



3rd Annual
TARS
Summer
Science



Camp

USF STARS: AN NSF GK12 PROGRAM

SPACE JAM



CAMP LESSONS

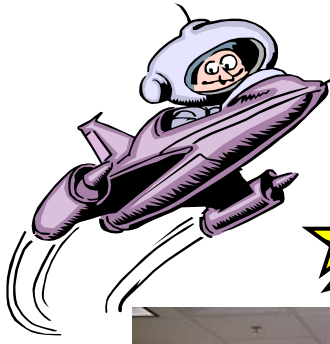
June 13 - 24, 2005

NAME: _____

TEAM: _____



USF UNIVERSITY OF
SOUTH FLORIDA



ABOUT S.T.A.R.S.



USF Team Members, Left to right, sitting:

Zoe Seda, Fellow, Department of Industrial Engineering; **Wandaliz Torres-Garcia**, Fellow, Department of Industrial Engineering; **Diana Martinez**, Undergraduate Fellow, Department of Biology; **Jorge Lallave**, Fellow, Department of Mechanical Engineering; **Nejma Petit**, Fellow, Department of Biology; **Emily Ferguson**, Fellow, Department of Life Sciences

standing: **Cherise Edwards**, Project Coordinator, Institute on Black Life; **Dr. Grisselle Centeno**, co-PI, Department of Industrial Engineering; **Souheil Zekri**, Fellow, Dept. of Mechanical Engineering; **Dr. Ashok Kumar**, co-PI, Department of Mechanical Engineering; **Dr. O. Geoffrey Okogbaa**, PI, Department of Industrial Engineering; **Chris Faulkner**, Undergraduate Fellow; **Caetano Cash**, Fellow, Department of Computer Science Eng.; **Rajesh Ganesan**, Project Manager, Department of Industrial Engineering; **Dr. Tapas Das**, co-PI, Department of Industrial Engineering

STARS members not in picture:

Dr. Louis Martin-Vega, Dean and co-PI, College of Engineering; **Dr. Brenda Townsend**, co-PI, Department of Education; **Dr. Michael Churton**, co-PI, Department of Education; **Elizabeth Hunnicutt**, Science Coordinator, School District of Hillsborough County; **LaNetra Clayton**, Fellow, Department of Chemistry.



The USF Students Teachers And Resources in the Sciences (S.T.A.R.S.) program is a National Science Foundation (NSF) grant awarded to the University of South Florida to infuse higher-level science & math concepts in grades 3-5. We have partnered with 5 elementary schools: Berkeley Preparatory, Edison Elementary, Lawton Chiles Elementary, Robles Elementary, and Tampa Palms Elementary.

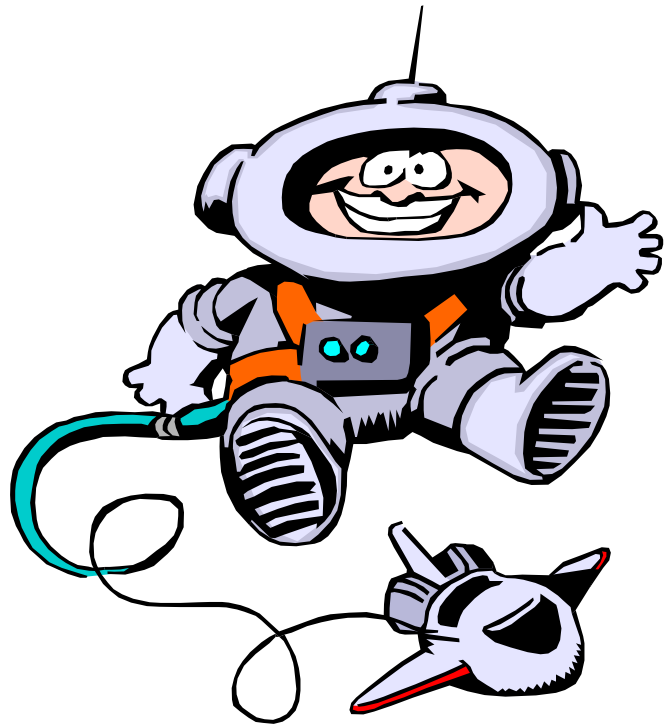
As an extension of the NSF initiative, the graduate students have organized a summer camp for elementary school kids throughout Hillsborough County. Students will participate in a series of lessons and activities that focus on aspects of water such as cave formations, water electrolysis, oil spills, water testing and much more. In addition, a water conservation lesson will be presented by the David L. Tippin Water Treatment Facility. Students will compete in an Olympiad in which they will design and construct a water treatment system. Culminating activities will include an awards ceremony on June 18, 2004 at 10:00 a.m.

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**HI! GET READY FOR
THE GALACTIC TRIP**



Galactic Trip

About Galaxies:

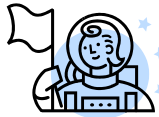
There are **billions** of Galaxies in the Universe. Some are very small with only a few million stars. While others could have as many as 400 billion stars or even more.



Galaxy: A large grouping of stars. Galaxies are found in a variety of sizes and shapes.

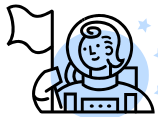
There are three kinds of Galaxies, **Spiral**, **Elliptical**, and **Irregular**. The only difference between the three is what shape they have.

Spiral - The most beautiful type of galaxies are Spiral Galaxies. Their long twisting arms are areas where stars are being formed.



Fact: they are like star farmers, planting star seeds where ever they go.

Elliptical - The stars found in Elliptical Galaxies are often very old. This is because elliptical galaxies don't actively create new stars.



Fact: If the Earth were inside an elliptical galaxy it would be bright both day and night.

Irregular - Irregular Galaxies are simply all the galaxies which are not spiral, or elliptical. They can look like anything and have many different characteristics.



Fact: Many irregular galaxies probably used to be spiral, or elliptical until they had some kind of accident which changed them.

Milky Way

Our Galaxy

Our own Milky Way galaxy is spiral in shape and contains several billion stars. Some galaxies are so distant that their light takes millions of years to reach the Earth.

Milky Way: The galaxy in which our solar system is located

As a galaxy, the Milky Way is actually a giant, as its mass is probably between 750 billion and one trillion solar masses, and its diameter is about 100,000 light years.

NOW... WE ARE READY TO MAKE OUR OWN CLUSTER OF GALAXIES

Galactic Mobile

Materials:

- 1 black-painted plate
- Scissors
- 2 - 1.5 ft long black string
- 4 black strings in different sizes
- 4 sequins or very small beads, black is best
- 4 patterns for galaxies
- 8 beads
- 1 skewer (optional)



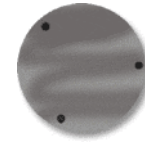
Procedure:

First: Prepare Galaxies

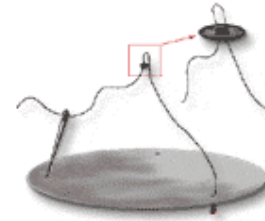
1. Cut your 4 patterns of galaxies along the lines.
2. Make a small hole in the center of each galaxy using a punch hole

Second: Make the frame for the mobile

1. Use the black-painted plate, and make three pencil marks equally spaced around the edge of the plate, about 0.5 inches (in) from the edge.



2. Using a skewer make a small hole through the three of the pencil marks on the edge of the cardboard circle. Push one of the 1.5 ft black strings through one of the holes.

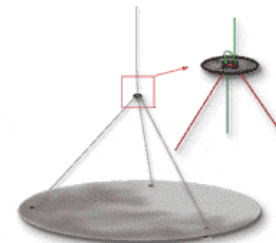


3. Then tie a fat knot in the end.

4. Take the holed button and push the string through one hole in the button and down through another.

5. Now push the thread down through another hole on the plate. Tie a fat knot at the end of the string.

6. Now, using your other 1.5 ft long string, push it up through the remaining hole on the plate. Tie a fat knot in the end.



7. Push the string up through one of the remaining holes in the button and then down through the last hole.

8. Tie a loop in the end of the thread for hanging the mobile from the ceiling.

Third: Hang the galaxies from the mobile frame

1. Make 4 marks on the bottom of the plate where you will be attaching each galaxy.

For each galaxy:

1. Take a piece of string and tie a bead to the end.

2. Push the string through the center of the galaxy.

3. Then place the string through one of the marks on the bottom of the plate. Adjust the length of the thread so the galaxy hangs nicely and tie a bead to the end.

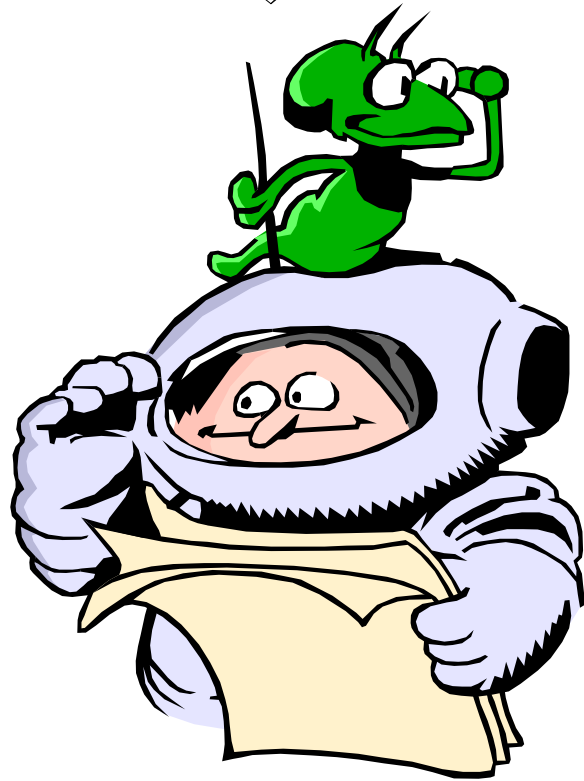
4.4: Make the galaxies hang at different levels, so they can turn freely without hitting each other.

Your galactic mobile is ready...

Hang your Galactic Mobile from the ceiling. Notice that you can adjust the string going through the button to make the plate hang level.



**LET'S BUILD A
PAPER ROCKET**





Space Transportation

Background

The twentieth century marked a turning point for mankind, from the industrial age to the space age. Some may argue that we are in the information age and if so, it was brought about through the knowledge and technology gained from our aviation, rocket and space pioneers.

Robert Goddard launched the world's first liquid-powered rocket, on March 16, 1926. He was the first of the early rocket pioneers to go beyond theory and design. He entered the realm of "systems engineering" - the complex business of making airframes, fuel pumps, valves, and guidance devices compatible. Being liquid fueled was crucial. Up until then, all rockets were based on a solid fuel, gunpowder, which dated back to China in the late third century before Christ. Solid fueled rockets did not have adequate power to do the things that Goddard wanted to do, like fly a rocket to the moon. On March 28, 1935 Goddard launched and test rockets that were pressurized by liquid nitrogen and has gyroscopic controls. It flew to a height of 4,800 feet and 13,000 feet downrange at a speed of 550 MPH.

The technological Pearl Harbor began on October 4, 1957, the USSR blindsided the United States with the launch of Sputnik I, the first man-made earth orbiting satellite. Circling the earth roughly every 90 minutes, its beeping radio signal shocked the U.S. and the world. This was followed closely by Sputnik II on November 3, 1957, which carried a dog named Laika, the first live organism launched into space. The flight brought back scientific data on the effects of weightlessness and space travel on a living animal.

Project Mercury began on October 7, 1958, one year and three days after the Soviet Union launched Sputnik 1 and was the United States' first manned space program. The objectives of the program, which was made up of six manned flights from 1961 to 1963, were specific: 1) to orbit a manned spacecraft around Earth, 2) to investigate man's ability to function in space and 3) to recover both man and spacecraft safely. Project Mercury was American's first "small steps" toward that "Giant Leap for mankind." **Launch vehicles** were used as an important transportation medium that link Earth to outer space. Launch vehicles put into space communication and weather satellites, which have a direct impact on our quality of life, as well as astronomical-observation satellites and planetary-exploration satellites.



Explorer I was the first satellite launched by the United States of America on January 31, 1958 on top of a version of the Redstone rocket, known as the Jupiter C. On that mission the NASA scientist discovered the James A. Van Allen radiation belts around the earth. Finally, the U.S. entered the space race but had a lot of catching up to do. Nowadays, launch vehicles play an

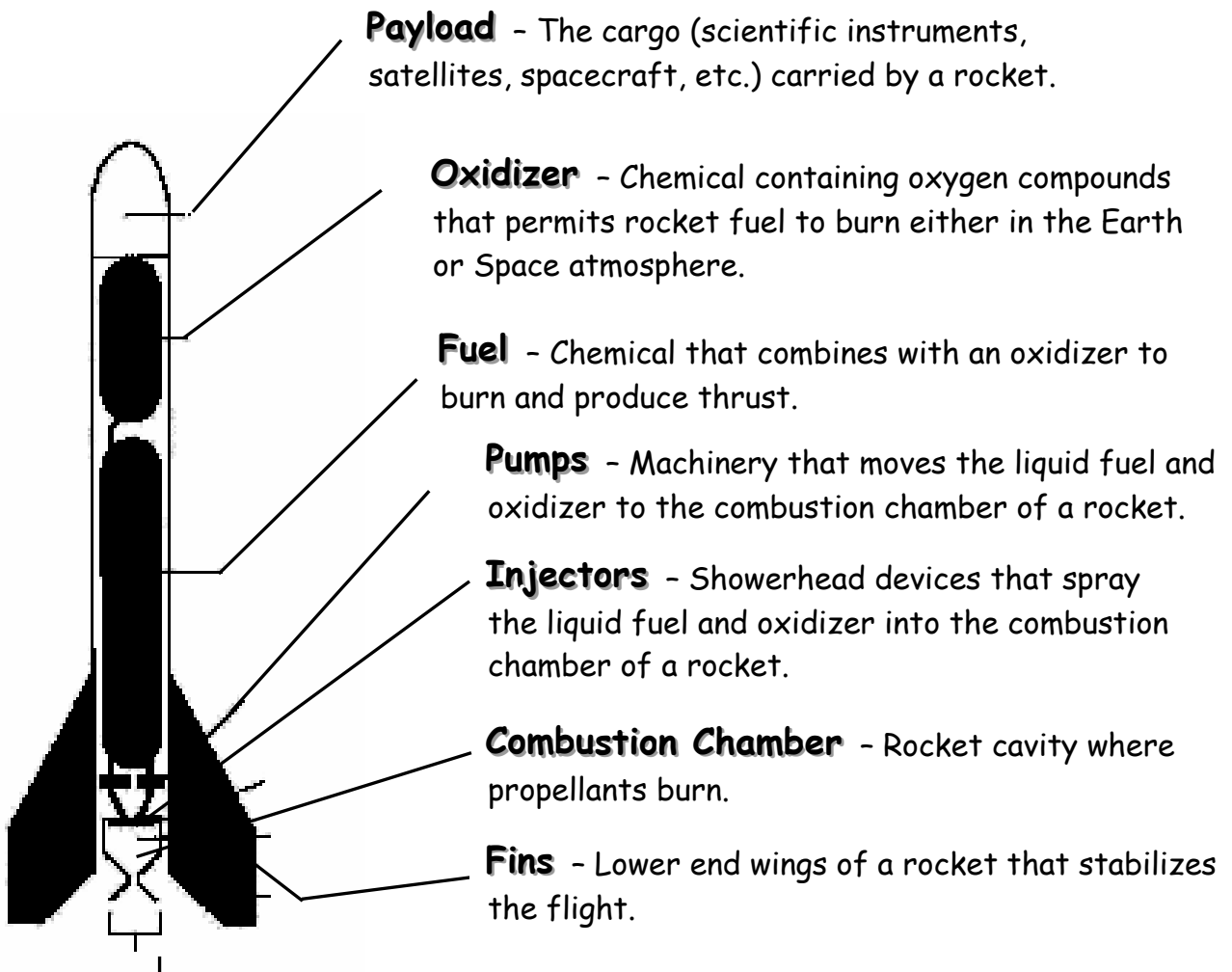
essential role in the assembly and supplying of the International Space Station.

