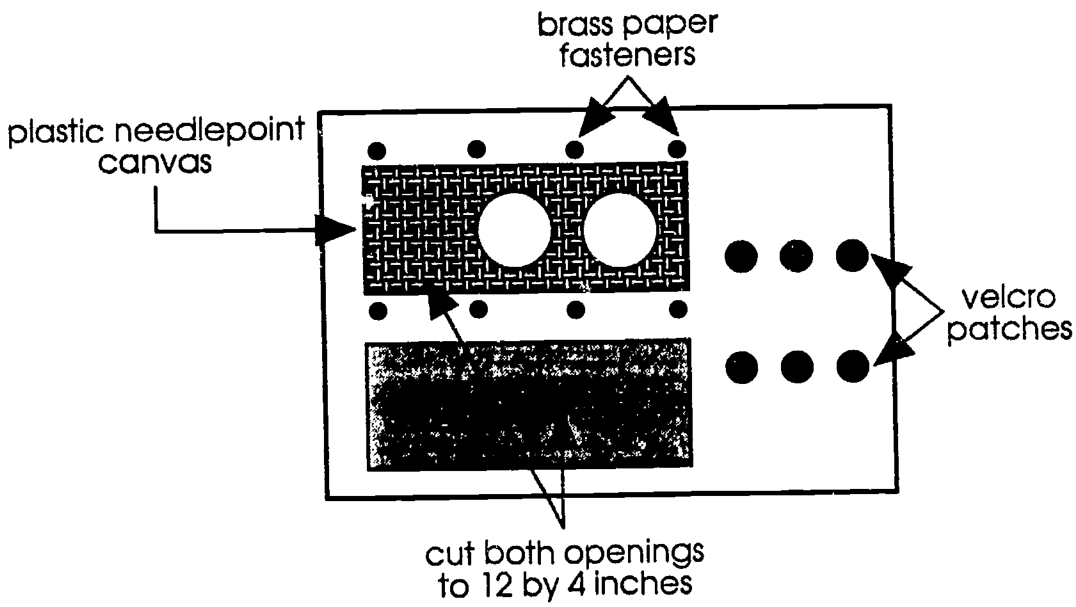
1. Cut two rectangular openings in the box as shown in the picture. The openings should be just large enough to fit three plastic freezer boxes snugly.
2. Trim the plastic foam sheet to exactly fit the inside of the box.
3. Glue the plastic foam to the inside of the box opposite the side the openings are cut. Close up the ends of the box and glue or tape them shut.
4. Carefully wrap the foil completely around the box and tape into place forming neat corners. The long seam should be positioned on the side opposite the openings. For a smoother finish, use rubber cement to bond the wrapping paper to the box.
5. Using a knife or scissors, cut the paper over the openings as shown so that the paper will neatly fold around the edges. Tape it to the inside of the box.
6. Punch eight holes as shown for the brass paper fasteners.
7. Cut the plastic canvas lengthwise. Then cut two round holes just large enough to hold the aluminum cans.
8. Attach the canvas to the inside of the box as shown in the diagram with the paper fasteners. Bend the fasteners to hold the canvas snugly.
9. Attach fastening patches to the backs of the plastic flatware and the corresponding wool patches to the food tray as shown.

Activity Idea

Make several food trays and place various commercial food items in the freezer boxes. Use foods like dry soups, cereals and freeze-dried fruits and vegetables. Many of these foods are available from supermarkets or from camping supply stores. Have the students prepare the foods using water water and then simulate a meal in space. While eating the food, discuss problems astronauts might have eating in space. What happens to spills? How does the food stay in the food boxes? How do the astronauts clean up after their meal?

Discussion

The Space Shuttle food system is designed for convenience and versatility in the apparent weightless condition of Earth orbit. Once food items have been prepared by adding water and heating (if necessary), individual food boxes are inserted in the slots of the tray. The tray can then be mounted to one of the orbiter's cabin walls or strapped to a crew member's lap for stabilization and easy eating.



Contributed by: John Hartsfield, LeRC, Aerospace Education Services Board, Oklahoma State University

Space Lunch Menu

ACTIVITIES 17

Name ______________________________

Food	**Amount**	**Calories**
Macaroni and cheese	3/4 cup	309
Asparagus/ sauce	1/2 cup	85
Green beans/ sauce	1/2 cup	63
Bread	1 slice	75
Shortbread Cookie	1	45
Chocolate Pudding	1/2 cup	175

1. For lunch, one astronaut ate an extra slice of bread and two extra cookies. What was the total calorie count of the meal? ____________

2. One astronaut had one extra portion of green beans with sauce and no asparagus. What was the total calorie count of the meal? ____________

3. How many more calories did the first astronaut eat than the second? ____________

4. If all the astronauts ate only what was on the menu how many total calories would each have eaten? ____________

(See answers on page 78.)

Keeping Fit

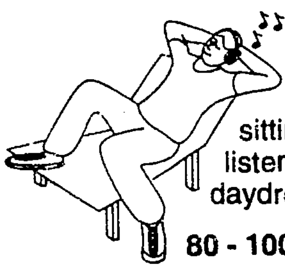
ACTIVITIES 18

Name ________________________________

How many calories do you need?

Use the chart below to help you complete the energy expenditure log for a 24-hour period. Then balance your total energy expenditure against your energy intake.

