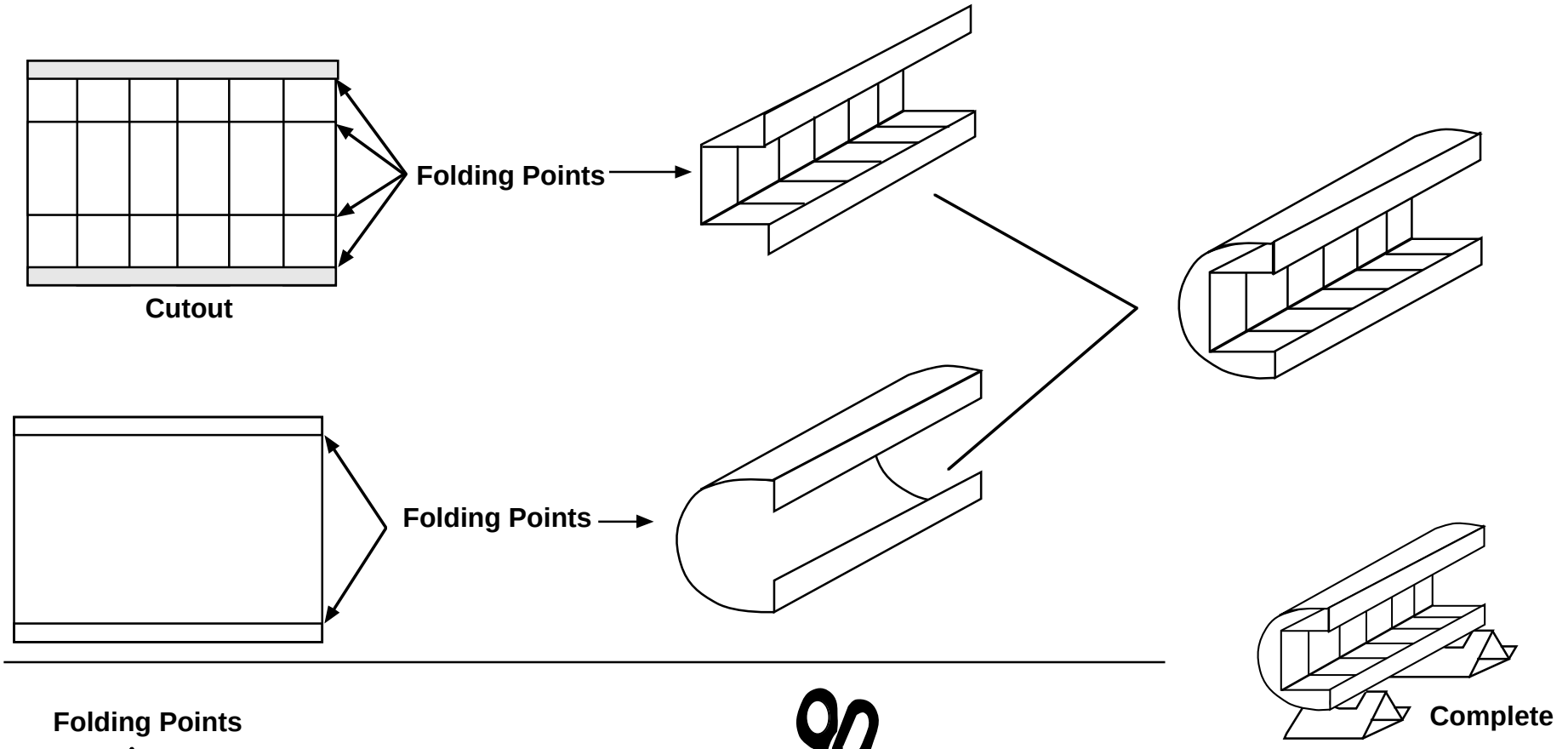
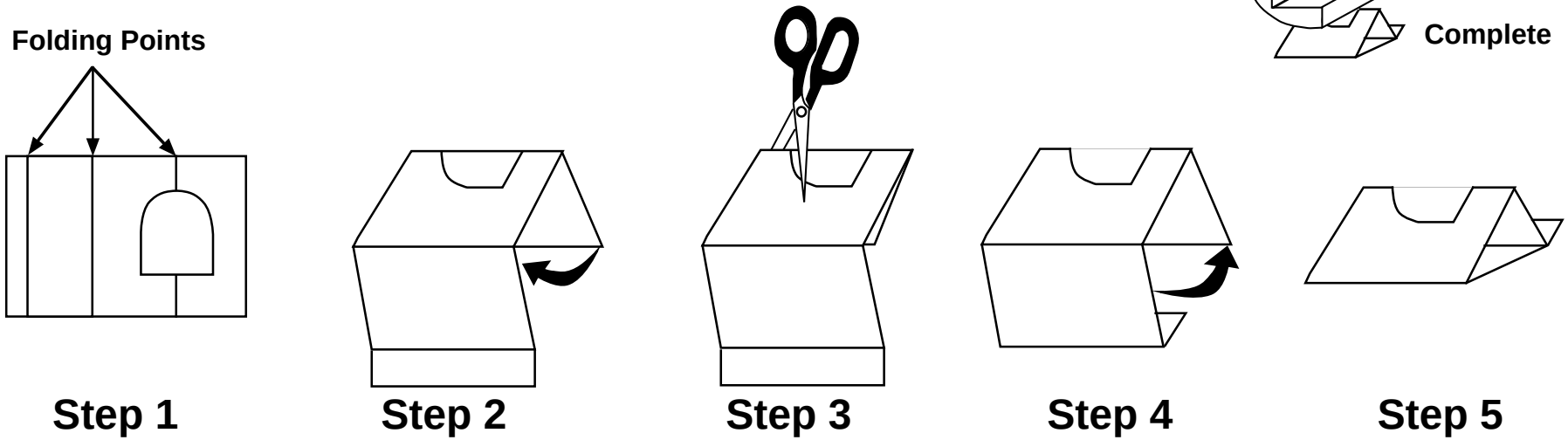
Habitat Module Folding Instructions





Outfitted for Space Work

Level (Grades K-5)

THEORY/INFORMATION

While on orbit in the space station, astronauts dress to live comfortably and work safely in the environment of space. Inside the station, the temperature is between 18.3 and 32.2 degrees Celsius (65 and 90 degrees Fahrenheit) with a relative humidity between 30 and 50 percent. Outside the station, temperatures vary from -100 Celsius to 120 degrees Celsius (-148 to 248 degrees Fahrenheit).