Project Gemini was a transitional step between the pioneering [Mercury Program](#) and the actual landing a man on the moon. Its success was critical to achieving the goal of reaching the Moon and was not without its problems and difficulties. The main objectives of the ten Gemini missions over a period of 20 months from 1965 to 1966, were to learn how to "fly" a spacecraft by 1) maneuvering it in orbit and by 2) rendezvousing and docking with other vehicles, which were essential skills for the later [Apollo missions](#). One of these missions, [Gemini VIII](#), nearly killed Neil Armstrong the first person to walk on the moon.



Example of Vehicles in Space

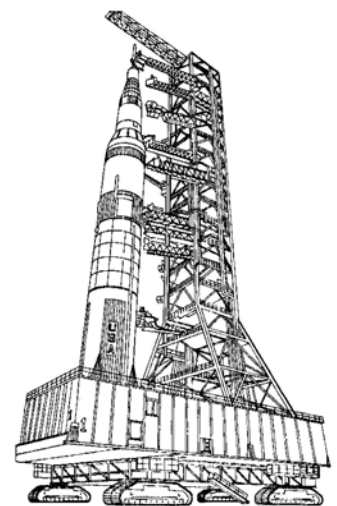
Today, rockets are more reliable. They fly on precise courses and are capable of going fast enough to escape gravitational pull of Earth. Modern rockets are more efficient today because we have a better understanding of the scientific principles behind rocketry. New technology has led us to developed a wide variety of advance rockets hardware and formulate new propellants that can be used for longer trips and more powerful takeoffs. Future transports might be driven by antimatter, fusion and electrodynamics, etc...



Nozzle- A bell shaped opening at the lower end of a rocket through which a stream of hot gases are directed.

For an ideal rocket, the total mass of the vehicle should be distributed following this general formula:

- Of the total mass, 91 percent should be propellants; 3 percent should be tanks, engine, fins, fuselage and 6 percent can be the payload.
- Payloads included satellites, astronauts, or

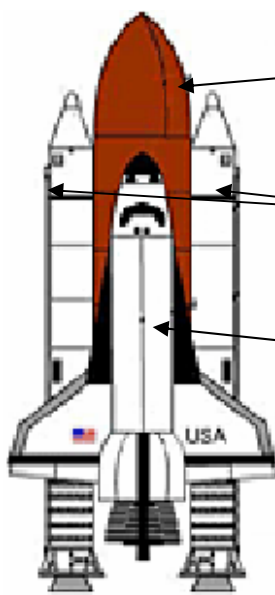


spacecraft that will travel on the mission to other planets or moons.

- The effectiveness of a rocket design is expressed in terms of **Mass Fraction**. Where it is define as the propellants of the rocket divided by its total mass.

The Space Shuttle is called the Space Transportation System (STS). It can carry astronauts into space.

These are the parts of the Space Shuttle and what they do:



External Tank This tank holds the fuel for the Shuttle.

Solid Rocket Boosters These boosters push or boost the Shuttle into the space.

Orbiter This is where the astronauts sit. It also holds everything that is going into space.

The Lunar Module is the manned portion of the space vehicle. It contains a crew compartment, hypergolic ascent engine, a behind equipment cove and tank section, and 16 reaction control engines. The **crew compartment** is used as an operations center by the astronauts during their lunar stay. Lunar descent, lunar landing, lunar launch, and rendezvous and docking with the Command and Service Module are also controlled from this compartment.

GENERAL DESCRIPTIONS AND CHARACTERISTICS

Main exterior parts of the lunar module:

Satellite or Antenna-

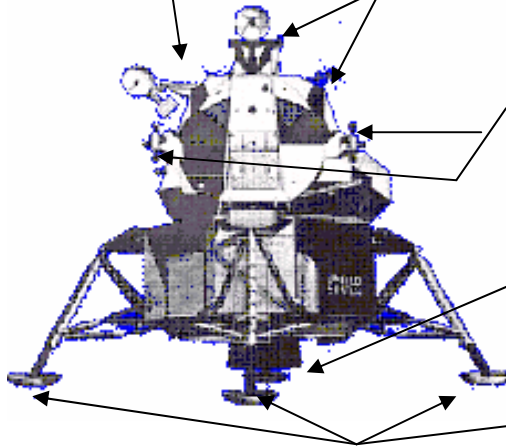
provides communication among the module, space center and other space stations.

Guidance, Navigation & Control - guides the module trajectory pattern and behavior.

Environmental Control - monitors the temperature, solar radiation, wind, pressure and gravitational force.

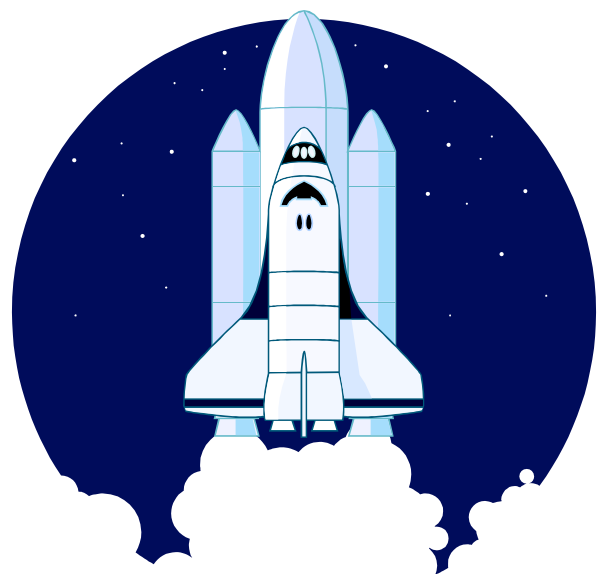
Propulsion - this booster pushes or boosts the module into the air.

Suspension System - it holds the lunar module during takeoff and landing process.



Internal parts of the following subsystems that are contained in the Ascent Stage:

- Crew Provisions/Displays
- Electro-Explosive Devices
- Instrumentation
- Electrical Power
- Reaction Control



Paper Rocket

Experiment Objective:

The students will design, construct, and fly paper rockets that will travel the greatest distance possible across a floor model of the solar system.

Background Information:

This activity will demonstrate how rockets fly through the atmosphere. A rocket with no fins is much more difficult to control than a rocket with fins. The placement and size of the fins will be critical to achieve the necessary stability while not adding to much weight.

Materials Needed:

- Scissors
- Glue
- Straws
- Metric Ruler
- Masking Tape
- Scotch Tape
- Pencil
- Eye Protection
- Protractor

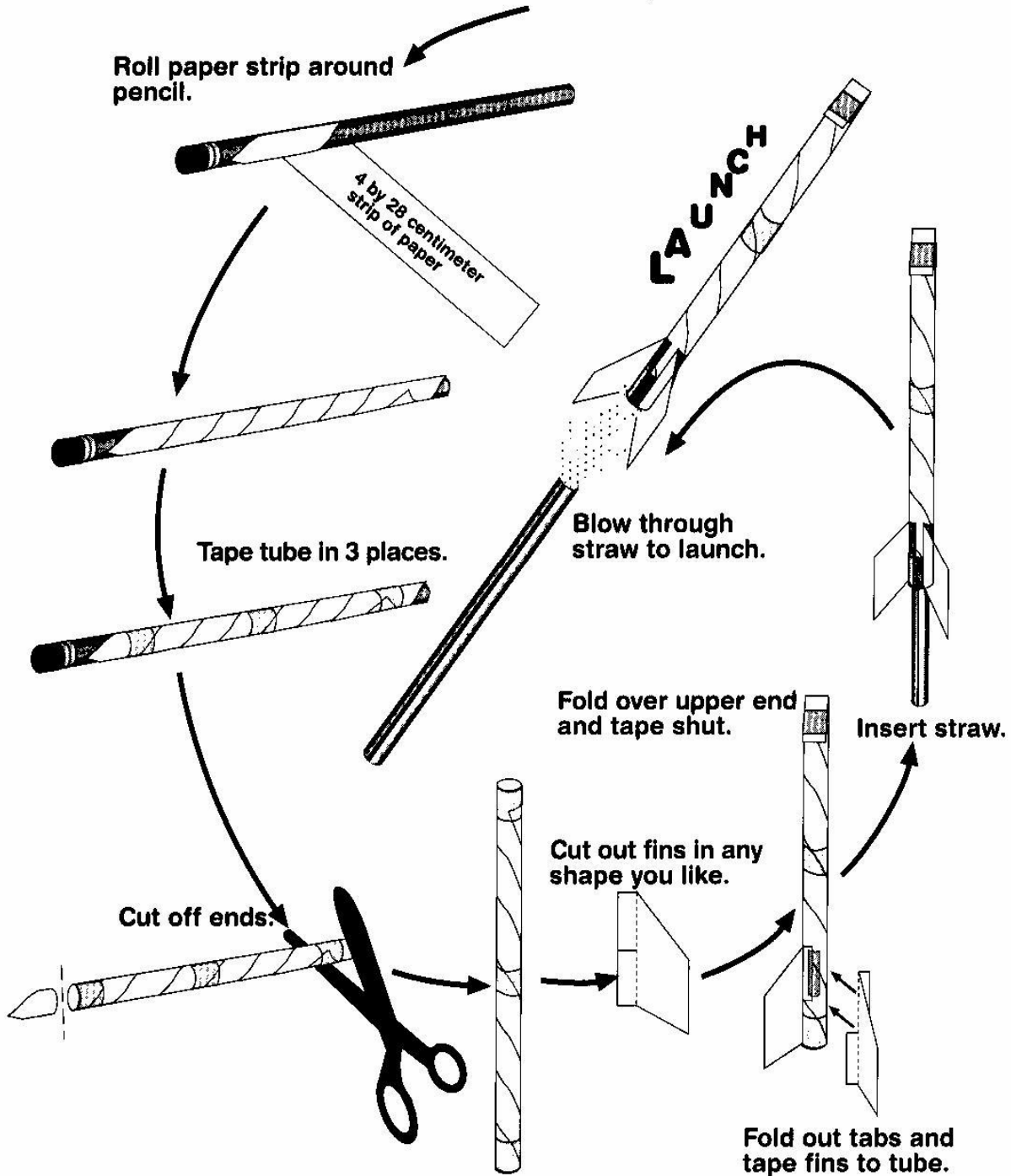
Experimental Procedure:

STEP1 How to construct your rocket

1. Roll paper strip around pencil (2 inch x 11 inch strip of paper).
2. Tape tube in three places.
3. Cut off the ends
4. Cut out fins in any shape you like.
5. Fold out tabs and tape fins to tube
6. Fold over upper end and tape shut.
7. Insert straw to blow through it for takeoff launch.

PAPER ROCKETS

Follow the arrows to build your rocket.



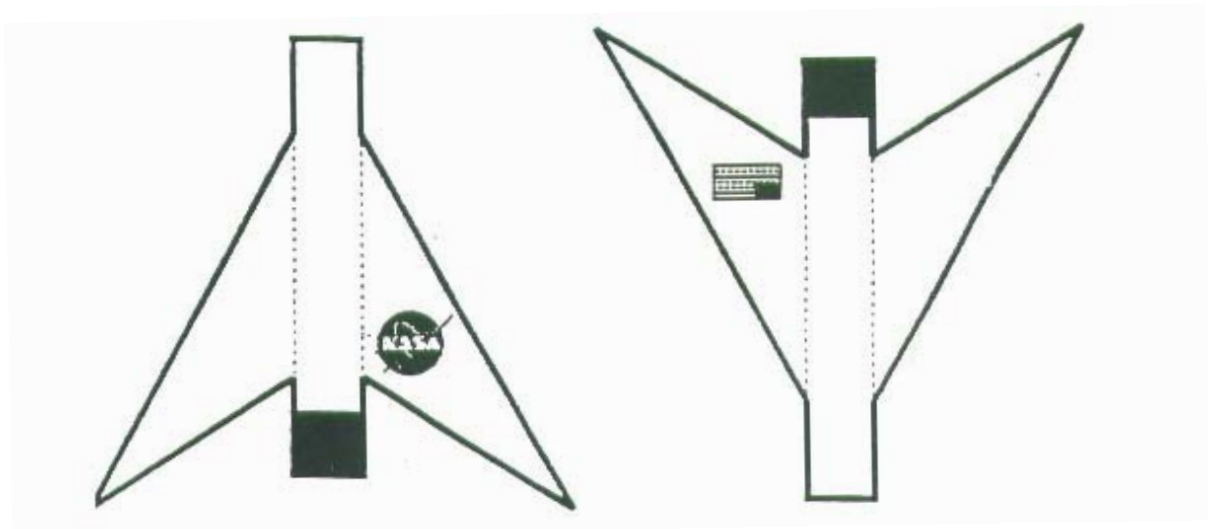
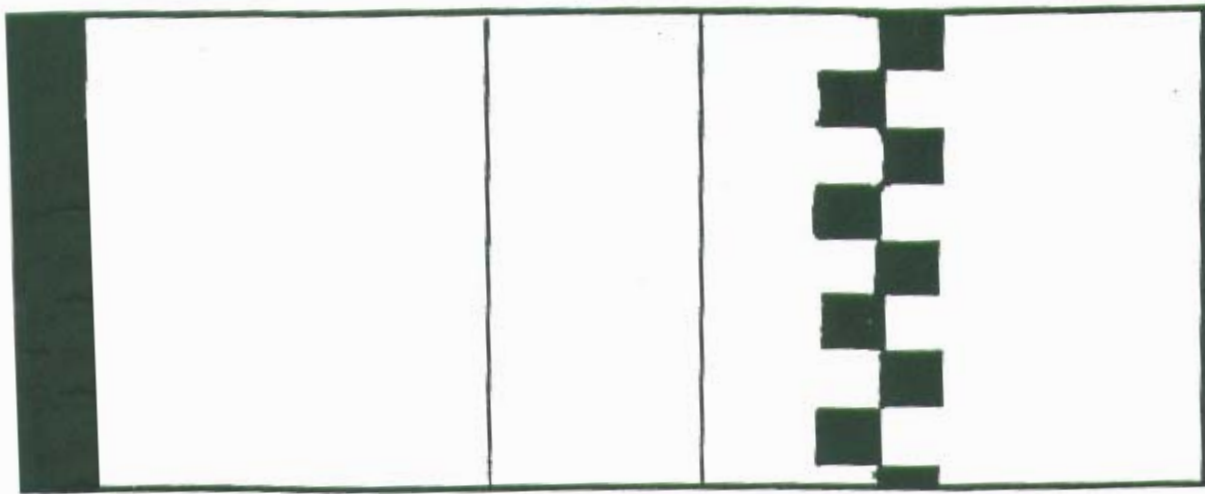
STEP 2: What you should do next?

