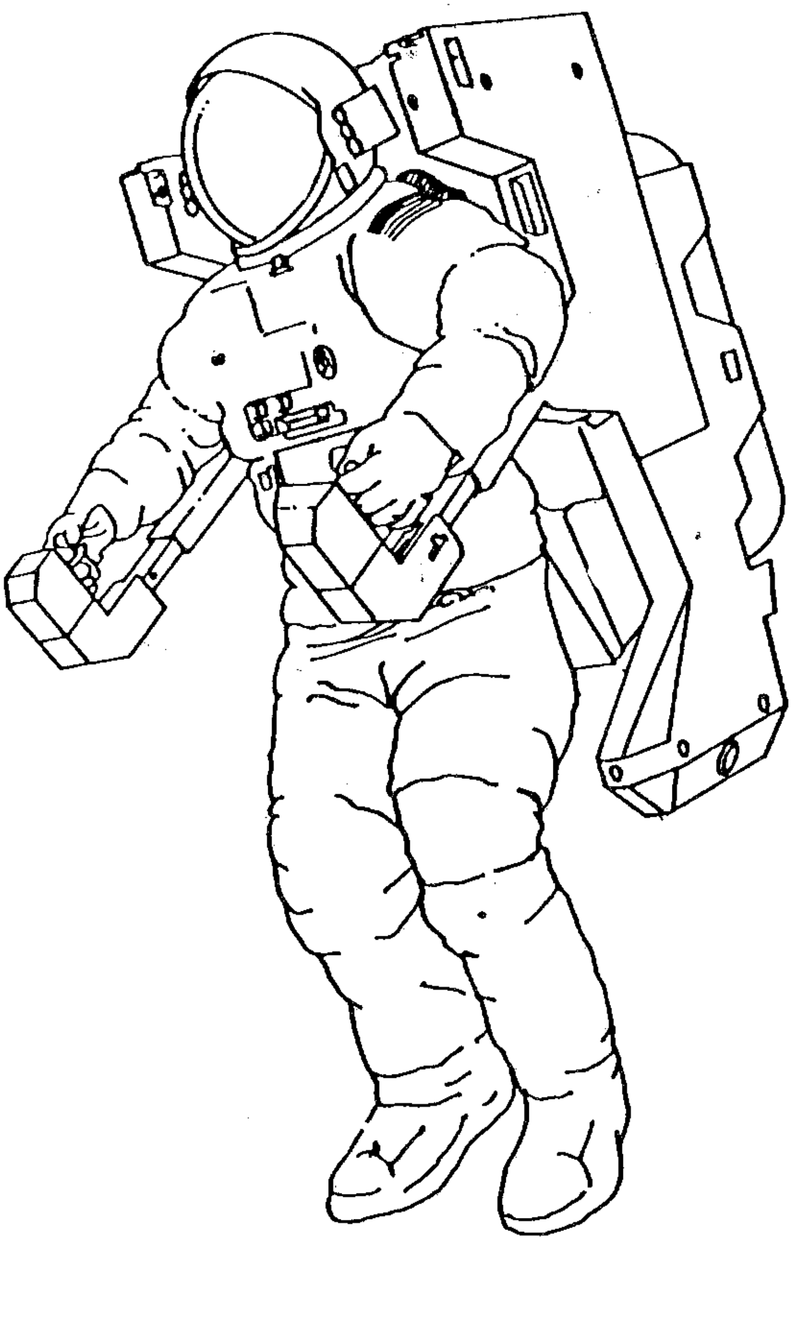
EXPLORATION STATION

HUMAN SPACE FLIGHT



Kennedy Space Center, NASA

MOON SURVIVAL

Instructions: You are a member of a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. Due to mechanical difficulties, however, your ship was forced to land at a spot some 200 miles from the rendezvous point. During re-entry and landing, much of the equipment aboard was damaged and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200 mile trip. Below are listed the 15 items left intact and undamaged after landing. Your task is to rank order them in terms of their importance for your crew in allowing them to reach the rendezvous point. Place the number *1* by the most important item, the number *2* by the second most important, and so on through number *15*, the least important.