Each astronaut is outfitted with the clothing needed for the work that is to be done during his/her 90-day mission. All the crew members have clothing for cooking, cleaning, relaxing, and sleeping inside the space station. The astronauts that work in the laboratory module with manufacturing, experiments, or science activities, have the clothing needed for that job, too. They also have safety goggles and rubber or fire retardant gloves. Most of the time, the crew wears slipper socks, but they also have tennis shoes and boots.

Some of the crew members must work outside the space station, and they have clothing to protect themselves. The complicated space suit worn outside the space station is called a extravehicular mobility unit (EMU). This suit provides correct air pressure, temperature, oxygen, drinking water, food, and electrical power. It also protects the astronauts from micrometeoroids.

Astronauts aboard the space station will use improved EMU space suits when they go outside to build, repair, and resupply the station; check experiments; or fix satellites. The suits have many layers of materials, and it is very difficult to work while wearing them. Outside the station on an extravehicular activity (EVA), the crew member must wear the EMU and MMU (manned maneuvering unit) equipment which weighs 148 kilograms (about 326 pounds). On Earth, the space suit (EMU) alone weighs 113 kilograms (about 250 pounds). To practice on Earth, the astronauts work in a huge tank of water called a neutral buoyancy simulator. This simulator helps the astronaut learn to work while wearing the stiff, bulky suit. Scientists can float the astronaut and the equipment so that they can practice the tasks they will do when they are working aboard the space station.

After 90 days, the space station crew will prepare for the arrival of the new crew. Each astronaut will complete his/her chores, pack up, and get ready to go home. They will put on their flight coveralls for the return trip to planet Earth.

OBJECTIVE

The student will choose an astronaut and dress him/her for the work to be done.

QUESTIONS

What clothing is worn by astronauts while they are aboard the space station? What clothing is needed for each activity?

MATERIALS

1 Set of paper dolls with the space station wardrobes
1 Pair of sharp scissors

PROCEDURES

1. An astronaut is going outside the space station to repair a satellite. Find the astronaut and the clothes he/she will need.

2. Cut out each piece of clothing and equipment. Now dress the astronaut.

3. One astronaut has time off from work, and he is going to look out the window and take photographs. Dress this astronaut.

4. One astronaut will be working in the laboratory. This astronaut will check the crystal growing experiments. What will he/she wear? Dress this person for work.

5. It is the last day of the 90-day tour of duty. One astronaut is getting ready to return to Earth. What will this person wear? Dress this astronaut.

6. Display each astronaut on the stand provided.

7. (Optional) Students may wish to color the clothing provided for each astronaut. The space suit and the underwear is white. Space clothing is usually white, light blue, or navy but students may select their own colors.

OBSERVATIONS, DATA AND CONCLUSIONS

1. List the clothing worn by the astronaut who works in the laboratory module.

2. List the clothing that astronauts wear when they are working outside the space station.

3. How many items of clothing or equipment did you put on the person that is going outside to work?

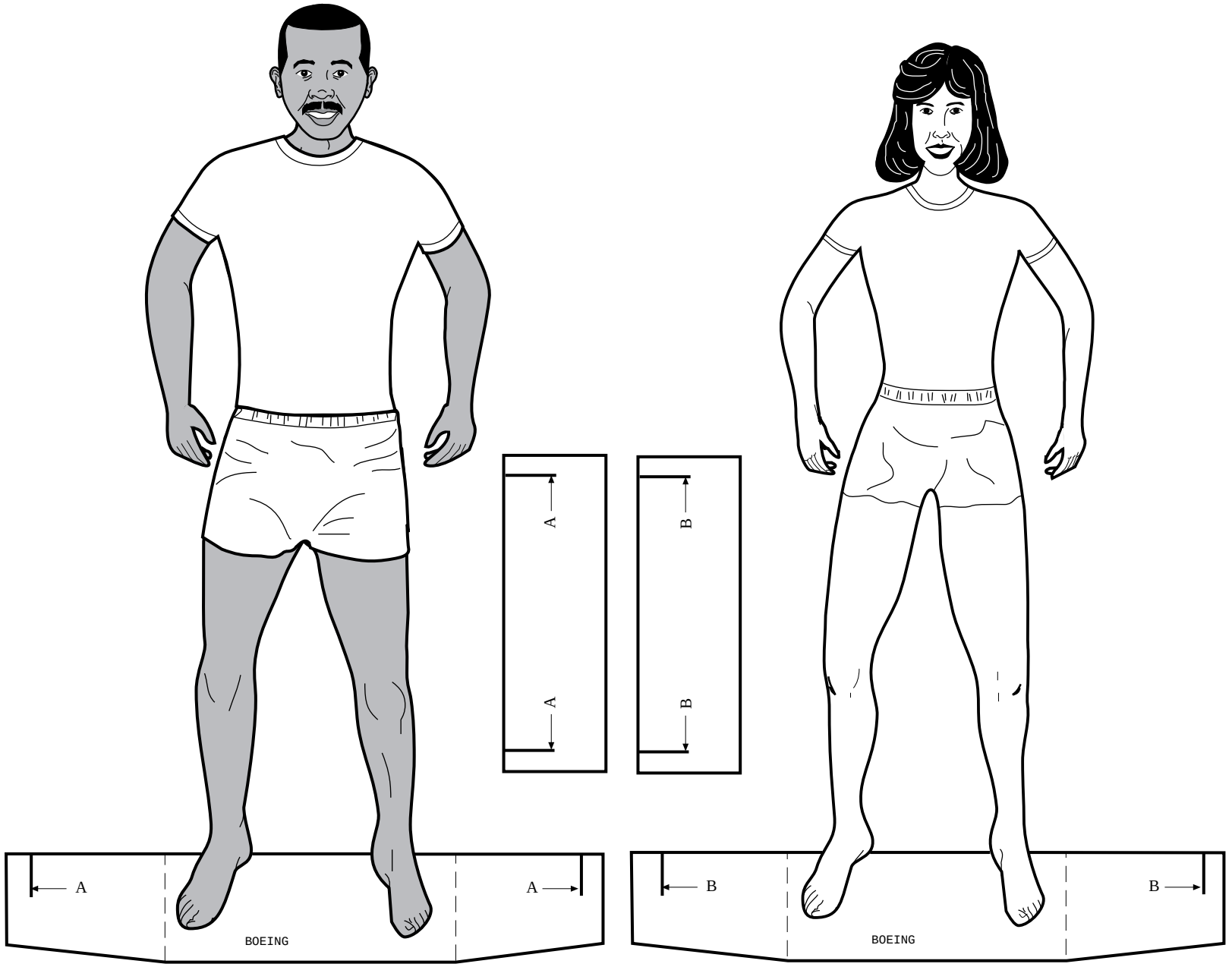
4. Would it be exciting to work outside the space station? Why or why not?

