Lockheed Martin Space Day:

Event Organizer

Lockheed Martin Space Day Tool Kit: Helpful Suggestions for Planning an Event and Activities for a Large Group

Lockheed Martin Space Day uses space-related activities to inspire and excite youth about careers in science, math, engineering and technology. Celebrated on the first Friday each May, Space Day is the culmination of a year-round educational program.

Both educators and Space Day event planners look for ideas to help organize or improve their Space Day events. This section provides helpful suggestions on planning events as well as simple hands-on activities for large groups and events.

The activities provided are inexpensive and easy to do. While all the activities can be tied to national educational standards, only limited information is provided here.

Another important source of information is the Space Day website: www.spaceday.org

Helpful Suggestions for Planning a Space Day Event

If you are planning a Space Day event and don't know where to begin, consider these contacts and ideas. These ideas may help you think larger. Perhaps they will even lead you to expand your event beyond your classroom to the entire school, or will spark an idea for how you can work with an organization such as the Girl Scouts or Boy Scouts. And remember, Space Day can be a way to incorporate many educational aspects, including art, writing and history, as well as science, math and technology.

What resources do I have available locally?

You will want to review local resources available in your community that can help you by hosting activities, providing volunteers, or providing materials or services you need, such as meals or printing. Remember, each organization may have a reason to want to be involved with your event, so try to find the win-win for each. For example, a printing company might donate its services in exchange for placing its name printed materials.

Publicizing your event is a good way to bring attention to the effort, and encourages others to participate. Send out news releases and photographs, public service announcements, and even letters to the editors to thank participants.

Here are some organizations and resources you might seek help from when organizing your Space Day:

- Interest groups such as rocketry or astronomy clubs;
- Industry and business leaders, particularly those in fields related to space, science or engineering;
- Local businesses which might be willing to provide volunteers;
- Local restaurants or food and beverage distributors might donate or reduce costs for food or civic organizations might want to bring concession stands, serving as a fund-raiser for their organization;
- Volunteers might come from retiree groups, particularly industry groups – and look for engineering, technology or space-related industries in your area;
- Local firefighters might like to bring a truck and share technological advances required to do their job and the educational backgrounds needed in math and technology;
- Military organizations in your area might be a source for volunteers or they might be willing to sponsor educational activities;
- A local planetarium or observatory, science center, children's museum or Challenger Learning Center might partner with your school or organization to help host an event;
- Local colleges or universities are a source for speakers, activity hosts or volunteers;
- Local high school students could host activities for elementary or middle school students. Math or science magnet high schools are an especially good resource;
- Similarly, older members of an organization such as Boy Scouts or Girl Scouts can mentor or provide hands-on activities to younger members. Helping them earn badges can be a part of the activities;

- Encourage community leaders to get involved: secure and present mayoral proclamations to the school or certificates to essay contest winners; or read space-related books to younger children;
- Investigate which of these organizations might have speakers available;
- Consider gifts or prizes for participating students and seek sponsors to help with their purchase (an outside vendor of Space Day products is available on spaceday.org).

Resources for speakers, grants, and other information resources include:

- JPL Solar System Ambassadors (http://www2.jpl.nasa.gov/ambassador/directory.htm)
- Your State's Space Grant Consortium (search at: http://calspace.ucsd.edu/spacegrant/webmap/sg_homepages.html)
- AIAA (American Institute of Aeronautics and Astronautics) Educator Associate (membership is free, grants up to $200/year; go to www.aiaa.org)
- Civil Air Patrol (CAP)'s Aerospace Education Membership (has a membership fee and also provides educator grants; go to www.cap.org)
- National Engineer's Week (http://www.eweek.org/site/Teachers/index.shtml)
- National INSTEP program (http://instep.cet.edu/main.html)
- Space Week's SIA Teacher Grant of $500; go to www.spaceweek.org for application
- NASA's Educator Resource Centers (http://www.nasa.gov/audience/foreducators/informal/contacts/ERCN_State_Listing.html)

Whenever possible, seek to include women or minority representatives from each organization and career field, so all children can find inspiration.

Who Else Needs to Know?

Ask yourself this question: "*Who Else Needs to Know?"* Be sure to include: your management; community leaders; emergency services (facility and community); community partners. Benefits can include:

Management or Community Leaders:

- Are a good resource to network you with local opportunities

Emergency Services:

- should know about your event in advance, in case you need their services in a hurry;
- an unassigned ambulance may stay at your event, serving as a medical aid center and as an educational station;
- schedule a fire truck as an educational station showing technology advancements, how human protective equipment is similar to space suits, and how math is applied in the calculations of truck ladder uses.

Space Day Activities for a Large Group or Event

This group of activities is easily expandable to groups larger than a single classroom, such as an entire school. These are also easy to do and inexpensive. Variations on the activities are sometimes made available.

1. **Alka Seltzer Rockets** – an entry-level paper rocket, easy to build cheap to operate, safe and fun for children.

2. **Rocket Using Skateboards** – models rocket behaviors (can be used with Activity 2.8 Balloon Jet Activity).

3. **The Size and Distance of Planets** – investigates the relative size and distance by creating a basic model of our solar system.

4. **Egg Drop** – challenges students to create a package to protect a raw egg when dropped from a height.

5. **Eating in Space** – a variety of activities about food, and eating in space.

6. **Clothing and Working in Space** – students experience the challenges astronauts have with their clothing.

7. **Spud Rover** – students transform potatoes to become robots sent out on a mission.

8. **Hoopster** – students make paper hoops that really fly!

9. **Outrageous Ooze** – students seek to understand “Is it a solid or a liquid?”

10. **Mission Patch Activity** – students identify attributes of mission patches and design, draw, and describe the attributes of an original mission patch of their own design.

11. **Hovercraft** – students build a simple hovercraft from inexpensive, everyday supplies and learn the science behind the design.

12. **Space Pursuits** – students play a space version of *Trivial Pursuits.* **(see separate file)**

13. **U.S. Space Shuttle Glider Kit** – print this model Space Shuttle glider kit, preferably card stock and assemble **(see separate file)**

3.1. Alka Seltzer Rockets

Objective: This is designed to be an entry-level aerospace education lesson. It is a paper rocket that is incredibly easy to build, cheap to operate and fun for children.