______ Box of matches
______ Food concentrate
______ 50 feet of nylon rope
______ Parachute silk
______ Portable heating unit
______ Two .45 calibre pistols
______ One case dehydrated Pet milk
______ Two 100-pound tanks of oxygen
______ Stellar map (of the moon's surface)
______ Life raft
______ Magnetic compass
______ 5 gallons of water
______ Signal flares
______ First aid kit containing injection needle
______ Solar-powered FM receiver-transmitter

KEY

NASA'S RANKING	NASA'S REASONS
15	No oxygen to sustain the flame
4	Good food source, efficient
6	Useful in scaling cliffs, tying together the injured
8	Will provide protection from sun's rays
13	Useless on dark side, not needed on lighted side
11	Possible means of propulsion
12	Bulky duplication of food concentrate
1	Most pressing need
3	Primary means of navigation
9	CO^2 bottle in raft may be used for propulsion
14	Magnetic field on moon is not polarized, worthless
2	Replacement for high water loss on light side
10	Distress signal when mother ship sighted
7	For injecting vitamins -- special aperture in suit
5	Talk to mother ship, FM needs short range and line of sight

WEIGHTS ON OTHER PLANETS

This activity is designed to:

a. Introduce students to the force of gravity.

b. Utilize students multiplication skills.

c. Compare the planets gravitational forces.

After completing this activity, the students will be able to:

a. Calculate personal weights on different planets.

b. List the planets in order from least gravity to greatest gravity.

Vocabulary and definitions:

a. Force - an influence which produces or tends to produce motion or change of motion.

b. Gravity - the force of attraction between all particles or bodies, or that accelerates one body toward another.

c. Mass - the measurement of the quantity of matter in a body.

d. Weight - the force which gravitation exerts upon a material body; heaviness. The measure of the mass times the acceleration due to gravity.

Preparation:

a. Research statistics about the Sun's planets.

b. Initiate discussions comparing and contrasting facts about these planets.

Materials

a. Copies of this activity sheet

b. Pencil

Procedure:

a. Find out what you would weigh on each of the other planets in the Solar System.

b. Then list the planets in order from least gravity to greatest gravity.

Example: Venus' gravity is 0.91 times that of the Earth. If you weighed 100 lbs. on Earth, how much would you weigh on Venus?

Solution: 100 x .91 = 91 lbs.

PLANETS	SURFACE GRAVITY	MY WEIGHT
Mercury	0.18	________
Venus	0.91	________
Earth	1.00	________
Mars	0.38	________
* Jupiter	2.34	________
* Saturn	0.93	________
* Uranus	0.85	________
* Neptune	1.14	________
Pluto	0.04	________

(* at cloud tops of gas planets)

List the names of the planets in order from least gravity to greatest gravity.

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________

Evaluation

a. How many times greater is the force of gravity on Neptune than on Earth ?

b. How many times less is the gravity on Mercury than on the Earth?

c. Which other planet would you visit if you wanted to weigh nearly the same as you do on Earth?

Extending Thoughts

a. How would you redesign a bathroom scale to give you your correct weight on Mars based on that planet's gravity?

b. Spacecraft like the Voyagers use something called gravitational assist to "slingshot" them on further in space. Explain how this gravitational assist works.

FAST BUCK

This activity is designed to:

a. Show that time is required to react to a stimulus.

After completing this activity, the students will be able to:

a. Describe the importance of allowing for a certain amount of time for response when planning an activity.

Vocabulary and definitions:

a. Brain - the part of the vertebrate nervous system that is the organ of thought and nervous coordination.

b. Muscle - body tissue consisting of long cells that contract when stimulated.

c. Nerves - one of the strands of nervous tissue which carry nervous impulses to and fro between the brain and spinal cord and every part of the body.

d. Reaction - bodily, mental, or emotional response to a stimulus.

e. Stimulus - something that rouses or incites to activity.

Preparation:

a. Using a diagram of the interior of a human body discuss with the students the process involved in reacting to a stimulus - reception of the stimulus, transmission of message by nervous system to the brain, processing by the brain, nerve transmission to the correct muscle, and finally the muscle function.

b. Let students examine muscle tissue from a cow or pig.

Materials:

a. Dollar bill

b. Table

c. Chair

Procedure:

a. Have a student sit at the table with forearm resting on the table and the hand hanging over the edge of the table.

b. Have a second student hold a dollar bill between the first student's open fingers.

c. The second student drops the dollar bill and the first student tries to close their fingers fast enough in order to catch the "buck."

d. Try this same experiment with both students standing instead of one sitting at the table. Have the dollar dropped between the fingers of the student's outstretched arm.

Evaluation:

After everyone in the class has tried the experiment answer these questions:

a. Which person had the fastest reaction?

b. Did it seem to you that boys or girls had a faster reaction?

c. Was the person's reaction faster when they were seated or when they were standing?