5. Why do you think the astronauts usually wear slipper socks instead of heavy shoes?

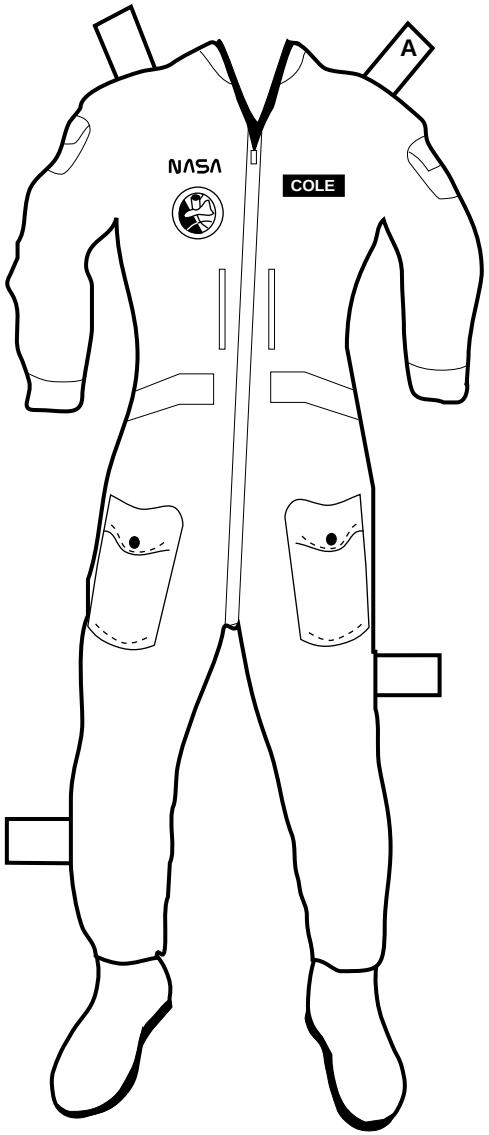
6. While living aboard the space station, the astronauts will not bath and change clothes every day. How would you like to wear the same clothes for two days before you took a bath and got a new set? How would you feel about wearing the same clothing day and night for a whole week?

