COSI ON WHEELS TEACHER PACK
LAUNCH INTO SPACE
PREVISIT ACTIVITIES

Launch Into Space is designed to introduce students to the basics of space exploration. The program consists of a 45 minute interactive assembly followed by exciting hands-on activities that engage the students and encourage the development of Science Process Skills.

During the assembly, the following concepts and more will be explored:

- Phases of matter
- Air pressure
- Thermal conductivity

Students will observe the COSI Educator using liquid nitrogen to launch a plastic bottle and heating a space shuttle tile with a torch. They will also work together to demonstrate the energy of molecules in solids, liquids and gasses.

The handson activities are presented in 30-45 minute sessions with each session accommodating 62 or fewer students. Hands-on activity session times are scheduled by your school's COSI On Wheels coordinator. Students will have the opportunity to launch a cork "rocket," watch the effects of air pressure on a marshmallow, and observe spectrums of known gases to identify the unknown star. In the hands-on sessions students informally interact with the activities, spending as little or as much time as they like at each station. While many students will try all of the activities, some may choose to have a more in-depth experience with only a few.

To prepare you and your students for **Launch Into Space**, we suggest familiarizing yourselves with the vocabulary list provided. We also encourage you to explore the activities detailed on the following pages.

NOTE: *Students should be reminded to never eat or drink any of their experiments, even when experimenting with food items.*

LAUNCH INTO SPACE
VOCABULARY

AIR PRESSURE: The force exerted by the atmosphere.

CHEMICAL CHANGE: A change by which one or more new substances are formed. This change occurs on the molecular level.

CRYSTAL: A solid body having plane surfaces that give it a certain geometrical form.

DEHYDRATION: The act of the loss or removal of water from a body.

DENSITY: The relation of weight to volume.

GRAVITY: The force that tends to draw all bodies toward the center of the earth.

HYPOTHESIS: An educated guess made as a starting point for further investigation.

MICROGRAVITY: One millionth of the normal acceleration of gravity felt on Earth.

PHASES OF MATTER: Physical stage of a substance.

- SOLID: Molecules with definite shape and volume.
- GAS: Molecules with no shape or volume.
- LIQUID: Molecules that move freely but do not separate.

PHYSICAL CHANGE: A change that rearranges or alters how a substance appears.

SPECTROSCOPE: Instrument for splitting various wavelengths (colors) from a light source (chemical) in a spectrum.

THERMAL CONDUCTIVITY: Movement of heat.

HOT SPOONS

ACADEMIC STANDARDS: Physical Science 4.5, 5.1, 5.2; Scientific Inquiry 3.5, 5.3

OBJECTIVE: The students will gain an understanding of thermal conductivity and learn the differences between high and low thermal conductivity.

MATERIALS: Wooden Spoon Metal Spoon
Plastic spoon Bowl of water

Butter 3 marbles

PROCEDURE:

1. Heat bowl of water so that it's hot, but not boiling.
2. Place a pat of butter on the ends of each spoon and press a marble into each pat of butter.
3. Place all three spoons into the bowl of water with the buttered ends sticking out.
4. When the spoons heat up the butter will begin to melt, eventually dropping the marbles.
5. Watch the marbles. The first to fall is from the spoon with the highest thermal conductivity.

WHAT HAPPENED: Each substance has a different level of thermal conductivity. This is the property that determines the movement of heat or cold through an object. Something with high thermal conductivity, like iron, is a good conductor of heat. That means it would get much hotter or colder than something like sand. Heat won't go very far through sand; it has a low thermal conductivity. Silica is the chemical taken from sand which is used to make the space shuttle tile. Silica protects the shuttle from heat during reentry. Record the results of each of your tested materials. Which is high? Low? In what situations would we want high thermal conductivity? Look around the room. What else would be a good carrier of heat? What would be a good insulator (objects with a low thermal conductivity)?

COMPARING CRYSTALS

ACADEMIC STANDARDS: Physical Science 1.3, 1.4, 4.1, 4.4

OBJECTIVE: To grow and compare three types of crystals.