After constructing the paper rocket a location for testing your rocket will be set. A room with an open floor space or a hallway is preferable. Prepare the floor by marking 8 to 10 meter test range with the pictures of the nine planets of our Solar system as targets. Launch your rocket from planet Earth, Venus or Mars at a 30° angle and determine the farthest distance you are able to reach with your rocket. Record the results 3 attempts per four angles 30, 45, 60, 75. Next, adjust the angle of your launch to 45° and record the farthest planet you are able to reach with your rocket. Repeat this exercise three times using 45, 60 and 75 degrees. Record the results in your experimental data log. Repeat for the first attempt.

The Planets



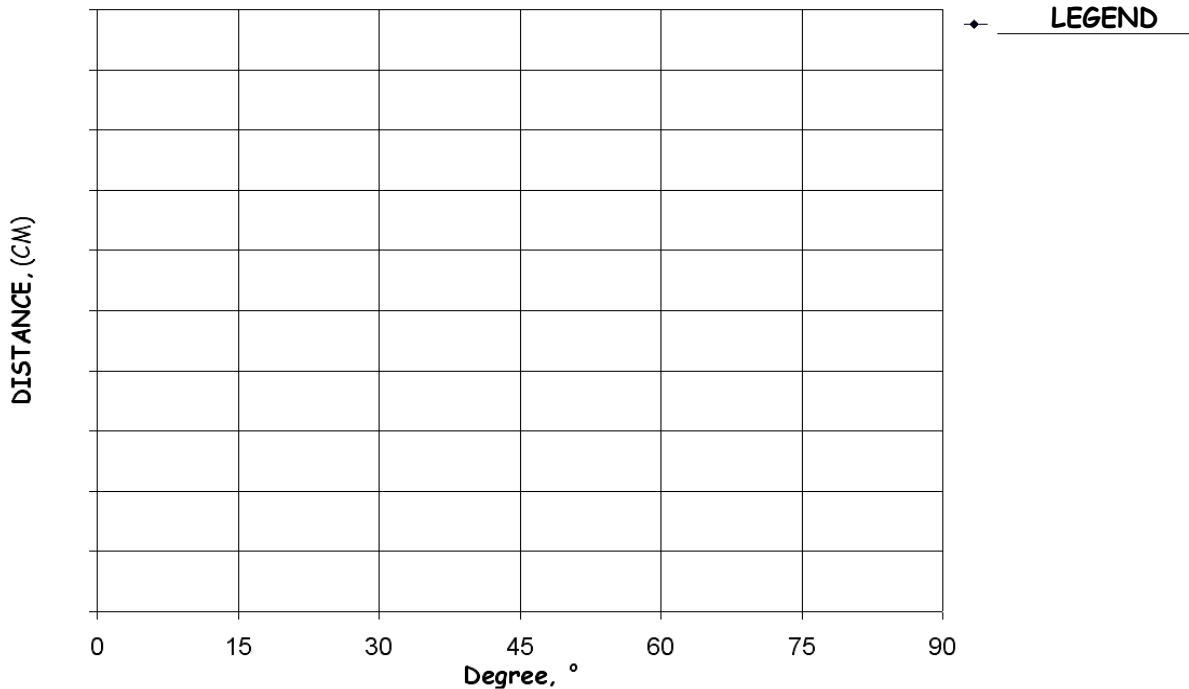
ONE-STRAW ROCKET



STEP 3: Scientific Data Log			
Angle	Base	Distance (cm)	Average Distance (cm)
30°	Earth		
45°	Venus		
60°	Mercury		
75°	Mars		

STEP 4: Graph your results

HOW THE ANGLE COULD AFFECT THE DISPLACEMENT OF A ROCKET



STEP 5: Draw your conclusions

1. As the angle increases, what happened with the travel distance?

2. What was the maximum average distance including all angles?

3. Enumerate the factors that affect the takeoff of your rocket?

A.	D.
B.	E.
C.	F.

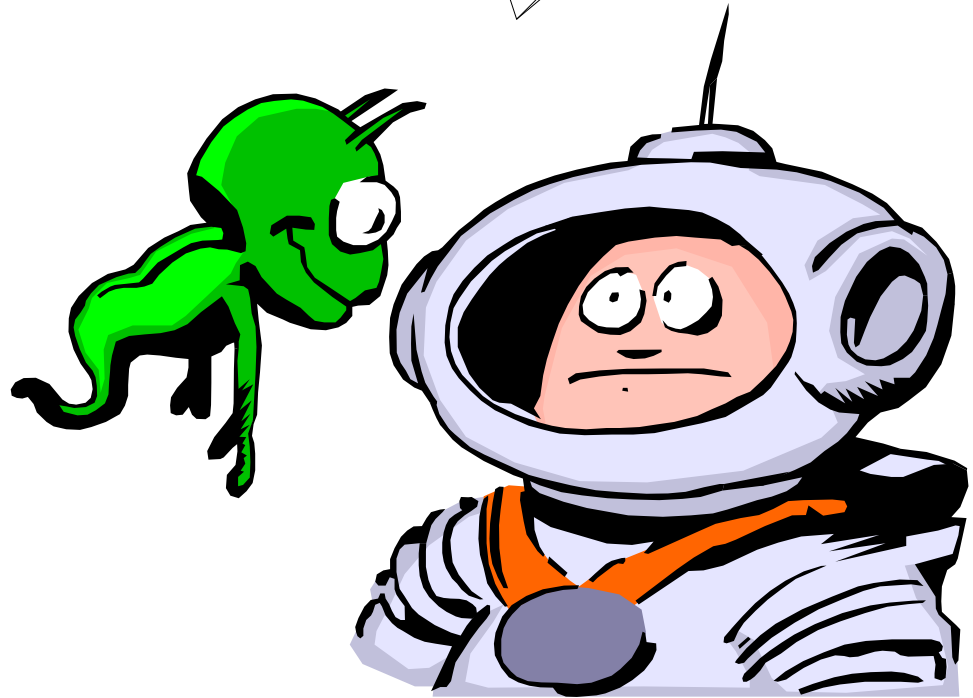
4. What is a propellant?

5. Enumerate the main parts of a rocket?

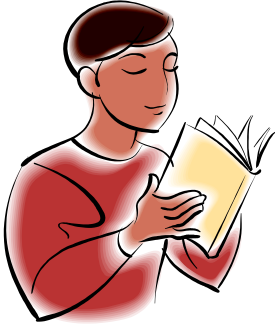
A.	E.
B.	F.
C.	G.
D.	H.

6. Enumerate the future mechanism in Space transportation?

**WHAT IS IN YOUR
BRAIN ?**



It's A No-Brainer!



Lesson's Objective:

To identify the **parts of the brain and their functions**, and to understand **the effects of pressure at the point of contact**.

Background Information:



The brain is the control center of your body. We now know that destruction of even small areas of the human brain can have devastating effects on behavior. Different sections of the brain control different body functions. There are five main functions controlled by the brain: vision, speech, balance, sound, memory, emotion, motor, and other senses. It is very important to protect the brain during activities that could cause trauma to the head.

Helmets work very well, as long as they are fitted securely and buckled when you crash. They can prevent up to 88 per cent of cyclists' brain injuries. Many helmet users are not securing their helmets level on the head and adjusting the straps carefully. Helmets have also been shown to offer substantial protection to the forehead and mid face.

Advanced technology figures into almost everything scientists do, and athletics is no exception. At the Super Bowl, you may not see the defense wearing space suits, but there is an element of aerospace research being used by just about every player on the field.

Take the helmets, for instance; the padding in the helmets was developed from NASA research, and the plastic in the shell is the same

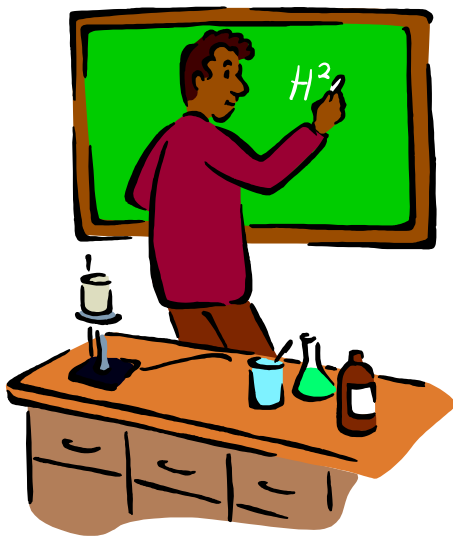
material used by astronauts on space walks. When it comes to the rough-and-tumble game of football, helmets are one of the most crucial pieces of safety equipment. Having well-padded headgear is essential to the safety of athletes involved in the game.

The outer shell of today's football helmets is made from the same plastic material used in astronaut helmets. It's a lightweight polycarbonate called Lexan. It helps reduce the impact of a tackle by spreading the force over a greater area of the head.



Materials:

- **Per Student**
- Puzzle sheets
- Color pencils, crayons, or markers
- Scissors



- **Per pair of students**
- Pieces of foam cushioning
- Raw chicken eggs
- Tape
- String
- Paper towels
- Self-sealing plastic bags
- **For teacher demonstration**
- Block of wood
- Two nails
- Hammer
- Paper Towel

Pre-Lesson Instructions:

1. Divide students into partners to complete this lesson.
2. Prepare a self-sealing plastic bag for every pair of students prior to the activity. Alternate the following items:
 - a. A plastic bag with just a raw egg in it

- b. A plastic bag with a raw egg, a piece of foam cut to cover half of the egg, and a piece of string long enough to tie around the foam and the egg. Tie the string around the egg and foam loosely.
 - c. A plastic bag with a raw egg, a piece of foam cut large enough to completely cover the egg, and a piece of string long enough to tie around the foam and the egg. Tie the string around the egg and foam loosely.
 - d. A plastic bag with a raw egg, a piece of foam cut to cover half of the egg. Tape the foam to the egg.
 - e. A plastic bag with a raw egg, a piece of foam cut to cover the egg completely. Tape the foam securely around the egg.
3. Make groups with the pairs that have the same materials in their plastic bag.
 4. Make egg demonstration and explain.
 5. Make hammer and nail demonstration.
 6. Explain that they are going to see how important it is to wear a helmet correctly. Use the following as representations.
 - The eggs in the bags represent a person's head, and the foam represents a helmet.
 - The students with just the raw eggs are not wearing a helmet.
 - The students with the small piece of foam and string are representing a person wearing a helmet that does not fit properly and is not fastened with the strap.
 - The students with the small piece of foam taped to the eggs are representing a person wearing a helmet that does not fit properly, but the strap is fastened.
 - The students with the foam that covers the egg and string represent a person wearing a helmet that fits but is not fastened with the strap.
 - The student with the foam that covers the egg and is taped around it is representing a person wearing a helmet that fits and is strapped on properly.
 7. Explain the rules of the egg-toss experiment and take the class outside.

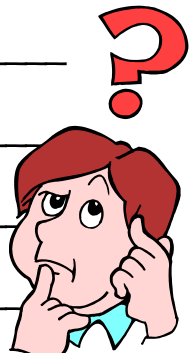
Discussion Questions:

1. Which provided the best protection? _____

2. Did having the foam loosely on the egg help protect it from cracks? _____

3. Did the impact surface have an effect on the amount of damage? _____

4. Do you think wearing a helmet will protect you from a head injury? _____



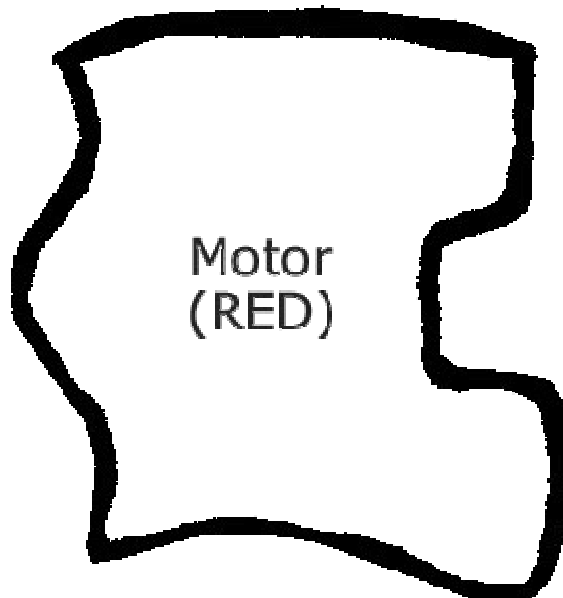
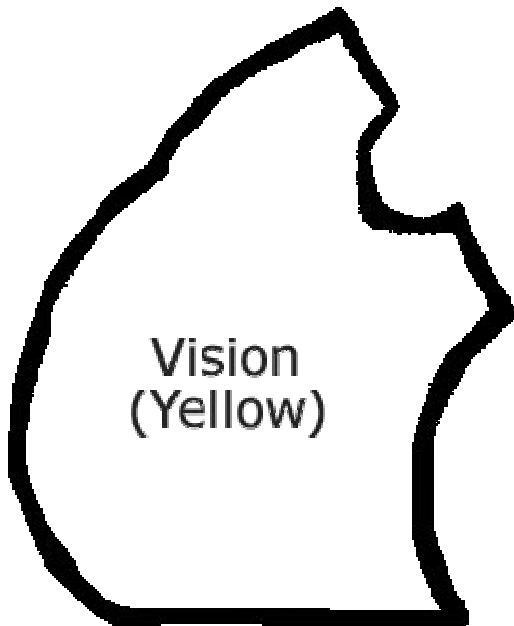
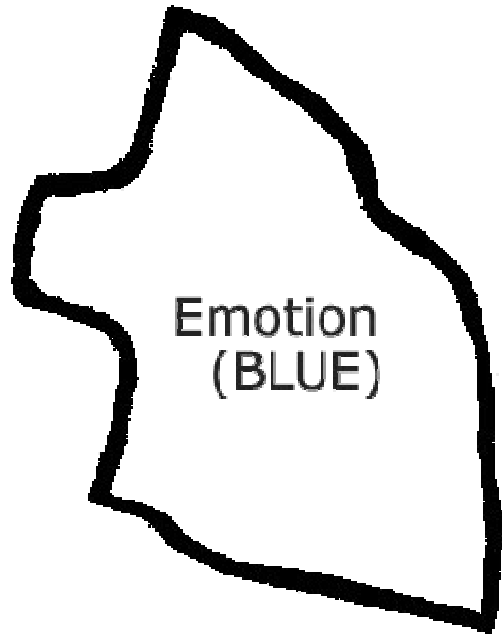
Instructions: Color, Cut, and connect the puzzle pieces on the next page to build your brain.