7. If you were an astronaut and you were sent to work on the space station, what kind of work would you like to do?

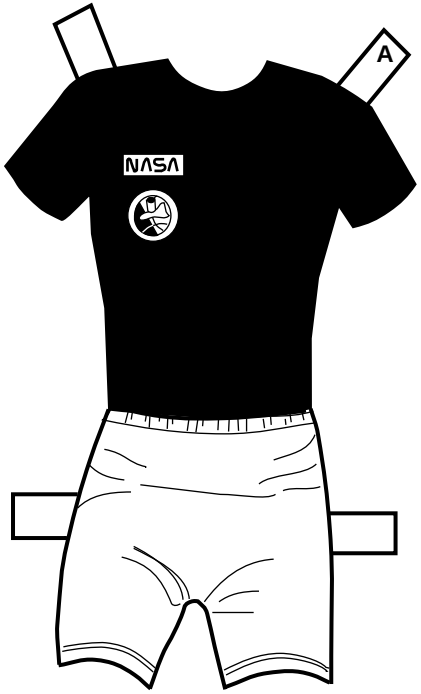
Space Station Astronauts



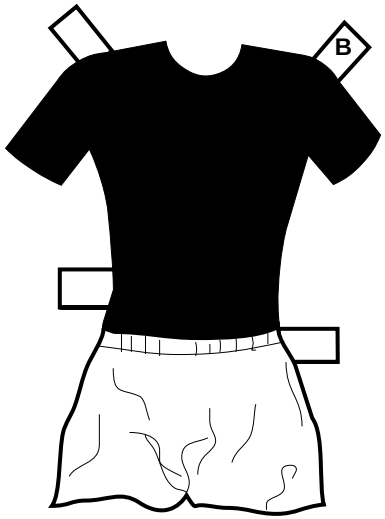
Space Station Clothing



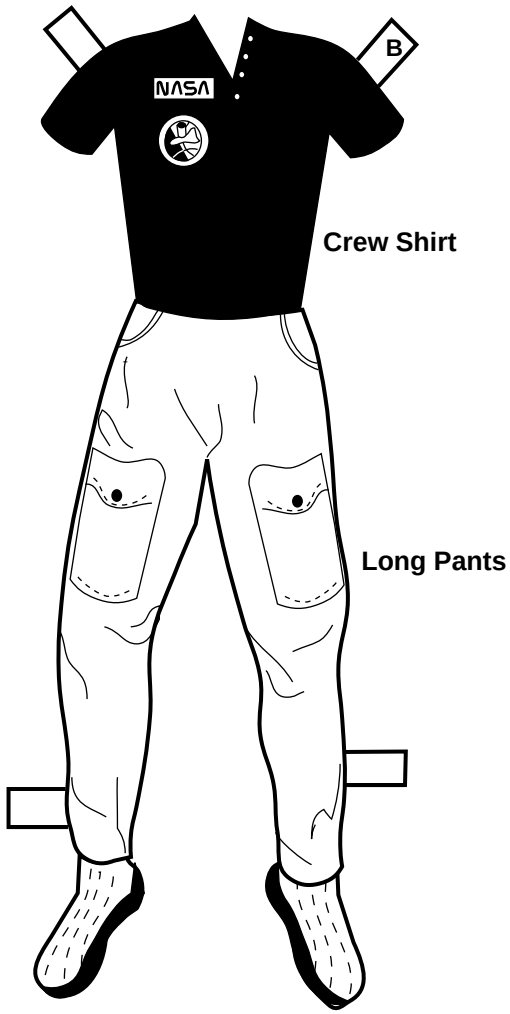
Flight Suit



Shorts & Crew Shirt



Sleeping Shorts & T Shirt



Crew Shirt

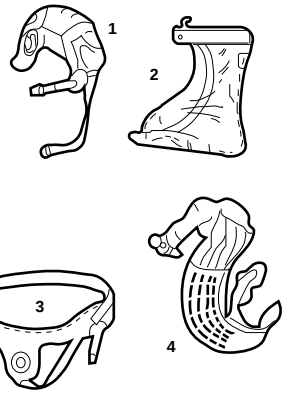
Long Pants

Sock Shoes

Space Station Space Suit

1. COMMUNICATIONS CARRIER ASSEMBLY Consists of microphone and headset. Allows astronaut to talk to the other crewmen in the orbiter or other space suit/life support systems.

2. INSUIT DRINK BAG Stores liquid in the hard upper torso and has a tube projecting up into the helmet to permit the crew to drink while suited.

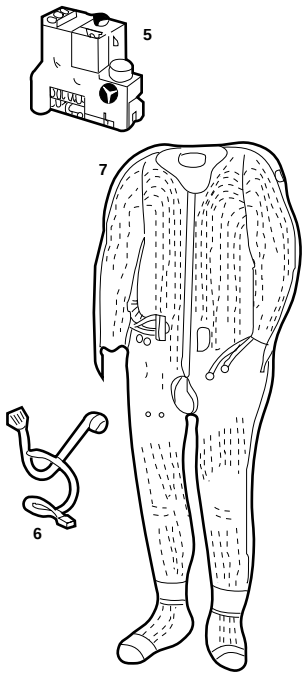


3. URINE COLLECTION DEVICE Consists of the adapter tubing, storage bag and disconnect hardware for emptying liquid.

4. SERVICE AND COOLING UMBILICAL Contains powers, recharge and communication lines, water and oxygen recharge lines and a water drain line. It has multiple connector at one end and a permanent fitting at the other.

5. DISPLAY AND CONTROL MODULE Chest mounted control module which contains all external fluid and electrical interfaces, controls and displays.

6. EMU ELECTRICAL HARNESS Provides bio-instrumentation and communications connections to the portable life support system.



7. LIQUID COOLING AND VENTILATION GARMENT Worn under the pressure garment. Consists of liquid cooling tubes that maintain desired body temperature.

8. EXTRAVEHICULAR VISOR ASSEMBLY Attaches externally to the helmet. Contains visors which are manually adjusted to shield the astronaut's eyes.

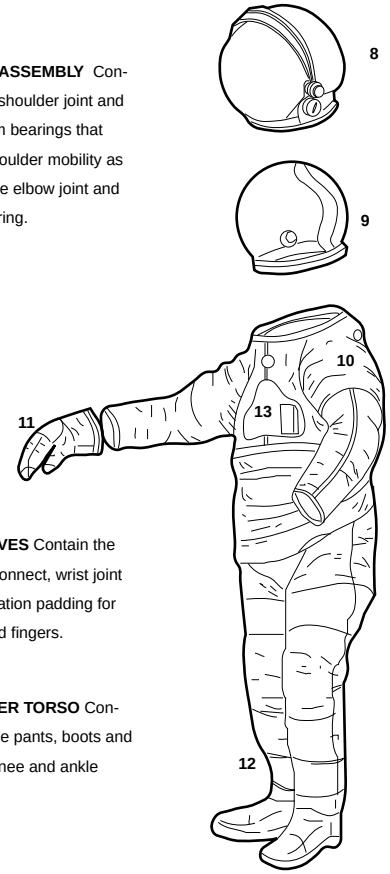
9. HELMET Consists of a clear, polycarbonate bubble, neck disconnect and ventilation pad.

10. ARM ASSEMBLY Contains the shoulder joint and upper arm bearings that permit shoulder mobility as well as the elbow joint and wrist bearing.

11. GLOVES Contain the wrist disconnect, wrist joint and insulation padding for palms and fingers.

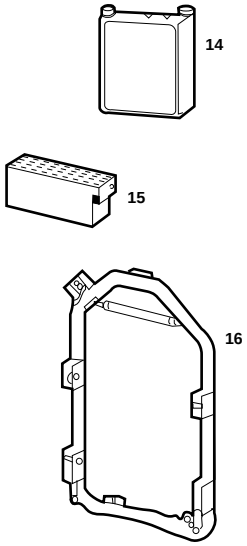
12. LOWER TORSO Consists of the pants, boots and the hip, knee and ankle joints.

13. HARD UPPER TORSO Provides the structural mountiong interface for most of the EMU-helmet, arms, lower torso, portable life support subsystem, displays and control moudule, and electrical harness.



14. CONTAMINANT CONTROL CARTRIDGE Consists of lithium hydroxide, charcoal and filters which remove carbon from the air the astronauts breathe. It can be replaced in flight.

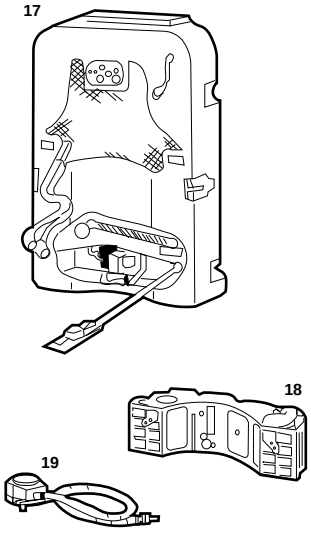
15. BATTERY Provides all electrical power used by the space suit/life support system. It is stored dry and filled, sealed and charged prior to flight. The battery is rechargeable.