Calories and Fitness

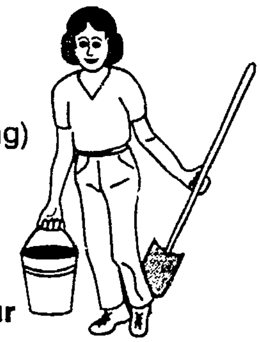


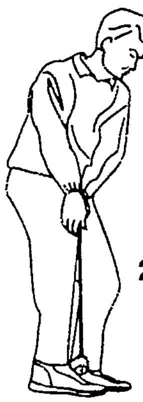
Quiet
reading
sleeping
watching TV
sitting around
listening to the radio
daydreaming

80 - 100 calories per hour

Light To Moderate
walking
shooting baskets (no running)
washing dishes
playing ping pong
making beds
light gardening

110 - 240 calories per hour



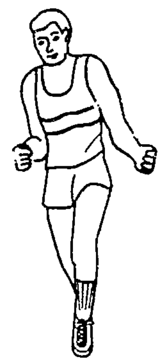


Active
walking fast
bowling
golfing
washing and waxing the car

250 - 350 calories per hour

Very Active
dancing
running
playing a hard game of basketball
tennis
skiing
swimming

350 or more calories per hour



Here's one way to figure how many calories you need each day:

Number of hours sleeping ____________ X 80 cal/hr. = ____________ cals.

Number of hours being very active ________ X 350 cal/hr. = ____________ cals.
(sports, dance, playing hard)

Number of hours in school ____________ X ____ cal/hr. = ____________ cals.

Number of hours quiet time ____________ X 80 cal/hr. = ____________ cals.
(watching TV, studying, listening to music)

Number of hours being active __________ X 250 cal/hr. = ____________ cals.
(walking home from school, work around house)

Estimated Total Per Day ________________________ cals.

This gives you a rough idea of your calorie needs.

A-B-C in Space

ACTIVITIES

Name ____

The Space Shuttle is composed of three main parts: the orbiter, the solid rocket booster, and the external fuel tank. The orbiter carries the crew and payload to and from orbit. The rest of the Shuttle system (the solid rocket boosters and the external fuel tank) is required to launch the orbiter into space.

Supplement

The Space Shuttle is launched like a rocket, but returns to Earth like an airplane and lands on a runway.

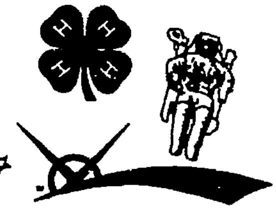
The orbiter can carry a total of nine people. For the first time, people who are not fully trained astronauts can go into space to carry out scientific and technical tasks.

Put the underlined words in A B C order.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________

(See answers on page 78.)

Space Shuttle Secret Message



ACTIVITIES

Supplement

Name____

Do the problems below. Then match your answer to the letters in the code. Write that letter in the box above the problem to find the secret message.

Code

A	B	C	D	E	F	G	H	I	J	K	L	M
2	4	6	8	10	12	14	16	18	20	22	24	1
N	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
3	5	7	9	11	13	15	17	19	21	23	25	27

Message

9	8	5		7	9	8	7	6	12	5
+6	+8	+5		+6	+7	+9	+8	+9	+12	+5

9	6		10	6	7	2		2	4		1
+9	+7		+7	+7	+3	+6		+0	+9		+1

10	7	9	5	11		8	3		4	2	2	6	15
+5	+4	+8	+1	+11		+7	+2		+2	+0	+9	+5	+10

5	3	10	6	4	1	2	1	6		14	1
+5	+6	+7	+12	+3	+0	+8	+3	+9		+1	+4

0	2	7		8	9	5	1		8	3	0	3	1
+2	+1	+1		+4	+2	+0	+0		+5	+4	+2	+3	+9

(See answers on page 78.)

Subject and Verb Handout

ACTIVITIES

Supplement

Name______________________________

Draw a line between the subject and the predicate. Draw one line under the simple subject. Draw two lines under the verb in the predicate.

1. Neil Armstrong landed on the moon July 20, 1969.
2. He said, "God's speed all the way, John Glenn."
3. Guion Bluford is the first African-American to perform a spaceflight.
4. On June 18, 1983, Sally Ride became the first American woman to fly in space.
5. In July of 1975, a U.S. spacecraft docked with a Russian spacecraft in the ASTP program.
6. Around the year 2000, NASA plans to erect a lunar base on the moon.
7. The crew of the space Shuttle can place satellites in orbit.
8. Astronauts exercise on a treadmill while in space.
9. The Shuttle is 121 feet long and weighs about 150,000 pounds empty.
10. EMU is another name for the spacesuit worn outside the Shuttle.