Did You Know …
Lockheed Martin manufactures the Space Shuttle's External Tank, which feeds liquid propellant to the orbiter and absorbs most of the 7 million pounds of thrust exerted by the orbiter's three main engines and the two solid rocket boosters. The External Tank is 154 feet tall, which is three feet taller than the Statue of Liberty (not including the statue's stone foundation).

Materials needed:
film canister (type with lid that snaps inside, not with an external lip; Fuji brand is best. Ask
your local photo processor to save them for you or search online to purchase)
4" x 4" piece of paper or use a 5" x 8" index card
markers, crayons, or colored pencils
paper for fins
tape
scissors
cone-drinking cup
Alka-seltzer tablets
water
metric tape measure or meter sticks

Procedure:
1) Cut a sheet of paper to 4" x 4" or use a 5" x 8" index card and decorate. Apply tape to one side and one end.
2) Tape one edge to the open end of the film can about a 1/2" up. This will act as a seal against water damage after repeated launchings.
3) The paper is carefully wrapped around the film can and formed into a tube. The remaining edge with tape is pressed to seal the tube. If using an index card, seal the 8" seam with tape.
4) A common cone-drinking cup is placed on top of the paper tube and marked at the paper's edge. By holding the cone and tube up to a light, you will be able to see the top of the tube inside the cone. If cups are unavailable, form a cone using a circle cut from paper, clipping a line from one edge to the center (the radius).
5) The drinking cup becomes the rocket's nose cone. When cutting the cone cup, leave little tabs. Attach the nose cone, inserting the little tabs inside the rocket body (tube). Tape the cone to the rocket body.
6) Make little fins from the remains of the drinking cup, or from the paper used to cut the body tube. Tape the fins so they are attached to the bottom of the tube next to the opening of the film can. Three fins make it more stable.

7) Add a small amount of water, up to one quarter full. Add a half table of Alka Seltzer and quickly snap on the lid. Place the rocket on the ground, lid down. Stand back and count down while you wait for launch.
8) Provide students Observation Sheet and measure variables in multiple experimental rocket flights.

This activity is best done outdoors. If gusty winds are a problem, place a quarter in the canister to keep the rocket from falling over. Launching near a wall where a metric tape has been hung or where meter sticks have been stacked may make it easier to judge how high the rocket goes. You may want to require students to wear safety glasses during this experiment as a general safety precaution. Everyone should stand away from loaded rockets when they are on the launch pad. It may take 15 to 20 seconds to build up enough pressure to launch, so a loaded rocket should not be approached prematurely. These rockets can shoot 5 meters or more into the air. No sharp objects should be placed on top of the nose cone or elsewhere on the rocket.

Background:
This outstanding activity illustrates Newton's Laws of Motion. The rocket lifts off because it is acted upon by an unbalanced force (First Law). This is the force produced when the lid blows off by the gas formed in the canister. The rocket travels upward with a force that is equal and opposite to the downward force propelling water, gas, and lid (Third Law). The amount of force is directly proportional to the mass of water and gas expelled from the canister and how fast it accelerates (Second Law).

A good resource to visually show the three laws in an easy-to-understand format is NASA's videotape entitled Episode 3: Newton in Space from the "Liftoff to Learning" series. This video and others can be ordered from NASA's CORE catalog and additional teacher resource material can be downloaded from http://core.nasa.gov/

How this relates to a real rocket: In a rocket, an unbalanced force must be exerted for a rocket to lift off from a launch pad or for a spacecraft to change direction or speed (First Law). The amount of thrust (force) produced by a rocket engine will be determined by the gas escaping the rocket (Second Law). The reaction, or motion, of the rocket is equal to and in the opposite direction of the action, or thrust, from the engine (Third Law).

National Standards:
<u>Science Standards:</u>

- Standard A: Science as Inquiry
- Standard B: Physical Science
    - Motions and forces
- Standard E: Science and Technology
    - Abilities of technological design
    - Understandings about science and technology
- Unifying Concepts and Processes
    - Evidence, models, and explanation

Technology Standards:

8. Understanding of the attributes of design
10. Understanding of the role of trouble shooting, research and development, invention and innovation, and experimentation in problem solving.
11. Ability to apply the design process.

Appreciation to activity designers: Art Kimura, Hawaiian aerospace educator, and Gregory Vogt, NASA educational specialist.

Alka Seltzer Rocket Observation Sheet

Name ______________________________________ Date ___________________

1) Describe what happens to make the rocket take off.

2) After the 1st launch, what results did you observe?

3) What would you change about your rocket to get greater height?

4) Try one of your changes and record the results.

5) Tell how this model relates to a real rocket.

6) Discuss Newton's Laws of Motion in relation to your rocket.

7) Experiment with different shapes attached to your power source to see if another design would work better.

8) Experiment with the proportion of Alka Seltzer to water in achieving maximum height. (Test only one variable at a time).

Experiment	**Variable #1 (Amount of Alka Seltzer)**	**Variable #2 (Amount of water)**	**Height of rocket**
1	1 / 4 tablet	_____ ml	
2	1 / 2 tablet	_____ ml	
3	3 / 4 tablet	_____ ml	
4	1 tablet	_____ ml	

Figure percentage of best combination.

9) (EXTRA: Try building a rocket powered by two, three, or more rockets, take into consideration the results of the initial tests.)

3.2. <u>Rocket: Using Skateboards</u>

Materials:
two skateboards
helmets

Procedures:
1) Two students each sit on one of the two skateboards, while wearing the helmets and face one another.
2) One student pushes against the other student's hands.
(Warning: Consider getting permission slips signed by parents before allowing students to take part in this exercise.)

Before the activity, ask, "What do you suppose will happen to your skateboard when you push against each other?"

Background
The *action* of the student pushing will cause the other skateboard to move. Notice the *reaction* to the pushing student forces his skateboard to move in the opposite direction, which is Newton's Third Law of Motion in action.