16. AIRLOCK ADAPTER PLATE A mounting fixture during storage, it is used as an aid in donning and doffing the space suit/life support system.

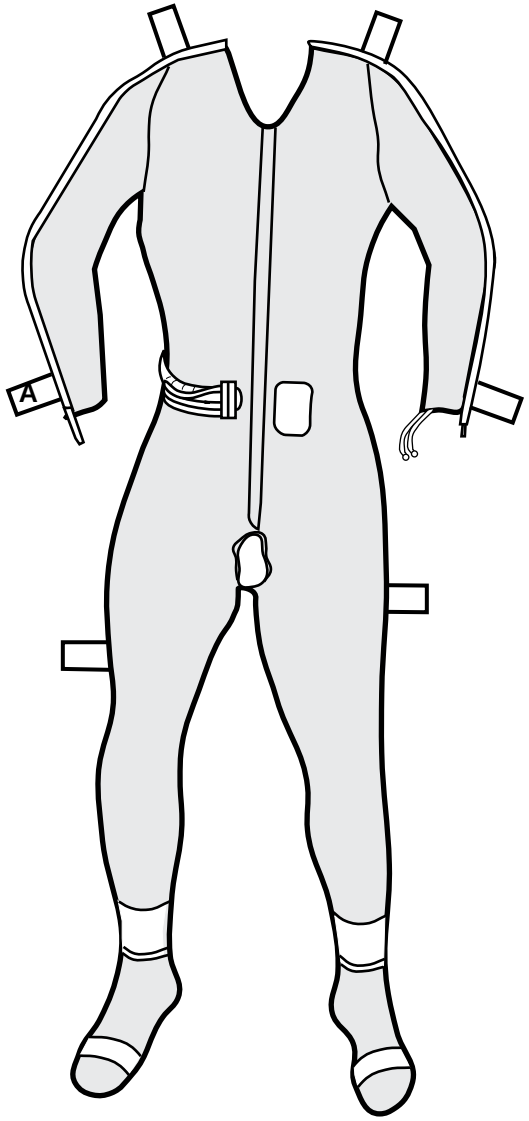
17. PORTABLE LIFE SUPPORT SUBSYSTEM Commonly referred to as the "backpack," this assembly contains the life support subsystem expendables (water and oxygen) and machinery.

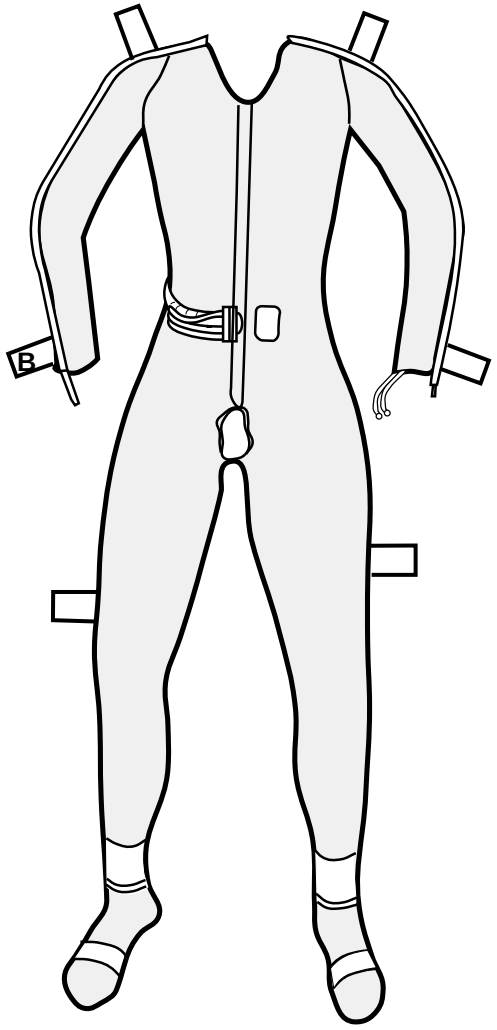
18. SECONDARY OXYGEN PACK Mounted to the base of the portable life support subsystem. It contains a 30-minute emergency oxygen supply and a valve and regulator assembly.



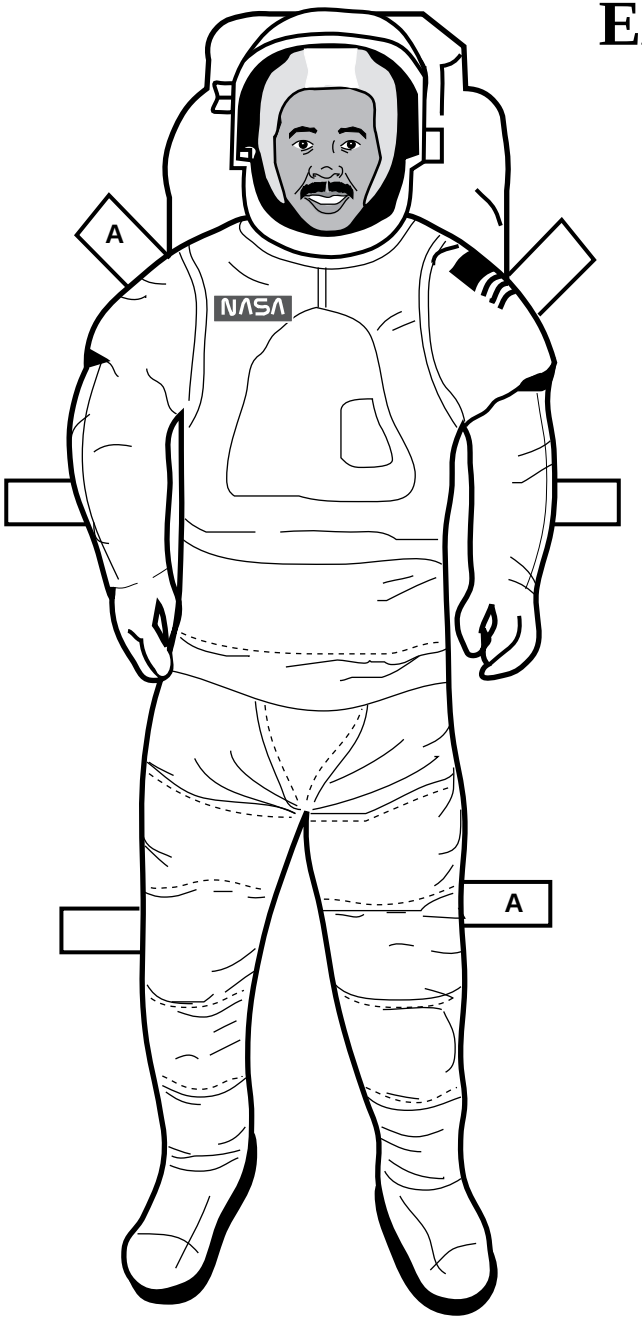
19. OXYGEN PURGE ADAPTER A hose which connects the airlock and the suit. Flushes nitrogen out of the space suit just before the astronaut seals the helmet.