Blue Sky Crossword

ACTIVITIES

Name ______________________________

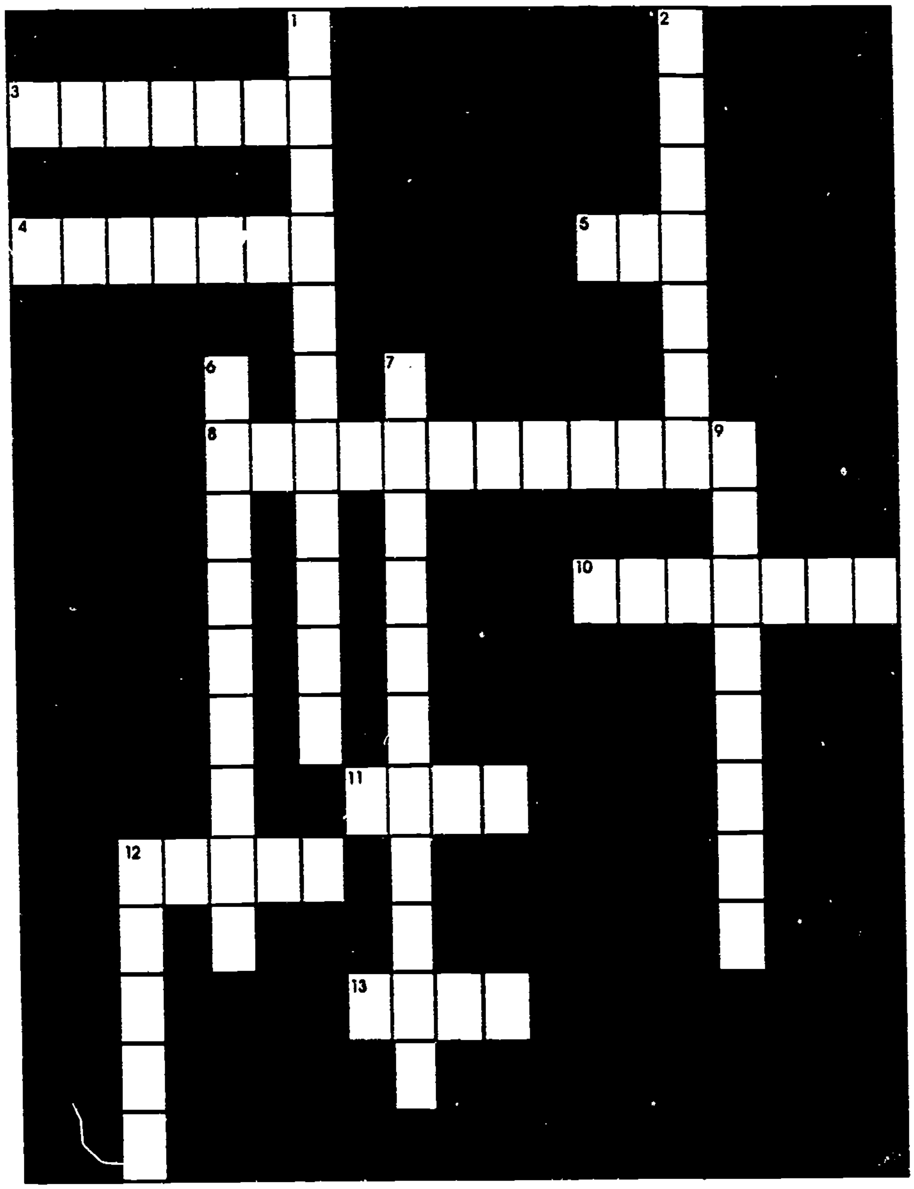
Supplement

Across

3. Polyester, Nylon, Spandex
4. It holds you to the Earth.
5. Extravehicular Mobility Unit
8. Used to "fly" to the moon.
10. The name of the project you are studying.
11. National aeronautics and space administration.
12. The group that everyone wants to join.
13. The man in the _____.

Down

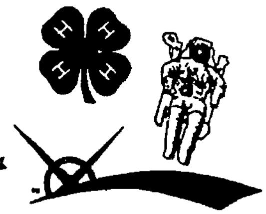
1. Adding water back into food.
2. Fibers from plants and animals.
6. They travel in space.
7. Removing water from food.
9. Burning off calories.
12. Used to move a large obj;ect.



(See answers on page 79.)

