Activity:
Observing the effects of UV rays

Avoiding harmful rays and radiation from the sun is important to probes, explorers and anything that leaves Earth's atmosphere. But the atmosphere doesn't block all harmful rays. As humans we use chemicals and shade to help prevent long term damage from the sun.

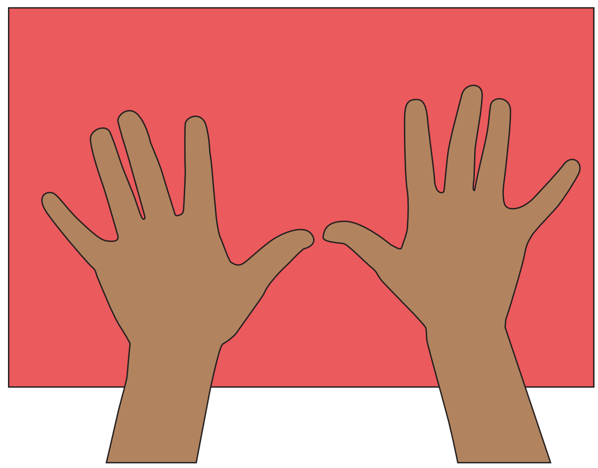
In this activity, students will see how sunscreen can help protect them from harmful UV rays while also observing the damaging effects of UV light.

Materials needed:
- Construction paper (red and green work best)
- Sunscreen (SPF 30 or more and doesn't contain metal oxides)
- Rocks or other small, heavy objects
- A sunny spot outside or inside

1) Provide one page of construction paper to each student.

2) Provide all participants with about a pea sized amount of sunscreen.

3) Rub hands together to cover only the palms and fingers of your hands. Try not to rub the lotion in completely. There should be a light, barely visible, layer of sunscreen left.



4) Place sunscreen covered palms down on the construction paper. Press down firmly allowing the palm and all fingers to touch the paper completely. Remove hands and clean off excess lotion from hands.

5) Place construction paper outside in the sunny area with the sunscreen facing up. May also be able to place them near a sunny window in a classroom.

6) Place rocks on the corners to keep the paper in place. This will prevent the paper from blowing away in the wind.

7) Leave outdoors for 3 to 4 hours in the Sun.

8) Once the time has elapsed observe the change in the paper. The sunscreen will have protected the paper from UV rays keeping the bold color in the hand prints. Unprotected areas will be faded from the extended exposure to UV rays.

Activity:
Ions in Action

As technology advances we find new and innovative ways to do tasks. In particular we have developed an ion propulsion system for our space crafts to use in place of other engines. Ion engines reduce system cost, reduce system complexity, and enhance performance.

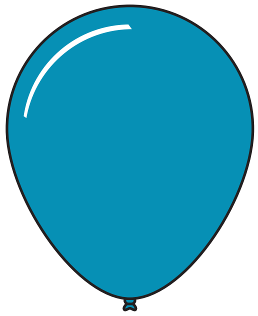
This activity demonstrates just how ions work and how it corresponds to how an ion engine works.

Materials needed:
- Balloon
- Paper
- Hole punch

What to do

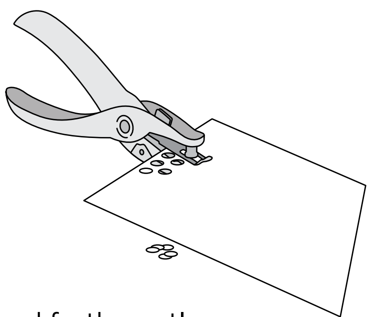
Preparation

1) Blow up the balloon large enough to hold in your hand but not to the point of possible popping.



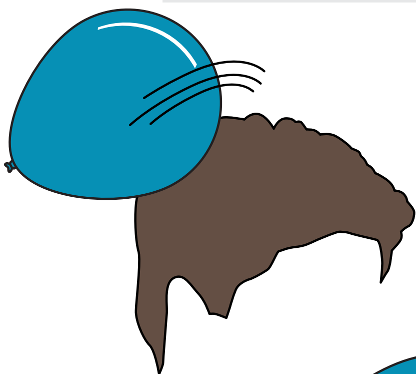
2) Tie off balloon with a knot.

3) Use hole punch to create small paper circles from the sheet of paper.



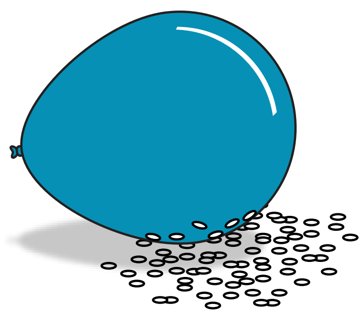
Experiment

4) Rub the balloon back and forth gently on you hair about 10 times. For best results hair should be clean, dry and oil-free.
As you rub the balloon on your hair the balloon will pick up electrons. These electrons have a negative charge (-).



5) Hold the balloon close to, but not touching the small paper circles. Observe what happens.

The paper has few electrons missing making their charge positive (+). As you hold the balloon close the paper will move toward the balloon and stick to it. This is the attraction between the negative (-) charged electrons and the positive (+) charged electrons pulling the two together.