When a rocket ignites, the fuel burns and makes huge amounts of hot gases that expand and shoot out the back of the rocket. As the gases thrust downward, the rocket is pushed upward.

3.3. The Size and Distance of Planets

Objective: In these activities, you'll investigate the concepts of relative size and distance by creating models of our solar system.

Activity 1:

Materials needed:

9 pieces of paper
1 roll of toilet paper
1 ruler
1 set of planet printouts (provided) or 1 compass to draw your own
1 pair of scissors
1 calculator
1 long hallway or outdoor space of at least 110 feet (30.5 meters). You can make a partial model if your space is smaller.
1 table with measures of planet radius and distance to the Sun relative to scale

Procedure:

1) Cut out the planet printouts provided, or using the measurements in the table below, use your compass to draw circles on paper. Note that this activity uses two scales: one for the printout and cut-outs (larger) and one for the distances between the planets (smaller). This is due to the enormous distances involved. The planet cut-outs would be too small to use on our scale model.
2) If you choose to draw your own circles, label each planet. Cut the circles out and use them as your planets.
3) Choose a point at one end of a hallway, large room, or outdoor space as the Sun and mark it as your starting point.
4) Without looking at the table, place each planet in order of the distance you think they are from the Sun. As a reference, use 22.4 inches (57 centimeters) for the distance between Earth and the Sun.
5) Using the table, measure the distances by rolling out the toilet paper. Mercury is 1.9 sheets relative to the Sun, Venus 3.6 sheets from the Sun, etc. See how well you did at estimating the distances. Move the planets to their proper distances, and you've built a scale model of the solar system

10 - Measures of the Planets

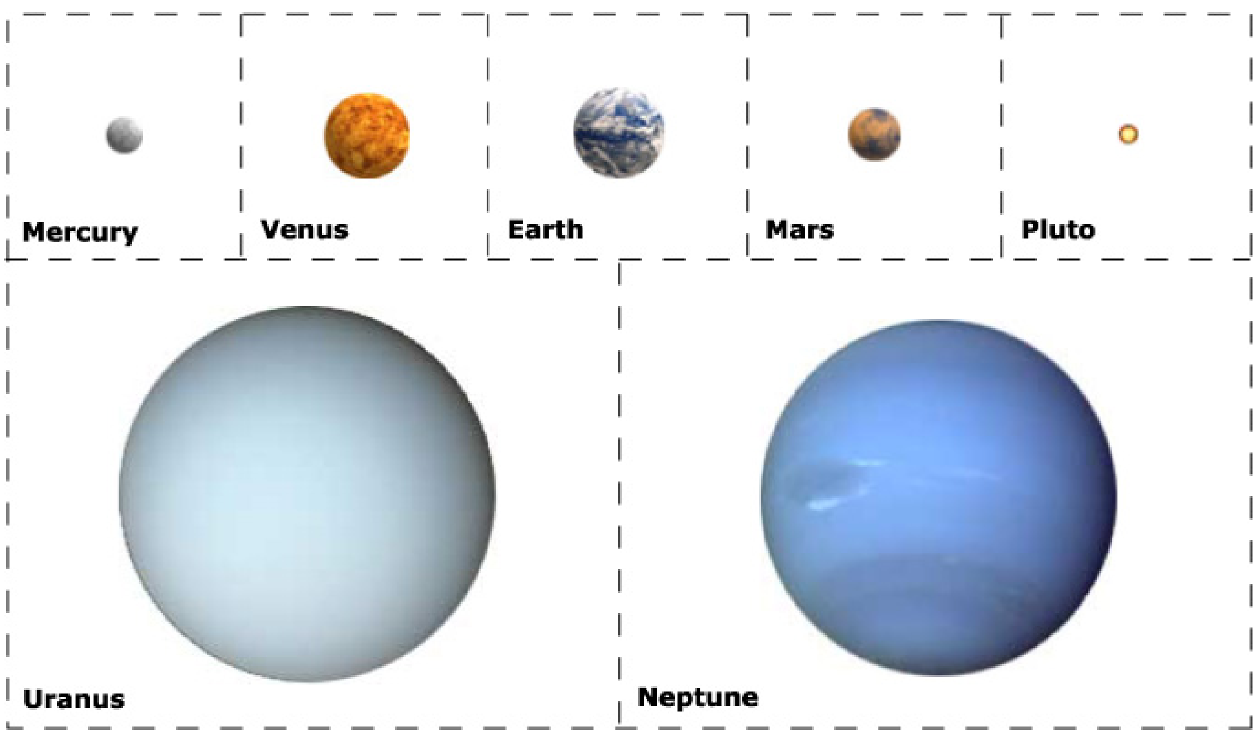
Larger Scale Model						
Planet	**True Diameter** in miles	**Diameter** in inches (50,653 miles/sheet)	**True Distance to the Sun** in miles	**Distance to Sun** in sheets (50,653 miles/sheet)	**Distance to Sun** in inches (50,653 miles/sheet)	**Distance to Sun** in feet (50,653 miles/sheet)
Mercury	3,032	0.267	35,983,610	710	3,197	266
Venus	7,521	0.664	67,232,360	1,327	5,973	498
Earth	7,926	0.699	92,957,100	1,835	8,258	688
Mars	4,222	0.371	141,635,300	2,796	12,583	1,049
Jupiter	88,846	7.658	483,632,000	9,548	42,966	3,580
Saturn	74,898	6.391	888,188,000	17,535	78,906	6,576
Uranus	31,763	2.576	1,783,950,000	35,219	158,486	13,207
Neptune	30,778	2.494	2,798,842,000	55,255	248,648	20,721
Pluto	1413	0.124	3,674,491,000	72,542	326,441	27,203
The Sun's diameter in inches (at this scale) is 76.7 in						

Smaller Scale Model						
Planet	**True Diameter** in miles	**Diameter** in inches (18,709,074 miles/sheet)	**True Distance to the Sun** in miles	**Distance to Sun** in sheets (18,709,074 miles/sheet)	**Distance to Sun** in inches (18,709,074 miles/sheet)	**Distance to Sun** in feet (18,709,074 miles/sheet)
Mercury	3,032	0.00073	35,983,610	1.9	8.7	0.7
Venus	7,521	0.0018	67,232,360	3.6	16.2	1.3
Earth	7,926	0.0019	92,957,100	5.0	22.4	1.9