Memory
(Green)

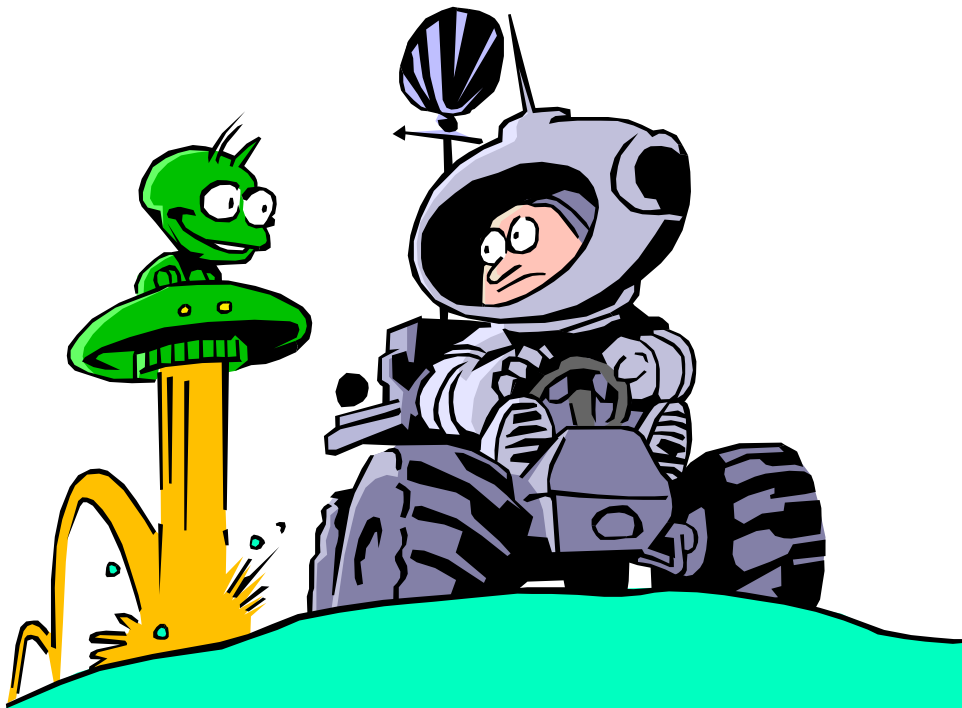
Speech
(Orange)

Sound
(White)

Others
Senses
(Purple)



**NEXT
SPACE CODE 101**



Space Code 101

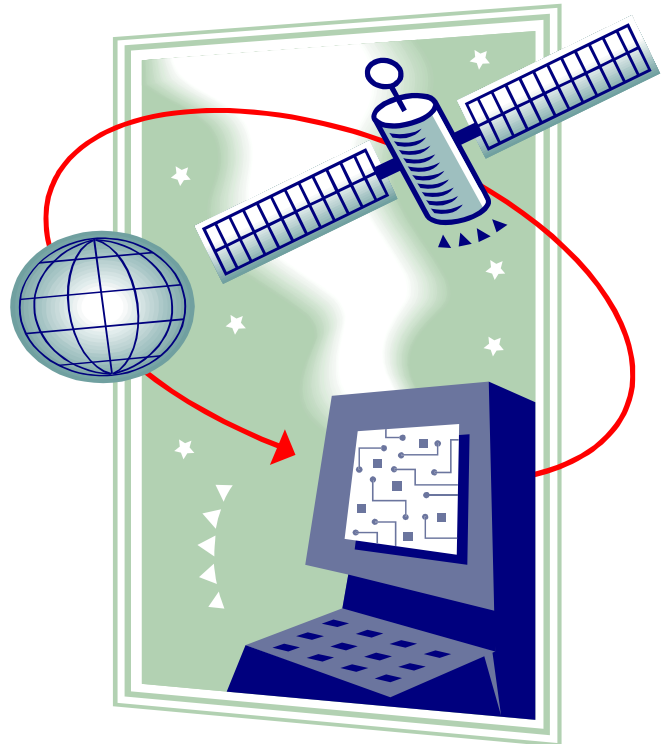
Objective:

To show how messages are sent into space using radio telescopes with the hope that the messages will be received and understood by intelligent life in other solar systems.

Activities:

The students will:

1. Decode a message that is written in binary code.
2. Study an actual message that was sent by the Arecibo radio telescope.
3. Design a simple picture on graph paper and code it in binary.

**Materials:**

For each student:

graph paper, pencil
copy of 10 by 10 binary code chart
copy of message sent from Arecibo

For the lesson:

Arecibo message with the explanations of some of the symbols
drawing of key to show what binary chart looks like uncoded

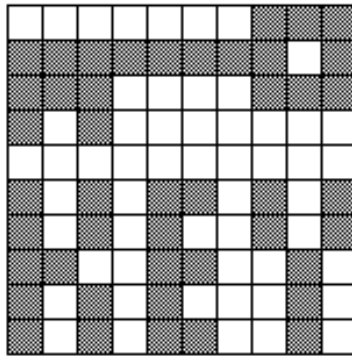
Previous Knowledge Necessary:

Knowledge of binary code (ties in with a lesson about computers)

Some background about radio telescopes, which are used to send and receive radio signals. They can be used to communicate with our deep space exploratory probes and with possible extraterrestrial life, although they are most commonly used to listen to the radio noise of outer space.

Procedure:

1. Using a copy of the binary code chart, each student transfers the binary lines onto her graph paper, leaving the square blank if the number is "0" and filling in the square if the number is "1."



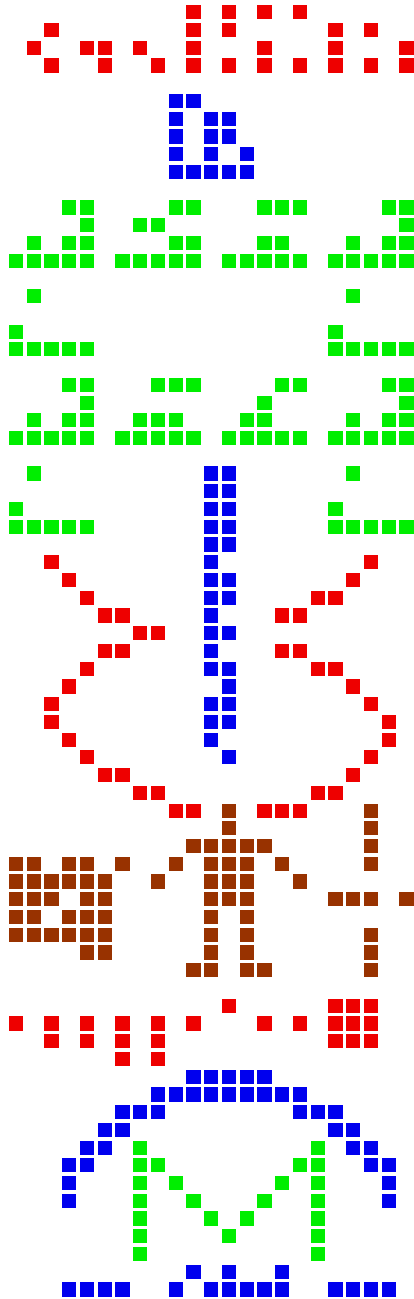
(The finished product is a drawing of a key with the word KEY underneath.)

2. Have the students look at the picture that was actually sent by radio telescope. Explain the message is coded in binary, but if any intelligent extraterrestrials find the message, they may be able to figure out that they can decode the binary by doing exactly what the students did actually the with the "key" message. See if anyone can guess about the meaning of the symbols portrayed in the picture. (A copy of the symbols with simple explanations of the meaning is enclosed.)
3. The students can then draw a simple picture on graph paper. Then they can code the picture in binary by assigning "0" to the blank squares and "1" to the colored squares.
4. Binary code message can be traded with friends or by lot and decoded by transferring the binary message onto graph paper. (This activity is the same as the first procedure.)

Date _____

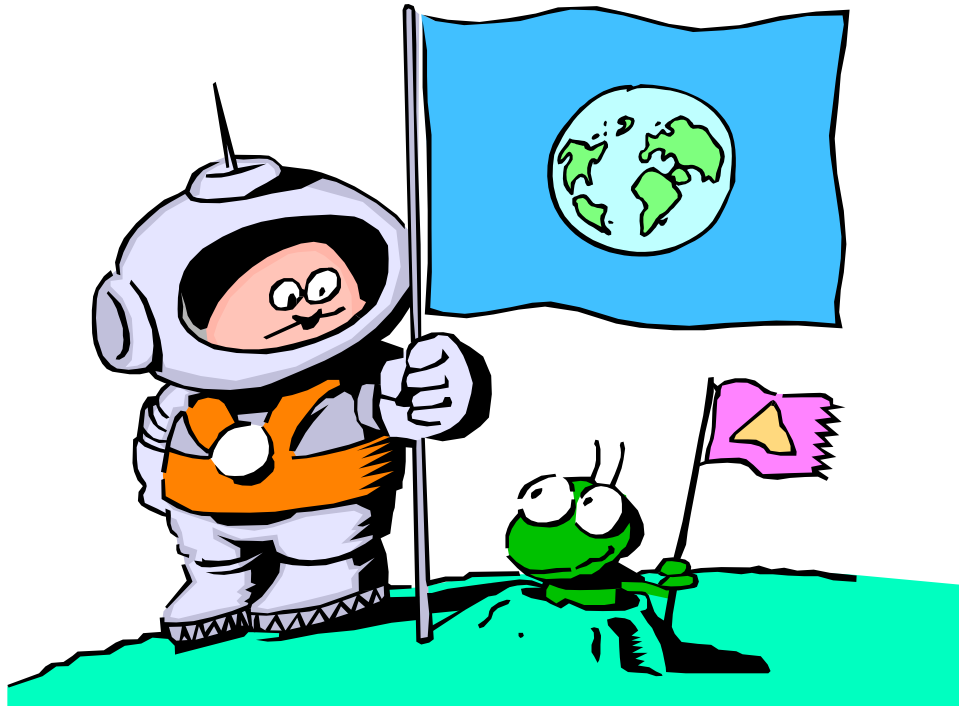
This activity was taken from a book by Harold R. Jacobs titled *Mathematics - A Human Endeavor*. It was published by W. H. Freeman and Co., San Francisco in 1971.

The Arecibo Message Explained



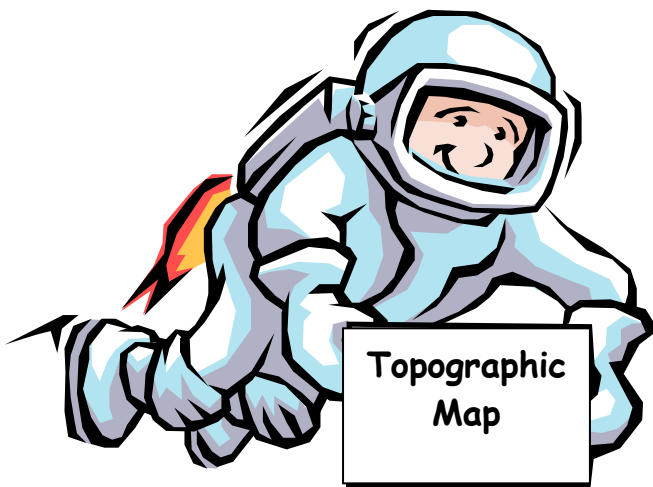
1. The first set of symbols (colored Red) represent the numbers from 1 to 10 reading from right to left.
2. The cluster in the center (colored Blue) codes the atomic numbers for certain elements.
3. These (colored Green) patterns represent formulas for sugars and bases in nucleotides of DNA.
4. The (colored Blue) vertical bar in the center specifies the number of nucleotides in DNA.
5. The double helix of DNA is represented by the (colored Red) curving lines that go from the (sugars/bases) formulas to the human figure.
6. The next set of symbols (colored Brown) represent the human population (on the left) on Earth, a figure of a human (in the center) and (on the right) the height of a human.
7. Our Solar System (colored Red) is displayed next. The dot representing Earth is displaced toward the human being.
8. The Arecibo telescope dish (colored Blue) is transmitting the message (colored Green) near the bottom of the picture. The last set of symbols (colored Blue) give the diameter of the Arecibo Radio Telescope.

**LET'S BUILD A
TOPO MAP**



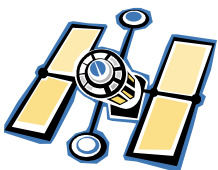
What is a Topographic Map?

A topographic map, or "topo map," is a way to show mountains and valleys on a flat piece of paper. Topo maps are handy and necessary for many uses, including building roads and hiking trails in the mountains. The map shows where the hills and valleys are and how steep they are. (Slope: be at an angle; "The terrain sloped down")



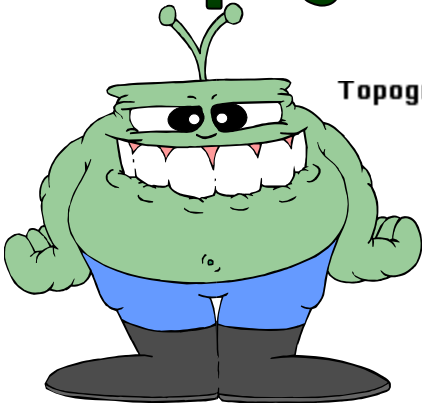
What Do "Topo" Maps Have to Do with Space?

We can use a technology called imaging radar to help create a picture of the terrain on Earth--or any other planet. Imaging radar instruments are flown over the land (or water) in an airplane, flown in space on the Space Shuttle, or put on a spacecraft and launched into orbit around the planet.

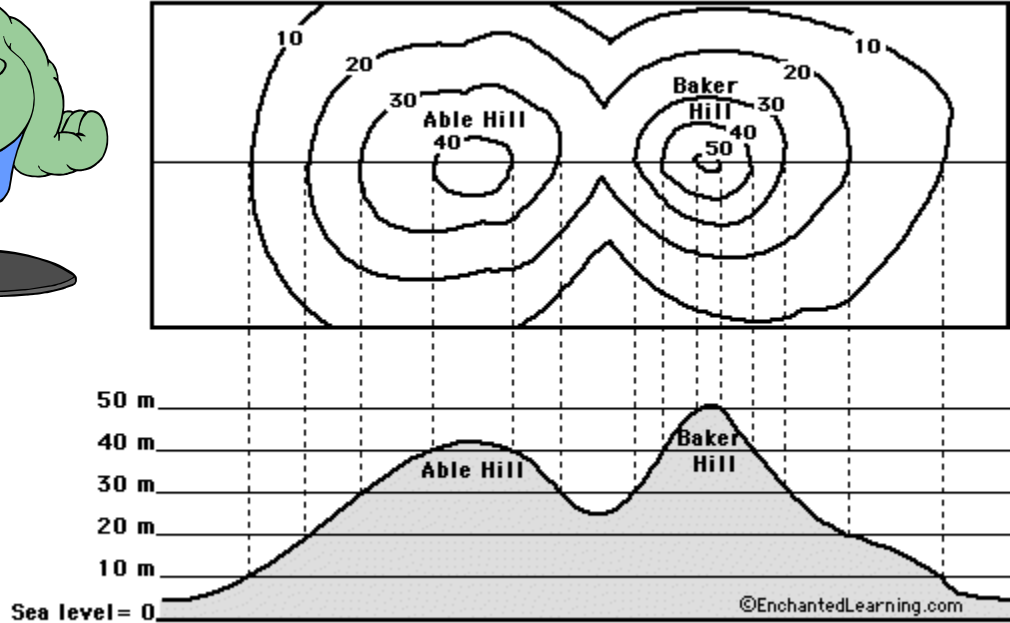


Fact: It will take scientists a long time to study all the image data and up to two years to make a map.

Topographic Maps Understanding *Activity*



Topographic Map (with contour lines that show points that are on the same level)



The two hills seen from the side, with elevations marked and dotted lines pointing to the corresponding contour lines.