Deep Space 1 Ion Engine

This ion engine contains a gas called xenon. The xenon is given a positive (+) charge. Inside the engine there is also a perforated sheet of metal that has been given a negative (-) charge. The metal will attract the xenon ions just like the balloon attracts the paper.

The charged metal will attract the ions in xenon making them move very fast. As they are attracted they will pass through the perforated metal very fast and shoot out the other side. As they shoot out they push back against the spacecraft moving it forward.

Activity:
Design and Build your own Spacecraft

All probes and satellites need to have the ability to communicate with Earth and make power for themselves. None of them share the same purpose so they all have different instruments. Some instruments are to monitor weather, map terrain, track, measure and more.

Materials needed:
Assorted elements for building. See box below for examples and ideas.

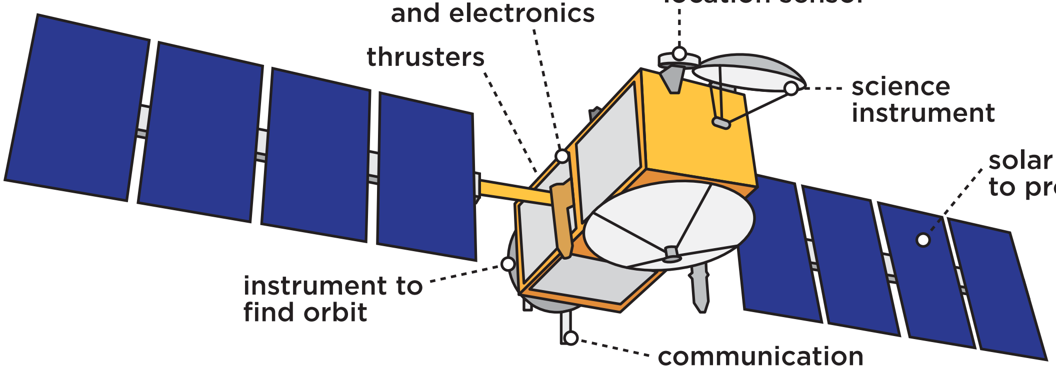
For younger students:
Let their creativity run wild! Set them up with juice boxes as the main base to their spacecraft. Allow them to decorate the box and add instruments with provided craft supplies.

For advanced students:
1) Assign a real satellite, probe or have them make up their own. Ask your students: What does your spacecraft do and what does it need to complete that task? Encourage them to research what instruments are needed.

2) Have them create a base for their spacecraft. Require the addition of a communication device and a power providing attachment.

3) When they have a basic satellite created have them add only instruments that pertain to their satellite's main purpose.

4) Once completed have the students present their satellites and talk about its instruments and their uses.



Material Ideas

- string, thread or yarn
- scissors, tape, glue
- cardboard box or tube, snack or juice box, shoe box
- egg cartons, styrofoam, paper cups, clay
- paper or plastic bowls and plates
- cotton swabs, screws, bolts, paper clips
- colored paper, plastic film, wax paper, foil, pieces of cardboard
- wooden craft sticks, chopsticks, stir sticks, wooden skewers

Activity:
Packing for a long trip to Mars

Pack your bags! You are going on a 2 and 1/2 year trip to Mars. This trip will start with a six month space trip as you make your way to the planet. Then a 19 month stay on Mars while you wait for Earth and Mars to be at their closest point again to optimize travel time and fuel. Lastly another six month trip back home.

In this activity you will pack what you would like to bring on this trip. Students will learn to work together to fill this imaginary box. They will need to brainstorm items, figure out the volume of each item and figure out if they will fit in the 1 m^3 space they are given.

Materials needed:

- Metric ruler or taper measure for each participant
- Graph paper
- Writing and coloring utensils

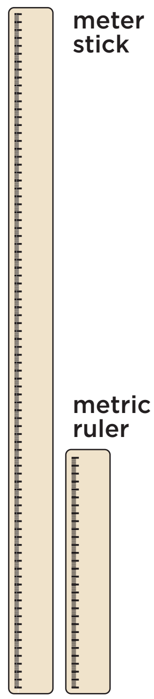
Separate into crews of 3 to 5 people.

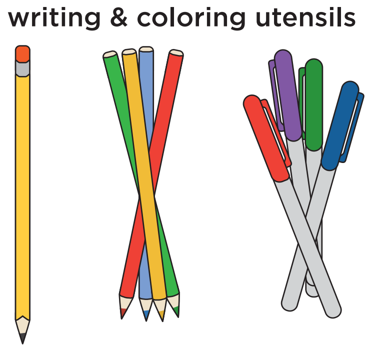
You and your fellow crew members will already have the basic needs of air, food, water, and warmth. The crew is allowed to bring along items of importance and entertainment but all of the crew's items combined must fit within a box that is 1 meter wide by 1 meter high by 1 meter deep.

