4-H LEADER/TEACHER HANDBOOK

BLUE SKY BELOW MY FEET™

ADVENTURES IN SPACE TECHNOLOGY

FORCES, FIBERS, FOODS

DEDICATION

These educational materials are dedicated to the memory of the Space Shuttle "Challenger" crew who lost their lives in the explosion of January 28, 1986. These astronauts focused their careers on the Space Shuttle and its technology, and chose to lead us in the exploration of space.

U.S. Air Force Lieutenant Colonel Ellison S. Onizuka of the *Challenger* crew was a former 4-H'er and the first Japanese-American and native Hawaiian to fly in space. His first mission was in January, 1985. During that mission he carried with him three 4-H flags. He credited 4-H programs with giving him opportunities to develop self-confidence, the ability to achieve and a spirit of exploration and challenge. LTC Onizuka was assisting in the production of *Blue Sky* before his death and is featured in the television programs.

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INTRODUCTION

Congratulations and thanks for being a Blue Sky 4-H volunteer. You and your members are about to embark on a new and exciting experience relating space and technology to the world in which we live. Whether you're a novice or an experienced volunteer leader/teacher, you can make this experience fun, exciting and educational for your members and you.

This guide will help you in planning and conducting activity-filled meetings with your group. Background information, lesson plans, individual and group activities and other learning experiences are all provided for you. It's up to you to motivate the youth, to generate excitement and enthusiasm for the project, and to provide support for your group throughout the program.

HERE'S HOW THE LEADER/TEACHER HANDBOOK IS ORGANIZED

The first few pages of this handbook explain what the Blue Sky project is and what's included in this new 4-H program. The purpose, goals and objectives are outlined, along with suggestions of how the materials are to be used. Some basic information on working with youth is provided for the leader, along with tips about materials and equipment needed to conduct the project.

You'll find a Curriculum Matrix which, at-a-glance, shows how all the program components fit together. Next is a basic lesson plan outline that can be used to teach each of the lessons. Following the Outline is specific information pertaining to each individual lesson, such as background information on the subject, teaching objectives, discussion questions and answers, individual and group activities, and suggestions of other 4-H projects which relate to the subject being taught. Where to find additional information on Blue Sky topics is also indicated. Finally, tips are provided for helping your members complete project record forms.

WHAT IS BLUE SKY?

Purpose, Goals and Objectives

Blue Sky Below My Feet—Adventures in Space Technology is a new multimedia 4-H program which introduces 9- 12-year-olds (grades 4-6) to the world of science and technology using features from the Space Shuttle program as working models. Using three different subject matter areas—**forces, fibers and foods**—the program links space-age technology to the everyday interests of boys and girls, increasing their knowledge and skills for daily living. Youth 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 of our bodies while on Earth and in space.

Additionally, the project will help promote career exploration and present positive role models for youth.

Blue Sky is designed as a self-contained teaching/learning package with great flexibility to meet special needs and situations. The program consists of three television video/film programs which are supported by a Mission Manual for members, a Leader/Teacher Handbook and an extensive choice of learning activities for youth. Together, these materials provide a wide range of opportunities to facilitate learning.

Purpose and Goal

This new multimedia project provides a quality 4-H educational program for youth relating science and technology to everyday living. Blue Sky links space-age technology to existing 4-H programs—science & technology, clothing & textiles, and food & nutrition—and enriches these programs with new and exciting learning opportunities for youth. It also introduces new methods of educational programming. Using various methods of presentation, new audiences can be reached through a quality educational experience.

Educational Objectives

The overall objectives of Blue Sky are:

- To increase appreciation of space technology.
- To increase understanding of the relationship between space science and technology and daily living.
- To improve problem-solving and decision-making skills.
- To develop initiative in learning by doing.
- To sharpen consumer skills.
- To promote career exploration.
- To establish positive role models.
- To recognize the relationships between events in this country and the global community.

Specific objectives for each lesson are outlined in the section called "Planning Your Project." See pages 14, 18 and 23.

WHAT'S INCLUDED IN BLUE SKY

Three half-hour videotapes/films

featuring Shuttle astronauts and "Impulse," an animated satellite, examine each of three subjects:

- Forces and Gravity
- Fibers and Textiles
- Food and Nutrition.

Each of these programs is available in 16mm film, one-inch or three-quarter-inch video cassette, and in half-inch VHS and Beta formats, for use with film projectors, home video systems and television stations. Each film is hosted by a pair of astronauts, nearly all of whom are 4-H alumni, who represent positive career models and can help build career aspirations of youth.

Mission Manual for members

is designed in a comic book format with spaces to write in answers to a variety of activities. The manual is divided into three subject areas, each supporting one of the lessons presented in the TV video/film series. A project record form is included at the back of the manual. Each youth should be encouraged to complete the form to help him keep track of the things he learns and the skills he gains from taking the Blue Sky 4-H project.

Leader/Teacher Handbook

is an invaluable guide to organizing learning experiences for youth. Especially designed for leaders and teachers, the handbook provides tips for planning, organizing and conducting the Blue Sky project.

Extension Staff Guide

is a brief guide to inform state, regional and local decision-makers about what Blue Sky is and the educational value and potential impact it may have on 4-H youth. The guide gives tips on promoting the project and obtaining endorsement of Extension, school administrators and television directors. Audiences and delivery modes are also suggested, along with guidelines for establishing a Blue Sky program in state and local areas.

In addition to core curriculum materials, the following have been developed to support the Blue Sky 4-H project:

POSTERS for promoting the series.

BUTTONS for identification and promotion.

T-SHIRTS for visibility, identification and promotion.

CERTIFICATES to recognize and acknowledge participation and completion of the project.

ROCKET KIT to provide hands-on experiences to support project work.

HOW THE MATERIALS ARE TO BE USED

Blue Sky is a complete teaching/learning package that's flexible and versatile enough to meet a variety of needs. The beauty of Blue Sky is that it was designed for multiple use. It is appropriate for all youth audiences, such as 4-H clubs and groups; upper elementary school classrooms; special interest groups; and other groups such as the Young Astronauts program. Project Blue Sky can be used in a variety of ways—at club meetings, workshops, fairs and camps, in school classrooms, library film programs and even at home for family fun and entertainment. The Blue Sky videos/films are available in several formats and can be shown in different ways—through film projection, home video systems, educational TV programs, and commercial and cable television stations. The versatility of this project will allow programming in just about any setting you can name.

Three different methods are suggested for conducting the programs. A leader can choose the method which best suits the needs of his group.

METHOD 1: Use TV videos/films with Mission Manual and supportive Leader/Teacher Handbook. This method of programming is encouraged because it effectively utilizes all components of the training package to facilitate learning. Each piece in the package supplements the other, expanding learning opportunities and experiences. The videos/films present the subject matter in an audiovisual format allowing youth to use sight and sound to reinforce learning. The Mission Manual provides experiences that will allow youth to recall the basic concepts and principles provided in the TV programs. Supportive activities and field trips outlined in the Leader Handbook provide hands-on activities that reinforce learning-by-doing. Through combined use of all pieces in the Blue Sky package, youth can make the connection between the principles outlined and their practical application to everyday life.

A proposed format for using this method is outlined on page 10 of this guide. This format provides the broadest base of knowledge and experience for youth and will be used as the model curriculum in the Lesson Plan Outline.

METHOD 2: Use TV series alone; follow up with a discussion of the film. This is a short version of Method 1 and could theoretically be completed in as little as three hours, allowing one hour for viewing and discussing each film. However, members will not benefit from the total program because they will lack the practical hands-on experiences provided in the Mission Manual and the supplemental activities provided in the Leader Handbook, all of which help to enhance, expand and enrich learning opportunities for youth.

METHOD 3: Use segments of Blue Sky to supplement ('piggyback') the curriculum of existing 4-H projects.

Examples of these projects are:

AEROSPACE–Learning about weather conditions and forecasting; how rockets are assembled and propelled; how the aerospace program impacts on society; and the interdependence of people in the aerospace program.

AGRICULTURE–Exploring where to grow crops on Earth's surface and suitable environments for growing crops.

CAREER EXPLORATION–Identifying the wide range of careers related directly and indirectly to the space program.

CLOTHING AND TEXTILES–Identifying differences between man-made fibers; the wide uses of fibers in our everyday lives; how fibers are made into fabrics and textiles; and careers. Youth also may study careers associated with the clothing and textile industry.

COMPUTER SCIENCE–Learning how computers affect our daily lives on Earth and how they are used in the space program.

CONSUMER EDUCATION–Selecting clothing and foods to meet personal needs.