Blue Sky Spelling

ACTIVITIES

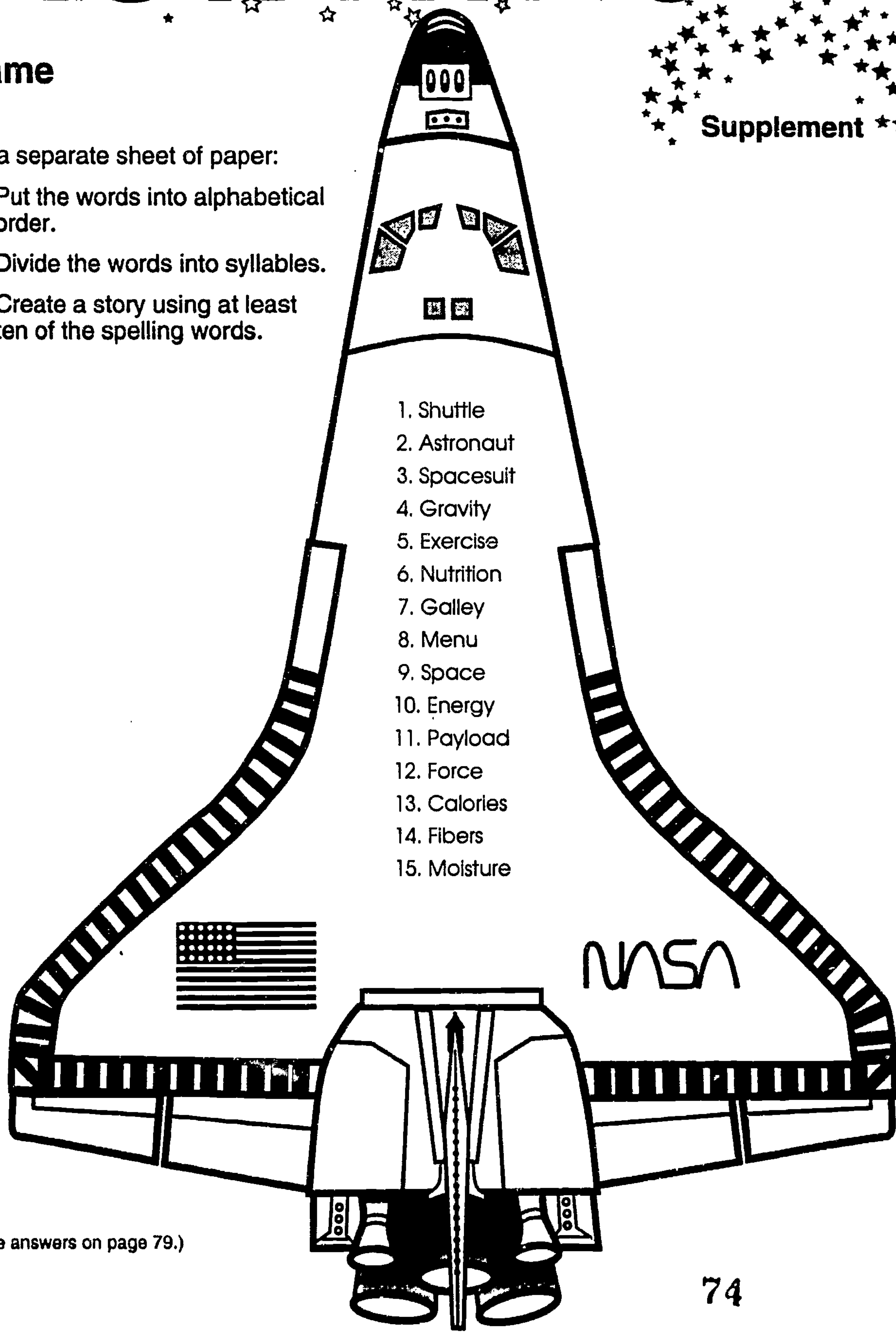


Supplement

Name

On a separate sheet of paper:

1. Put the words into alphabetical order.
2. Divide the words into syllables.
3. Create a story using at least ten of the spelling words.



1. Shuttle
2. Astronaut
3. Spacesuit
4. Gravity
5. Exercise
6. Nutrition
7. Galley
8. Menu
9. Space
10. Energy
11. Payload
12. Force
13. Calories
14. Fibers
15. Moisture

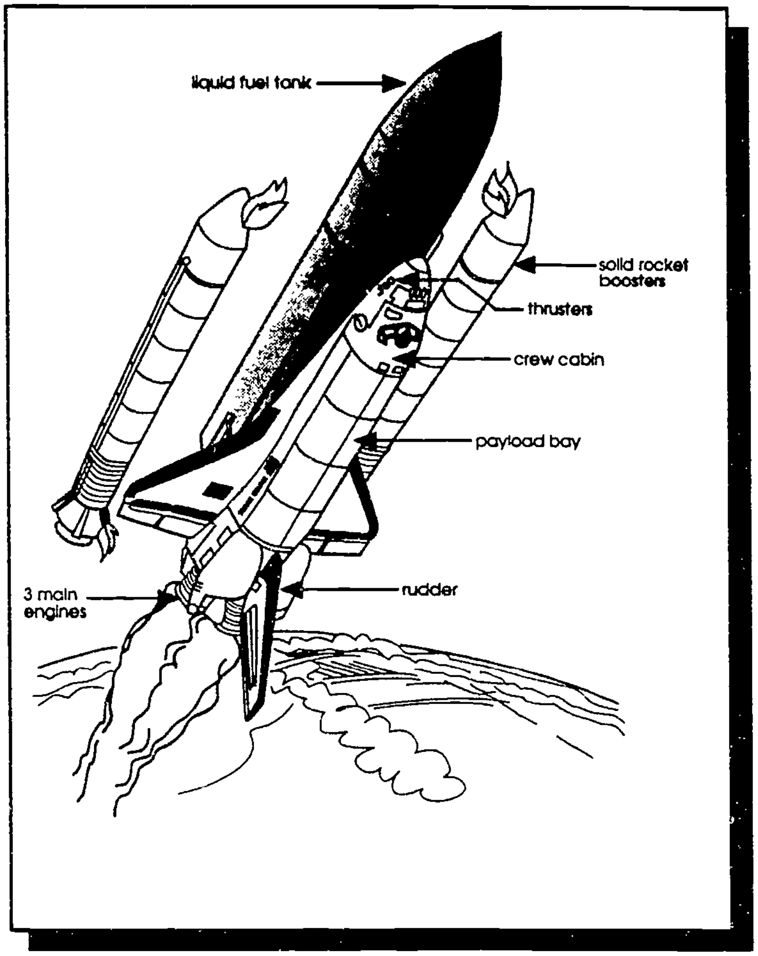
(See answers on page 79.)

Answer Key

ACTIVITIES

1 — Parts of the Space Shuttle

page 48



4 — Gravity and Space Word Search

page 52

O	R	E	Z	A	I	Z	M	J	F	G	A	B	V
W	A	F	E	K	E	Y	C	O	G	H	V	W	Y
M	E	B	R	M	A	N	O	D	H	A	S	R	R
R	Z	I	O	J	S	H	R	D	O	I	T	Y	I
A	H	H	G	Z	A	O	B	Y	H	N	N	L	A
R	D	W	R	H	S	X	I	Q	E	P	E	M	U
O	A	G	A	F	T	O	T	E	N	A	M	Z	B
T	O	V	V	E	R	L	R	S	T	J	I	R	I
A	L	I	I	K	O	Y	E	K	A	L	R	C	L
L	Y	U	T	I	N	H	J	S	N	A	E	I	L
U	A	K	Y	K	A	M	H	M	S	U	P	O	J
P	P	L	J	I	U	U	O	F	I	N	X	C	X
I	E	G	A	V	T	G	F	O	R	C	E	S	Z
N	C	O	M	T	S	L	L	O	N	H	N	S	D
A	U	G	L	I	H	M	P	G	P	D	Q	A	S
M	Z	E	N	V	I	R	O	N	M	E	N	T	C