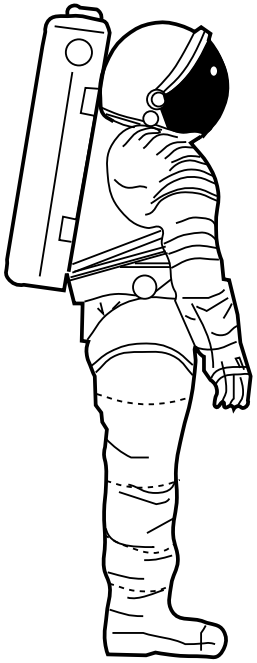
Space Station Space Suit
Liquid Cooling and Ventilation Garments

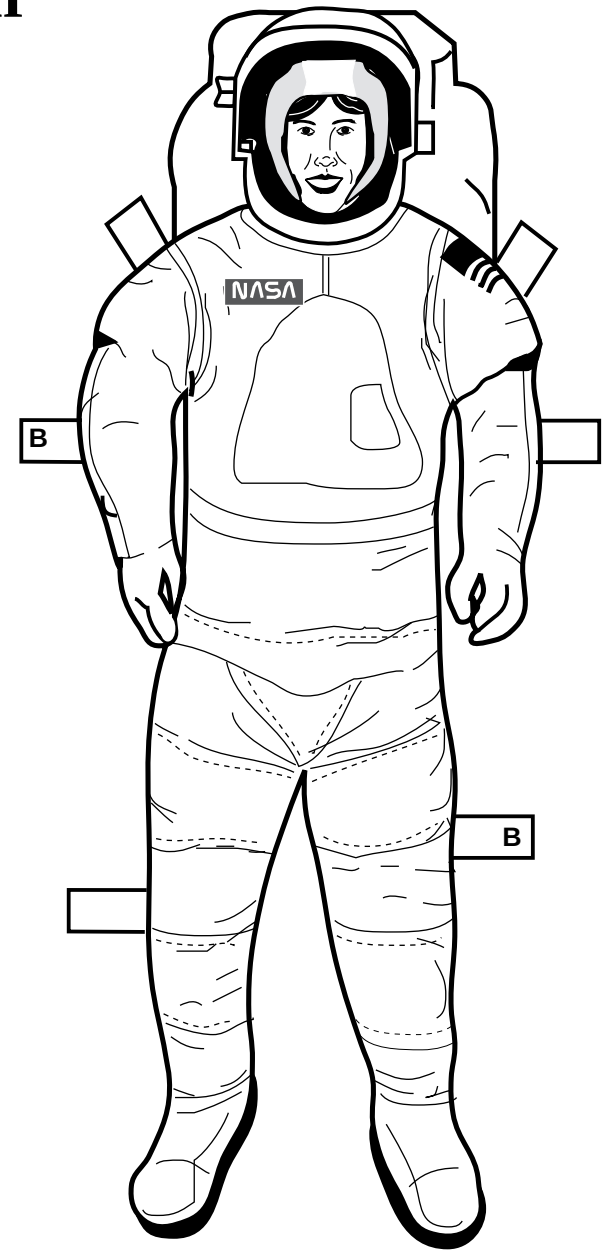




Space Suits/ Extravehicular Mobility Units (EMU)







Water Conservation on Space Station

Level (Grades K-5)

THEORY/INFORMATION

Each crew member on the space station will be given about 23 liters or 6 gallons of water each day. This water is used for drinking, cooking, washing, and cleaning. All water on the space station will be carefully conserved. Even the waste water will be filtered, distilled, chemically treated, and reused. Scientists working with the Environmental Control and Life Support System (ECLSS) project at NASA are already able to make drinkable water from human waste.

Objective

The student will measure his/her daily consumption of water and make a plan to use as little water as possible for drinking, cooking, bathing, and flushing the toilet.

Questions

What is the smallest amount of water you can use in one day and stay healthy? What is the smallest amount of water that you can use to drink, cook, bathe, and flush the toilet?

Materials

6 Clean, plastic gallon jugs
1 Cup measure
2 Water Conservation Record sheets (#1 & #2)
1 Water Conservation Plan for Day #2 sheet
1 Pencil

Procedures

1. Measure the amount of water each time that you drink.

2. Record the amount of water you drink on the Water Conservation Record - Day #1 sheet.

3. Carefully measure the amount of water used to cook the food you eat. Record the amount each time your food is cooked.

Procedures

4. Find out the size of the tank on your toilet at home. Record this amount each time you flush the toilet.

5. Estimate the amount of water you use in the shower. Record this amount each time you shower.

6. After you have collected all of this information, make a plan that will help you to use less water.

7. Write your plan on the sheet called "My Water Conservation Plan - Day #2." See the following instructions:

A. Fill the 6 clean, plastic, gallon jugs. Plan to use this water first. Hint: One gallon equals 16 cups.

B. Be sure to drink 8 glasses of water, because water is necessary to keep all the body systems healthy.

C. Plan to eat healthy food that needs very little water to prepare. If you choose to eat fresh fruit, remember the astronauts can only have it for the first two weeks on orbit because fruit spoils.