ELECTRIC ENERGY–Learning how electric energy affects man and his environment; how electric energy is generated and transmitted; how it is used to produce heat, light, power and communications.

FOOD AND NUTRITION–Exploring the sources and functions of food nutrients; how food is processed and packaged; and careers relating to food and nutrition.

Whatever your group's needs or interests, Blue Sky can provide something for everyone.

WHAT YOU NEED TO KNOW AND DO AS A LEADER

Know How to Work With Youth

In planning any project it's important to know your audience. Although many leaders, teachers and others using Blue Sky have experienced working with 9-12 year olds, everyone can benefit from a brief review of the characteristics associated with this age group.

In general, 9- 12-year-olds:

CHARACTERISTICS	IMPLICATIONS
Are extremely curious	9- 12-year-olds constantly ask "why." Do not answer all their questions. They will learn by finding some answers on their own. Encourage a few members to find answers and report back to the group.
Have a short interest span	Keep activities short and easy to understand. Assign different tasks that are short in duration.
Like group activities	Place members in small groups when planning and conducting some of the activities. Solicit the assistance of parents to help with field trips.
Are easily motivated, eager to try new things	Use a variety of individual and group activities.
Are quite active; have boundless energy	Put emphasis on "hands-on" learn-by-doing activities. Keep youth busy with individual or group projects.
Need a lot of guidance and direction	Activities must be planned and laid out in detail. Outline "things to do" and make assignments. Members will probably need individual and group guidance. Suggest how parents and other volunteers can help.
Admire and imitate older boys and girls	Acquire the help of teen leaders.
Need recognition and praise for good work	Give recognition in front of peers and parents. Let members know that they will receive a certificate for completing the project.
Do not like to keep records; do not see the value of them; need assistance and close supervision in preparing them	Make record-keeping simple. Review the project record form with the group step-by-step. Give clear instructions and solicit the help of parents to assist their children with record-keeping.

Get Acquainted With the Materials

In order to plan a successful program you must become familiar with all the materials which support the Blue Sky project. You should review the materials thoroughly so that you know what each element has to offer.

Step 1

- Begin by reviewing the *Leader/Teacher Handbook* in detail. It should answer most of the questions you may have. Whether you are a novice or seasoned volunteer or teacher, you'll discover the Handbook's value as a time-saver and idea-promoter in helping you structure a quality educational experience for youth.

  Review the basic lesson plan format on page 10. Look through the lesson plan outlines for the three programs. Read the background information for each lesson. Study the question and answer sections. Become familiar with the supplemental activities provided; make note of the activities which interest you. Study the curriculum matrix. It will help to pull the total program together.

Step 2

- Fully preview each *videotape/film.* Make notes that may be of help to you in planning your program.

Step 3

- Carefully review the *Mission Manual* for members. Review or complete the exercises and activities to get a feel for the kinds of things members are asked to do.

Step 4

- Review the *Record Form* for members, located at the back of the Mission Manual. It will give you an idea of the kinds of information required for member's records.

Obtain Needed Materials and Equipment

Before ordering videotapes or films you must first know the kind of equipment that will be available to you. To show the videos/films you will need the following equipment:

For Video:

- VCR tape player with VCR-to-monitor cable and stand
- Monitor(s) with stand (ideally one 25-inch monitor for every 23-25 viewers)
- Videotapes for each program (in correct size and format)

For Film:

- 16mm projector and stand
- Projection screen
- 16mm film for each program

Naturally, a power source and room darkening capability will be needed. Extension cords may also be required.

A *Mission Manual* should be provided for each of your members. The activities in this workbook will help youngsters recall and practice what they learn.

A *Certificate* to acknowledge participation and completion of the project may be awarded to each member.

Additional items may be necessary to complete supplementary activities, depending on your program plan. Review the activities you plan to do prior to each lesson. Make a checklist of needed materials and equipment.

Now that you are familiar with all the components of the Blue Sky 4-H Project you're ready to begin planning your program. The next section, "Planning Your Project," will be beneficial as you outline your plans.

PLANNING YOUR PROJECT

Curriculum Matrix

The Curriculum Matrix provides a suggested format for using the Blue Sky materials. The Matrix is outlined to correspond with each of the lessons—Forces, Fibers and Foods. At-a-glance you can see how it all fits together and you can make modifications to meet your group's interests and needs.

Individual and group activities are each comprised of simple comparisons, identifications and games that can be completed in a relatively short timeframe. "Individual Activities" refers to those items which can successfully be completed by an individual member working alone. "Group Activities" are more suited for two or more members working together as a group. Some of the activities may overlap and can be completed by an individual or group. Most of the activities can be completed at home, in a club meeting, school classroom or during a field trip.

"Field Trip" experiences reinforce basic principles, concepts and objectives being taught throughout the Blue Sky series. Field trips give youth the opportunity to get out and talk with experts and to see first-hand how these basic principles apply to everyday living.

"Discussion Questions" are provided for each of the three lessons. They help stimulate interest and can be used in a follow-up discussion after viewing each video/film.

"Piggyback Projects" refers to using segments of Blue Sky to enrich other 4-H projects and activities. For instance, the Blue Sky lesson on "Fibers" could be used as a supplement to the 4-H clothing project to teach youth about thermal properties of fabric and how our clothing protects us from heat and cold. Additionally, special 4-H events, such as workshops, fairs and camps, are also referenced under the "Piggyback" section of the Matrix.

Curriculum Matrix

Lesson	Individual Activities	Group Activities	Discussion Questions & Answers	Field Trip Learning Opportunities	Piggyback Projects & Activities	Suggested Resources
THE SPACE SHUTTLE, GRAVITY & FORCES	Complete exercises and activities in the Mission Manual, pages 3-8. Activities 1-10, pages 16-17.	View TV video/film Activities 3, 8, 10 (No activities on the Space Shuttle. See Mission Manual) Field Trips, page 17.	See Q & A numbered 1-15 on pages 15-16.	Amusements parks Science centers Construction and oil drilling sites Fire stations Health & fitness centers Airports NASA training center	Career Education Computer Science Environmental Awareness Citizenship Education International Programs Safety Education Electric Energy	NASA Teacher Resource Centers School science teachers Librarians
FIBERS & TEXTILES	Complete exercises and activities in the Mission Manual, pages 9-13. Activities 1-6, 9, 11, pages 20-21.	View TV video/film Activities 2,3,5,7,8,9,10,11 Field Trips, page 22.	See Q & A numbered 1-24 on pages 19-20. Natural and man-made fibers 1-7, 12 Properties of fibers 19-23. Consumer information 1-17, 23, 24	Fabric & sportswear stores Textile mills Tailors & seamstresses Farms Variety of occupations Natural History Museum A college of textiles NASA training center	Career Education Clothing & Textiles Consumer Education Computer Science Health & Safety International Programs Safety Education	NASA Teacher Resource Centers County Extension Agent School home economics teachers Librarians Clothing specialists Textile research analysts Chemists
FOOD & NUTRITION	Complete exercises and activities in the Mission Manual, pages 14-18. Activities 1-8, pages 25-26.	View TV video/film Activities 1, 3, 5, 7, 9, 10, 11 Field Trips, page 26.	See Q & A numbered 1-25 on pages 23-25. Nutrients & calories 1-9 Consumer information, food processing and labeling 10-14 Exercise, fitness & health 15-18 The Space Shuttle and research 19-25	Restaurant kitchen, school or hospital cafeteria, or community food service kitchen Food processing facility or bottling company School or community gymnasium Grocery store Foods research lab NASA training center	Agriculture Career Education Health Education Food & Nutrition Food Safety & Preservation Plant & Soil Science and Gardening Consumer Education Computer Science International Programs Health & Fitness workshops, fairs & camps Nutrition workshops, fairs & camps	NASA Teacher Resource Centers County Extension Agent School home economics, health & physical education teachers Librarians Food Specialists Food processors Food scientists Dietitians or food service managers

Step-by-Step Procedures

Lesson Plan Outline

The Blue Sky 4-H project can be conducted in a variety of ways with varied audiences and groups. The method you choose should depend upon the needs of your groups. To keep the procedure simple, each of the lessons can be taught using the following basic format.

LESSON PLAN OUTLINE

Introduction
Show TV video/film
Discussion of film
Complete Activities in Mission Manual
Assign Individual & Group Activities
Review Answers to Exercises in the Mission Manual
Follow up With Field Trips
Summarize the Lesson

(Repeat Procedure for Each Lesson)

Preparation Pointers

Before you begin, make sure that you are familiar with all the components of the Blue Sky project, as outlined earlier:

- TV video/film for each lesson
- Mission Manual for members
- Leader/Teacher Handbook for volunteers
- Other support pieces, as needed

(Refer back to section called "What's Included in Blue Sky" on page 4 for descriptive information on each item.)