Extending Thoughts:

a. During a space flight astronauts are required to be able to respond quickly to any given situation. Describe a number of situations aboard a Space Shuttle mission which would require a quick response.

b. Describe why it would be important to have a fast reaction when riding a bicycle, a skateboard, or surfboard or driving a car, boat, or plane.

EXPLORATION STATION

HUMAN SPACE FLIGHT

Random Number Dexterity Matrix

10	7	7	10	3
6	12	2	9	1
8	12	5	8	1
4	2	3	11	5
6	9	13	11	4

In this matrix there are randomly distributed black numbers ranging from one through thirteen, and white numbers from one through twelve.

The object of this exercise is to locate, touch, and orally call out the numbers. First time through touch and call only the black numbers in ascending order (1-13). Second time, only white numbers in ascending order (1-12). Third time, black numbers in descending order (13-1) Fourth time, white numbers in descending order (12-1). Fifth time, the black numbers are called in ASCENDING order and white numbers in DESCENDING order ALTERNATELY. Thus, begin with "One black, twelve white, two black, eleven white. . .

Score is based upon the time for a successful completion.

DESIGN YOUR OWN SPACE STATION

COMMUNICATIONS EXERCISE

SUBJECT: Communications and Space Station Freedom

TOPIC: Designing a layout for a space station design and communicating this information accurately to a colleague.

DESCRIPTION: Each pair of participants is given a set of generic components for a space station. One arranges them in a logical design and communicates (or attempts to communicate) this information to the partner. Then the roles are reversed.

MATERIALS: Space station component parts. See the figure. [These generic pieces may be glued to cardboard, cut out, and placed in envelopes or zip lock bags. The sets need to include equal numbers of each piece.

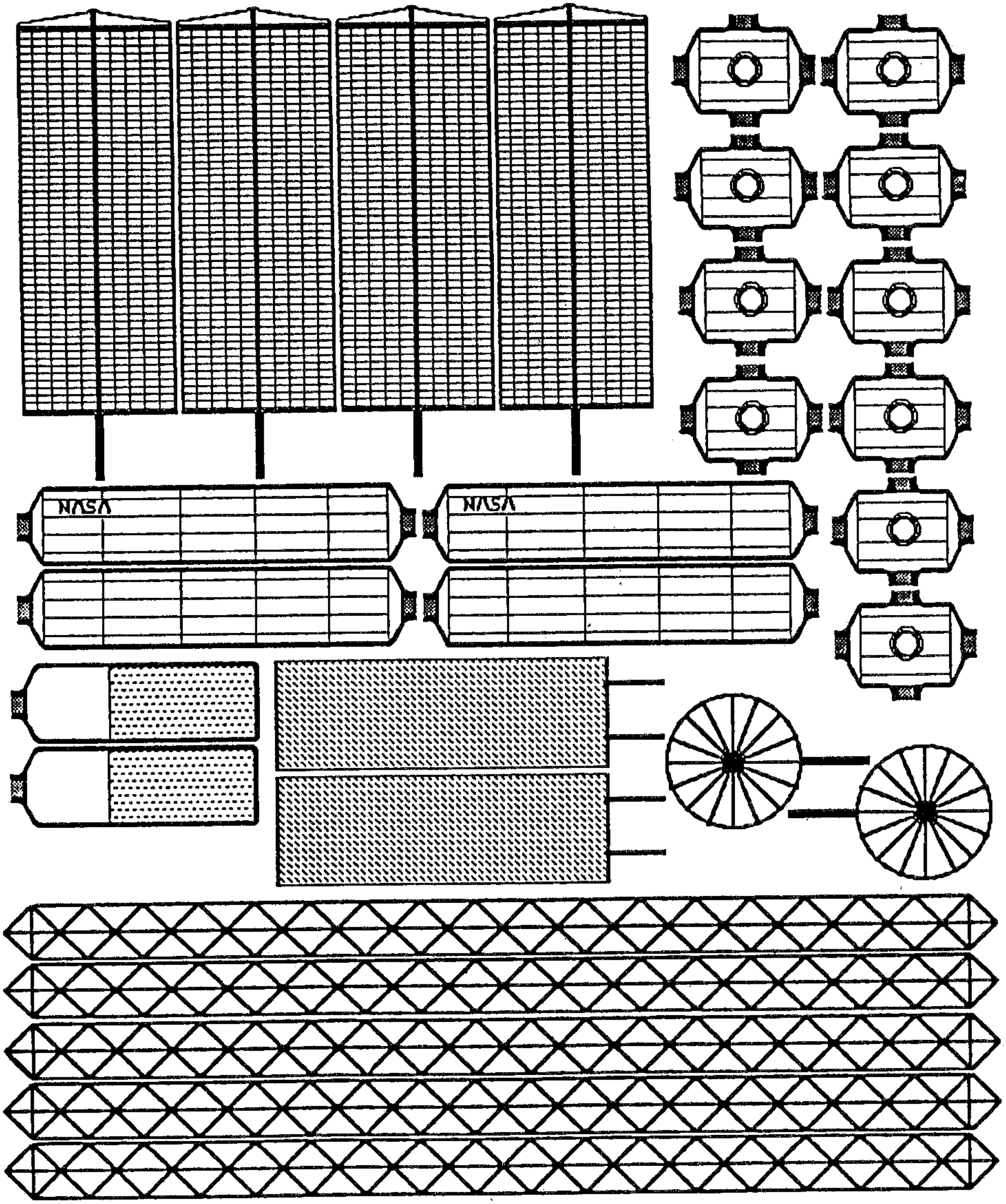
PROCEDURE: Pairs of participants are given a set containing equal numbers of the generic component parts for a space station. The participants divide the set equally. One member creates a design for a space station and arranges the parts in that design. This information is then communicated orally to the teammate who cannot see the design. Then the roles may be reversed.