Answer Key

ACTIVITIES

6 — Effects of Gravity

page 54

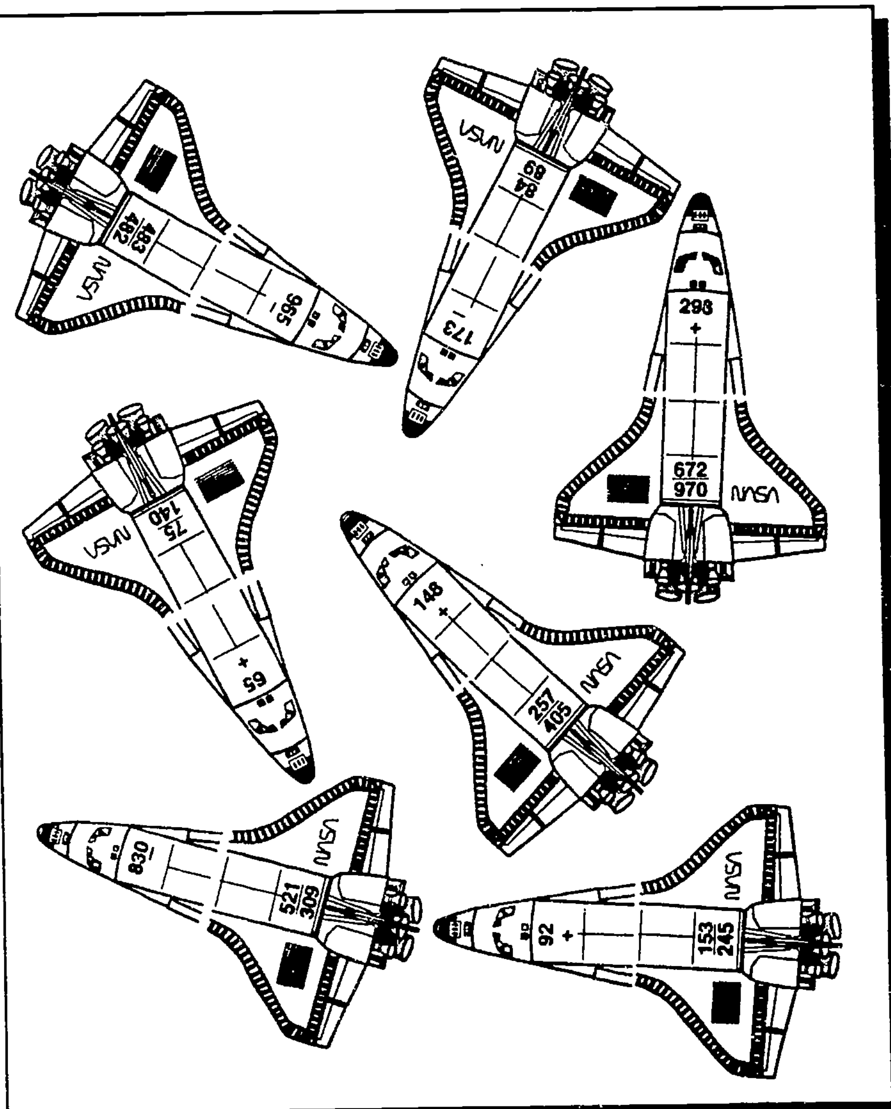
Answers

roller coaster	construction crane	merry-go-round
rotating swings	parachute drop	logslide
airplane overhead	rotating rockets	stairs
Ferris wheel	sun in the sky	ballfield baseball game
balloons	ring-the-ball	pitch-n'-toss

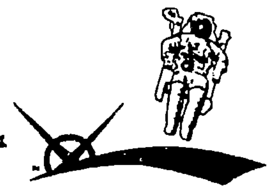
7 — Matching Up The Space Shuttle

page 55

Cut out all the pieces of the Space Shuttles. Match the top half of the Shuttle to the bottom half to make a correct math problem.



Answer Key



ACTIVITIES

9 — Fibers and Textiles Word Search

page 57

Y	F	R	D	J	M	V	V	J	A	Y	O	L	P	H	C	V	F	S	W	N
M	B	Y	J	N	T	U	O	R	K	M	K	D	V	Y	P	M	P	W	E	D
P	C	D	O	R	I	O	T	K	B	D	K	W	M	M	C	Z	Y	M	H	Q
C	Q	R	K	Q	N	M	N	E	N	I	L	H	J	K	K	Q	F	T	O	L
R	J	T	L	S	U	A	E	Z	M	M	I	C	D	Q	P	J	D	C	C	B
G	A	S	Q	Y	Y	G	P	W	T	A	S	S	T	X	M	O	L	N	P	U
N	C	L	P	R	T	H	O	E	Z	R	P	A	G	L	U	B	M	M	S	T
Q	Q	Q	U	O	I	O	X	E	I	A	M	H	K	L	T	V	C	R	C	Q
M	E	D	T	C	L	T	D	N	N	D	S	R	V	B	N	Y	E	I	T	N
L	P	E	J	E	I	Y	Q	D	Y	K	T	Q	I	O	A	B	H	I	O	D
F	B	B	C	L	B	H	E	D	Z	F	U	Z	L	A	I	X	U	T	U	V
R	N	C	E	L	O	X	E	S	T	J	A	Y	N	F	H	S	T	Z	E	F
R	Q	S	I	J	M	Q	Q	V	T	F	N	G	L	U	E	O	V	P	D	H
W	O	Q	S	L	H	N	A	S	A	E	O	A	L	C	C	Q	M	L	N	Y
K	Y	R	N	X	Y	F	I	B	E	R	R	F	A	B	R	I	C	U	B	U
Z	C	L	A	R	D	R	E	F	A	U	T	P	A	D	F	T	R	R	J	Y
B	M	S	K	E	Q	F	C	W	T	H	S	X	P	F	X	L	C	M	I	M
S	G	X	G	T	M	X	M	A	N	M	A	D	E	F	I	B	E	R	S	F
Y	J	D	B	J	E	Q	N	H	V	Q	X	F	B	V	O	T	N	O	V	O