Next, you must decide which teaching method will be most appropriate for your group:

Method 1 Using TV video/film with Mission Manual and Leader/Teacher Handbook

Method 2 Using TV series alone, with supportive discussion questions from the Leader/Teacher Handbook

Method 3 Using Blue Sky as a "Piggyback Project" to supplement and enrich an ongoing 4-H project.

(Note: If you select method 1, you can follow the lesson plan format outlined on pages 10-12. If you choose an alternate plan you will need to create your own variation of the Lesson Plan Outline.)

In either case, you must determine in which order you will teach the lessons. Individual lessons can be taught in any sequence; however, starting with the Space Shuttle, Gravity and Forces will provide background information and knowledge which will be needed before moving on to the specialized areas of Fibers and Foods.

The next step is to select and assemble needed materials and equipment. You will need a Mission Manual for each member; a videotape/film for each lesson; suitable equipment for showing the video/film; and a project certificate for each member. Other items such as buttons, T-shirts, posters, etc., are optional, depending on your program plan.

Introduction–Introduce the lesson to the group. Review the goals and objectives for each lesson. They are stated at the beginning of each lesson in the Mission Manual and the Leader/Teacher Handbook. Clearly understand your purpose and what you're trying to teach.

Preceding each lesson is a Background Information Sheet on the subject. Read each sheet carefully. This information will provide a wealth of knowledge and support for you as you introduce and work through each lesson, especially if you are not very familiar with the subject being

taught. It will give you an idea of the information being presented in each lesson and it will help provide answers for questions posed by curious youngsters.

The Background Information Sheet is a condensed version of the subject matter being taught in each lesson. Use it as background information to introduce the lesson and to support the material presented in the videos/films, Mission Manual and activities in the Leader/ Teacher Handbook. Explain to members what they will be seeing, doing and learning. Invite them to volunteer what they hope to see. Ask questions to stimulate interest and excitement!

Show TV Video/Film–The Blue Sky videos/films are meant to inform and entertain. After introducing each lesson, show the video/film in its entirety, uninterrupted (about 30 minutes).

Discussion of Film–Immediately following each show, it's important to encourage members to discuss what they saw. The discussion may last up to 20-30 minutes. What kinds of questions can you ask to promote a good discussion? Questions and answers are provided for each lesson. They can be modified, expanded or changed to suit your needs. Try to get the total group involved in the discussion. Remember, this material is sometimes technical in nature, so it may be necessary to show the film a second time, depending on the astuteness of your group.

Complete Activities in the Mission Manual–The Mission Manual is divided into three parts; each complements one of the TV videos/films. Each member should complete the exercises and activities in the Mission Manual that correspond with the appropriate video/film. It is important that each member individually complete these activities to help identify and recall basic concepts and principles provided in each TV program. These exercises help reinforce learning-by-doing.

Before the youth start to complete the workbook exercises, review with them what they will learn. Teaching concepts are identified at the beginning of each lesson in the Mission Manual. Also, in each section, a variety of matching, multiple choice and fill-in-the-blank questions are provided to stimulate interest, creativity and fun. "Impulse Input" activities usually require that the member does something on his own, outside the group meeting or classroom, such as going on a scavenger hunt or collecting samples from a fabric store. It may be necessary to plan for these activities just as you would for a field trip. "Screen Scans," on the other hand, provide a recall or review of factual information. Remind members to complete all the activities in the Mission Manual for each lesson.

Note: Since answers to the exercises are printed in the Manual, you may want to caution youth not to look at the answers until after they have tried to complete the activities.

Assign Individual & Group Activities–Involve youth in the supplemental activities provided in this Leader Handbook. These hands-on experiences and field trips will help expand knowledge through everyday applications and practical use. Some of the activities are more appropriate for individuals to complete alone. Others are more suited for two or more members working together. Remember that it's important to know your group. Many youth aged 9-12 enjoy group activities and need to be kept busy. Their attention span is short so activities should be kept short and simple. They are easily motivated and like to try new things so use a variety of individual and group activities. Encourage members to 'dig a little deeper' and try to develop activities, puzzles and games on their own. Youth this age can sometimes be very creative and making them feel that it's partially their project will help stimulate motivation, enthusiasm and interest.

To help promote leadership and the sharing of knowledge and skills, give youth the opportunity to report some of their findings back to the total group. Whether working individually or in small groups, reporting helps youth develop decision-making and record-keeping skills.

Review Answers to Exercises in the Mission Manual–Youngsters are always curious to know how well they have done. Review the answers to the Mission Manual exercises with the group. This review provides another opportunity to discuss what they have learned. Let the members volunteer the answers. Their eagerness and enthusiasm will be an indication of how well they have grasped the material.

Follow Up with Field Trips–Plan for field trips well in advance. And feel free to solicit the assistance of parents and teens. There are quite a few tasks associated with planning the event, such as: deciding on a date; contacting the tour facility; arranging transportation; obtaining permission letters from parents of youth; planning the program (what you want members to do, see and learn while they're at the tour site); and follow-up activities or discussion after the tour.

Summarize Each Lesson–Give a brief summary of each lesson before moving on to the next. This will alert members that the lesson is over and it's time to begin a new one. Recap the objectives of the lesson and highlight those activities that were most interesting to your group. Have members recall how the basic principles apply to their daily lives.

No matter what lesson you're teaching, the procedure outlined can be used for each lesson. The format is basic and flexible enough for you to make modifications according to the needs of your group. By combining the suggestions in the Lesson Plan Outline with the information supplied in the Curriculum Matrix, you should be able to plan an exciting program for you and your members. All you need now is the specific information for each lesson.

In the next section you will find core materials to assist you in conducting each lesson: background information sheets; goals and objectives; discussion questions; individual and group activities; and relationships of the lesson to other 4-H projects and activities. You will be using this information throughout the Blue Sky project.

I guess you're set. As soon as you acquire your Mission Manuals, film and equipment you're ready for lift off. 5-4-3-2-1, have fun!

Materials For Individual Lessons

Basic Information on the Space Shuttle

Originally conceived in the late 1960's, a Space Shuttle is an aircraft designed to carry astronauts into outer space to conduct research and to explore space. Three Shuttle vehicles are in operation: "Columbia," "Discovery" 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 and covers approximately 420,000 miles per day. 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 a maximum crew of nine, a Shuttle is designed to carry up to 65,000 pounds of payload into space. This payload can be experimental equipment or satellites of all kinds.

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 maneuvering units (MMUs) permit the astronauts to move about and work untethered for about six hours in space outside the Shuttle. A variety of experiments can be performed by crew scientists aboard the Space Shuttle.

The Shuttle can also carry into orbit experimental space laboratories such as "Spacelab" or large solar power stations for future use. A number of operations in the payload bay are conducted using a 50-foot manipulator arm directed from within the Shuttle.

The Shuttle is moved three miles to the launch pad on a gravel road 130 feet wide by a six-million-pound crawler transporter. 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 with payload). It's about the size of a DC-9 airplane, with a payload bay 60 feet by 15.

The Shuttle is propelled into space by three main liquid engines (fed supercooled oxygen and hydrogen from the 500,000-gallon fuel tank) and by two 150-foot-high solid-fuel rocket boosters, the largest ever flown. Each contains more than one million pounds of propellant. The liquid fuel tank is the only part of the Shuttle that isn't reusable. It drops off and burns up in the atmosphere. The solid rocket boosters burn for about two minutes with five million pounds of thrust before being jettisoned and

parachuted into the ocean 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 6000°F. The Shuttle takes off like a rocket, maneuvers in Earth orbit like a spacecraft, and lands like a glider at about 200 MPH.

The Shuttle is an amazing craft. In addition to the three main engines and the two booster rockets, the Shuttle has 46 other maneuvering engines. Teams of engineers and designers also had to design power generators, hydraulic systems, environmental controls and waste disposals 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, and a world-wide communications system with hundreds of computers provides two-way Shuttle and crew-to-Earth communications. Special NASA ships are contacted to retrieve the reusable rocket boosters from the ocean.

Thermal protection is given the Shuttle during entry to and from Earth to protect it from surface temperatures of up to 3600°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. Together, protective tiles cover approximately 70 percent of the Shuttle's surface.