Although we see many designs for Space Station Freedom which are apparently "final", there still will be modifications and it is certainly not the only logical or functional design.

This design must be displayed in two dimensions, but the basic concepts of logical designs for our space station will be apparent.

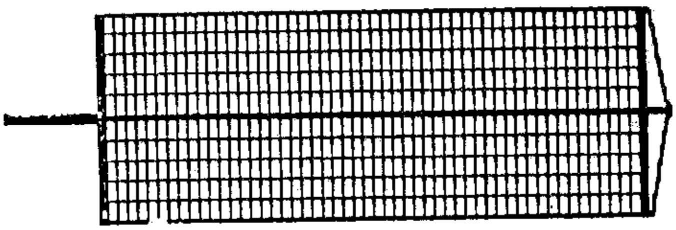
This is a simple (and space saving) follow-on activity for communication blocks and an introduction to the important concepts in space station design. [Habitable modules, power sources, communications systems, gravity gradient, multiple paths for crew safety, etc.] One may use a transparency of the component parts to facillitate the use of proper terms for the parts. Also the participants may be given a sheet of the component parts which they may use for identification, they may also use the sheet as a master to preprare sets for their own students.

DESIGNED BY: Dr. Harry B. Herzer, III, AESP NASA HQ

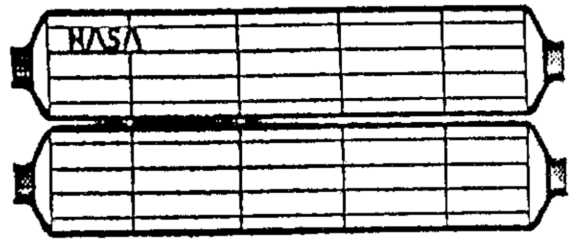

NASA
NASA

DESIGN YOUR OWN SPACE STATION

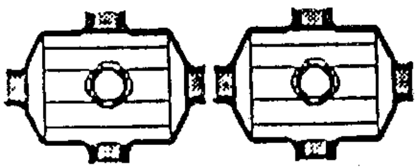
HERE ARE SOME COMPONENT PARTS . . .



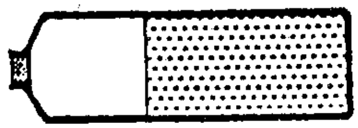
SOLAR PANEL



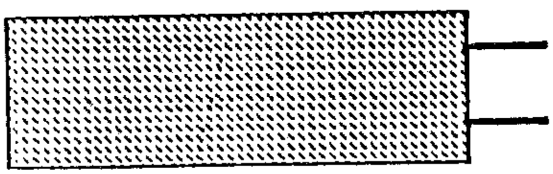
HABITAT MODULE or
EXPERIMENT MODULE



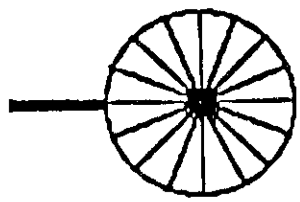
NODES



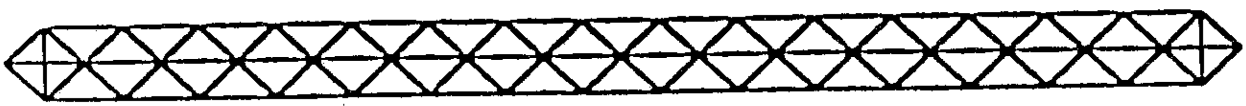
LOGISTICS MODULE
[RESUPPLY MODULE]