Color the elevations on the topographic map as follows. Red: 50m and higher, Orange: 40-50m, Yellow: 30-40m, Light green: 20-30m, Dark green: 10-20m, Purple: 0-10m.

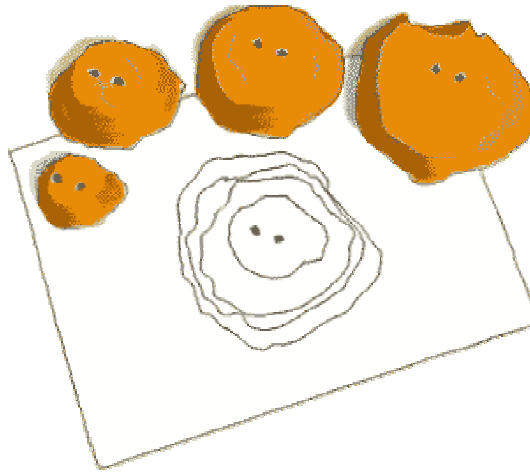
Answer the following questions using topographic map shown above.

1. Approximately how tall is Able Hill? _____
2. Approximately how tall is Baker Hill? _____
3. Which mountain is taller, and by about how much? _____

4. How many meters of elevation are there between contour lines on the topographic map? _____
5. Which mountain has steeper slopes? _____
6. Are the contour lines closer together on Able Hill or Baker Hill? _____



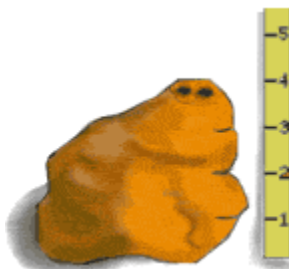
Let's Build a Topo Map



Materials:

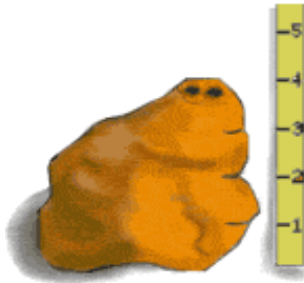
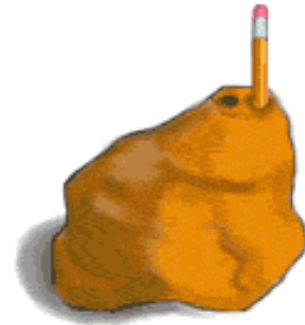
- A lump of clay or Play-Doh® about the size of a coffee mug.
- Piece of cardboard or large tile on which to work the clay
- Piece of dental floss, about 2 feet (around 60 centimeters) long
- Ruler
- Piece of plain, white paper
- Long pencil
- 2 toothpicks
- Crayons

Step by Step Directions:



1. Put the lump of clay on the cardboard and shape a mountain about 4 inches high. Making the map is more fun if you make your mountain a little lopsided or oddly shaped. However, the mountain should be flat on the bottom.

2. Use the long pencil to poke two holes straight down through the center of the mountain. Make sure your two holes go all the way through the mountain.

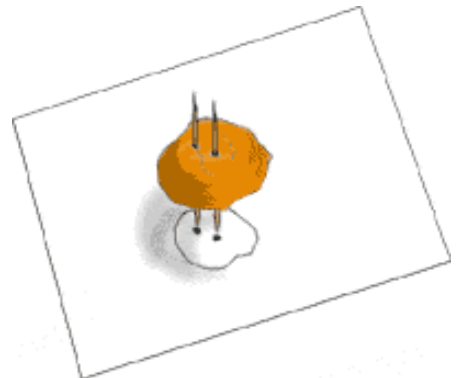


3. With the ruler, measure down about 1 inch (2.5 centimeters) from the top of the mountain and make a little dent mark with the pencil. Make two more dent marks lower down on the mountain about 1 inch apart. Or, without using the ruler, just make three marks to divide your mountain into four slices all about the same thickness.



4. Stretch the dental floss until it is taut, wrapping the ends around your fingers so you have a good grip on it. Use the dental floss to cut through the mountain at top-most mark you made. Hold the floss as horizontal (level with the table or floor) as you can.

5. Remove this clay slice and place it on the paper. Use the pencil to carefully trace around it. Push the pencil through one of the holes in the clay and make a dot on the paper; do the same with the other hole. Put the slice aside, but don't squash it. You'll need it again later.



6. Cut a second slice at your next mark down from the top. Lay the second slice over the tracing of the first one, being careful to place the holes in the second slice over the dots on the paper. To line up the holes, poke the two toothpicks through the holes in the slice and line them up with the two dots on the paper. Carefully trace around the second slice. Your tracing will form a circle outside the tracing of the first slice. (If you have "outcroppings" on

your mountain, the second circle could cross into the area of the first circle).

7. Cut another slice at the next mark down. Line up the holes with the dots and trace it as you did before. Finally, place the bottom slice on the paper, line up the holes, and trace it.

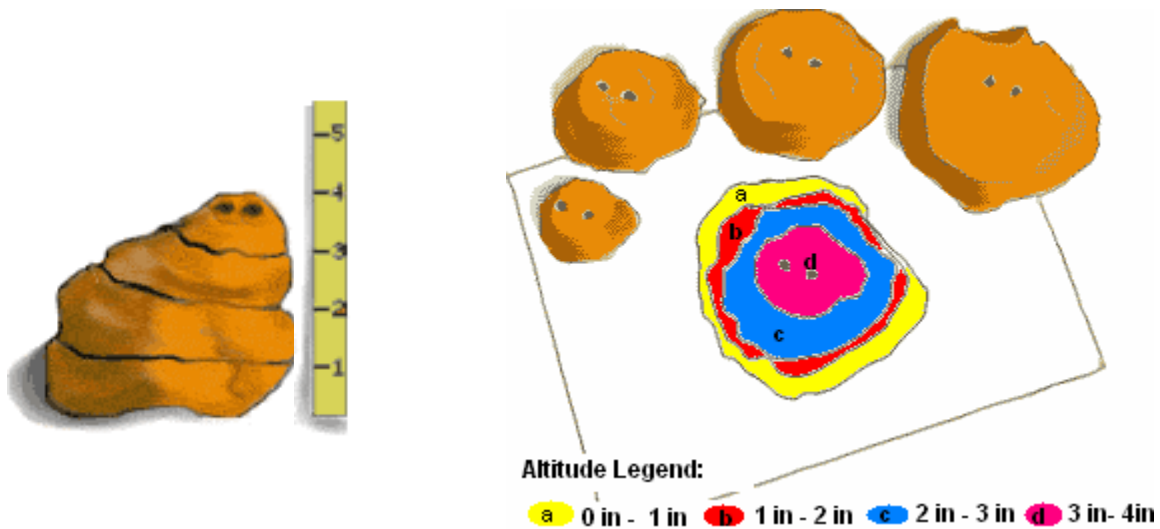


8. Stack the slices back up in order on the cardboard. Be sure the holes line up.

9. Admire your topo map!

10. Compare the topographic map you have just made to the model mountain.

11. Finally, let's create a legend for our topo map, since we make the mountain's cut based on height, our legend will be describing the possible height of each areas in the topo map. For example;



Conclusions:

1. Why are some of the traced lines closer together than others? _____

Date _____

2. On your topographic map, where are the steepest slopes? _____

3. Looking at your map, where would be the best place to build a trail to climb to the top of the mountain? _____

4. Do you think the topo maps are useful? If yes, why? _____

References:

<http://www.enchantedlearning.com/geography/mapreading/topo/>

<http://spaceplace.nasa.gov>



**WHAT DO YOU KNOW ABOUT
SOLAR AND FUEL ?**



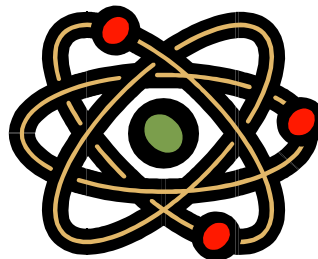
Water Electrolysis/ Fuel Cell Cars

Students will recognize and/or understand:

1. Specific aspects of the atomic theory
2. Water as a molecule
3. The theory and applications of water electrolysis
4. The design and theory of a car powered by a fuel cell

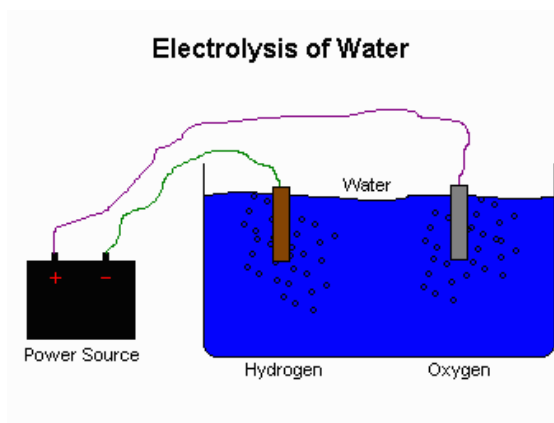
1. Atomic Theory

- Components of the atom
 - Nucleus
 - Protons
 - Neutrons
 - Electrons



2. Atoms and Molecules

- How atoms form compounds
- Compounds as molecules
- Water molecule



3. Water Electrolysis

- HOW? and WHY?
- Electrolysis Apparatus (9V battery, water, and platinum wires as electrode)

4. Fuel Cell

- What is it?
- How does it work?
- Theory/Applications
- Design of fuel cell powered car

5. Set-up

- First 20 minutes will involve an introductory lecture on powerpoint discussing atomic theory, atoms, molecules
- The next 15 to 20 minutes will be a combination of lecture and activity on water electrolysis.
- The next 1 hour will involve discussion of fuel cell technology and the construction of the fuel cell car.

6. Materials

- Five Fuel Cell kits
- Gum drops/toothpicks
- Water electrolysis kit

Note: This kit is reusable and includes many options for other experiments that will be developed for the future and included in a fuel cell oriented module.

SOLAR AND FUEL Cells

Pre-lab Activity

Think about the following questions and be prepared to discuss them with you teacher:

- Describe an atom and a molecule and give examples?

- What is the difference between atoms and molecules?

- How many atoms are in a water molecule?

Give two examples in history where people used water as a source of energy?

Example 1: _____

Example 2: _____



Experimentation

Experiment objectives

Today's experiments will explore the use of Solar energy to dissociate break water molecules. You will also explore the use of Hydrogen (H_2) and Oxygen (O_2) in a fuel cell. This lesson will help you understand how NASA scientists use solar power to run many systems in space.

Question/Hypothesis

- 1) Think about which parts of the water molecule are involved in "breaking" the chemical bonds between atoms.

Materials

Fuel cell kit

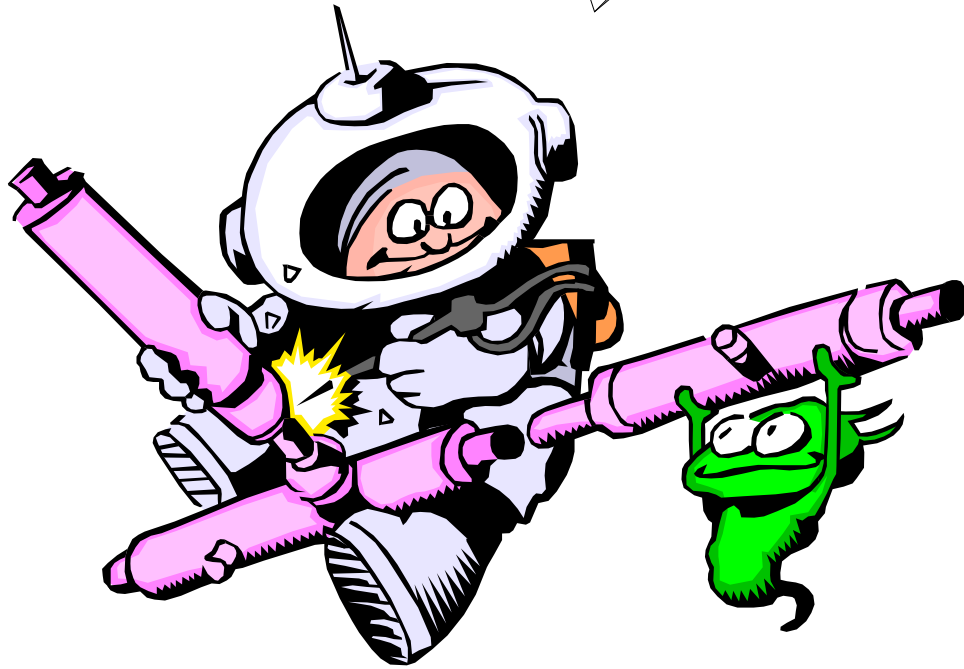
TOPIC QUESTION:	
PURPOSE:	PROCEDURE:
	<u>MATERIALS LIST:</u>
	<u>VARIABLES:</u>
	MANIPULATED VARIABLES:
HYPOTHESIS:	
	RESPONDING VARIABLES:
	VARIABLES HELD CONSTANT:

GRAPH:

CONCLUSION:



**LET'S LEARN ABOUT
ROBOTIC ARMS**





Robot Schematics

Objective



The purpose of this lesson is to stimulate students to discover what is behind a robot. The science that studies the robots is acknowledged as robotics. During this experiment the student should be able to recognize different type of robots and applications. In addition, the students will be able to identify different types of robot, joints and mechanism. This will also give the student the basic knowledge of robotics design and understand the benefits and advantages of robots.

Background

The components to build a robot are numerous according to each **physical configuration**. Every **physical configuration** promotes a working space and this breathing space is limited according to the **degrees of freedom** or possible movement. The flexibility of motion is increase when different types of joints are link to his structure. At least six degrees of freedom are necessary to emulate the motion of a human arm and wrist. In this lesson the students are going to be able to operate an **Articulated Robotic Arm** on class. They will be able to see the movement and possible applications of this type of robot. The advantages and disadvantages of the articulated arm configuration will be outlined next.

Advantages:

1. All joints are rotary.

2. Maximum flexibility since any point in the total workspace volume can be reached.
3. Joints can be completely sealed and protected.
4. This is very useful in dusty or corrosive environments, or under water.

Disadvantages:

1. Very difficult to visualize and control.
2. Restricted volume coverage.

Robots are capable of performing many applications; the complexity involved with using a robot to perform the application may require too much time and effort to allow justification of the robot. This can only be evaluated on a case by case basis, based on the complexity of the application, the run length and the cost of support. Articulated Robotic Arm is perhaps the most widely used arm configuration because of its capability to reach any part within the working envelope.

Due to the flexibility, this robot type can be used in such advanced applications like:

1. Spray painting
2. Weld sealing
3. Assembling

This **Articulated Robotic Arm** offers five axes of motion that can be define as follow:

1. Base Right / Left 350 degrees
2. Shoulder 120 degrees
3. Elbow 135 degrees
4. Wrist rotate clockwise & counter clock wise 340 degrees
5. Gripper open and close 50 mm (2 in)

General Arm Motion

1. Vertical movement. Up and down motion of the arm. May be caused by moving the whole robot body vertically.

2. Extension and retraction of the arm allows the effective length of the arm to be changed.
3. Rotation about the base of the robot.