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

Basic Information on Gravity and Forces

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

What are three of these principles? One is that every particle, no matter how small, attracts every other particle. Another is that the amount of *attraction*—*gravitational pull*—depends on the mass or weight of both particles. Large objects such as Earth, have great mass and therefore great gravitational pull. Finally, the greater the distance between the centers of objects or masses, the less gravity's force.

To push the Space Shuttle away from Earth's pull you need tremendous power. Engineers provide this with five huge powerplants, three engines on the Shuttle itself, and two in the form of solid rocket boosters. When these five powerplants burn huge quantities of propellants very quickly they provide forces that counter gravity and project the Shuttle into orbit.

The two solid rocket boosters are the largest ever flown: they're 150 feet high, half as high as a football field. Filled with over two million pounds of solid fuel, they weigh more than two-and-one-half-million pounds. To overcome gravity, they develop some five million pounds of thrust and push the heavy Shuttle 24 miles into space. Yet they burn up in only two minutes! To escape Earth's gravity their start-up speed must be phenomenal: they burn at full operating pressure in just half a second. And how hot and fast are the counter forces so the Shuttle can escape Earth's pull? The exhaust gases coming from the cones are over 6000°F and exit at 6000 MPH!

Once they separate from the Shuttle and stop burning, in spite of their size, heat, and speed, the solid rocket boosters use large parachutes to counter gravity's downward pull. *At less than 70 MPH they fall into the ocean where ships recover them.* On land, technicians refill them with solid fuel for new Shuttle flights.

The Shuttle craft itself has three large engines developing more than a million pounds of thrust. Unlike the solid rocket boosters, the Shuttle engines burn for more than eight minutes. Also unlike the solid rocket boosters, the Shuttle engines burn *liquid fuels: hydrogen and oxygen.* Their burn temperature is the same, about 6000°F. But rather than separating from the Shuttle and falling to the ocean by parachute, they shut down and remain part of the Shuttle, landing with it.

The half million gallons of supercold fuel for the three Shuttle engines is stored in a giant 150-foot-high fuel tank to which both the solid rocket boosters and Shuttle are attached. The fuels are chilled below -290°F. Like the two rockets, this tank separates from the Shuttle and breaks up

in the atmosphere. Once in space, the Shuttle pilot uses two small engines to achieve orbit (approximately 172 miles above the Earth); the pilot can also maneuver from one orbit to another, rendezvous with other objects, and leave orbit. With another series of very small engines (44 in all), the Shuttle captain can alter orbit speed and change the Shuttle's attitude (pitch, roll or yaw).

The five powerplants allow the 200,000-pound Shuttle to escape Earth's gravitational pull. If the Shuttle and rocket engines were smaller, Earth's pull would be less. But smaller engines wouldn't achieve break-away from Earth's gravity. So scientists and engineers balance size and engine power.

In orbit another kind of balance comes into play. Once in orbit, the Shuttle can stay there because of its speed, 17,500 MPH. With balance between its speed and the Earth's gravitational pull equal, the Shuttle rotates around the Earth every 90 minutes. It's then that the astronauts begin to experience *near-zero gravity.* Then they and everything else in the Shuttle that isn't fixed begin to float as if *weightless.*

The everyday experiences with gravity disappear: objects no longer fall from ceiling to floor; food angles off plates; sleepers float from their cots; tools wander off workbenches; fluids drift out of glasses. Everything must be secured, bolted or fixed in place. In this state, your body stretches about one inch taller and your waist also expands, because body fluids held in the lower portion of your body by gravity flow upwards in the absence of gravity. The astronauts must do their workouts strapped down on a treadmill to simulate the benefits of exercise they could normally gain from working against gravity.

Part of the training of astronauts is to learn to work in this weightless environment. Some training is done in a large over-sized 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 orbiter to fit inside it. A fully suited astronaut is placed under water and weighted so as to be neutrally buoyant. Under the water the astronauts practice functions 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 Earth's gravitational force is almost eliminated (*it's about 1/8th of what it is on Earth).* For instance, how perfectly can honeybees make combs in these weightless conditions? Do the roots of plants sense in space which way the Earth's gravity would be pulling them so they'll 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?

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

The goals of this lesson are to:

- Provide youngsters with an understanding of the basic principles of a natural force—gravity.
- Help youth explore the effects of gravity in their daily lives.
- Relate to youngsters how gravity affects the Space Shuttle on Earth and in orbit.
- Demonstrate how forces of one kind are used to balance others through complex teamwork.

Relationships to Other 4-H Projects

Piggyback Projects

- *Computer science*: how to quickly process large amounts of complex information and data.
- *Electronics*: how electric energy is used for Shuttle systems, such as in guidance, monitoring, control and communications.
- *Environmental education*: how gravity affects Earth's surface and plant growth; how man deals with the effects of gravity in daily living.
- *Career education*: career identification and exploration in a variety of fields, such as aeronautics, oceanography, mathematics.

- *Citizenship/International:* the need for programs like the Space Program and how they will affect people of the world.
- *Safety education:* how to prevent accidents in threatening environments.

Discussion Questions

1. **What are three basic principles of gravity?**

   1: Every particle, no matter how small, attracts every other particle. 2: The amount of attraction—gravitational pull—depends on the mass or weight of both particles. 3: The greater the distance between the centers of objects or masses, the less the pull of gravity.

2. **How is gravitational pull affected by the mass or weight of an object? By distance?**

   (See "Three Principles" above.)

3. **What effects does gravity have on our daily lives?**

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

4. **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 (only ⅛th Earth's gravity) causes near-zero weightlessness.

5. **How does gravity affect what we do?**

   Walking–We must lift our heavy arms and legs.

   Climbing–We must lift our entire body weight.

   Sitting–Holds people in place.

   Sleeping–Holds people, including arms and legs, in bed.

   Standing–Keeps people from floating in air.

   Rolling over–Holds you down until you reach an anticipated spot.

   Riding in a car–Keeps passengers in their seats.

6. **How much energy do you use to overcome the force of gravity each day? A little? A lot?**

   Only a little; astronauts use somewhat more energy in space than on Earth because of "floating" instead of "walking."

7. **When does Earth's gravitational pull completely disappear?**

   Never! Earth's gravity extends through the solar system but, for example, nearer another planet its gravity is counterbalanced by the gravity of the other planet.

8. **What are some problems the astronauts could face at near-zero gravity in Earth orbit?**

   Holding down objects–Objects float in space.

   Sleeping–Sleepers float, arms float away from the body.

   Eating–Food doesn't stay in place.

   Moving about with feet and arms–Astronauts must "swim" rather than "walk."

   Using tools–Tools don't stay put, they float.

   Storing materials and objects–They must be fixed in place or they will float.

   Using liquids–Liquids float out of containers, unless tightly sealed in special containers.

9. **How big are the rocket boosters on the Space Shuttle? What fuels do they burn?**

   Rocket boosters are 150 feet high and burn solid fuels.

10. **Why are rocket boosters needed?**

    On liftoff, they help the Shuttle overcome the initial strongest pull of Earth's gravity.

11. **Why are the rocket boosters so large?**

    To overcome gravity, they develop some five million pounds of thrust and push the heavy Shuttle 24 miles up into space.

12. **Why are the three main liquid fuel engines needed on the Shuttle? How similiar 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 jettisoned and 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.

13. What effect does gravity have on the jettisoned rocket booster engines? How do parachutes overcome these effects?

Gravity pulls the booster engines back to Earth. Parachute wind resistance slows their rate of fall so they do not disintegrate.

14. What parts of the Shuttle are reusable?

All parts except the liquid fuel tank are reusable.

15. Why does the Space Shuttle have so many different size engines?

Different sizes of engines are required to maneuver in different gravitational situations.

Individual & Group Activities

1. Go into your bedroom. Consider how you would need to secure everything in your room if it were to be transported into space aboard the Shuttle. Consider weight and space. How would liftoff be affected? Would there be any effects while in orbit? Write a speech or give a demonstration. (Weight would be a problem at liftoff. It would require significantly more engine thrust. Once in orbit, weight is not a problem; space is.)

2. Sit in your family car. Pretend that it's a Space Shuttle. What changes would you have to make to permit it to operate in Earth orbit? (You would have to bring along enough air for the engine to burn in orbit. All liquids and fluids, such as battery water, antifreeze, window-washer fluid, oil and gasoline would have to be sealed in tightly. Doors and windows would have to be sealed and other items, such as seat belts, floor mats, purses, objects on the dashboard, occupants and pets, would have to be secured to keep them from floating in space.)

3. Identify some jobs which deal almost exclusively with forces such as gravity. (Pilots, elevator engineers, water supply crews, highway engineers, power dam operators and crane operators.)