THERMAL RADIATOR



ANTENNA



TRUSS / BEAM

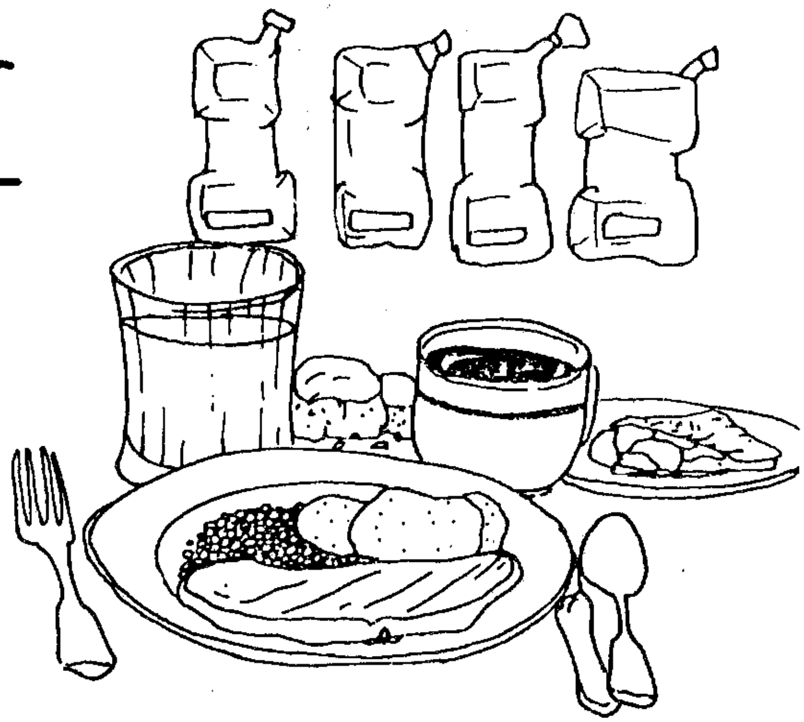
WHAT DO YOU EAT IN SPACE?

About fifty different kinds of foods are available for an astronaut to eat in space. However, he can not use a knife and fork the way we do on earth since there is no gravity. The meat might float right off his plate!

He often squeezes food out of a tube like putting toothpaste on a toothbrush. He can eat bitesized pieces of anything. A typical meal could be like a balanced meal on earth.

An astronaut can store enough food for one week in a package about the size of a shoe box. Most foods are freeze-dried

Study the balanced meals with your parents. Plan a meal that you could eat in space.



____

____

Create a balanced meal using dehydrated baby food available at the grocery stores. This product is another spin-off from the technology achieved from the Space Program.

Child
Serving

3 milk or milk product

1 meat, fish, poultry, eggs

1 green and yellow vegetables

1 citrus fruits and tomatoes

1 potatoes, other fruits and vegetables

3 bread, flour and cereal

Nutrients in 1 or 2 cups of milk daily can be satisfied by cheeses or ice cream
Meat, fish and poultry may be alternated with eggs or cheese, dried peas, beans
3 to 5 cups of fluid daily is recommended.

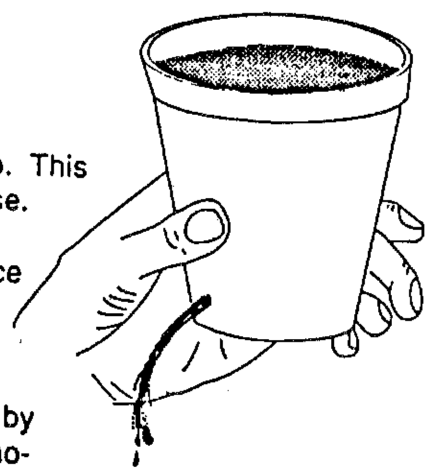
Zero-G Demonstrator

SUBJECT: Space Flight
TOPIC: Free fall
DESCRIPTION: A water stream coming out of a hole in a styrofoam cup stops when the cup is dropped.
CONTRIBUTED BY: Dale Bremmer, HQ

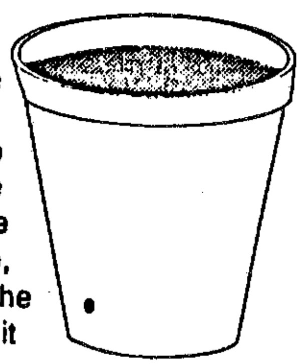
MATERIALS:
Styrofoam coffee cup
Pencil or other pointed object
Water
Bucket or other water catch basin