D. How can you shower, and still save water? What is your plan?

E. Can any water be reused?

F. Can you think of different ways of doing things so that you use less water?

8. On Day #2 use "Your Water Conservation Plan." Again measure all the water that you use. Be sure you get 8 glasses of water to drink.

9. Find the Water Conservation Record - Day #2 and record the amount of water used on Day #2.

OBSERVATIONS, DATA AND CONCLUSIONS

1. How much water did you use on Day #1?

2. How much water did you use on Day #2?

3. What activities used the most water?

4. List as many ways to conserve water as possible.

5. Water has many uses, but when there is not enough water for everything you must decide which activities are most important to you. If you needed to save water on the space station, and you had to give up one activity, what would you give up? Why?

6. On Earth, each person needs to drink about 8 glasses of water each day. Why is it important to have enough water to drink during the 90-day Space Station Mission?

7. If you live on the space station, you will be given 6 gallons of water each day. Some of this water is sent up on each launch, and some of it will be made on orbit. How will more water be made usable?

8. When people stay on orbit for 90 days or more on the space station, they need to take foods that does not need much water to prepare. Describe some foods that you might take and tell why you chose them.

9. In this lesson water for drinking, cooking, bathing, and flushing the toilet was planned, but water is needed for other daily activities too. On orbit aboard the space station, what other activities might require water?

10. On Earth, some equipment like toilets, showers, and dish washers use a lot of water. What will these same machines need to be like if they are to be used in space?

My Water Conservation Plan

I, _____, will conserve water by using it wisely. I will plan the following activities so that I can use less water.

Drinking Plan

Cooking Plan

Bath/Shower Plan

Toilet Flushing Plan

Water Conservation Record - Day #2

Date _____ Time _____

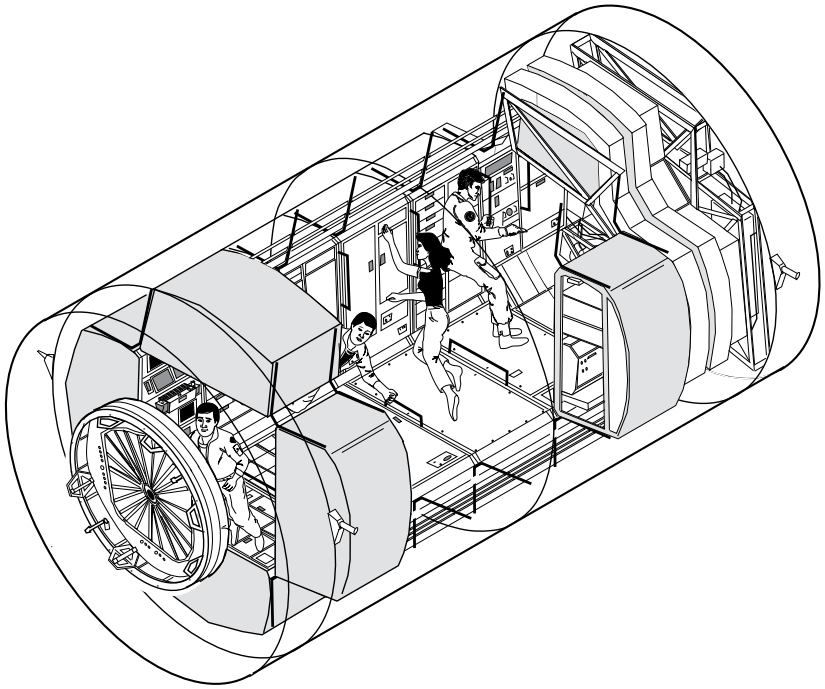
Amounts of Water Used in 24 Hours				
	Drink	**Cook**	**Bathe**	**Toilet**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Totals				

Day #2
Total Amount _____

Space Station Math

Level (Grades 3-5)

MATH (Calculator Optional)



1. The space station is an international science and technology project shared by the United States, Japan, Canada and 9 European nations. The Russian Space Agency will also be part of the space station project. With the Russians participating, how many countries will work together on the space station?

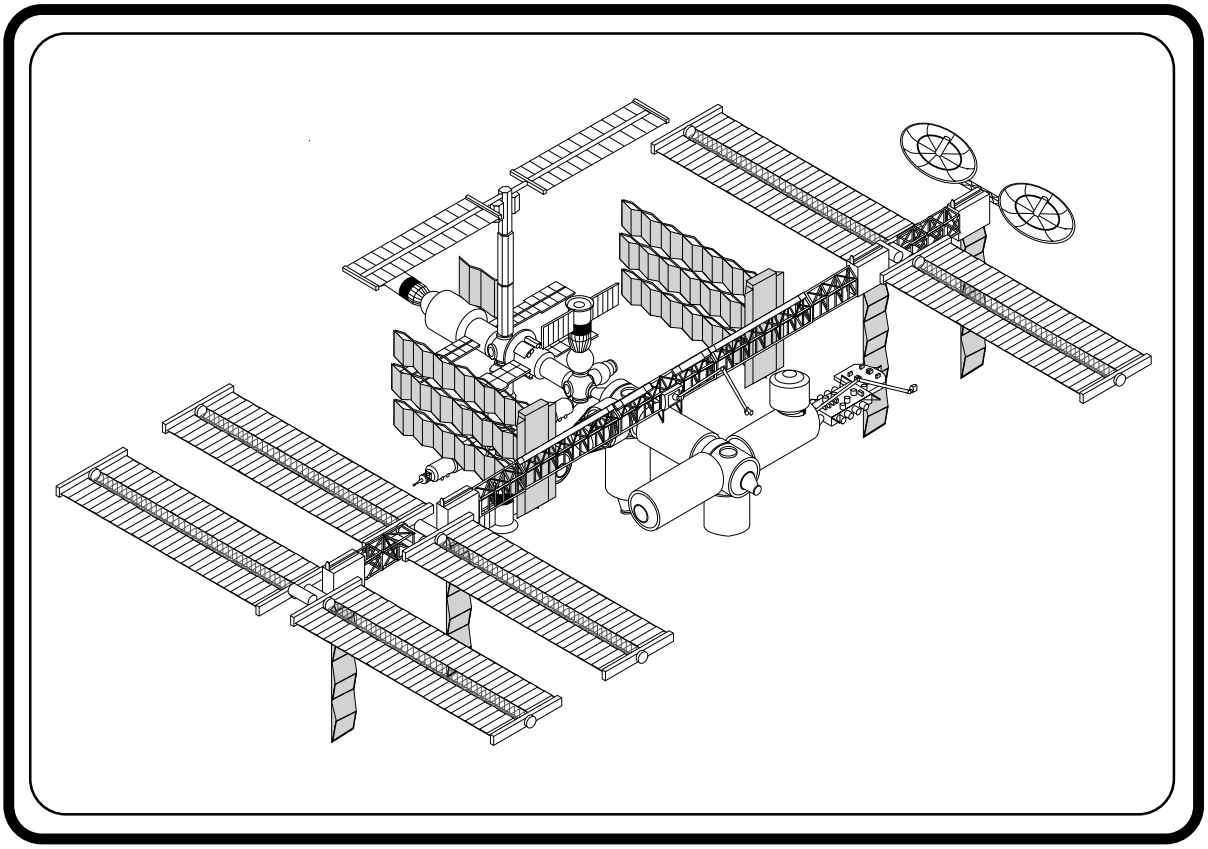
2. The crew of the space station will be changed four times each year, and each crew will be on orbit for a 90-day shift. When the station is at permanent human capacity, there will be 6 crew members on the station. If each crew member serves only one shift, how many crew members will serve the first year? How many crew members will serve aboard the space station in 10 years?