4. While floating in a swimming pool, try some simple tasks such as cleaning a smudge off the pool wall. Observe how much more energy is needed to keep yourself in place as you do these tasks. (The feet are used very little to keep yourself in place; the hands are used a great deal.)

5. Watch falling objects such as rain, snow, leaves, seeds and dust. What would happen if gravity did not influence these objects? What would Earth's atmosphere look like? Draw a picture. (If gravity did not influence these objects they would float and Earth's atmosphere would look like a jumbled mass of floating objects.)

6. Guess what might happen to objects, such as tools or satellites, left in near-zero gravity in Earth orbit. (Because of gravity/speed balance they continue to float in place. They continue to orbit for a very long time, although eventually they reenter Earth's atmosphere and are burned up. However, while they are in orbit they could potentially collide with astronauts and spacecraft, so they do pose possible danger.)

7. Try this simple gravity test.

   Drop two objects of different weights to the ground. Do they hit the ground at the same time? Why? (Yes, because gravity affects both of them the same way.) How fast would these objects fall in the Space Shuttle? Why? (In the Shuttle they would not fall at all; they would float because when in orbit the gravitational pull is only ⅛ of what it is on Earth.) What about on the surface of the Moon? (They would fall more slowly because Moon's gravity is less than the Earth's, but each would fall at identical rates to the surface.)

8. Try different exercises to see in which ones you experience the greatest effects of gravity. Try arm lifts, leg lifts, jumping, hopping, push-ups and pull-ups.

9. In a large open area try throwing objects of different sizes and weights

as high as you can. What limits the heights you can reach? (The thrust or propellant force of your wrist and arm. You can increase the thrust by using simple machines, such as a slingshot or bow.) Can you measure the energy used? (Not easily, but you can measure how high the object can go.) How much higher can a simple rocket go? (It depends on what you use to propel the rocket. The more upward thrust you provide, the higher the rocket will go.)

10. Go to a store in a shopping mall. See who can first identify 10 examples of gravitational pull that would have 'funny' effects if gravity suddenly stopped working. For example, water in fountains, clothing on racks, people on escalators, and hanging signs.

Field Trips

1. Arrange to go on a field trip to a gravity factory such as an amusement park or science center. Make notes about the different effects of gravity you see there (climbing, falling, etc.) How much energy is needed to overcome the effects of gravity? Why is it fun to overcome gravity's pull? To feel its effects?

2. Visit a construction site to see how various workers overcome the forces of gravity when doing their jobs. Note the tools and machinery they use on the job to counter the forces of gravitational pull, such as cranes, lifts, elevators and hoists.

3. Visit a construction or oil drilling site to see how engines are used on big pieces of equipment (hoists, cranes, power ladders) to overcome the forces of gravity.

4. Visit a fire station. Ask the firefighters how pumps, ladders, jacks and lifts are used to overcome the force of gravity in fighting a fire or rescuing a person trapped on an upper level.

5. Take a trip to an airport to see how engines are used on different aircraft to counter gravitational pull. Find out how aircraft slow down the effects of gravity when landing without parachutes.

6. Visit a health spa or fitness center. Have an instructor explain how various equipment is used in body toning. How are the forces of gravity overcome in working out on the equipment?

Basic Information on Fibers and Textiles

Fibers, the individual strands sometimes referred to as filaments and/or staples, are the substances from which yarns and threads are made. Fibers are either natural or man-made. Natural fibers are classified as *cellulosic,* which includes cotton, flax, hemp, jute and ramie; and *protein* which includes silk, wool and specialty hair. Man-made or those fibers derived from a manufacturing process and not provided by nature, are grouped into 19 classifications. Examples of man-made fibers include acrylic, aramid, modacrylic, nylon, olefin, polyester, saran and vinyon. Substances man-made fibers are manufactured from include coal, gas, water, glass, metal, synthetic polymers, cellulose, rubber, polyurethane, vinyl chloride and other substances.

Each fiber has built-in characteristics that influence the properties of the textile product made from it. For example, cotton fibers or staples may be short or long. A stronger, smoother fabric results when longer fibers are used. Man-made fibers and silk may be cut into fibers of selected lengths before they are processed into yarns.

Frequently fibers are mixed before being made into yarns. Cotton fabric can be made stronger by adding regulated amounts of polyester. Stretch and recovery can be gained by adding spandex, rubber, or by the construction method used. Special effects can be achieved by adding metallic, luster yarns or other additives during the weaving process.

Fibers are made into textiles by basic methods: (1) *weaving*, which is interlacing lengthwise and crosswise yarns and is done on a loom; (2) *knitting,* which involves interlocking a series of loops of one or more yarns; and (3) *bonding,* which is adhering fibers together with heat, adhesive chemicals or mechanical methods.

Most fabric is not aesthetically attractive at this stage of development and is called *greige* goods. However, after a series of inspections, finishing operations and color applications, the fabric is ready to be used.

This is a bird's-eye view of the many steps involved in the development of textiles and textile products. The industry is a major force in the national and international economy. Approximately three million people in the United States are employed in the production and sale of textile fibers and products. These jobs are in the manufacture of fiber, textiles and textile products and do not include the producers who grow cotton and flax, raise sheep for wool, or provide petroleum products for man-made fibers.

Some part of the industry takes place in most states and the territories. The industry generated $45 billion in GNP in 1983 compared to $40 billion generated by the auto industry and $26 billion by the petroleum refining industry.

A mention of the textile industry frequently awakes a correlation with apparel only. A review of the many uses for textiles in industry alone proves this assumption to be false. Geotextiles, fabrics designed for use in geotextile engineering, is an excellent example. Current uses include drains under pavement; bank protection; linings for reservoirs, ponds and sewage lagoons; erosion control; forms for concrete; railroad and highway beds; rut prevention; retaining structures; and sea blankets. Other uses for industrial fibers include rockets; cables ten times stronger than steel and fine enough for sophisticated communication transmission; boat hulls and airplane shells; defense; artificial arteries and sight cloth.

In fact, it is difficult to think of a moment during your lifetime that is not touched in some way by textiles or textile products. Consumers need to analyze what their needs are and what product is effective for meeting those needs. Do you need protection from the elements such as temperature, water, fire or abrasion? Are you looking for identity such as a business suit, a fireman hat, a doctor's coat or a ski jacket? Perhaps you need protection from pesticides, sports injuries or contamination.

Needs on Earth are similar in many ways to those in space. The focus inside the Space Shuttle is on comfort, fit and usability. The astronauts inside the Shuttle live in an atmosphere similar to indoor life on Earth. Needs outside the Shuttle are more specific and life threatening. These include protection from temperatures ranging from 250°F to -250°F; atmospheric conditions, due to a lack of oxygen that affects breathing; an absence of pressure, needed to keep the body from exploding; and protection from meteoroids.

Continual developments of new treatments, blends and uses for fibers and textile products come from research efforts and from need. These developments result in a wide range of choices and careers available to consumers; and a need for understanding the complexity and importance of fiber to man in space and on Earth.

The goals of this lesson are to:

- Inform youngsters about fibers and textiles, their origins and characteristics.
- Demonstrate how fibers are made into textiles and textile products, and the purposes for which they are best suited.
- Learn what fiber and textile products are used in space; the purposes for which they are used; and compare the ways fibers and textile products are used on Earth and in space.
- Develop and promote the use of consumer skills including selection, purchase and care of fiber and textile products.
- Create an awareness of the diversified and constant use of textiles and textile products in industrial and home use; their impact on the economy, world trade, and scientific development; and their contribution to the quality of life for man.
- Explore vast career opportunities available in the textile industry.

Relationships to Other 4-H Programs

Piggyback Projects

- *Career exploration*: the wide range of careers associated with the clothing and textile industry.
- *Clothing and textile programs*: how the clothing and textile industry affects the national economy and world trade; how fibers and textiles affect our quality of life.
- *Computer education*: how computers are used in a variety of settings to increase productivity, make comparative selections, and maintain inventories and budgets.
- *Consumer education*: how to get the best buy for your dollars; how and when to shop; how to make decisions.
- *International education*: how many countries rely on fiber and textile industries to meet their economic needs.
- *Safety education*: how clothing protects the body from various hazards and environmental conditions.

Discussion Questions

1. **What is a major difference between man-made and natural fibers?**

   Man-made fibers are manufactured; natural fibers come from plants or animals.

2. **What are blends?**

   Blends are mixtures of fibers, for example, 65% cotton and 35% polyester.

3. **How are man-made fibers made?**

   These fibers are made by forcing a liquid solution through a spinnerette and allowing the resulting elements to harden.