PROCEDURE:
1. Punch a small hole in the side of a styro foam cup near its bottom.
2. Hold your thumb over the hole as you fill the cup with water. Ask students what will happen if you remove your thumb.
3. Remove your thumb and let the water stream out into the catch basin on the floor.
4. Again seal the hole with your thumb and refill the cup. Ask students if the water will fall out of the hole if you drop the cup as you remove your thumb.
5. Drop the filled cup into the catch basin. The demonstration is more effective if you hold the cup high before dropping it.

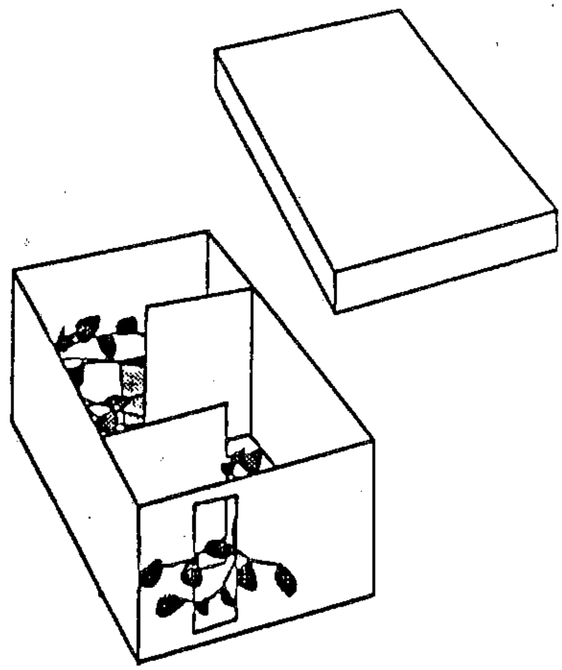
DISCUSSION:
Zero-G that astronauts experience inside the Space Shuttle is really not zero-G at all. Zero-G implies that gravitational pull in space is zero. This is not the case. Astronauts "float" in space because they are in a state of free fall produced by their orbital motions around the Earth. Astronauts and their spacecraft are falling together. The condition is better described as "weightlessness" because a bathroom scale inside the Shuttle would not record any weight for an astronaut standing on it. The scale would be falling too.



The falling styrofoam cup demonstrates weightlessness (or zero-G) for a brief period of time. When stationary, water freely pours out of the cup. If the cup falls too, the water remains inside the cup for the entire fall. Even though the water remains inside, it is still attracted to the Earth by gravity and it ends up in the same place that the water from the first experiment did.