10 — Parts of the EMU

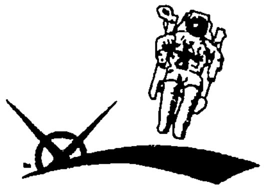
page 58

1. Airlock Adapter
2. Contaminate Control Cartridge
3. Battery
4. EMU Electrical Harness
5. Extravehicular Visor Assembly
6. Helmet
7. Arm Assembly
8. Hard Upper Torso
9. Glovers
10. Lower Torso
11. Service and Cooling Umbilical
12. Extravehicular Communication Umbilical
13. Liquid Cooling Vent Garment
14. Portable Life Support System
15. Secondary Oxygen Pack
16. Communications Carrier Assembly
17. Insuit Drink Bag

75

Answer Key

ACTIVITIES



11— Math Match,
page 59

A	S	T	R	O	N	A	U	T	S
7	2	67	17	0	95	6	73	43	5
+10	x10	-62	+13	+2	-33	+11	-19	-38	x4
17	20	5	30	2	62	17	54	5	20

W	E	A	R		A
5	4	19	15		62
x7	+17	-2	+15		-45
35	21	17	30		17

S	P	A	C	E	S	U	I	T
15	2	87	9	16	2	41	62	5
+5	x8	-70	+9	+5	x10	+13	-22	x1
20	16	17	18	21	20	54	40	5

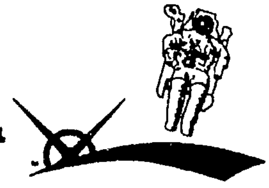
C	A	L	L	E	D		A
2	37	41	32	3	37		28
x9	-20	+15	+24	x7	+27		-11
18	17	56	56	21	64		17

E	X	T	R	A	V	E	H	I	C	U	L	A	R
13	49	7	50	12	3	71	4	20	3	27	32	19	3
+8	+0	-2	-20	+5	x9	-50	x4	+20	x6	+27	+24	-2	x10
21	49	5	30	17	72	21	16	40	18	54	56	17	30

M	O	B	I	L	I	T	Y		U	N	I	T
10	2	6	64	7	46	5	100		2	80	32	5
-0	x1	x6	-24	x8	-6	+0	-10		+52	-18	+8	x1
10	2	36	40	56	40	5	90		54	62	40	5

Answer Key

ACTIVITIES



13 — Processing and Packing,

page 61

Activity 1

A. Removing all water from food
B. Turning ice into vapor
C. Cooking and sealing in cans
D. Using rays to preserve
E. Adding water to food
F. Removing part of the water from food

Activity 2

A. Natural Form
B. Natural Form
C. Grapes Intermediate Moisture
D. Thermostabilized
E. Freeze Dried
F. Thermostabilized
G. Dehydrated
H. Dried
I. Irradiated
J. Dehydrated
K. Natural Form

14 — Math Fractions

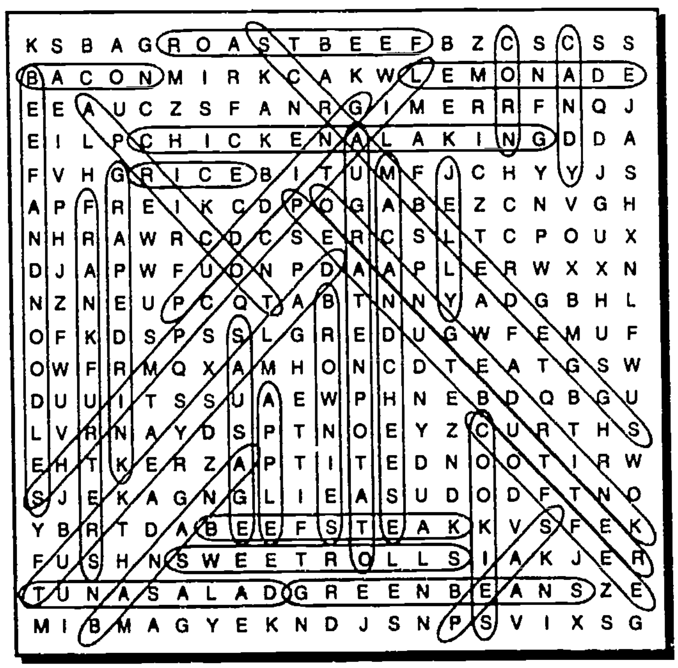
page 62

This activity requires the student to read a circle graph, use common denominators to change fractions, and compare fractional values.

1. Rehydrated food is used most often.
2. Natural and rehydrated forms are used half the time.
3. Irradiated and intermediate moisture are used as much as natural forms.

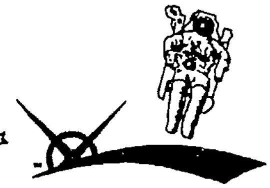
15 — Foods Eaten in Space

page 63



Answer Key

ACTIVITIES



17 — Space Lunch Menu
page 66

1. 917 calories
2. 730 calories
3. 102 calories
4. 752 calories

A-B-C In Space
page 68

1. airplane
2. astronauts
3. boosters
4. crew
5. Earth
6. launch
7. payload
8. rocket
9. runway
10. scientific
11. space