Possible Wrist Motion

1. Wrist pitch, which is up and down movement of the wrist.
2. Wrist roll, rotation of the wrist clockwise or counterclockwise. Rotation and pitch can together produce yaw as described below.
3. Wrist yaw, movement of the end-effectors to the left or right.

Note: Alligator clips are recommend for those children who have physical disabilities with their hands.

Materials

- | | |
|--------------------------|-------------------|
| • Robotic Arm kit | • Diagonal Cutter |
| • Remote Control box | • Pencil |
| • 4 batteries size D | • Pen Knife |
| • Screwdriver (+) (M3) | • Ruler |
| • Long - nose Pliers | • Protractor |
| • Small Hammer | |

Student Procedure

Students group will begin the experiment verifying first if they have all the materials required to proceed with the experiment. They will follow the teacher instruction all the time. Follow these steps when conducting the experiment:

1. Place students in groups of 4 or 5.
2. Set-up stations for each group with all necessary materials.
3. The students should check the instruction manual and classify all the materials require per step. So they will have the opportunity to get familiar with the **Articulated Robotic Arm**.



Fig.2 The previous image illustrate the final assembly of the **Articulated Robotic Arm (OWI-007)** and Remote Control Box

4. Each group has to provide a list of materials at the end of the experiment.
5. After the assembling process it is necessary to set the computer software to program the robot movement. This could be done by the teacher or someone with enough experience with this type of equipment.
6. Test the remote control box and robot motion according to the manual of instruction.
7. Proceed to answer the experimental data sheet once each group gets familiar with the control movement.
8. Discuss your findings and answer the entire experiment sheet question.

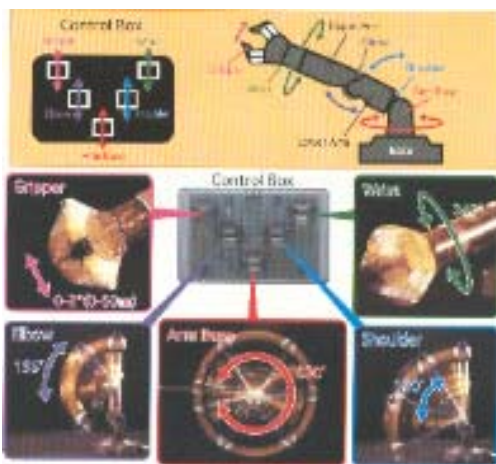
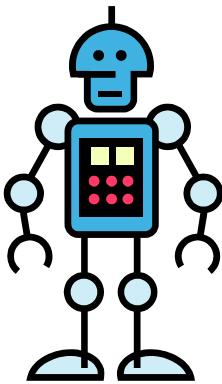


Fig.3 Illustrate all the possible movement of the **Articulated Robotic Arm (OWI-007)** using Remote Control Box

I. Experimental Data Sheet

A. How many Servo motors and Joints are parts of the Robotic Arm? Explain your answer. _____

B. What is the voltage of your source? _____



C. Enumerate degrees of freedom existing in OWI-007.

- | | |
|----------|----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |
| 5. _____ | |

D. Measure the displacement of the Arm when it is oriented at 180 or 90 degrees the distance is the same yes or no? Write your results in inches (inch.) and centimeters (cm.) and explain you answer.

E. Measure the gap of OWI-007 grip if there is any when is close? Write your results in inches (inch.) and centimeters (cm.).

F. Measure how wide OWI-007 grip can be open?

Date _____

G. Measure how many degrees of movement can be achieved by the following components:

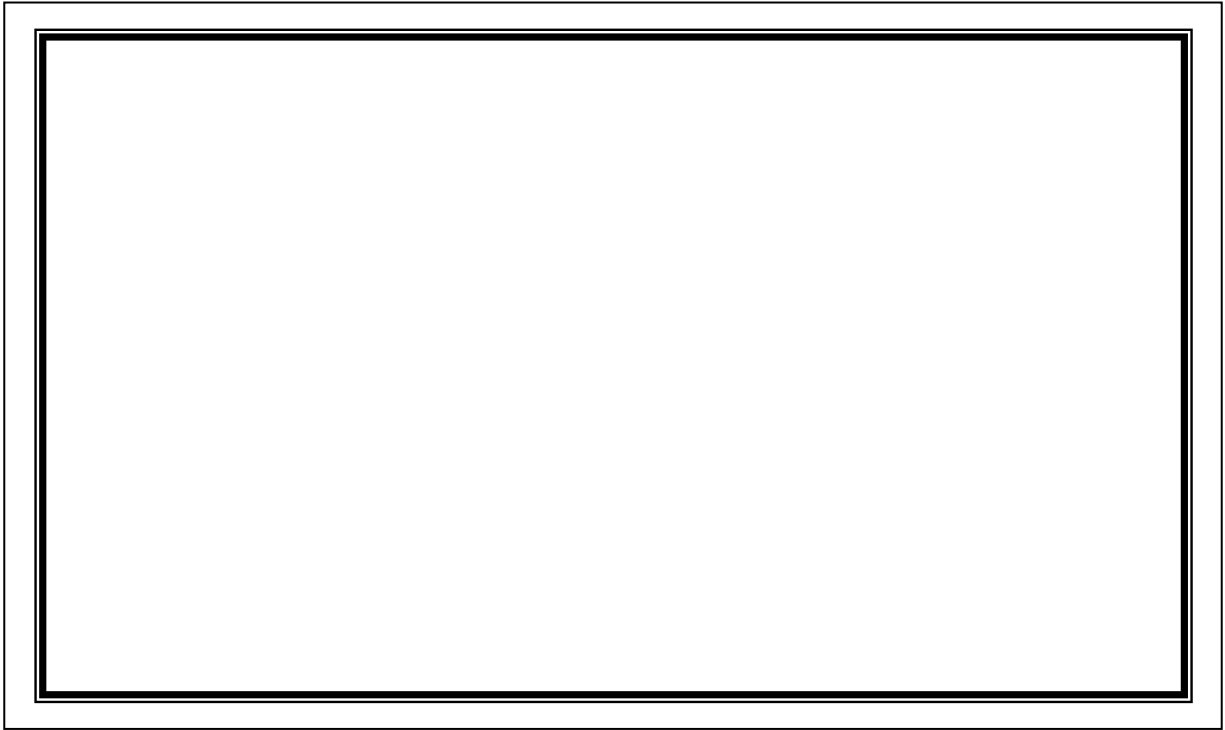
Mechanism	Degrees	Type of Angle
Shoulder		
Elbow		
Base		

II. Outline and Engineer Drawings

A. Draw a diagram and identify the main components or parts and reference frame of the Articulated Robot Arm.



B. Draw the Workspace Envelop of this type of robot?



C. How you determine if this breathing space represents the correct answer? Explain in your own words.



**LET'S TRY SOME
SPACE FOOD**



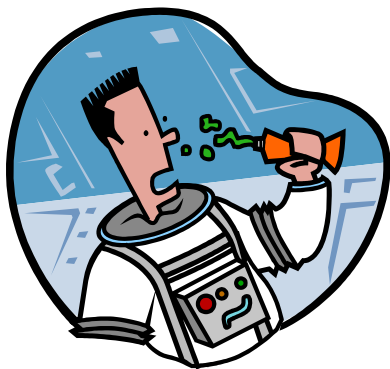


First Objective:

Students will determine the acceptability of food products for space flight by participating in a sensory taste panel.

Background Information:

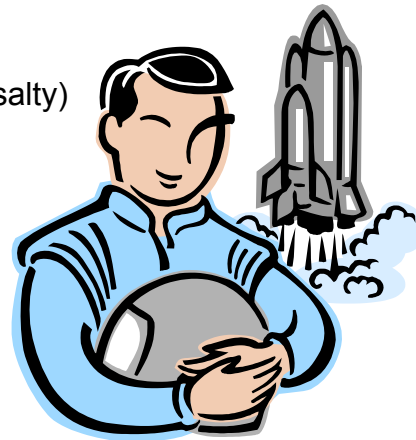
Astronauts select their menus for space about 5 months before they fly. For the Space Shuttle, they select a menu that will serve them through the duration of their flight. They store the food in the galley of the shuttle. A special taste panel is set up for the astronauts to taste a variety of foods when they are selecting their menus. This lets the astronauts know whether they like the food before going into space. Foods are tested for appearance, color, odor,



flavor, and texture. It does not help astronauts to take foods into space if they will not eat them. This taste panel helps in the selection of a desirable menu and reduces waste of uneaten portions.

Materials

- Paper plates
- Food samples (ranging from bitter, sweet, sour, and salty)
- a Taste Panel Evaluation Form
- Water



Procedure

1. Answer the following questions:

- What is your favorite food?

- Would it be considered bitter, sweet, sour, or salty?

- If you were going into space, what foods would you take with you?

- Why do you think it is important to test foods before you take food into space?

2. Choose a food item and rate it on a scale of 1 to 3 according to appearance, color, smell, taste, and texture.
3. Repeat step one until you have tested all of the food items.
4. Total the scores for each food and list them on the form.
5. Be ready to share your findings with the rest of the class.

Questions

1. Which food got the highest score?

2. Which food got the lowest score?

3. Which sense of taste is the food you liked best considered?

4. Which sense of taste is the food you liked the least considered?



Date _____

Taste Panel Form

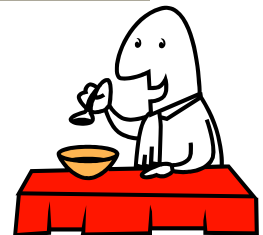
Food Item				
Appearance				
Color				
Smell				
Taste				
Texture				
Total Score				

Rating Scale:

1 - Bad

2 - Good

3 - Great





Second Objective:

Students will plan a nutritious 3-day flight menu for astronauts in space.

Background Information:

In the past, space food was not that great. Astronauts had to eat dried food from metal tubes that squeezed out like toothpaste. It was not very tasty. Space food has become more like the food we eat on Earth.

All weight going into space raises the fuel consumption at liftoff. It is important to eliminate as much weight as possible. Because the fuel cells on the Space Shuttle produce water as a byproduct, water is easily attainable. Therefore, taking foods along that can be rehydrated with this water makes sense because this reduces the amount of weight on liftoff. The **rehydrated** foods also take up much less space, and space is a valuable commodity onboard the Space Shuttle.

Planning food for a space flight can be tricky. It is the job of the meal planners at **Johnson Space Center's Space Food Systems Laboratory** to create healthy meals for astronauts. They use the same food pyramid guide we use here on Earth. Foods such as soft drinks don't work because of **microgravity**. Ice cream can't go up without freezers. Fresh fruits and vegetables have to remain at room temperature. This limits how much can be taken. The food can only be heated to room temperature. Pizzas have not been perfected yet. Beyond that, astronauts can eat anything you might order from a typical menu.

It is important for astronauts to eat a balanced diet while in space. They have to be able to keep their energy up and stay focused. It is the job of the meal planners at Johnson Space Center to plan these nutritious meals. The planners use the Food Pyramid when making their space flight menu.

Materials:

- USDA Food Pyramid Guide
- Food list
- 3-day menu chart

Procedure

1. Answer the following questions:

- *How many groups of food are there?* _____
- *How many servings of each group do you need a day?* Refer to the Food Pyramid sheet.

- *What is your favorite food group?*

2. Read over the list of food items available for the 3-Day space flight. Some menu items may contain more than one food group. For example, Banana Pudding is part of the fruit group and dairy group.

3. Using the Food Pyramid and Food List, select three meals for Monday (breakfast, lunch, and dinner). Make sure you include all the servings you need for the day.

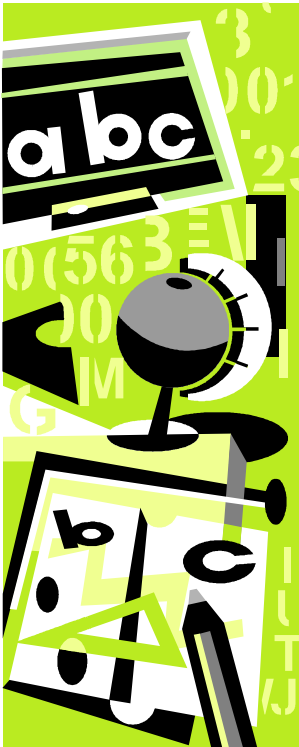
4. Write your selections down in the 3-Day Space Menu Chart.

5. Repeat steps two and three. Try not to repeat the same foods. Make your menu have a good variety.

6. Write down your favorite meal.

7. List five healthy foods. List five unhealthy foods.

Healthy	Unhealthy



Discussion Questions:

1. Discuss why it is important for astronauts to receive the recommended daily servings.

2. Discuss types of problems you might face while trying to eat in space.

*Have students share their menus in class and state their favorite space meal for the trip.

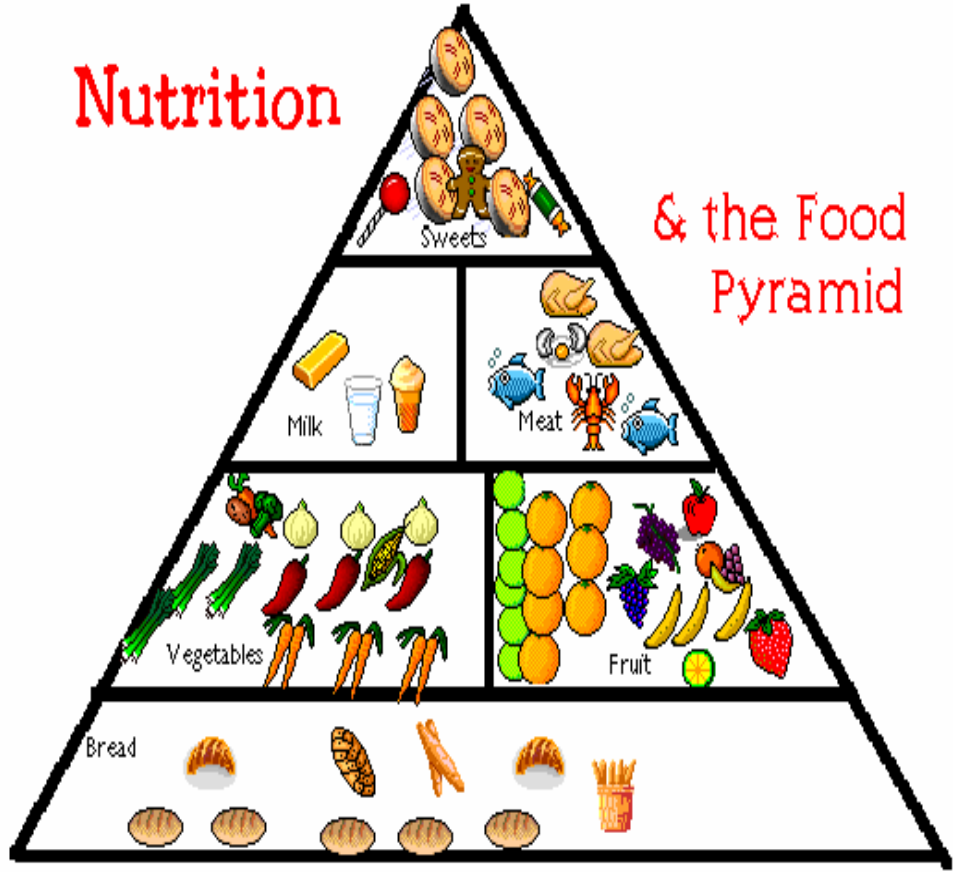
Food List and 3-Day Menu

Breakfast	Lunch	Dinner
<ul style="list-style-type: none"> • Bacon • Cinnamon Toast Bread • Strawberry Cubes • Grapefruit Drink • Orange Drink • Sausage Patties • Sugar-Coated Cornflakes • Peaches • Water • Fruit Cocktail • Banana Pudding 	<ul style="list-style-type: none"> • Cheese Crackers • Cream of Chicken Soup • Grape Punch • Tuna Salad • Apple Sauce • Sugar Cookies • Turkey Bites • Pea Soup • Ham and Potatoes • Chocolate Pudding • Water • Grapes 	<ul style="list-style-type: none"> • Chicken and Rice • Beef Stew • Grape Drink • Chicken and Vegetables • Chocolate Cubes • Spaghetti and Meat Sauce • Turkey and Gravy • Pork and Scalloped Potatoes • Dry Fruitcake • Water