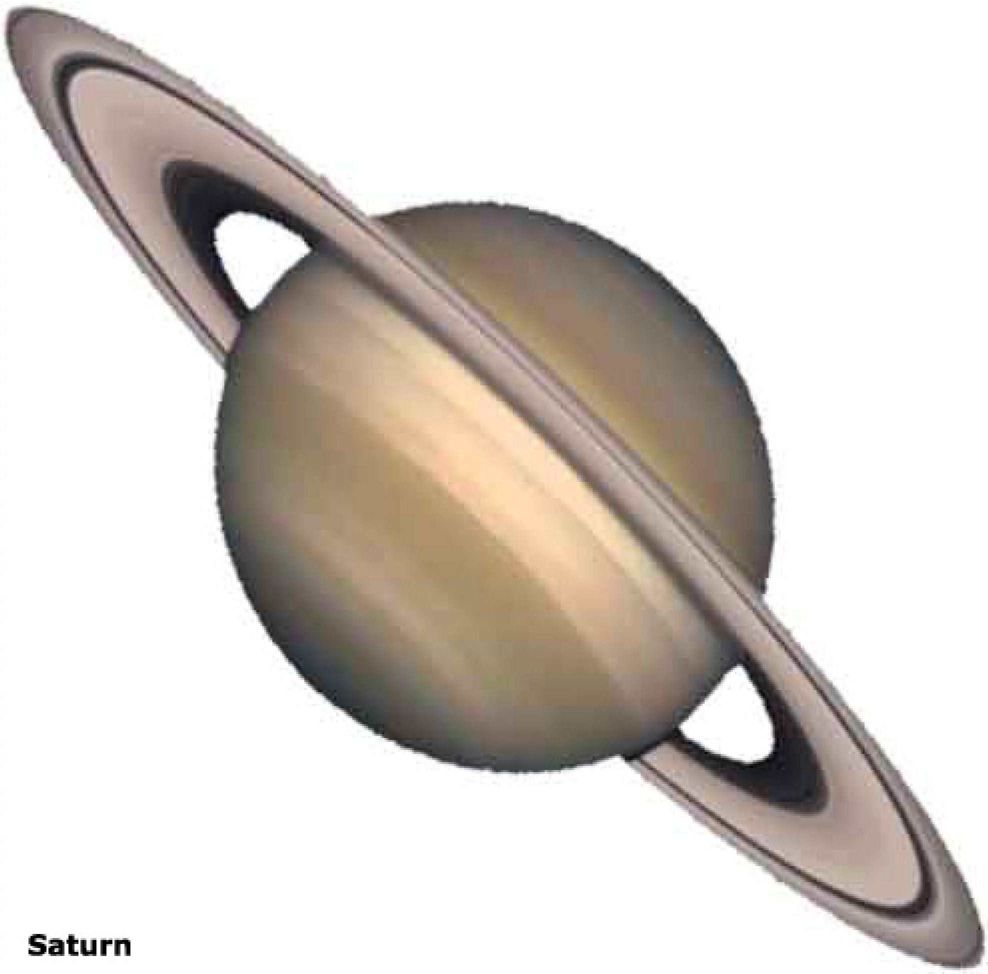
Jupiter	88,846	0.0214	483,632,000	25.9	116.3	9.7
Saturn	74,898	0.018	888,188,000	47.5	213.6	17.8
Uranus	31,763	0.0076	1,783,950,000	95.4	429.1	35.8
Neptune	30,778	0.0074	2,798,842,000	150.0	673.2	56.1
Pluto	1413	0.00034	3,674,491,000	196.4	883.8	73.7
The Sun's diameter in inches (at this scale) is 0.208 in						

Important Note: The order of the planets given here is based on the planets' average distances from the Sun. Because Pluto's orbit is quite elliptical in shape, at times Pluto travels closer to the Sun than Neptune's orbit. This was the case from January 1979 through February 1999, when Neptune was the farthest planet from the Sun.

Planet Printouts:



Jupiter



Saturn

Appreciation to: The Center for Science Education at Space Sciences Laboratory, UC Berkeley, website http://cse.ssl.berkeley.edu/AtHomeAstronomy; and derived from "A Toilet Paper Solar System Scale Model" from Project Pulsar, St. Louis Science Center.

<u>Alternate Activity:</u>

Planet Sizes: Create a visual display that compares the different sizes of the planets. Conduct research to complete a planet comparison chart.

Materials:

Planet comparison chart (following)
Resource books, encyclopedias, Internet
Pencils
Ten objects – basketball, softball, baseball, two golf balls, two Ping Pong balls, marble, small marshmallow, kernel of unpopped corn

Procedure:

1) Divide students into pairs. Reproduce the Planet Comparison Chart for each pair.
2) Review the comparison chart. Discuss the kind of information each column is asking for and where this information can be found.
3) Set a due date for completion of the chart. Compare information. What might account for a variation in answers?
4) Using information from the charts, place the objects listed above to create a visual display of the planets according to their size and relationship to the sun. Start with the basketball (the sun) in the center. (Hint: the sequence will be basketball, marble, Ping Pong ball, Ping Pong ball, marshmallow, softball, baseball, golf ball, golf ball, popcorn.)

Planet Comparison Chart

	Distance from the Sun	Diameter	Number of Satellites	Period of Rotation	Orbital Speed
Earth					
Uranus					
Neptune					
Pluto					
Mars					
Mercury					
Venus					
Saturn					
Jupiter					

3.4 <u>Egg Drop Activity</u>

Objective: This activity challenges students to create a “package” that will protect a raw egg when it’s dropped from a height of 8 feet (or whatever height you decide).

Did You Know …
Lockheed Martin designed and built the aeroshell structure and thermal protection system that protected the Mars Pathfinder on its mission in 1997. The cone-shaped shell shielded the Pathfinder from heat and friction as it traveled 18,000 miles per hour through the Martian atmosphere.