Space Shuttle Secret Message,
page 69

Message

T	H	E		S	H	U	T	T	L	E
9	8	5		7	9	8	7	6	12	5
+6	+8	+5		+6	+7	+9	+8	+9	+12	+5
15	16	10		13	16	17	15	15	24	10

I	S		U	S	E	D		A	S		A
9	6		10	6	7	2		2	4		1
+9	+7		+7	+7	+3	+6		+0	+9		+1
18	13		17	13	10	8		2	13		2

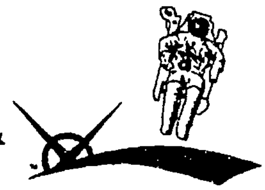
T	R	U	C	K		T	O		C	A	R	R	Y
10	7	9	5	11		8	3		4	2	2	6	15
+5	+4	+8	+1	+11		+7	+2		+2	+0	+9	+5	+10
15	11	17	6	22		15	5		6	2	11	11	25

E	Q	U	I	P	M	E	N	T		T	O
5	3	10	6	4	1	2	1	6		14	1
+5	+6	+7	+12	+3	+0	+8	+2	+9		+1	+4
10	9	17	18	7	1	10	3	15		15	5

A	N	D		F	R	O	M		S	P	A	C	E
0	2	7		8	9	5	1		8	3	0	3	1
+2	+1	+1		+4	+2	+0	+0		+5	+4	+2	+3	+9
2	3	8		12	11	5	1		13	7	2	6	10

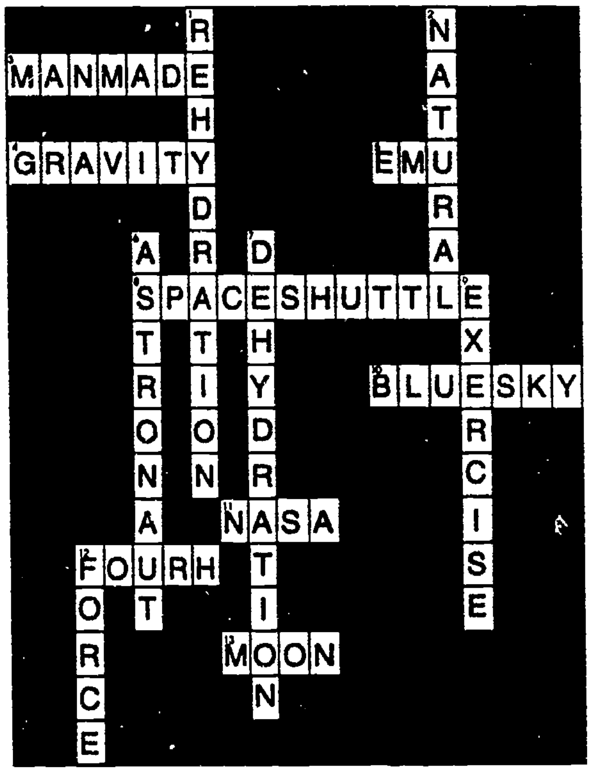
Answer Key

ACTIVITIES



Blue Sky Crossword,

page 71



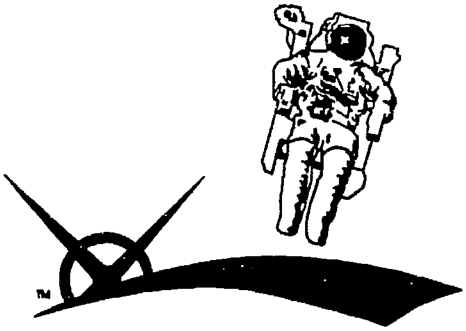
Blue Sky Spelling,

page 72

On a separate sheet of paper:

1. Put the words into alphabetical order.
2. Divide the words into syllables.
3. Create a story using at least ten of the spelling words.

Astronaut
Calories
Energy
Exercise
Fibers
Force
Galley
Gravity
Menu
Moisture
Nutrition
Payload
Shuttle
Space
Spacesuit



Forces

Pre/Post Test

Name ____________________

Circle the best answer

1. Which of the following is not a part of the space shuttle?
   A. Payload Bay
   B. Launch Pad
   C. Solid Rocket Boosters
   D. Thrusters

2. Which is a true statement about gravity?
   A. Gravity is present on the moon.
   B. Gravity is stronger on earth than in space.
   C. Gravity pulls object away from earth.
   D. Gravity allows things to "float " around.

3. How does gravity affect object weight in space?
   A. It weighs the same on earth as in space.
   B. It weighs more on earth than in space.
   C. It weights less on earth than in space.
   D. The weight does not change.

4. The payload bay is where the:
   A. crew lives and eats.
   B. extra engines are located.
   C. spacesuits are stored.
   D. equipment and satellites are carried.

5. In order to return to earth, the space shuttle:
   A. turns around.
   B. uses smaller engines to slow down..
   C. uses gravity to pull it down.
   D. All of the above.

6. What keeps the shuttle in orbit?
   A. Gravitational pull from the moon.
   B. The speed of the shuttle is equal to the force of gravity.
   C. Gravitational pull from earth.
   D. The booster rockets.

7. True or False. Weightlessness in space lets tools and equipment float.

8. True or False. Because of the lack of gravity in space a person is taller on the moon than on earth.

9. True or False. The main engines are released from the shuttles and are picked up in the ocean.

Forces

Pre/Post Test — Answer Key

Circle the best answer

1. Which of the following is not a part of the space shuttle?
   A. Payload Bay
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Fiber and Textiles

Pre/Post Test

Name ____________________

Circle the best answer for each question.

1. True or False — Nylon used by the space program is now used on earth in everyday life.

2. True or False — Man-made and Natural fibers are the same fabric.

3. The spacesuit worn by the astronauts:
   A. protects them from the extreme heat and cold.
   B. protects them from micrometeoroids.
   C. protects their bodies from the lack of air pressure.
   D. All of the above.

