

Space Day

This group of activities is easily adaptable for larger groups or smaller groups. You may also choose to set this up as a community fair or event for a service unit. Age levels are listed next to the activity.

Girls need to complete 5 of the activities to complete this step of the GSHPA Backyard Astronomer Program.

Activities

1. **Alka Seltzer Rockets (JCSA)**– an entry-level paper rocket, easy to build, cheap to operate, safe & fun for all.
2. **Rocket Using Skateboards (JCSA)**– models rocket behaviors
4. **Eating in Space (ALL)**– a variety of activities about food, and eating in space.
5. **Tasting Party (ALL)** – using store food simulate how and what astronauts would typically eat.
6. **Menu Planning (JCSA)**– create a full days menu using the food guide provided.
7. **Clothing in Space (ALL)**– students experience the challenges astronauts have with their clothing.
8. **Working in Space (ALL)**– students experience the challenges astronauts have doing simple tasks in space with protective gear.
9. **Spud Rover (ALL)**– students transform potatoes to become robots sent out on a mission.
10. **Hoopster (JCSA)**– students make paper hoops that really fly!
11. **Outrageous Ooze (ALL)**– students seek to understand “Is it a solid or a liquid?”
12. **Hovercraft (ALL)**– students build a simple hovercraft from inexpensive, everyday supplies and learn the science behind the design.

Detailed Activities

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.

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	cone-drinking cup
markers, crayons, or colored pencils	Alka-seltzer tablets
paper for fins	water
tape	metric tape measure or meter sticks
scissors	

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.

Answer these questions about your flight.

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.

7) Did someone have a different shape attached to their power source? Did that design work better?

8) Experiment with the proportion of Alka Seltzer to water in achieving maximum height. What works best?

2. Rocket: Using Skateboards

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. Eating in Space

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

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.

4. 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.

5. Menu Planning

Using the food list below, plan what food you would want to eat in a days time. Remember nutrition and pay close attention to the abbreviations. You don't want your food floating out to Pluto.

Materials

Food list

Meal Planning handout

Pencils

What other foods in the store might you be able to eat in space?

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) - Thermo stabilized

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 Consommé

(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,

Aparragas (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) - Thermo stabilized

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)

6. Clothing 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.

7. 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, snow pants, boots, long-sleeved T-shirt, knit hat, gloves (heavy gloves like ski gloves if possible), helmet

Refrigerator box with one side cut out (this will be the air lock changing room)

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.

8. Spud Rover

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 display their creations to the rest of the group and the judges.

9. Hoopster

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

10. 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

1/2 cup of water

Procedure

- 1) Put newspaper down on your counter or tabletop.
- 2) Put the cornstarch into the bowl. 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.

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.

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, silly putty or hot glue, and a used CD.

Procedure

1. The pop-up lid is secured by either the silly putty or 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.