MATERIALS: Six clear plastic beverage cups
Epsom salt
Small mixing spoon
Teaspoon
Three colors of food coloring
Table salt
Warm water
Tablespoon
Magic marker
Sugar

PROCEDURE:

1. Label two cups "Table Salt."
2. Do the same for "Epsom Salt" and "Sugar."
3. Place six tbsp. water in one "Table Salt" cup.
4. Place five tbsp. water in one "Sugar" cup.
5. Place six tbsp. water in one "Epsom Salt" cup.
6. Add a different color of food coloring to each of your cups containing water.
7. Place five tbsp. table salt in "Table Salt" cup.
8. Place 12 tbsp. sugar in "Sugar" cup.
9. Place five tbsp. Epsom salt in "Epsom Salt" cup.
10. Stir contents of each cup thoroughly until most of the salt or sugar dissolves.
11. Remove one tsp. liquid from the full "Table Salt" cup and place in the empty "Table Salt" cup.
12. Do the same for the "Sugar" and "Epsom Salt" cups.
13. Place all six cups in a warm, sunny place and wait several days.

WHAT HAPPENED: The water evaporated from the cups containing one tsp. solution, leaving behind three very different types of crystals. As the water evaporates from the solutions small, unseen crystals start to stack together. Further evaporation increases the building process and larger crystals are produced. (All water should evaporate from the cups containing the greater amounts of solutions in about a month, leaving substantial crystals behind.)

TO THINK ABOUT: How would the crystals grow in space? What would be different about them?

BALLOON IN A BOTTLE[1]

ACADEMIC STANDARDS: Physical Sciences 3.3, 4.4; Scientific Inquiry 2.5, 5.3

OBJECTIVE: To demonstrate that air takes up space and has pressure.

MATERIALS: Cola bottle or any small-mouthed bottle
Balloon – large enough to fit over the mouth of the bottle

PROCEDURE:

1. Slip the balloon through the neck of the bottle.
2. Stretch the opening of the balloon around the mouth of the bottle.
3. Try to inflate the balloon by blowing into it.

WHAT HAPPENED: The balloon expands only slightly. The bottle is filled with air. Blowing into the balloon causes the air molecules inside the bottle to move closer together, but only slightly. The air pressure inside the bottle is pushing on everything, the bottle and the balloon, not allowing it to be inflated.

TRY THIS: Punch a small hole (about the size of a nail) into the bottom of the bottle. Then repeat steps one through three.

WHAT HAPPENED: The hole in the bottle provides an exit for the air molecules in the bottle. These air molecules are then forced out, as the air in the balloon fills the space.

TRY THIS: Heat water in a flask until boiling occurs. Remove flask from heat and set flask upon a hot pad. Immediately place mouth of pre-stretched balloon over the mouth of the flask, leaving remainder of the balloon outside the flask. As the water cools, the balloon is pushed into the flask by the change in air pressure.

LIGHT AS AIR[2]

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[1] Spangler, Steven. "Balloon in a Bottle." Steven Spangler Science: Making Science Fun. http://www.stevespanglerscience.com/experiment/00000166

[2] "The Little Book of Experiments." Planet Science. 5 July 2007 <http://www.planet-science.com/experiment/downloads/NewExp_Part2.pdf >.

ACADEMIC STANDARDS: Earth & Science 4.1; Physical Science 4.4; Scientific Inquiry 2.7, 2.8, 3.1, 4.1

OBJECTIVE: To demonstrate that air has weight.

MATERIALS: A yard stick (or dowel rod) String Tape 2 Balloons

PROCEDURE:

1. Tie the string around the center of the yard stick. Use tape to hang the yard stick from a light, doorframe, or the ceiling. Adjust the stick until it is balanced horizontally, then tape the string so it stays attached to the correct point on the stick.
2. Tie a string around a deflated balloon.
3. Hang the deflated balloon a few inches from one end of the stick. Use the tape to attach the string. The stick will be extremely unbalanced at this point.
4. LOOSLEY tie a string of equal length around the other deflated balloon. Loop the other end of the string around the other end of the stick.
5. Move the second balloon along the stick until you find where the two balloons are balanced. Tape the string to the stick at the appropriate point.
6. Carefully untie the second balloon. Inflate the balloon and tie it off.
7. Before reattaching the balloon ask the class for predictions of what will happen once the balloon is reattached. Will they still be balanced, or will one of the balloons be heavier than the other?
8. Re-tie the inflated balloon to the string that is hanging from the stick. Be sure to level the stick with your hands before releasing it. Release the stick. What happens?