Materials:
You can use many different materials when fashioning a protective cushion. Provide students an assortment of packing materials to choose from. They can include: bubble wrap, foam peanuts, peanut butter, boxes, balloons, and materials to construct with, including tape, string, twist ties, scissors. Students may try to construct a parachute, so fabric or paper are options. *(Warning: be sure no one in the group has a peanut allergy before using peanut butter.)*

Procedure:
Students can work individually or as teams. Ask them to imagine they are a space engineer with the task of developing a lander that will safely get its cargo (the egg) onto a planet’s surface after being launched from an orbiting spacecraft. They may choose from a variety of materials to build the lander. Once constructed, drop the egg packages from an appointed height. An upper floor window or rooftop are options, as long as the location is safe. One helpful hint: spread a plastic tarp over the spot where eggs will land to protect the floor or ground. Students can experiment with different protective cushions. Ask students how would they change of improve for future designs.

Background
On July 4, 1997 the Mars *Pathfinder* lander touched down on the surface of Mars. Parachutes and airbags protected the lander as it dropped to the planet’s surface. The lander bounced at least 15 times without any of the airbags tearing. After the lander gently rolled to a stop, the airbags deflated and the lander opened. From 111 million miles (178.6 million km) away, scientists rolled up the airbags and opened the ramps. Then the small rover, called the *Sojourner*, was sent out to explore the Martian surface and examine rock and soil samples. For 83 days, the instruments on board the lander and on Sojourner sent back valuable information about the Martian soil, atmosphere and weather.

Appreciation to: Civil Air Patrol (www.cap.gov/ssm)

3.5 <u>Eating in Space</u>

Objective: A variety of activities about food and eating in space.

Did You Know …
Lockheed Martin helps feed the astronauts who fly in space. The Corporation supports NASA’s Space Food Systems Laboratory at the Johnson Space Center. Lockheed Martin dietitians ensure that the astronauts' daily menus are nutritious and enjoyable. The company's food scientists develop new space foods. And the Corporation plays a role in packaging the food and loading it onto the Space Shuttle.

Eating in Space

Materials
paper cup
water
straw
bench or two chairs pushed together

Procedure
1) Fill the cup with water, put the straw in it, and place it on the floor at the end of the bench.
2) Have a student lie on their front side on the bench, with their mouth lower than their stomach. Ask them if they can drink the water. Ask, “Do you think you could still eat and drink in a near weightless environment? What do you think would happen if you tried to eat a cracker while standing on your head? Could you do the same trick in space?”

Background
Eating in space is not easy. You can’t pour a drink into a glass, and food won’t stay on a plate. Early astronauts mostly ate freeze-dried foods, stored in tube-shaped plastic bags. When they were ready to eat, they added hot water to one end of the bag. After mixing the food and water together for a few minutes, it was ready to eat. The astronaut would cut off the end of the bag and squeeze the food into his mouth.

Pantry or Supermarket Scavenge

Procedure
Ask students to look in their pantry or refrigerator at home and bring in small items in ready to serve packages, preferably individual portions. Or, ask students to look on the shelves of the supermarket, and bring a list of the foods they can find, challenging them to find the many foods developed for astronauts to eat in space available at their supermarket. One example is a single serving of canned pudding. It does not need refrigeration, sticks to a spoon, requires no preparation, and tastes good.

Menu Planning

Overview
Some guidelines for planning space meals are: if a food needs utensils to eat, it must stick to the fork or spoon; no foods that make crumbs; meals must be nutritionally balanced and high in calcium and potassium; only hot or cold water may be added; and no leftovers are allowed.

Procedure
1) Plan a menu for one day's meals on the Space Shuttle. Each meal should be about 1,000 calories, nutritiously balanced, and as delicious as possible.
2) Use the guidelines above and nutritional information on food packages to help you plan the menus. See food listing for ideas.

Tasting Party

Overview
Eating out of a zip closure baggy is similar to eating from the spoon-bowl packages the astronauts use.

Materials
very warm and cold water
small zip closure plastic bags
powered orange drink or other drinks
instant mashed potato flakes
spoons
straws

Procedure
1) Place single serving portions of drink mix and instant potatoes in small plastic bags.
2) With adult supervision, add the warm water to the potatoes. Mix together for a few moments, then taste.
3) Repeat with the drink mix and cold water.

Food Listing

BASELINE SHUTTLE FOOD AND BEVERAGE LIST

Courtesy of the Lyndon B. Johnson Space Center Flight Crew Support Division

FOODS

ABBREVIATIONS
(B) - Beverage
(FF) - Fresh Food
(IM) - Intermediate Moisture
(I) - Irradiated
(NF) - Natural Form
(R) - Rehydratable
(T) - Thermostabilized

Beef w/BBQ Sauce (T)
Beef, Dried (IM)
Beef Pattie (R)
Beef Steak (I)
Beef Stroganoff w/Noodles (R)

Bread (FF)

Breakfast Roll (FF)

Brownies (NF)
Candy,
- **Coated Chocolates (NF)**
- **Coated Peanuts (NF)**
- **Gum (NF)**
- **Life Savers (NF)**

Cereal,
- **Bran Chex (R)**
- **Cornflakes (R)**
- **Granola (R)**
- **Granola w/Blueberries (R)**
- **Granola w/Raisins (R)**
- **Grits w/Butter (R)**
- **Oatmeal w/Brown Sugar (R)**
- **Oatmeal w/Raisins (R)**
- **Rice Krispies (R)**

Cheddar Cheese Spread (T)

Chicken,
- **Chicken, Grilled (T)**
- **Chicken Salad Spread (T)**
- **Chicken, Sweet 'n Sour (R)**
- **Chicken, Teriyaki (R)**

Cookies,
- **Butter (NF)**
- **Shortbread (NF)**

Crackers, Butter (NF)

Eggs,
- **Scrambled (R)**
- **Mexican Scrambled (R)**
- **Seasoned Scrambled (R)**

Frankfurters (T)