4. **What are two major advantages made possible by man-made fibers?**

   They meet new needs and lower production costs.

5. **Name three man-made fibers.**

   Acrylic, polyester and aramid.

6. **Where do natural fibers come from?**

   Plants, animals and minerals.

7. **How have textile and fiber uses changed in the last 20 years?**

   There has been a tremendous increase in the use of man-made fibers. Man-made fibers have taken on the properties of natural ones.

   How will they continue to change?

   There continues to be ongoing developments of new treatments and blends and new areas of application and use.

8. **What do you need to know about your size and shape in order to make good clothing and fabric selections?**

   Know your needs under different environmental and work conditions and how various fabrics can help meet those needs.

9. **What are some important factors to consider in selecting clothing?**

   Purpose for which it will be worn, durability, quality of workmanship, fit, style, cost, need and comfort.

10. **What do you need to know about caring for and repairing fabrics and clothing?**

    Know methods of cleaning, such as washing and dry cleaning, and how to mend.

11. **What role should appearance play in selecting clothing?**

    Select garments that flatter your figure. Do not forget other factors such as cost, durability and comfort.

12. **Why is testing of fibers and fabrics important?**

    Testing helps analyze strength and durability, and helps match fabrics' characteristics with specific needs.

13. **Who pays for fiber and textile research?**

    Ultimately the consumer; but the consumer benefits from better matches of fabrics and needs.

14. **What is the role of the United States in the world of fibers?**

    For decades the United States has played a major role in the production of fibers, fabrics and clothing. Countries with less expensive labor are producing at ever-increasing rates, particularly in the clothing and apparel fields; thus more clothing is being imported.

15. Name six countries you find represented on the labels of imported clothing.

Taiwan, Korea, China, Poland, England and France. What are the pros and cons of importing large quantities of clothing from foreign countries? Importing large quantities of clothing increases variety in the American market place. Some imports are very high in quality while others are made with low-cost labor and sold at an initial low cost. However, these items are many times inferior in quality causing repeat buying. The low cost sometimes drives American competitors out of business, thereby costing American workers their jobs.

16. What fiber and fabric problems have you recently had?

Consider selection, care, construction, wear and durability.

17. Name six kinds of workers other than farmers and weavers who are involved in the fiber and textile industry.

Truckers, chemists, salesmen, models, engineers and researchers.

18. Why are some fabrics bonded?

Bonding adds special characteristics to the fabric, such as stabilization. It also reduces the number of steps needed in construction of articles, such as interfacing.

19. Why do you wear the fabrics you do under these environmental conditions?

Rain–To keep your body and other clothing dry.

Cold–To keep body heat in and cold out.

Heat–To cool; to allow body heat to escape; to shield the skin from the sun.

Wind–To shield the body from cold wind or wind burn.

20. How does the extravehicular space suit protect the body?

It protects against heat, cold, bodily explosion from lack of air pressure, and speeding micrometeorites. Why is it needed? It allows astronauts to work in space outside of the Shuttle.

21. How might 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.

22. What are the differences in clothing needs inside and outside the Space Shuttle?

Inside the Shuttle, emphasis is placed on comfort, convenience, appearance and fit. Outside the Shuttle, emphasis is placed on temperature, protection, durability and puncture-proof qualities.

23. Name some sports which require special shoes and/or boots.

Hockey, football, baseball, soccer, roller skating and figure skating.

24. In what sports are gloves used? Why?

Gloves are used in hockey, baseball and boxing to protect the hands.

Individual & Group Activities

1. Identify jobs which require protective clothing, such as toxic waste removal, diving, sports and firefighting.
2. Identify clothing that is bonded, such as jackets, and the purpose of the bonding. Examine the bonding used in rainwear.
3. Make a list of places where different types of fibers are used in the home, car and school. Identify the fibers by type. For example, man-made or natural.
4. List the clothing needs of an astronaut, sports star or explorer.
5. Explain how different types of clothing worn for exercising are important to the person. Consider shoes, shorts, warm-up and cool-down garments, etc.
6. Unravel fabric swatches to identify fabric structures.
7. Demonstrate insulation factors, using various pieces of fabric, a thermometer and a lamp.
   - Place a lamp in the center of a table. Do not turn it on. Lay a thermometer on one end of the table and record the

room temperature. Turn on the lamp and measure the temperature change in 5- 10-minute intervals.

Record the change in temperature.

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. Next, try two layers, then multiple layers. Try different fabrics on the top layer, such as aluminized mylar, and so on. How do several thin layers of a given fabric compare in insulation characteristics to one single layer? Try different fabrics.

8. Conduct a fabric scavenger hunt. Give teams specific assignments to bring back examples of selected fabrics within a set time period. Make the assignments as challenging as possible. For instance, have one group search for blends in men's clothing.
9. Play a matching game of fabrics and uses. Have youth collect fabric swatches. Have them show and tell what the samples might best be used for.
10. Play blindman's bluff to identify different fabrics by touch. In sequence, have each individual blindfolded. While the youngster is blindfolded, hand different fabric samples to him for identification. Keep score to see who can best identify the fabrics by touch.
11. Have youngsters develop crossword puzzles that use fabric names and related words. Let them exchange their puzzles and see who completes his first. Were the puzzles workable? Youngsters can be very creative.

Field Trips

1. Take a shopping trip to a fabric store or department store to see how many different fabrics are available. Compare the fabrics that you find. Consider color, texture and design. What can some of the fabrics be used for?
2. Take field trips to visit firefighters, policemen, medical professions or a military installation. Explore how different professions use fibers. For instance:

   Medical—paper disposables, arteries, sight cloth, bandages.

   Firefighters—heat/flame resistance.

   Policemen—protection from weapons and bullets.

   Military—detection, weather, dress.
3. Visit a retail sportswear store to examine how different sports clothes or shoes meet different needs.
4. Visit a local farm to see cotton or wool production. you may get to see sheep being sheared.
5. Visit a textile mill or weaver's guild to see spinning and weaving. Some farms or craft classes have these demonstrations.
6. Visit a tailor, seamstress or ready-to-wear manufacturer to observe clothing being constructed.
7. Visit a Natural History Museum. Compare clothing worn in different cultures, climates and time periods.

Basic Information on Food and Nutrition

Nutritious food, exercise and rest are important in keeping healthy on Earth and in space. Just as the Shuttle burns propellant (fuel) to lift off, the body burns food energy (fuel) to go and grow. Food contributes nutrients which bodies need for good health, growth and energy. The key nutrients are proteins, carbohydrates, fats, vitamins, minerals and water. The first three (proteins, carbohydrates and fats) provide energy which is measured in calories.

Astronauts use a lot of energy working in a weightless environment in Shuttle orbit. You also use energy. When just sitting around you burn about 100 calories an hour. When you do moderate activity, such as walking fast, you use about 200-250 calories an hour. When you exercise vigorously, such as playing tennis, dancing or running, you use 350+ calories per hour. The more active you are, the more calories you burn. And, the less active you are, the fewer calories you need.

One aspect of keeping physically fit is regulating the intake of calories to guarantee you don't have more than you need. To lose weight, you can reduce the calories you eat *and* burn off excess calories to lose more weight. To gain weight, you can increase your caloric intake.

Some foods provide more nutrients for the same amount of calories than others. A doughnut, for example, has the same amount of calories as three slices of

bread. But the bread is richer in vitamins and minerals.

Everyone requires all the key nutrients. As growing youngsters, youth need to be very concerned about getting the nutrients needed for energy to build strong bodies and to help them go and grow. Many foods have information on their labels which tells the number of calories and the amount of protein, fat and carbohydrates in each serving. Comparing labels to buy the most nutritious food is one step to good nutrition.

Knowledge about nutrients helps us to make wise food decisions. Good sources of protein—to build and repair tissue and muscles—are meat, milk, beans and nuts. Good sources of vitamin A—to promote healthy eyes and skin and also help in resisting infections—are fruits and vegetables. Fruits and vegetables also are good sources of vitamin C—it strengthens blood vessels, keeps teeth and gums healthy and speeds healing.

Vitamin D-fortified-milk and fish are good sources of vitamin D which helps build strong bones and helps with natural growth. Thiamine helps develop a healthy nervous system, and good appetite and aids in digestion. The best sources of thiamine are meats, grains, breads and cereals.

Two especially important minerals for youth are calcium and iron. Milk and cheese provide calcium for strong bones and teeth. Meats, beans, enriched and whole grain bread and cereals provide iron for healthy blood.

Most foods contain a number of nutrients in varying amounts, yet there is no "perfect" food which contains all the nutrients in the "right" proportion. Therefore, it is important to eat a variety of foods and maintain a balanced diet.