_____ 3-Day Space Menu

Monday	Tuesday	Wednesday
Breakfast		
Lunch		
Dinner		

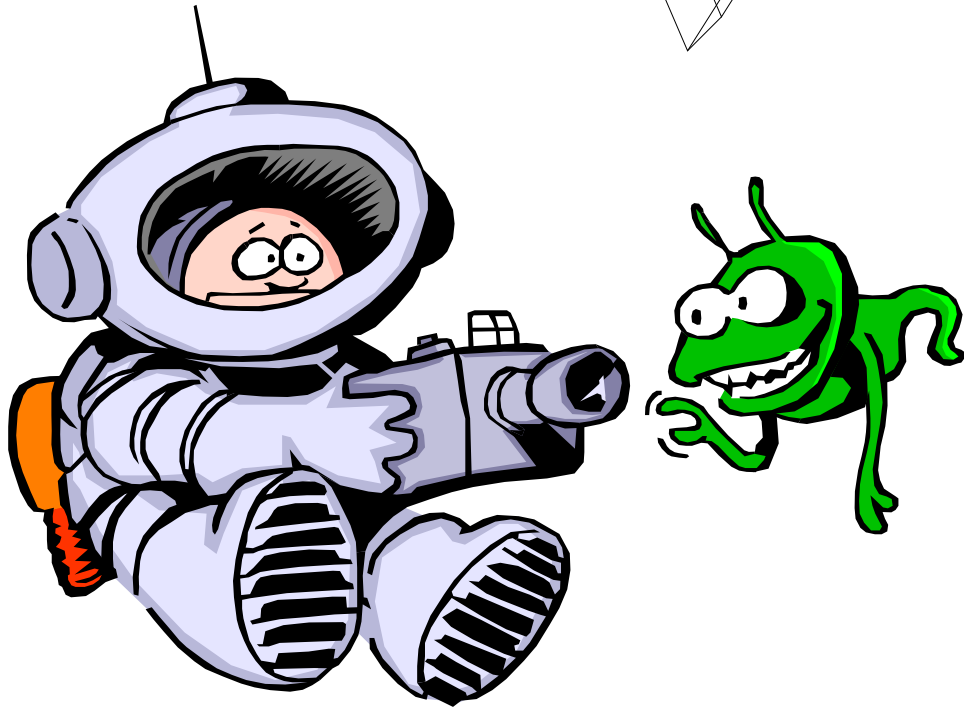
Nutrition & Food Pyramid



Nutrition

& the Food Pyramid

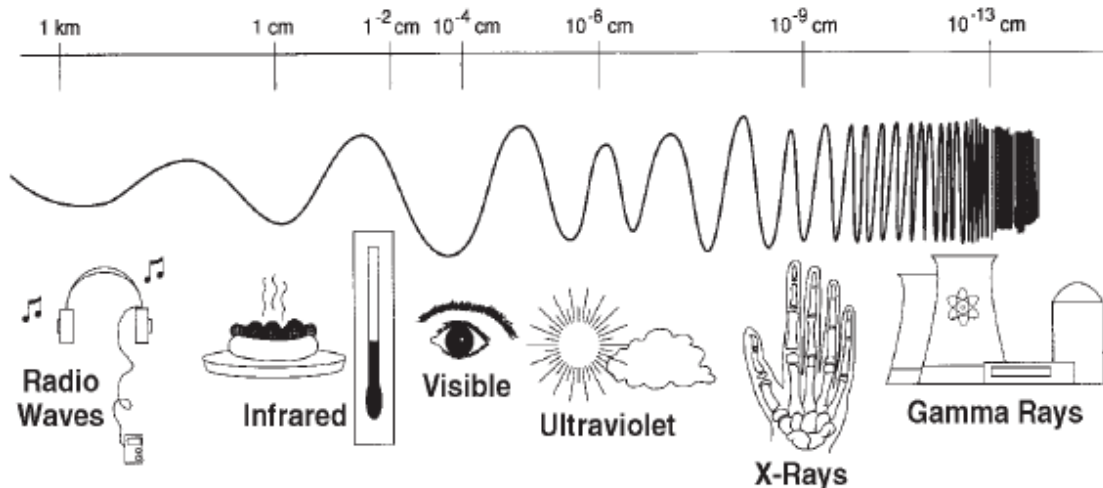
**LET'S HAVE A
SPACE TALK**





All around the world every minute of every day people are talking, and they are all talking at the same time. Think of places that you have been where everyone is talking at once—between classes at school, football games, and shopping malls. Was it hard to hear just one particular conversation?

When you turn on a radio, you hear people talking or you hear music. As you change the tuner to successive stations, you find that there is some form of audio on all the stations. You may wonder how they can all talk at once, but you can only hear one station at a time. This is due, in part, to **electromagnetic waves**— waves that are partly electric and partly magnetic and carry energy emitted by vibrating electric charges in atoms. All waves are on an electromagnetic spectrum.



The **electromagnetic spectrum** is a continuous range of waves—radio waves, infrared, visible, ultraviolet, x-rays, and gamma rays. It is a means of classifying electromagnetic waves according to their frequency. Waves all move, or vibrate, at the same speed ("c" for constant), but differ in their frequency. The **frequency** is how often a vibration occurs. This unit of frequency is called a **hertz** (Hz). When Heinrich Hertz first demonstrated radio waves in 1886, he found that the source of all waves was something that vibrates. Radio and television stations often announce that they are operating on a frequency of "x-number" of Megahertz. This is the frequency range assigned to them by the International Telecommunication Union (ITU). This organization divides the entire range of communications frequencies among those who use them. This includes

commercial radio, television, and Amateur Radio. Radio waves vibrate at the lowest frequency and have the longest wavelengths on the electromagnetic spectrum.

Visible light is just a small part of this vast spectrum. Light waves and radio waves are both electromagnetic waves that originate from the vibration of electrons. Sound waves are not electromagnetic waves, but a mechanical vibration of matter. So even though we hear a radio by means of sound waves, radio waves and sound waves are not the same.

A specific radio frequency is assigned to Amateur Radio operators when they are transmitting to space. All Amateur Radio operators, this includes those who operate for Space Amateur Radio Experiments (SAREX) missions, use a small portion of the frequency bands on the electromagnetic spectrum. Any amateur station that is located more than 50km above Earth's surface is defined by the Federal Communications Commission (FCC) as a space station. Amateur satellites, the Space Shuttle orbiters, the Russian MIR Space Station, and the International Space Station all fall under this category.

If you drop a pebble into a pond circular waves will emanate from the drop source. The human eye can follow

these waves as they progress outward from the drop point. These waves like all other waves have **amplitude**, **wavelength**, and **frequency**. These three characteristics are present in all waves that make up the electromagnetic spectrum.

The **frequency** of a wave is measured in hertz, the wavelength in meters. Thus, the speed of a given wave is measured in meters per second. This relationship is the same for all kinds of waves, such as sound waves, light waves, or water waves.

A **wavelength** is the distance a wave travels through space in a single cycle. It can be measured from any point along the wave as long as it is consistently measured from the same point. The speed of the wave is equal to the frequency times the wave length. The **amplitude** of a wave is the maximum displacement on either side of the midpoint of a wave. The **midpoint** is the point at which the wave is at rest.



Lessons taken from
<http://teacherlink.ed.usu.edu/tlnasa/units/index.html>
Amateur Radio In Space

ACTIVITY:

"Hello Over There"



Objective

- Demonstrate with light beams how Amateur Radio satellite and repeaters send and receive signals
- Problem solve how a beam of light can be directed around a barrier

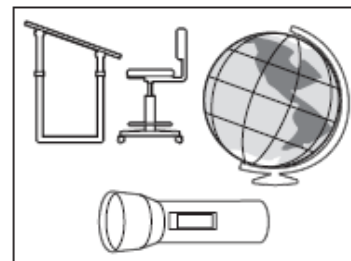
Activity Overview

This activity will allow students to simulate radio waves being transmitted and received using repeaters. Earth will be observed so students will understand why this method of communication is needed. In teams of four, students will problem solve to send a beam of light from one side of a barrier to the other. They will learn the path that light follows and how it reacts when a smooth, shiny surface (mirror) is placed in its path. Amateur Radio vocabulary will be introduced. Students will complete a Data Collection Sheet detailing methods used to solve a problem. Older students will predict where the light waves will be positioned on the other side of the barrier.

Materials

For each team of 4:

- 1 flashlight
- 1 mirror
- 1 chair or desk to act as barrier



- 1 piece of white paper
- Globe or map of Earth
- Data Collection Sheet

Science Standards

- Science as Inquiry
- Science and Technology
- Abilities of Technological Design

Technology Standards

- Technological Knowledge
 - Technological Concepts and Principles
- Technological Processes
 - Utilizing and Managing Technological Systems
- Technological Contexts
 - Informational Technology

Mathematics Standards

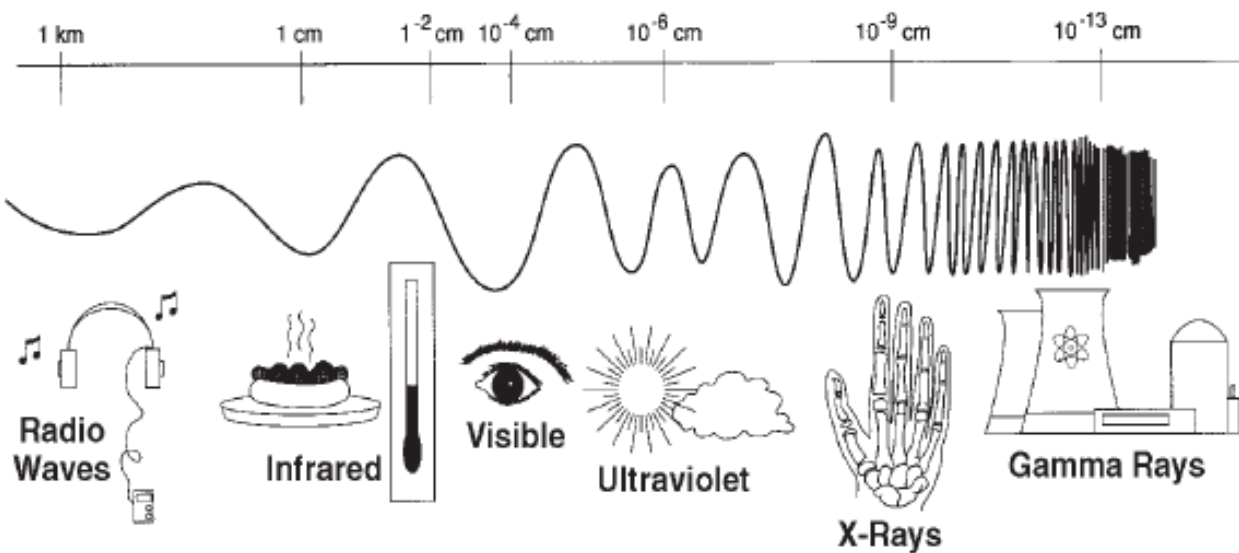
- Problem Solving
- Communication
- Geometric and Spatial Relations

Timeframe: 30-45 minutes

When looking at a relief map of the Earth, one cannot help but notice that Earth is not a flat plain. There are many valleys and mountain ranges. When standing on an ocean shoreline, Earth appears flat. But we know that Earth is round. Pictures sent from satellites and orbiting spacecraft have allowed us to see our round Earth. Since radio waves travel in a straight line, how then can we send a signal to the other side of a barrier and beyond? Some radio signals, called **direct waves**, travel in a straight direction or line-of-sight. These signals cannot bend or "jump" over a barrier

such as a hill or mountain range. They are also unable to curve around Earth. The signal from a radio on one side of the hill is transmitted to the other side by a repeater positioned on the top of the barrier. A **repeater** receives a signal on one frequency and simultaneously sends, or re-transmits (repeats) it on another frequency to a radio on the other side of the barrier thereby extending the range of the re-transmitted signals.

The frequency it receives on is the **input frequency**, and the frequency it transmits on is the **output frequency**. Often located atop a tall building or high mountain, VHF and UHF repeaters greatly extend the operating range of Amateur Radio operators using mobile and hand-held transceivers. When a transmitter and receiver are combined into one box, it becomes a transceiver and can send and receive signals. If a repeater serves an area, it's not necessary for everyone to live on a hilltop. But you have to be able to hear the repeater's transmitter and reach the repeater's receiver with your transmitted signal.



Procedure

1. Share background information with students. Show globe or relief map of Earth. Have students write or draw their observations of Earth on the Data Sheet. Discuss these observations orally.
2. Gather students together around a barrier (chair, desk, etc.) Explain to students that the barrier represents a very tall hill or mountain range.
3. Show flashlight, mirror, and piece of paper. Discuss the properties of each, how they are used in our daily lives, and any prior knowledge students may have about light beams and how they travel. The flashlight beam represents radio waves, the mirror represents the repeater on top of a hill, and the piece of paper represents the radio on the other side.



HINT: Cover the flashlight with a piece of paper that has a small, vertical slit cut in the middle. This will create a narrower light beam.

Discuss vocabulary words and have students write definitions to those words on the Data Collection Sheet.

4. Tell students they will work in teams of four. The problem they must solve is to **devise a way to send a beam of light to the other side of the barrier going over the top of the barrier**. The light must travel from the flashlight held touching the floor on one side of the barrier to the piece of paper placed on the floor on the other side of the barrier. Remind them that they must go over the barrier. They will need to document the steps they take in the Data Collection Sheet.

After a group discussion, make sure students understand the task. Give ample time for students to work in their groups to write the happen, solve the problem, and write down the information on the Data Collection Sheet. Have each group share their procedure with the class. Allow the class to ask questions and make suggestions.

5. As a follow up to the initial activity, each group can take what they have learned from watching the other groups and the suggestions they have been given and improve their procedure.



Date _____

Data Collection Sheet

Name _____

Group Names _____

Date _____

Observations of Earth

Problem to Solve



Repeater

Input Frequency

Output frequency

Data Collection Sheet

What Materials Did You Use? _____

What Did You Do? _____

What Did You Observe? _____

What Did You Learn? _____





Objectives

- State oral directions clearly and correctly
- Construct a structure using oral directions

Activity Overview

- Students will work in pairs to discover the importance of correct communication.
- They will construct a simulated microphone and learn how to use it correctly. They will work as a NASA astronaut and the Capsule Communicator (CAPCOM) to explain how to correctly build a structure with pattern blocks.
- The microphone will be used correctly each time they speak.
- The class will discuss and assess the importance of correct communication as it pertains to space travel.