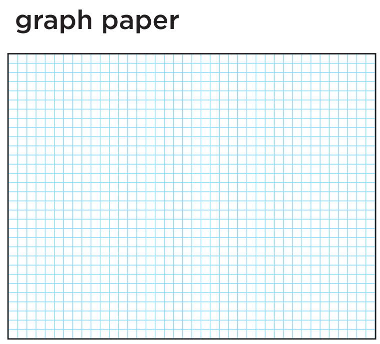
Start by thinking of all the items that would help you pass the time and make you happy.

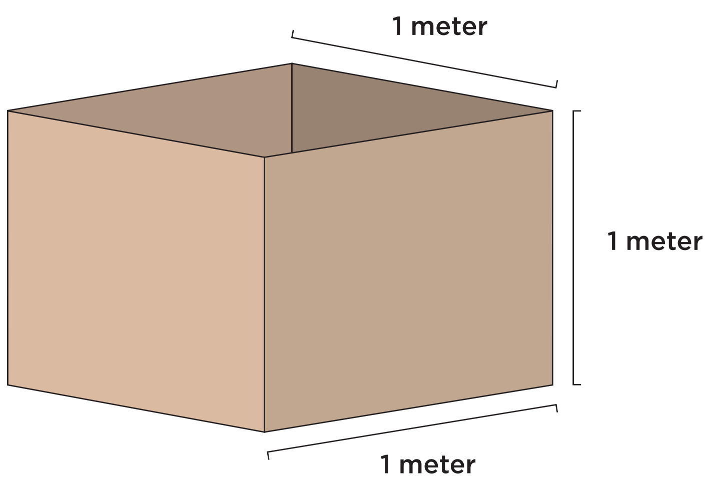
Keep in mind:

- No internet in space.
- Cell phones get no service in space.
- Cable and satellite TV are not available in space.
- For electronics that require batteries you must take along enough batteries to last 2.5 years.
- There are no electronic repair shops or computer experts in space.
- Consider items that disassemble or shrink to help save valuable space.
- During travel you will be in zero gravity. On Mars you will have 1/3 the amount of gravity Earth has.
- The weight of your items does not matter. We will assume that the Mars-bound spacecraft is assembled and launched in space.
- Consider items the crew can share or use together to optimize the amount of use per item.

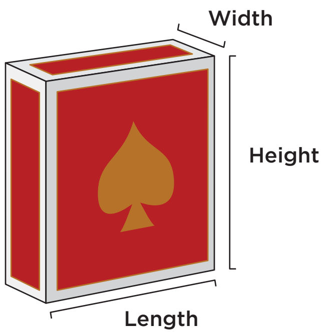




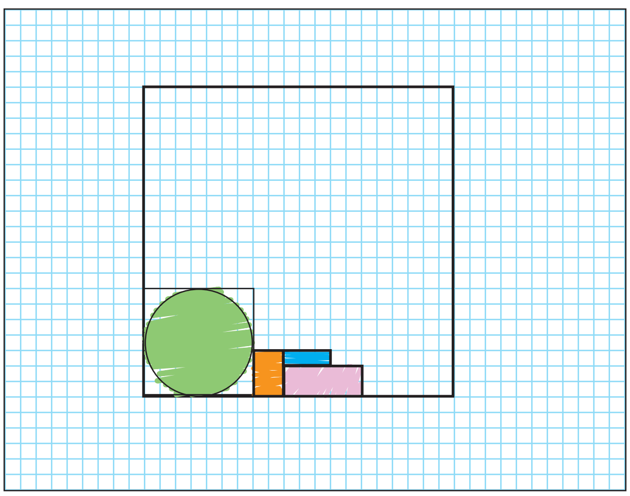




Activity Continued: Packing for a long trip to Mars



Length x Width x Height = Volume



▼ **Conversion Factors**

Inches to millimeters	inches	x 25.4	= mm
Inches to centimeters	inches	x 2.54	= cm
Feet to centimeters	feet	x 30.48	= cm
Feet to meters	feet	x 0.3048	= m
Yards to meters	yard(s)	x 0.9144	= m
Miles to kilometers	mile(s)	x 1.6	= km

Once the list of items is created divide the items so everyone in the crew is responsible for finding the volume of some of the items.

How to find volume:

Measure the height, width, and depth of an item in centimeters or millimeters. Once acquired multiply them all together to get its volume. If the object is an unusual shape consider how large of a box it would take to hold it and only measure the areas where its dimensions are its largest.

If an object is not present for measuring try using the internet to find a site the item is for sale on. The dimensions will most likely be in inches so you will need to convert the measurements to centimeters or millimeters before calculating the volume.

After all the items have their volume calculated we will need to pack the box. Using graph paper and colored pencils map out the box. Starting with deciding a unit of measurement for the graph paper. For example 1 graph paper square could equal 5 centimeters.

As a group draw in the items you will be taking with you. Use multiple colors to help distinguish one object from another.

Once that side is completed use another piece of graph paper to draw the box from another side. Continue this until you have all 6 sides of the box drawn out.

Once completed have everyone present their packed boxes and explain:

- What was the process your team used to decide what to put into the box?
- What compromises were necessary in choosing the items?
- Why were the items picked?
- What items had to be left out?
- Do all the items represent the agreement of the team, or were some individuals given their chosen item?