In space, astronauts eat basically the same nutritious diets they'd eat on Earth, but because of the extra effort needed in the Shuttle, they simply eat more. Just like youngsters on Earth—for instance, young athletes—they eat more when they exert extra effort.

Astronauts exercise more carefully in space than on Earth. And the dietitians who plan their meals take precautions to assure them all the nutrients and calories they need to remain healthy during space flight.

However, foods are processed and packaged differently for space flight. The crew compartment on the Shuttle is small and there's little room for food storage. Foods in grocery stores are too bulky and heavy for space flight, so NASA processes the food before it is put into the Shuttle. Although food can be cooked in space the Shuttle doesn't yet have any refrigeration. But it does have water to replace the water that's removed during processing.

Several processing methods can be used: *Freeze-drying*—removing ice by vaporizing it, a method often used on vegetables such as corn. Or it can be simply *dried*—dehydration—as with soup mixes, cereals and meats. *Thermostabilization*—cooks and then seals foods, such as tuna fish, fruits, puddings and applesauce, in aluminum cans or flexible packages. The *Intermediate moisture process*—for drying foods to certain moisture content such as drying grapes into raisins and drying other fruits. *Irradiation*—preserves breads and meat so they don't need refrigeration. Some foods, such as crackers, nuts and gum go aboard just as they are.

The Space Shuttle has a special food preparation area where astronauts prepare meals for eating, mostly by adding water (rehydration) and heating. Crew members can enjoy eating anywhere they want to and in just about any position—sitting, squatting, floating or hanging. However, they usually attach themselves to an anchor, such as a chair, the ceiling, a wall or a corner of the Shuttle. Specialized pouches and containers are used to keep food from floating freely in weightlessness.

The Shuttle program has taught many things about how to process, package and store lightweight, nutritious foods for long voyages. But the principles of good nutrition remain the same—for youngsters and astronauts—on Earth or in space.

The goals of this lesson are to:

- Teach youngsters the fundamental concepts of the relationships between food, nutrition and health.
- Help youth understand the importance of regular exercise.
- Impress upon youth the need for

certain food nutrients for proper growth and development.

- Show similarities in the relationships between good food and nutrition requirements on Earth and in space.
- Identify various methods of food processing and show how they affect the foods we eat here on Earth and in space travel.
- Food and nutrition programs develop skills in food selection and preparation that promote good health.

Relationships to Other 4-H Programs

Piggyback Projects

The food and nutrition segment of Blue Sky relates to several other 4-H projects. Blue Sky can be used to enrich or enhance learning experiences for these programs:

- *Agriculture*: Explore where to grow crops on Earth's surface and suitable environments for growing crops.
- *Career exploration*: the variety of careers in the food industry.
- *Computer science*: discover the many processes of storing, analyzing and retrieving data; how to make comparative selections; and maintaining food inventories and budgets.
- *Consumer and food economics programs*: how to choose the most nutritious foods for your needs and dollars; how to go about making decisions.
- *Food preservation and safety*: how foods are processed, packaged, handled and stored.
- *Health & fitness fairs and camps*: study the elements and importance of good nutrition; sources of food nutrients; functions of nutrients; the relationship between exercise, food and fitness; and food preparation.
- *International programs*: how nutritional requirements are being met around the world in different cultures; how different diets across the world provide nutrition for people; shows cross-cultural differences in eating patterns, styles, diets and food choices.
- *Plant science and gardening*: how gravity affects plant growth; some new techniques being used to grow foods.

Discussion Questions

1. What are the major nutrients found in foods?

The major nutrients found in foods are proteins, carbohydrates, fats, vitamins, minerals and water.

2. Which nutrients give us energy?

Protein, carbohydrates and fats provide us energy which is measured in calories.

3. Why do we need calories from food?

Our bodies require energy for maintenance, functions and growth.

4. What nutrients are found in the following foods?

Whole grain or enriched cereals
carbohydrate, thiamine and iron

Candy and carbonated beverages
Sugar (a carbohydrate)

5. What nutrients does milk contain?

Protein, calcium, riboflavin, fat and lactose.

6. How many calories an hour do you burn in various activities?

Sleeping—80; *studying*—150; *walking*—200-250; *working hard*—350.

7. How many calories do you need in a normal day?

About 2,500 (depends on size, sex, age and amount of exercise.)

8. How do you know the amount of calories you're getting?

Use a calorie counter and information on food labels to run a check.

9. What key nutrients help you develop the following healthy body characteristics?

Strong bones and teeth ..... calcium, vitamin D

Growing tissues and muscles ..... protein

Blood supply and energy flow ..... iron

Healthy teeth and gums ..... vitamin C

Nervous and digestive systems ..... thiamine

Good eyes and skin ..... vitamin A

10. What useful information does the nutrition panel on food labels provide?

The nutrition information panel gives serving size, servings per container, the numbers of calories and the weight in grams of protein, carbohydrate and fat per serving. Every nutrition information panel gives the percentage of the U.S. Recommended Daily Allowance (U.S. RDA) for protein, five vitamins and two minerals. Percentage of the U.S. RDA for an additional 12 vitamins and minerals may be listed.

11. Describe how each of these methods of *food processing* works.

Thermostabilization–preserving food with heat and sealing the container, as in canning tuna fish, fruits, puddings, applesauce.

Dehydration–removing water from food, such as drying fruit.

Freeze-drying–removing ice from frozen food by vaporization, a method often used on vegetables.

Drying–same as dehydration, as with soup mixes, cereals and meats.

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

Intermediate moisture process–for drying foods to contain certain amount of moisture such as drying grapes into raisins and drying other fruits.

12. What are some of the factors you need to consider when you make 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 provides?

Nutritional value–Does it provide significant amounts of more than one nutrient?

Balanced diet–How does it fit into a day's meal plan?

Ease of preservation and use–Do you know how to prepare it or can you learn how?

Ease of preparation–Do you know how to prepare it or can you learn how?

Quantity needed–How much will you need?

13. What factors are considered in the pricing of food?

Growing the food–Costs of land, farming, harvesting.

Advertising–Costs of promoting and marketing products.

Processing–Is the method for processing it complex and costly?

Delivery/transportation–Is the food shipped long distances? Does it have to be refrigerated?

Availability and season–How common is the food in your area? Can it be grown locally or does it have to be shipped in? Is the food in season?

14. Think of examples of each of the following types of newer foods:

Powdered foods and beverages–citrus drinks

Compressed food–food and cracker cubes

New food packaging–retort pouches, aseptic packages, new lightweight containers

Food coating to eliminate crumbs–cookies, snacks

Irradiated foods–fruits and vegetables, meats and spices

15. What's the relationship between exercise and nutrition?

Exercise builds strong and healthy bodies. It also helps the body use nutrients efficiently and effectively.

16. Think about a typical day's diet. How do you make certain you're getting a balanced diet?

Use the daily food guide as a standard. Run a check every once in a while to see if you're eating a variety of foods from the various food groups in the proper amounts or serving sizes.

17. Why do astronauts eat the same balanced diets that you eat on Earth?

Astronauts are human beings and physiological needs for energy and adequate nutrition while in space as they do on Earth.

18. Why do youngsters have to be as concerned about balanced diets as astronauts do?

In addition to maintenance of bodily health and functions, youngsters must provide for rapid body growth.

19. What is eating in space like?

The process of eating is somewhat more difficult because of weightlessness or near-zero gravity. Foods must be packaged in special containers and fastened down to keep them from floating in space. The astronauts can eat comfortably while sitting down, lying down, floating or in most any position due to the weightless environment.

20. What two methods do astronauts use most in food preparation in space?

Rehydration and heating.

21. What challenges do a lack of refrigeration present to the Space Shuttle astronauts?

Many foods we are used to eating fresh from the refrigerator or from the freezer must be processed and prepared in different forms to provide balanced diets.

22. Why is food research important?

Food research helps assure an adequate long-term supply of food and helps us learn more about what nutrients are available and needed.

23. How will food research play a role in the ability to staff space stations for long periods in the future?

New ways of growing, processing and packaging foods are critical to how long man can stay out in space. The more abundant the food supply, the longer man can survive in space. Current research suggests that it will be necessary and possible to grow animals and insects in space to provide food.

24. How much do you think foods will change in the future? Will most of the changes be in new methods of processing or do you think there will be very different new food products? Explain why.

In the past, foods have changed rather slowly, although more varieties of food and food products have become more available due to better processing, preservation and transportation methods. However, when the current biotechnology development undergoes a major breakthrough, we may see many more new foods and new food products in the future.