WHAT HAPPENED: The inflated balloon is filled with air molecules. The air molecules have weight. We know that the two balloons are an equal weight, but the inflated balloon has the additional weight of the air *inside* it. Since we are measuring the weight of the balloon plus the air, the inflated balloon weighs more than the deflated balloon, and it pulls one side of the stick down lower.

DID YOU KNOW? Once the astronauts leave the Earth's atmosphere there is little air in space. Since there is little air, humans in space have to wear a special suit which provides them with oxygen to breathe. What would happen if you released a balloon full of air into space?

DENSITY STACKER

ACADEMIC STANDARDS: Physical Science 3.1; Scientific Inquiry 1.9, 2.5, 2.6, 5.3

OBJECTIVE: To illustrate the property of density.

MATERIALS: Glass jar
Liquid measure
Golden syrup
Cooking oil
Water
Piece of plastic
Grape
Small cork

PROCEDURE: Pour one-third cup golden syrup into glass jar, followed by equal measurements of cooking oil and water. Drop in the piece of plastic, then the grape, followed by the cork.

WHAT HAPPENED: The syrup remains at the bottom of the jar, the water settles on the surface of the syrup, and the oil floats on top of the water. Each object will sink to the level of the liquid that has a greater density than the object. The object will then float on that layer.

ADDITIONAL RESOURCES

Find additional information on outer space with NASA online resources for educators!

- www.hq.nasa.gov/education
- www.quest.arc.nasa.gov

Write to the following addresses to have information sent about space!

- NASA CORE
  Lorain County Joint Vocational School
  15181 Route 58 South
  Oberlin, OH 44074

- NASA John H. Glenn Research Center
  NASA Educator Resource Center
  2100 Brookpark Road
  Cleveland, Ohio 441352017

SCIENCE PROCESS SKILLS

On the day of the program students will have the opportunity to participate in a variety of hands-on activities. The activities are intended to create a fun and stimulating environment which encourages the development of Science Process Skills. The skills include:

OBSERVING: Using the senses and/or appropriate tools to gather information. Observing may also include the skills of: **Measuring, Comparing** and **Classifying.**

INFERRING: Making preliminary conclusions by assessing what is already known. Inferences are what you reason to be true, but have not observed or tested.

QUESTIONING: Raising questions about objects, events, or phenomena. This includes recognizing and asking *investigable* questions, often beginning with phrases like 'What causes,' 'How does' or 'What makes.'

HYPOTHESIZING: Offering a possible explanation or testable statement. A hypothesis can be a good reference point for further investigation.

PREDICTING: Using ideas or evidence to foretell the outcome of a specific future event. Often involves an action and a reaction or an if/then statement.

PLANNING: Designing one's own investigation using procedures to obtain reliable data. *Planning is <u>not</u> always formal.*

INVESTIGATING: Carrying out a planned experiment based on your hypothesis. Investigation uses many of the previously stated Process Skills.

INTERPRETING: Drawing conclusions by assessing the data. Finding patterns or other meaning in the data.

COMMUNICATING: Expressing observations, ideas, conclusions, or models by talking, writing, drawing, etc.

RELATING & APPLYING: Relating makes parallels to similar concepts, and applying uses the knowledge gained to help solve a challenge.

<u>LAUNCH INTO SPACE HANDS-ON ACTIVITIES:</u>

Cool Crystals: Students observe several kinds of crystals and find out how their growth is different in space than it is on Earth.

Made for Earth or Space: Students will explore many of the inventions that have been created for use on earth and in space and guess which are which. Some may surprise you.

For the Love of Gravity: Students simulate micro-gravity right here on earth with this amazing activity that uses circulation to demonstrate the fluid shift in the bodies of astronauts in outer space.

Glove Box: Students will learn how astronauts perform experiments in space.

Marshmallow Man: Students watch the effects of air pressure on a marshmallow and see firsthand just how important those space suits are.

Oil and H2O: Students have the opportunity to perform an experiment about the effect of gravity on oil and water while watching a video of Ohio Northern University students doing the same experiment in the "Vomit Comet," an airplane that simulates zero gravity.

Rocket Launch: Alka-Seltzer® and water become the fuel for launching rockets at this station that explore projectile angles and chemical reactions.

Space Spuds: Students learn what is involved in "astronaut cooking" by re-hydrating mashed potato flakes.

Spec It Out: Diffraction gratings are used by the students to identify spectrums of known gases to identify an unknown star.