Fruit,
- **Apple, Granny Smith (FF)**
- **Apple, Red Delicious (FF)**
- **Applesauce (T)**
- **Apricots, Dried (IM)**
- **Banana (FF)**
- **Cocktail (T)**
- **Orange (FF)**
- **Peach Ambrosia (R)**
- **Peaches, Diced (T)**
- **Peaches, Dried (IM)**
- **Pears, Diced (T)**
- **Pears, Dried (IM)**
- **Pineapple (T)**
- **Strawberries (R)**
- **Trail Mix (IM)**

Granola Bar (NF)

Ham (T)
Ham Salad Spread (T)

Jelly,
- **Apple (T)**
- **Grape (T)**
- **Turkey Tetrazzini (R)**

Macaroni & Cheese (R)

Noodles and Chicken (R)

Nuts,
- **Almonds (NF)**
- **Cashews (NF)**
- **Macadamia (NF)**
- **Peanuts (NF)**
- **Trail Mix (IM)**
- **Peanut Butter (T)**

Potatoes au Gratin (R)

Puddings,
- **Banana (T)**
- **Butterscotch (T)**
- **Chocolate (T)**
- **Tapioca (T)**
- **Vanilla (T)**

Rice w/Butter (T)
Rice and Chicken (R)
Rice Pilaf (R)

Salmon (T)

Sausage Pattie (R)

Shrimp Cocktail (R)

Soups,
- **Chicken Consomme (B)**
- **Mushroom (R)**
- **Rice & Chicken (R)**

Spaghetti w/Meat Sauce (R)

Tortillas (FF)

Tuna,
- **Tuna (T)**
- **Tuna Salad Spread (T)**

Turkey,
- **Turkey Salad Spread (T)**
- **Turkey, Smoked (I)**

Vegetables,
- **Asparagus (R)**
- **Broccoli au Gratin (R)**
- **Carrot Sticks (FF)**
- **Cauliflower w/Cheese (R)**
- **Celery Sticks (FF)**
- **Green Beans & Broccoli (R)**
- **Green Beans/Mushrooms (R)**
- **Italian (R)**
- **Spinach, Creamed (R)**
- **Tomatoes & Eggplant (T)**

BEVERAGES (B)

ABBREVIATIONS
A/S - Artificial Sweetener
(B) - Rehydratable Beverage
(T) - Thermostabilized

Apple Cider
Cherry Drink w/A/S
Cocoa
Coffee,
- **Black**
- **w/A/S**
- **w/Cream**
- **w/Cream & A/S**
- **w/Cream & Sugar**
- **w/Sugar**

Coffee (Decaffeinated),
- **Black**
- **w/A/S**
- **w/Cream**
- **w/Cream & A/S**
- **w/Cream & Sugar**
- **w/Sugar**

Coffee (Kona),
- **Black**
- **w/A/S**
- **w/Cream**
- **w/Cream & A/S**
- **w/Cream & Sugar**
- **w/Sugar**

Grape Drink
- **Grape Drink w/A/S**

Grapefruit Drink

Instant Breakfast,
Chocolate
Strawberry
Vanilla
Lemonade
Lemonade w/A/S
Lemon-Lime Drink
Orange Drink
Orange Drink w/A/S
Orange-Grapefruit Drink
Orange Juice
Orange-Mango Drink
Orange-Pineapple Drink
Peach-Apricot Drink
Pineapple Drink
Strawberry Drink
Tea,
Plain
w/A/S
w/Cream
w/Lemon
w/Lemon & A/S
w/Lemon & Sugar
w/Sugar
Tropical Punch
Tropical Punch w/A/S

CONDIMENTS

Catsup (T)
Mayonnaise (T)
Mustard (T)
Pepper (Liquid)
Salt (Liquid)
Tabasco Sauce (T)
Taco Sauce (T)

3.6 Clothing and Working in Space

Overview
Protective clothing needed to protect astronauts in space is cumbersome to dress into and work in, and requires practice using. Various activities help students experience the challenges astronauts have with their clothing.

Working in Space
Students practice the challenges of working in space with multiple layers of hand protection.

Materials
light cotton gloves
rubber kitchen gloves
heavy workman’s gloves
gardening gloves
wide-mouth plastic cups
barbecue tongs
paper lunch bags
variety of items such as buttons, coins, paper clips, screws, etc.

Procedure
1) Place the cups on the ground. Spread out the assorted “samples” on a table.
2) Astronaut’s gloves are made of several layers of protective materials. Ask a student to put on the cotton gloves first, then the rubber gloves to simulate the layer called the pressure bladder. Next, put on the plastic gardening gloves for strength, and finally the workman’s gloves for protection.
3) Try to pick up the items from the table and put them in the bag. Then try to use the barbecue tongs to pick up the cups from the ground. Can you stack the cups? Practice and see.

Background
Many of the tasks astronauts perform are carried on inside the spacecraft. Sometimes an astronaut has to go outside into space to perform a particular task, perhaps a routine inspection or repair, or launching or repairing a satellite. When an astronaut leaves the spacecraft, it is called *extravehicular activity,* or EVA.

Astronauts wear protective space suits when they leave the spacecraft. The astronauts who explored the moon wore the first self-contained space suits, carrying out experiments and collecting samples while wearing bulky backpacks containing their life-support equipment. On a satellite recovery mission, astronauts put on jet-propelled backpacks called MMU’s, or *manned maneuvering units*. By firing small thruster jets, the astronauts move through space without attachment to the spacecraft.

Each astronaut has a pair of gloves custom made using laser scans of his or her hands. The finished gloves have rib-like ridges on the finger joints and a complex pattern of diamonds and squares on the palms.

Dressing for Space

Students practice taking instructions, and learn about the layers of clothing used by astronauts and the purpose of each layer.

Materials:

Activity script (provided)
Clothing: tights or long underwear (preferably one piece), pants, boots, long-sleeved T-shirt, knit hat, gloves (heavy gloves like ski gloves if possible), helmet

Procedure

1) Have students stand in an area with plenty of room to move around.
2) Instruct students to put on each layer of clothing as you read aloud. Speak slowly, pausing to give students time to act out each activity. Make sure to allow enough time to allow students to explore each step before continuing.

Script:

Imagine you are an astronaut and have a task to perform outside your spacecraft. Imagine you are in an airlock on the Space Shuttle and it is time to get into your space suit.