25. 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.

Individual & Group Activities

1. Compare three different canned vegetables for their nutritional value using nutrition label. What did you find from your comparison? List the price of each item. Does the cost seem to relate to nutritional value? Try this with three other food types. What did you discover?
2. Keep a record of the foods you eat for two days. Using a calorie counter and nutrition labeling information, calculate your calorie and nutrient intake for two days. Are you surprised at what you find? Is the surprise a good or bad one? What can you do about what you've discovered?

   Option. Use a computer program to calculate your calorie and nutrient intakes.
3. Compare three items of fresh food and their dried counterparts. What did you learn about this method of food processing, considering weight, water content, taste and preservation?
4. Eat several of the same foods processed in different ways. Describe why one is more appealing than another. What did you learn about foods from this comparison?
5. List some foods that give the most nutrients for the lowest price.
6. Imagine that you have $7.00 to spend on a meal. Write a story explaining how you would get a balanced meal for your money.
7. Separate the foods in your family's pantry according to the food processing methods used in preserving them. Which method is most often used? Why? (This can also be done as

a group activity by having members bring in food samples to show-and-tell.)

8. Get involved in a rhythmical exercise program. If you have not been active before starting the program, does your appetite improve as a result of the exercise? What other changes do you see in yourself as a result of the exercise program? Explain.
9. Play a game of word scramble using only food and food product terms. Use only terms such as meat, bread, boil, eggs, and so on.
10. Try eating a variety of foods while blindfolded to see if you can identify them by taste alone. Guess how each is processed.
11. Tell make-believe stories about the ideal foods and meals to be eaten in space and on Earth.

Field Trips

1. Visit a grocery store. Look for foods that have nutrition labeling. Ask the youth these questions.
   A. Which foods have labels? (Mostly packaged and processed foods.) Which ones don't (Fresh foods.) Why? (Fresh foods are difficult to label because of unspecified amounts of food and because there is no package to affix a label to.)
   B. Is the information on the label sufficient? Is it easily understood? (Sometimes, information varies slightly from label to label. Compare the labels you're looking at.)
   C. Do most alcoholic beverages and soft drinks have nutritional labeling? Why? Why not? (No, because non-essential foods are not required to carry labeling.)

   Note: Regulations for nutrition labeling are changing. More foods, depending on the method of processing or its nutrition claims, will be required to carry nutrition labels in the near future.
2. Go to a school gymnasium. Ask a physical education teacher how the equipment is designed to help develop good exercise habits. Ask what's the relationship between these habits and good nutrition? (Exercise strengthens the body and helps the body use nutrients efficiently and effectively. It also helps maintain a healthy body.)
3. Arrange to tour a nearby food processing facility or bottling plant. Learn the steps that are used in the processing of foods or drinks.
4. Visit a restaurant kitchen, school cafeteria or a community food service facility, such as Meals on Wheels. Have the food service manager or dietitian explain the relationship between planning and providing well-balanced meals. What guidelines are followed? Are they written? How do they take the needs of the people being served into consideration?

What are the differences between the Recommended Dietary Allowances (RDA) and the U.S. Recommended Dietary Allowances (U.S. RDA)?

The RDA's are amounts of 15 vitamins and minerals plus protein and calories estimated to be needed for both sexes throughout the life cycle. The allowances will maintain good nutrition in essentially all healthy persons in the United States under current living conditions. They are designed to afford a margin of safety above average physiological requirements to cover variations among individuals in the population. They were established by the Food & Nutrition Board of the National Academy of Sciences-National Research Council first in 1943 and revised several times since as new research data has become available.

The U.S. RDA's are amounts of protein, 19 vitamins and minerals set by the Food & Drug Administration in 1973 utilizing the NAS/NRC RDA as a base. The RDA table has been condensed to four categories: infants, children under four, adults and children over four years of age, and pregnant or lactating women.

Generally, the highest values on the NAS/NRC RDA table were selected for use within each U.S. RDA category. Considering the margin of safety already built into the NAS/NRC's RDA, the U.S. RDA values are frequently higher than the needs of most people. Individuals may need only ½ to ⅔ of the U.S. RDA for some nutrients. Except for infant foods or special dietary foods, the nutritional information on labels will be expressed for the U.S. RDA values for adults and children over four.

ADDITIONAL SOURCES OF INFORMATION ON BLUE SKY TOPICS

Additional information on Blue Sky topics can be obtained from many sources, such as brochures, magazines, newspaper articles, books, films and audiovisual resources. To get access to this information you might try any of the following locations:

- Visit your local community library. Reference such topics as "outer space," "space shuttle," "fibers," "textiles," "fabrics," "textile industry," "nutrition," "food processing," "food preparation" and other related topics, including "careers." Ask a school librarian for resource information.
- Talk with a local science teacher. (Note: Some junior and senior high schools even have planetariums which your group could possibly visit.)
- Visit a museum or science center; many have libraries and give out fact sheets and brochures. Many also have planetariums.
- For information on clothing and textiles or food and nutrition, contact your local Cooperative Extension Service. A 4-H or Home Economics Agent should be able to assist you.
- For more information on the Space Shuttle, space travel, gravity and forces and related items, contact the Education Officer at the NASA Center that serves your state. See the list which follows:

If you live in AK, AZ, CA, HI, ID, MT, NV, OR, UT, WA or WY contact: NASA Ames Research Center, Moffett Field, CA 94035.

If you live in CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI or VT contact: NASA Goddard Space Flight Center, Greenbelt, MD 20771.

If you live in CO, KS, NE, NM, ND, OK, SD or TX contact: NASA Lyndon B. Johnson Space Center, Houston, TX 77058.

If you live in FL, GA, PR or VI contact: NASA John F. Kennedy Space Center, Kennedy Space Center, FL 32899.

If you live in KY, NC, SC, VA or WV contact: NASA Langley Research Center, Langley Station, Hampton, VA 23365.

If you live in IL, IN, MI, MN, OH or WI contact: NASA Lewis Research Center, 21000 Brookpark Road, Cleveland, OH 44135.

If you live in AL, AR, IA, LA, MS, MO or TN contact: NASA George C. Marshall Space Flight Center, Marshall Space Flight Center, AL 35812.

RECORDS

A project record form is included in the back of the Mission Manual. Each member should be encouraged to complete an individual record. The 4-H project record is important. It helps the participant recall what he has done and it serves as a kind of measuring stick. The recorded information keeps both the member and leader informed of progress being made in the project. It also builds leadership and record-keeping skills and is necessary for some 4-H competitions.

Members should be referred to the record form as you *begin* the project so that they get a feel for the kinds of information they will need to keep throughout the project.

A special reference should be made to the category "Activities I did to share knowledge and skills with others." Youth should be made aware that this section is extremely important to 4-H work, too. It involves community service and sharing ideas with others, two areas often forgotten by this age group. Any number of activities can be included in this section, such as: giving speeches and demonstrations, making posters, writing news stories, photo stories, radio interviews and any kind of volunteer work with community groups or individuals which relates to the Blue Sky project.

4-H: A Successful Partnership

The 4-H program is a distinctive American phenomenon, begun at the turn of the century to supplement the formal education structure.

The federal 4-H partner—4-H, Extension Service, U.S. Department of Agriculture—cooperates with states and counties in planning, implementing and evaluating the 4-H program; provides new program development models; maintains a national 4-H data bank for planning and research; and collects and disseminates documentation on the impact of the 4-H program.

The historic success of the Cooperative Extension Service and 4-H in every state is due, in large part, to the tie to the land-grant university system. State and county Extension staff—all members of the state land-grant university faculty—work with local citizens to develop programs to serve the community.

Professional and paraprofessional county agents and staff also work with over 600,000 adult and teen leaders who serve as 4-H volunteers, assisting with hundreds of 4-H projects, clubs, and special learning groups reaching youth ages 9-19.

4-H reaches youth as members of organized clubs, participants in special interest groups and enrollees in short-term projects; through television, school-related programs, camping and other educational methods.

Private donors support awards and recognition programs at the county, state and national levels. Recognition for participation in "Blue Sky" might appropriately be included in such areas as food-nutrition or clothing. It may be included in achievement, electric energy, leadership (for work with younger children or community groups) or safety. "Blue Sky" activities might supplement the member's record for projects such as agriculture; food, fitness and nutrition; gardening and horticulture; plant and soil science; and photography.

National 4-H Council is a not-for-profit educational organization that uses private resources to support the 4-H program of the Cooperative Extension Service of the state land-grant universities and the U.S. Department of Agriculture.

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