Materials (For each pair of students)

- Pattern blocks
- 1 manila folder (or hard bound book)
- 2 Popsicle sticks or tongue depressors, or two cardboard centers from paper towel rolls
- Aluminum foil pieces
- Books or short stories about space (1 for each group)
- Optional: 2.5 cm Styrofoam ball for top of microphone
- Data Collection Sheet

Science Standards

- Science as Inquiry
- Science and Technology
- Science as a Human Endeavor

Technology Standards

- Technological Knowledge
 - Linkages

- Technological Processes
 - Utilizing and Managing Technological Systems
- Technological Contexts
 - Informational Technology

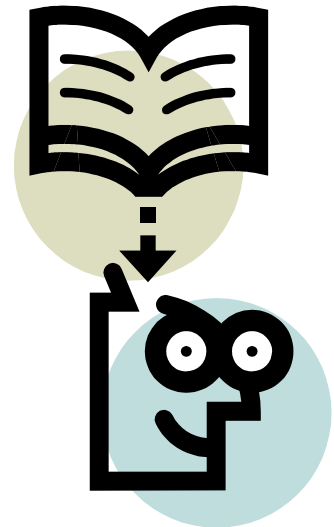
Mathematics Standards

- Problem Solving
- Communication
- Geometric and Spatial Sense
- Patterns and Relationships

Background

Communication is an important, vital, and necessary part of all spaceflights. The members of each Shuttle and International Space Station crew must talk with each other and with workers on the ground to carry out the many functions needed to fly the spacecraft and rendezvous with other objects in space. Mission Control must keep in constant contact with other personnel at sites around the world to monitor the progress of the spacecraft as it orbits Earth. Teachers and students in schools communicate with each other to learn more about space travel and how it is changing our lives each and every day.

The astronauts use a radio on board the Shuttle on frequencies used by Amateur (or “ham”) Radio operators to communicate directly with large groups of students. For all operations, Earth stations listen to the input or receiving frequency and transmit only when the Shuttle is in range of the ground station and the astronauts are using the radio. Students listen for any instructions from the astronauts as to the output or transmitting frequency before transmitting to avoid interfering with other radio users. They practice using a microphone correctly just as the astronauts must do during their training for the mission.



Procedure

1. When students, astronauts, and ham radio operators use the Amateur Radio to talk with people next door, all over the world, or orbiting in space, they use a microphone. Explain to students that they are going to make a “pretend” microphone that will be used when practicing how to talk correctly over the radio. Give each student one Popsicle stick, tongue depressor, or cardboard center

from a paper roll, and a large piece of aluminum foil. Demonstrate how to wrap the foil around the top of the stick in a ball so it looks like the top of a microphone. A 2.5 cm Styrofoam ball may be placed on top of the stick and covered with one layer of foil instead.

2. Model for students how to hold the microphone in one hand, not too close to the mouth. Say the names of the nine planets to demonstrate how to speak slowly and distinctly. Be sure to tell the students each time they have finished speaking that they are to say "Over." This is the word used by Amateur Radio operators to signify they have finished their transmission and others may now talk. Allow time for students to make a microphone and to practice speaking with their teammate. Circulate among the students and make sure they are holding the microphone correctly and speaking correctly. Have one student say the nine planets, stopping wherever they wish and saying "Over." The teammate must begin speaking into the microphone saying the next planet, and when finished, saying, "over." Example: "Mercury, over." "Venus, Earth, Mars, over." Jupiter, Saturn, over."

After the initial practice time, tell students they are going to read to their teammates. Each student in the team will read a paragraph or page from a book or story while holding the microphone correctly.

Each time they have finished reading, they must say "over" before the next person can begin. Teammates are not to begin until they hear the word "over."



When the class has had sufficient practice time, have them put down the microphones and show them the pattern blocks. Ask students to tell you what they know about each shape. Have students draw each as you display them to the class. (Square, triangle, two parallelograms, hexagon, trapezoid)

HINT: For older students, use one block of each shape. For younger students, pick only two or three.



Explain to students that when astronauts are in space, they talk to the ground through a Capsule Communicator (CAPCOM). This is another astronaut located in the Mission Control Center (MCC) at Johnson Space Center (JSC) in Houston. All information and directions are relayed to the astronauts on orbit through the CAPCOM.

3. Tell students that one member of each team will be taking the role of astronaut and the other member will be CAPCOM. Show students the blocks you are going to use and ask them to get those blocks from their pile.

4. Model the activity by taking the role of CAPCOM and having all students become astronauts. Build a structure behind a manila folder so students cannot see the structure. Make sure students understand spatial perspective and orientation of left and right. After you have built a structure, use your microphone to give detailed instructions so the students will be able to replicate what you have built. Remember to say “over” after each set of instructions.

5. After the students have completed building, compare the structures. Discuss which words you used that were helpful to them in building. Have students make a list of these words on the Data Collection Sheet.

6. Students will now be given time to build with their partners. They will build many times, switching roles each time, and using the microphone each time. Circulate among the class to monitor and assist.

7. When building has been accomplished many times, have students write directions on the Data Collection Sheets. These sheets can be taken up for assessments. They can also be used as written instructions for other students to build structures.

8. Discuss the importance communication played in building the structure.

How would this be important in spaceflight? How will this be important in building the International Space Station?

Data Collection Sheet

Name _____

Group Names _____

Date _____

Names/Shapes of Pattern Blocks

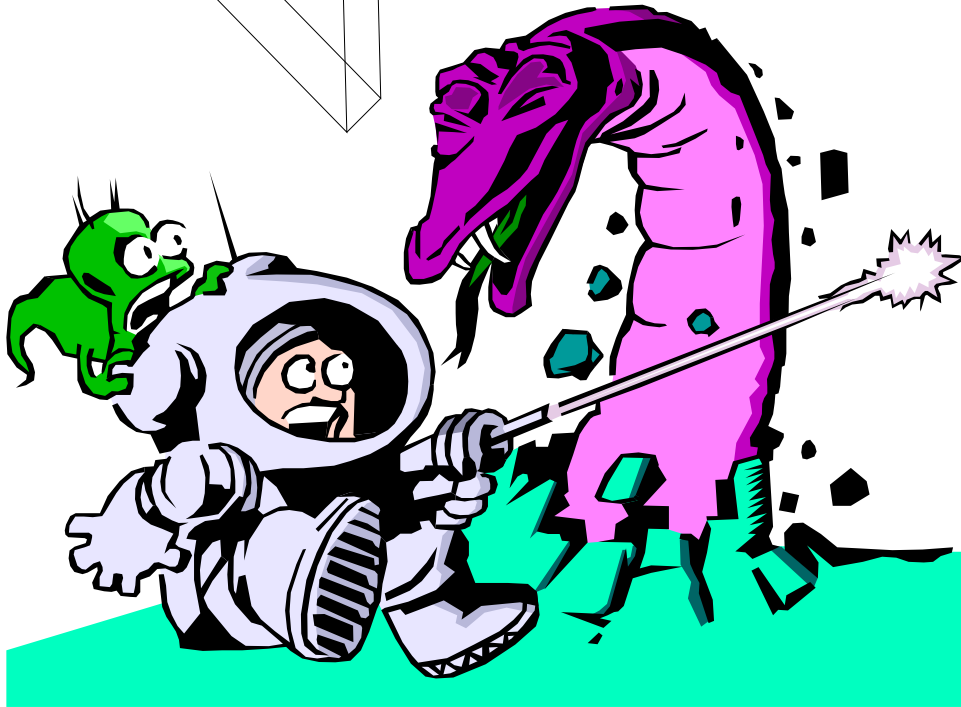
Directions for building my structure:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Communications are important in spaceflight because: _____

What have you learned? _____

**AHHHH... SOMETHING IS
MAKING CRATERS**



ABOUT CRATERS



Definitions

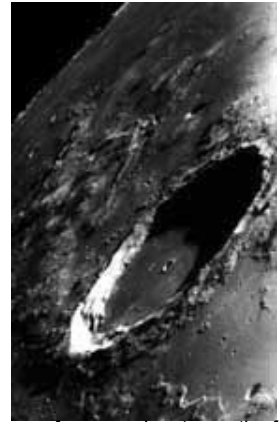


Image of unnamed crater on the far side of the moon courtesy of NASA.

Crater: A hole or depression. Most are circular or oval in shape.

Meteoroid: A small, rocky object in orbit around the Sun.

Meteor: This term describes the bright streak of light caused by a meteoroid as it burns up in Earth's atmosphere.

Meteorite: A part of a meteoroid that survives through the Earth's atmosphere.

Asteroid: A medium-sized rocky object orbiting the Sun.

Comet: a medium-sized icy object orbiting the Sun

Facts:

- On the Moon most are made by the impacts of meteorites.
- Meteoroids are smaller than asteroids.
- Asteroids are smaller than the planets, but larger than the meteoroids.
- Comets are smaller than the planets.



MAKING CRATERS

Materials:

- 4 balls of different sizes
- Flour (as necessary)
- Cocoa (as necessary)
- A shallow container
- 1 ruler
- 1 pencil
- Data Sheet

Procedure:

1. To begin the activity, your teacher or instructor will fill one of the containers with flour and will sprinkle a little cocoa on the surface. This will make the changes caused by the balls more visible.
2. Gather the various balls; they will be the "meteoroids."
3. Write in your data sheet the description of each ball.
4. Pick out one of the balls and drop (*not throw*) the ball from about a height of 30 cm.
5. Describe what you observe, measure the crater diameter and crater depth. Record there results on your data sheet.
6. Repeat Steps 4 and 5, but using the other three balls (one at the time).
7. Repeat Steps 4, 5 and 6, but this time dropping the balls at height = 90 cm and height= 120 cm.

Conclusions:

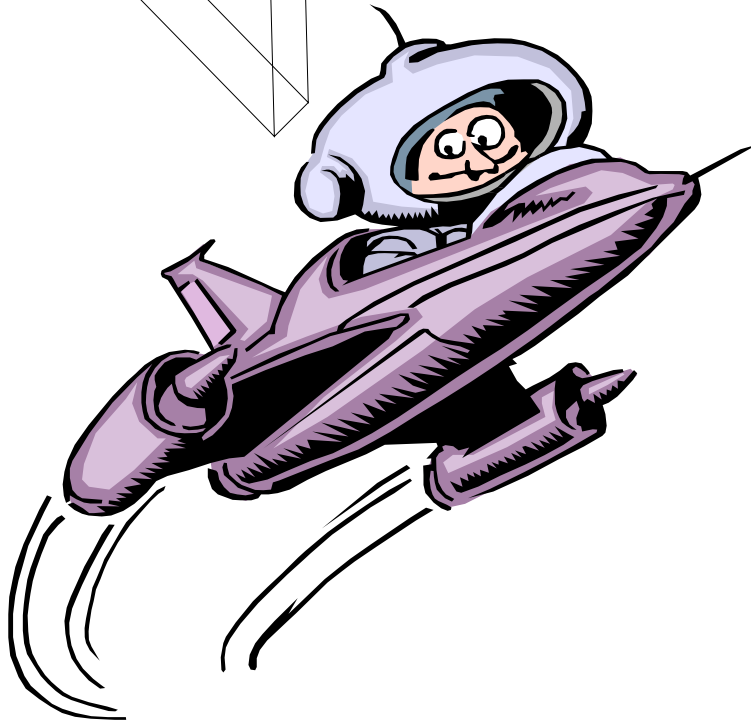


IMPACT CRATERS

Data Sheet

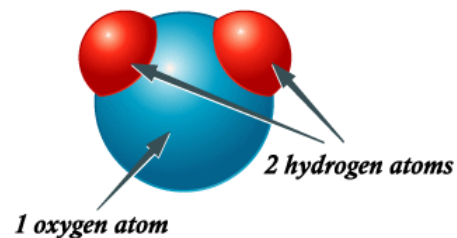
	Description such as weight, size, texture, etc	Drop Height = 30 cm		Drop Height = 120 cm	
		Crater Diameter	Crater Depth	Crater Diameter	Crater Depth
Ball #1					
Ball #2					
Ball #3					
Ball #4					

**LET'S GO FOR A TRIP ON A
BOTTLE ROCKET!**



Water Matters

Water Molecule

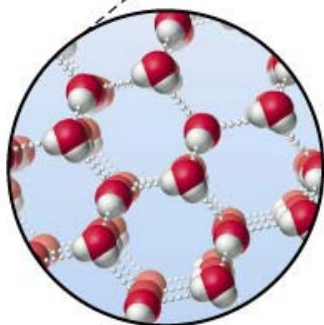


Students will recognize and/or understand:

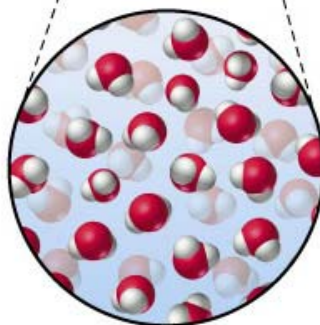
5. The three states of matter (solid, liquid, gas)
6. Solubility as a function of temperature
7. Ice renucleation
8. Polymer solubility
9. Surface tension

1. States of Matter

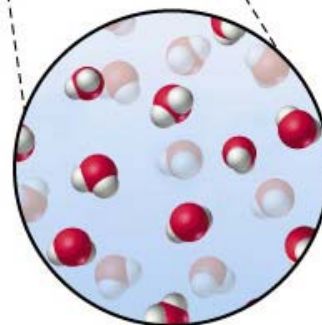
- Introduce term "solid"
- Introduce "liquid"
- Introduce "gas"



(a)



(b)



(c)

2. Water Stations

- solubility as a function of temperature
- ice renucleation
- polymer solubility
- solubility

Set-up

- First 20 minutes will involve an introductory activity of the three states of matter
- The next 20 minutes will be a discussion of the theory pertaining to the specific stations
- The next 1 hour will involve experimental work performed by the students at each station.

General List of Materials:

- Hot Plates
- Magnetic Stirrers
- Ice
- Water (DI)
- Beakers/glassware



Water Bottle Rocket Design



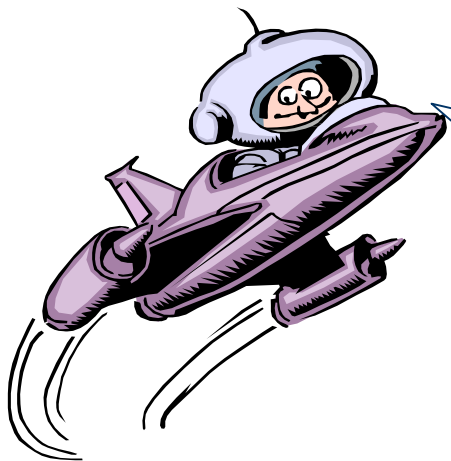
Rocket Design Activity

Follow your instructor to determine the best way to build your rocket. Using the website found in the materials section, optimize the parameters for building your *rocket*.

ENJOY!

Experiment Objective

Today's experiments will explore the use of design parameters learned in the rocket design activity to build your own water bottle rocket.



So, get ready to build and
lunch your own rocket into
deeeeeeeeeeeeeeeeeep
space!