4. The spacesuit:
   A. is manufactured in one size.
   B. is composed of several layer of fabric.
   C. is a very comfortable garment that is easy to move in.
   D. is made from all natural fibers.

5. Protective clothing is worn by:
   A. fire-fighters to protect them from extreme heat.
   B. by athletes to protect them from being injured.
   C. by hospital workers to protect them from contamination.
   D. All of the above.

6. Fibers and textiles are used to make:
   A. clothing.
   B. computers.
   C. windows.
   D. All the above.

7. Name two man-made fibers.

8. Natural fibers come from animals and:
   A. coal.
   B. plants.
   C. rubber.
   D. water.

9. Which of the following is not part of the spacesuit?
   A. helmet
   B. screw driver
   C. inflatable bladder
   D. gloves

Fiber and Textiles

Pre/Post Test — Answer Key

Circle the best answer for each question.

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   C. inflatable bladder
   D. gloves

Food

Pre/Post Test

Name ____________________

Circle the best answer

1. True or False — The shuttle has a special food preparation area called a galley.

2. True or False — Astronauts do not have to exercise during a space mission.

3. True or False — Astronauts eat less calories in space then on earth.

4. Food aboard the space shuttle is prepared and packaged in:
   A. large bulk size containers.
   B. glass containers.
   C. special small, lightweight containers.
   D. containers like in the grocery store.

5. Food taken aboard the space shuttle might be:
   A. freeze dried.
   B. in its natural form.
   C. irradiated.
   D. All of the above.

6. When traveling is space the astronauts eat:
   A. seated at a table.
   B. standing at a corner.
   C. at the kitchen counter.
   D. in any position they wish.

7. To maintain the appropriate body weight you need to:
   A. balance your calorie in-take to calorie out-put.
   B. exercise more.
   C. eat fewer foods that are high in fat and sugar.
   D. go on a diet.

8. One way to prepare food in space, the astronauts must:
   A. remove food from the refrigerator and heat it on a stove.
   B. add water to the dehydrated food and heat it.
   C. squeeze the food from a tube.
   D. remove food from the refrigerator and just eat it.

9. Name three different ways food can be taken on a space mission

10. To dehydrate foods:
    A. moisture is removed from the food.
    B. no moisture is removed from the food.
    C. food is heated and sealed in aluminum cans.
    D. food receives high energy rays.

Food

Pre/Post Test — Answer Key

Circle the best answer

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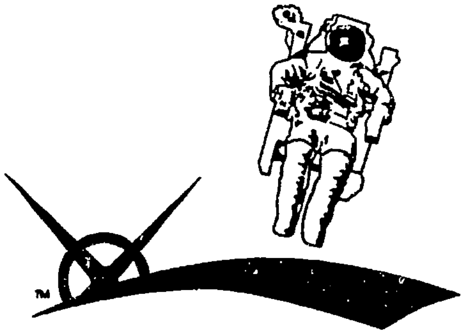

Support Materials

Videos

Three half hour videos are available. They feature:

- NASA shuttle astronauts
- Impulse, the animated satellite
- Members of the 4-H Blue Sky Club
- Actual Scenes of astronauts in space and training for space at Johnson Space Center.

Video 1 — Gravity and Forces

Discover what gravity is, what it's like to be weightless, how to work in space, how to sleep in space, and how gravity affects our lives on earth.

Video 2 — Fiber and Fabrics

Find out how space suits are made, how different layers of fabric work, if astronauts wear the same fabrics in space that we wear on earth, why we wear certain fabrics for sports, others for our jobs, others at home, the difference between man-made and natural fibers.

Video 3 — Food and Nutrition

Explore how food is prepared for space, how astronauts eat in space, what kinds of foods astronauts eat in space, how good nutrition affects health and the ability to perform various tasks.

Optional Materials

You may wish to order these if you organize your classroom as a 4-H Blue Sky Club:

Mission Manual

Comic book format depicts learning activities for each of the three programs. This workbook for young people reinforces major concepts, enlarges upon subject matter areas and makes learning fun.

Membership Card

Participating youth become members of the 4-H Blue Sky Club.

Certificate of Completion

Recognize each Blue Sky member with a certificate upon completion of the various program missions.

T-Shirts

Every club has their own T-Shirt complete with the club emblem, and the 4-H Blue Sky club is no different.

Blue Sky Shuttle Models

A special model for club members to assemble themselves.

Space Posters

Famed futuristic space artist Dexter Dickinson created six posters depicting life in space. Each poster is backed with an explanation of featured scenes. Posters were designed especially for the Blue Sky Project.

Model Rocket Kit
A 12-inch streaner recovery rocket kit with instructions.

Buttons
Club members will want to have their own 4-H Blue Sky Club emblem.

Contact the local Extension office for information about obtaining copies of the 4-H Blue Sky videos or optional 4-H Blue Sky Club materials.

For specific information about NASA's Shuttle program or other space related topics, contact the NASA Lewis Teacher Resource Center office by calling (216) 433-2017 between 8 a.m. and 4 p.m. Monday through Friday, or by writing to: NASA Lewis Research Center, Mail Stop 8-1, 21000 Brookpark Road, Cleveland, OH 44135

More than 800 videotape programs are available for duplication. Programs cover all areas of NASA's projects and range in length from 5 to 60 minutes. Duplicating formats include 3/4-inch cassette, 1/2-inch VHS and BETA. The center also has space related teaching materials for K through 12 including lesson plans, posters, worksheets and handouts. Contact the center for a complete listing.

THE 4-H PLEDGE

I Pledge
My Head to clearer thinking,
My Heart to greater loyalty,
My Hands to larger service, and
My Health to better living, for
My Club, My Community,
My Country
and My World