1) Begin with your first layer of clothing, which is like a pair of long underwear. Since tubes are running all through this layer, it is not as easy to get into as long underwear. Put your legs in first, one at a time and then wiggle the suit high enough to put your arms into the openings. Fasten up this layer of clothing.
2) The next layer is your space trousers, which are very thick and bulky, and connects to the boots. Wiggle your feet to be sure they are comfortable inside all the layers.
3) The next layer is for your torso, or upper body, so your arms go into this layer of the space suit. You must squat down and reach up into the suit. Pull it down over your head. The undergarment has thumb loops, so be sure they are over your thumbs.
4) Be sure the tubes in your layers to the life support system are connected. Now pull the torso flap down over the trousers.
5) Put on the communications carrier, which is like a hood with a headset. Adjust the headphones so they fit snugly over your ears and test the microphone. Adjust the oxygen flow in the suit with the controls on the front of the suit.
6) Put on the gloves and wiggle your fingers inside the thick gloves. Snap the closures around the wrist and lock the connecting rings by sliding the tab into the locked position.
7) Put on the helmet, making sure it rests on the right spot of the torso, then twist it to lock it onto your space suit.
8) When you are ready, climb out of the hatch in the airlock into the cargo bay of the Shuttle. Attach your lifeline to the safety wire running along the side of the bay.
9) Pretend you are floating in space, protected by your thick space cocoon.

3.7 <u>Spud Rover</u>

Objective: It's time to be creative! Students dress a potato to become a rover or robot sent out on a mission. In teams, students brainstorm various jobs for a robot or rover and plan how to dress their spud and create its environment. They are then judged on originality, elaboration and productivity. Each group receives materials needed for their masterpieces and is encouraged to use as much as possible (even the bag). Creativity and teamwork are important when designing real spacecraft such as rovers.

Materials

set of markers (one per team)
Elmer's glue
pair of scissors (two per team)
large oblong potato (1 per team)
shoe box (one per team)
designer bag:
one sheet 8-1/2" x 11" white construction paper
one small plastic cup
two paper clips
two cotton balls
eight star stickers
small piece of burlap (4" x 6")
12" piece of yarn
sheet of comics from the newspaper
two pipe cleaners
four to six Styrofoam packing peanuts
piece of foil
four toothpicks
miscellaneous items

Procedure

1) Divide students into teams of three or four.
2) Discuss robots and rovers and how they can do jobs human beings cannot do. Think of as many ways they are used today and possibly in the future.
3) Using the items in the designer bag, part of the team works on the spud and designs a robot or a rover to do a particular job.
4) The other part of the team needs to create a home, landscape, arena, or other type of environment for the spud with the shoebox. The box may be used vertically or horizontally and should match the spud's characteristics.
5) As a team, students need to share ideas, plans, and the work itself. They need to use at least part of all the materials in the designer bag, including the bag itself.
6) Explain that the spuds will be judged for originality, elaboration and productivity, which means how well you worked as a team to design the potato.
7) Give only 10 minutes to brainstorm and 10 minutes to construct.
8) Students present their creations to the rest of the group and the judges.

3.8. <u>Hoopster</u>

Objective: Students make paper hoops that really fly!

Materials
scissors
ruler
3x5 inch file cards (or a file folder, or another type of stiff paper)
clear plastic tape
plastic straws (not the kind that bend)

Procedure
1) Cut a file card the long way into three equal strips. If you're using stiff paper, make three strips that are 1 inch wide and 5 inches long.
2) Place a piece of tape on the end of one strip. Curl the paper into a little hoop and tape the ends together.
3) Put the other two strips together so they overlap a little. Tape them together to make one long strip, and put another piece of tape on one end. Curl the strip into a hoop and tape the ends together.
4) Put one end of a straw onto the middle of a strip of tape. Put the big hoop on top of the straw and fold the tape up the sides of the hoop.
5) This part can be a little tricky. Put another strip of tape at the other end of the straw. Press the small hoop very gently onto the tape. Move it around until it lines up with the big hoop, then press the tape down firmly. Your Hoopster should have both hoops lined up, so it looks like a telescope.
6) Now comes the fun! Hold the Hoopster in the middle of the straw, with the little hoop in front. Throw it like a spear. It may take a little practice, but once you get the hang of it, your Hoopster will really fly!
7) If you want to experiment with Hoopsters, here are some other things you can try:

- Put a paper clip at the bottom of the small hoop.
- Make a really long Hoopster with two straws. Cut a little slit at the end of one straw and pinch it so it fits inside the other straw, then tape them together.
- Make a double Hoopster with two little hoops side by side on one end and two big hoops side by side on the other. (You'll need two file cards.)

Appreciation to: www.exploratorium.edu/science_explorer/hoopster.html

3.9 Outrageous Ooze

Objective: Students seek to understand “Is it a solid or a liquid?”

Materials
newspaper
measuring cups
1 cup of dry cornstarch
large bowl or pan
food coloring (if you want)
1/2 cup of water

Procedure
1) Put newspaper down on your counter or tabletop.
2) Put the cornstarch into the bowl. Add a drop or two of food coloring. (Use whatever colors you like.) Add water slowly, mixing the cornstarch and water with your fingers until all the powder is wet.
3) Keep adding water until the ooze feels like a liquid when you’re mixing it slowly. Then try tapping on the surface with your finger or a spoon. When Ooze is just right, it won’t splash – it will feel solid. If your Ooze is too powdery, add a little more water. If it’s too wet, add more cornstarch.
4) Play around with your Ooze!

- Pick up a handful and squeeze it. Stop squeezing and it will drip through your fingers.
- Rest your fingers on the surface of the Ooze. Let them sink down to the bottom of the bowl. Then try to pull them out fast. What happens?
- Take a blob and roll it between your hands to make a ball. Then stop rolling. The Ooze will trickle away between your fingers.
- Put a small plastic toy on the surface. Does it stay there or does it sink?

Background
Ketchup, like Ooze, is a non-Newtonian fluid. Physicists say that the best way to get ketchup to flow is to turn the bottle over and be patient. Smacking the bottom of the bottle actually slows the ketchup down!