Phototropism Maze



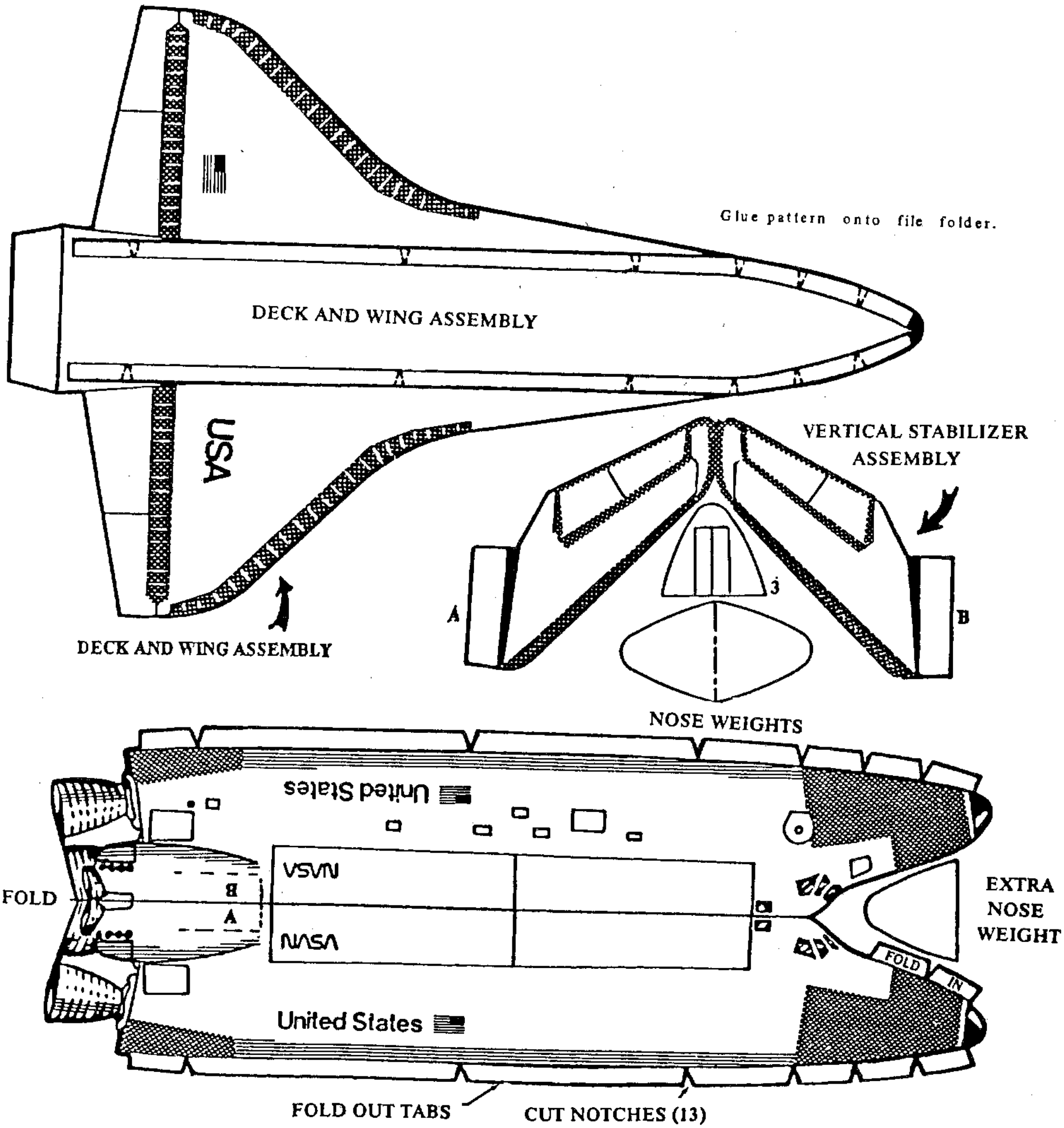
SUBJECT: Biology
TOPIC: Phototropism in green plants
DESCRIPTION: An enclosed "mouse maze" is used to demonstrate that plants will seek light.
CONTRIBUTED BY: Gregory Vogt, OSU

MATERIALS:
2 Cardboard boxes and lids used for copy machine paper
Large nails or masking tape
Sharp knife or heavy duty scissors
Sweet potato
Water glass
Toothpicks
Water

PROCEDURE:
1. Cut two or three light baffles from one of the two cardboard boxes. The baffles will be mounted inside the second box and should be tall enough to reach from the bottom of the second box to the lid and wide enough to stretch across from one side to just past the middle point.
2. Using large nails or masking tape, mount the baffles in the box as indicated in the diagram. If using nails, place one edge of each baffle along the inside of the second box. Push the nail through the box wall and into the corrugation of the baffle. Do the same from the bottom.
3. Cut a small light opening in one end of the box.
4. Push four toothpicks into a small sweet potato so they look somewhat like the spokes of a bicycle wheel. Set the potato in a glass. The toothpicks will keep the sweet potato from touching the bottom. Fill the glass with water so that the sweet potato's bottom is immersed. Keep the glass filled.
5. When the sweet potato begins sprouting small vines, place the glass in the far corner of the box away from the hole. Cover the box and place it in a location where it will not be disturbed and where sunlight or a strong room light will enter the hole.
6. Check on the plant periodically to make sure the water has not evaporated away. Study the growth of the vines.

DISCUSSION:

Green plants grow towards light in a process called phototropism. Through phototropism, plants maximize the amount of light energy reaching leaves for photosynthesis. Plants grown in orbiting spacecraft require light just as Earth-grown plants do. In space, however, plant growth is often confused because of the weightless condition orbit deprives plants of gravity effects that normally cause stems and leaves to grow up and roots to grow down. Phototropism helps plants to partially alleviate the situation by directing leaf and stems growth towards light sources in growing chambers.


Glue pattern onto file folder.
DECK AND WING ASSEMBLY
USA
DECK AND WING ASSEMBLY
VERTICAL STABILIZER ASSEMBLY
A
B
3
NOSE WEIGHTS
United States
NASA
NASA
B
A
FOLD
EXTRA NOSE WEIGHT
FOLD
IN
United States
FOLD OUT TABS
CUT NOTCHES (13)

SPACE SHUTTLE MODEL

ASSEMBLY INSTRUCTIONS

Read carefully before assembly:

1. Cut out all parts using scissors.
2. Cut out V-shaped notches on Fuselage to create tabs along the outside edge. Fold tabs out.
3. Glue or tape three Nose Weights to the underside of the nose of your glider. Use the fourth weight provided if needed for extra trim after assembly.
4. Fold Fuselage along middle line.
5. Starting at the nose, glue or tape Fuselage to Deck and Wing Assembly. Match tabs on Fuselage exactly to those printed on Deck and Wing Assembly.
6. To close the nose, glue or tape the two halves together using tabs provided.
7. Fold Vertical Stabilizer Assembly. Fold out tabs A and B. Glue or tape the Vertical Stabilizer assembly to make one solid piece except for tabs A and B.
8. Attach Vertical Stabilizer to Fuselage, matching tab A with point A and tab B with point B.

PREFLIGHT INSTRUCTIONS

For best results, launch your Shuttle glider with a gentle, level toss. Bend the Body Flap up slightly for a greater lift.

HUMAN AIR CONSUMPTION

This activity is designed to:

a. Acquaint students with respiratory anatomy and physiology.

b. Measure volume of air used in respiration.

c. Determine air requirements for a Space Station.

After completing this activity, the students will be able to:

a. Calculate the volume of air exhaled with respect to time.

b. Calculate the amount of air required for respiration on a closed biological system such as a Space Station.

Vocabulary and definitions:

a. Diaphragm - The muscular partition beneath the lungs which drives the breath.

b. Lungs - The paired organs located in the chest which provide surface area for exchange of oxygen and carbon dioxide.

c. Respiration - The placing of air into intimate contact with the blood of an organism: the act of breathing.

d. Trachea - The windpipe.

Preparation:

a. Diagram the anatomy of the lungs, trachea, diaphragm, brochial tubes, etc.

b. Examine the respiratory system in an animal dissection. (A meat packing plant can probably provide either pork or beef lungs.)

Materials:

a. 1, large plastic basin

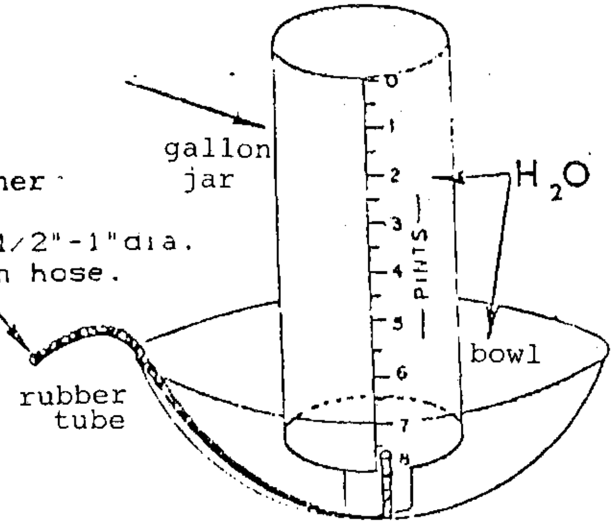
b. 1, 1 gallon plastic container

c. 1, 2 foot piece of large (1/2"-1"dia. plastic tubing or garden hose.

d. 1 measuring cup.

e. water

f. clock or watch



Procedure:

a. Using cup measure, make a mark on the glass jar at the four cup level. This shows the correct one quart volume.

b. Fill basin approximately two thirds full of water and invert glass jar in it. Using tube, suck air out of jar until it is completely full of water.

c. Student, while being timed, breathes at normal rate, exhaling into tube, bubbling air into the jar. When one quart of air has been exhaled, time is stopped. The time shows how long it takes to breathe one quart of air. Multiply by four to get the time required to breathe a gallon of air.

e. Calculate how much air would be used in one hour: then for one day (24 hours).

Evaluation:

a. In case of an emergency, the Space Station should be able to become a "safe haven" for the astronauts. If six astronauts are required to spend six months aboard the space station how much air does the above experiment tell us they will require?

Extending Thoughts:

a. Exercise increases air requirements. Repeat this activity having a student run, jump rope, do calisthenics, etc. just prior to measuring breath volume.

b. We only use a small percentage of the oxygen in the air we breathe, most of it is exhaled. Lithium hydroxide absorbs carbon dioxide and can be used on space missions to cleanse exhaled air. If you can "rebreathe" 90% of the air you exhale, how does this change the storage volume of oxygen for the Space Station?