Why does Ooze act like that? Ooze is made up of tiny, solid particles of cornstarch suspended in water. Chemists call this type of mixture a *colloid.* As you found out when you experimented with Ooze, this colloid behaves strangely. When you bang on it with a spoon or quickly squeeze a handful of Ooze, it freezes in place, acting like a solid. The harder you push, the thicker the Ooze becomes. But when you open your hand and let your Ooze ooze, it drips like a liquid. Try to stir the Ooze quickly with a finger, and it will resist your movement. Stir it slowly, and it will flow around your finger easily. Smack water with a spoon and it splashes. Smack Ooze with a spoon and it acts like a solid. Most liquids don’t act like that. If you stir a cup of water with your finger, the water moves out of the way easily – and it doesn’t matter whether you stir it quickly or slowly.

Your finger is applying what a physicist would call a *sideways shearing force* to the water. In response, the water *shears*, or moves out of the way. The behavior of Ooze relates to its *viscosity* or resistance to flow. Water's viscosity doesn't change when you apply a shearing force – but the viscosity of your Ooze does.

Back in the 1700s, Isaac Newton identified the properties of an ideal liquid. Water and other liquids that have the properties that Newton identifies are called *Newtonian fluids*. Your Ooze doesn't act like Newton's ideal fluid. It's a *non-Newtonian fluid.*

There are many non-Newtonian fluids around. They don't all behave like your Ooze, but each one is weird in its own way. Ketchup, for example is a non-Newtonian fluid. (The scientific term for this type of non-Newtonian fluid is *thixotropic*. That comes from the Greek words *thixis*, which means "the act of handling" and *trope* meaning "change."

Quicksand is a non-Newtonian fluid that acts more like your Ooze – it gets more viscous when you apply a shearing force. If you ever find yourself sinking in a pool of quicksand (or a vat of cornstarch and water), try swimming toward the shore very slowly. The slower you move, the less the quicksand or cornstarch will resist your movement.

Appreciation to: www.exploratorium.edu/science_explorer/hoopster.html

3.10 <u>Mission Patch Activity</u>

Objective: students identify attributes of mission patches and design, draw, and describe the attributes of an original mission patch of their own design. This interdisciplinary activity introduces students to the science, symbolism, and social science art that underlies mission patch design, enabling them to create similar "mission" patch works of art.

Materials
Several NASA mission patches. Seek especially those with scientific symbols and historical symbols. (Apollo 11, STS — 4, STS — 71). Mission patches are available at NASA Center gift shops and online stores. Teachers can also obtain several samples from their local NASA ERC (these may be in the form of a sticker). And patch images can be downloaded from:
http://www.hq.nasa.gov/office/pao/History/mission_patches.html

Procedure
1. Demonstrate and share 2 or 3 mission patches. Describe the mission and explain symbols on each patch.
2. Divide participants into groups. Give each group a NASA mission patch.
3. Ask the group to observe and describe the patch. (The group can also be given the crew's mission explanation — which can be found online at http://nasa.gov.) Direct the groups to pay close attention to the symbols on the patch.
4. Have each group report to the class their observations — ask them to make inferences about the meaning of the patch.
5. Have each group design their own mission patch, using appropriate symbols, which represent each member.
6. Have each group present their group's mission patch to the class, describing the symbols chosen and the reasons for each choice.

Key Terms:
Symbol, symbolism
Descriptive science, observe, describe, infer
Mission patch
Communication
Elements of art — pattern, line, form, shape, texture
Scientific symbols — Venn Diagram, double helix, infinity, vector

National Standards:
Activity is designed to be interdisciplinary — with references to art, history, mathematical design, and space science.

Appreciation to: NASA's Dryden Flight Research Center's Educational Workshops

3.11. Hovercraft

Objective: students build a simple hovercraft from inexpensive, everyday supplies and learn the science behind the design.

Materials
a toy balloon, a pop-up lid from a water bottle, a hot glue gun, and a used CD.

Procedure
1. The pop-up lid is glued to the CD. Be sure that your glue is applied only to the perimeter of the lid and that you make a good air-tight seal to the CD.
2. Make sure the lid is in the closed position.
3. Install the balloon onto the bottle lid.
4. Inflate the balloon from the opposite side after opening the sliding lid seal (through the balloon).
5. Try sliding the balloon along and you will notice a resistance to movement.
6. Now carefully release the lid sealer and let the air flow through the CD. You will notice the little hovercraft starts to move.
7. Blow the balloon up again and when the pressure is released, flick it with your finger and you will be amazed to see it glide away from you.
8. Variations on this project include a larger balloon and various surface terrain.

Background: A hovercraft is also known as an ACV or "air cushion vehicle." It travels on a layer of compressed air that keeps it just above the surface of the Earth. The compressed air serves as an invisible cushion that eliminates almost all of the friction between the vehicle and the ground. Numerous hovercraft are used around the world for civilian and military purposes.

Extra science information:
A hovercraft works by being propelled forward by the downward thrust of air being propelled backwards through special vents or by propellers mounted on top of the craft. The craft is steered by rudders that direct the back thrust or by propellers that produce a sideways thrust.

A hovercraft is a vehicle supported on a cushion of air supplied by a powered fan mounted on the craft. A hovercraft minimizes friction and drag. The hovercraft was one of the most successful inventions of the 20th century. British engineer, Christopher Cockerell's experiments with coffee cans, kitchen scales, and a hairdryer in the early 50's led to the first manned Hovercraft 'flight' in 1959.

National Science Standards:
Content Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry

Content Standard B: Physical Science
- Position and motion of objects

Content Standard E: Science and Technology
- Abilities of technological design

Unifying Concepts and Processes
- Evidence, models, and explanation

Appreciation to: Civil Air Patrol (www.cap.gov), Activity from "More AEX II"
CD Hovercraft

3.12 <u>**Space Pursuits**</u> – students play a space version of *Trivial Pursuits* **(see separate file)**

3.13 <u>**U.S. Space Shuttle Glider Kit**</u> - print this model Space Shuttle glider kit on card stock and have students assemble **(see separate file)**