3. Since all supplies have to be taken up to the space station, the crew is only allowed to use about 23 liters or 6 gallons of water each day. How many liters of water will one crew member use in 90 days? How many liters will six crew members use each 90 days?

Space Station

BOEING

Answer Booklet



The Boeing Company - Huntsville, Alabama

Space Station Answer Booklet

Level (Grades K-5)

Lesson 3: Outfitted for Space Work

1. The astronaut working inside the laboratory module would probably wear a knit shirt, short or long pants, tennis shoes, safety goggles, and gloves.

2. The astronaut that works outside will wear an improved EMU (extravehicular mobility unit). The EMU is a very complicated space suit that protects the astronaut and keeps him/her comfortable and healthy. This space suit is made up of many layers. The EMU used in the space shuttle program has 12 layers, and the full suit consists of 19 different items. It takes the astronaut about 15 minutes to get dressed.

3. The real EMU includes 19 separate items. The drawing of the EMU has about 8 of these items.

4. Answers may vary.

5. The slipper socks worn by the astronauts are very comfortable and they keep the feet warm and clean. Heavy shoes are not needed, and the astronauts might damage the equipment if they push against it as they float around in the space station.

6. Answers may vary.

7. Answers may vary.

Space Station Answer Booklet

Level (Grades K-5)

Lesson 2: Space Station Habitat and Laboratory Modules

1. The outside of the habitat and laboratory modules are shaped like cylinders or long metal cans. The outside wall is called a bulkhead.

2. The inside of both the space station habitat and laboratory modules has four box-shaped flat surfaces. Two of the four surfaces are marked to look like walls with lights and air vents around the top. The racks located overhead and under foot are marked to look like the ceiling and floor of the two modules. More return air vents are located along the floor. Because the astronauts will spend long periods of time in space, scientists and engineers have tried to design the space station so that it is easy to live and work in the weightless environment.

3. There are 24 racks in the paper model of the habitat module. The real habitat module of the space station will have 24 racks, and the laboratory module will also have 24.

4. The galley is the eating area. It is located in the right half of the paper model.

5. The restroom and shower are two racks located side by side. These two racks are located on the wall opposite the galley and at the opposite end of the module. They are on the left half of the paper model.

6. If the furniture were placed in the space station, it would float unless it was attached to the floor.

7. While on orbit the astronauts can sleep almost anywhere because they are weightless and they float. Some astronauts have slept with their head down at the floor and their feet toward the lights. No matter how astronauts choose to sleep, they usually use some kind of sleeping restraint to keep them from bumping into the equipment or against a return air vent.

8. Answers will vary. The student might mention cooking, eating, bathing, taking photos, making movies, or relaxing.

9. (Optional) Any reasonable answer is acceptable.

Space Station Answer Booklet

Level (Grades K-5)

Lesson 3: Outfitted for Space Work

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3. The real EMU includes 19 separate items. The drawing of the EMU has about 8 of these items.

4. Answers may vary.

5. The slipper socks worn by the astronauts are very comfortable and they keep the feet warm and clean. Heavy shoes are not needed, and the astronauts might damage the equipment if they push against it as they float around in the space station.

6. Answers may vary.

7. Answers may vary.

Space Station Answer Booklet

Level (Grades K-5)

Lesson 4: Water Conservation on Space Station

1. Answers will vary. Encourage the students to make accurate measurements and keep detailed records.

2. Answers will vary, but the amount of water used should be much less than the amount reported in Question 1.

3. Answers may vary. Flushing the toilet and bathing will probably use the most water.

4. Answers will vary.

5. Answers will vary. Depending on the age of the student, some students might like the idea of giving up the daily bath.

6. The astronauts must drink enough water everyday so that all their body systems stay healthy.

7. All water on the space station will be reused. All water including that recovered from respiration, perspiration, and urination is recovered, treated, and reused.

8. Answers will vary.

9. Answers will vary. Some activities that might require water include: brushing teeth, washing dishes, cleaning the space station, and experimenting.

10. All machines sent in to space must be designed to use very small amounts of water and energy.

Space Station Answer Booklet

Level (Grades 3-5)

Lesson 5: Space Station Math

1. Add, 13 countries.

2. Multiply, 4 x 6 = 24 crew members each year, 24 x 10 = 240 crew members in ten years.

3. Multiply, 23 x 90 = 2,070 liters, 2,070 x 6 = 12,420 liters.

4. Divide, 90/7 = 12 with 6 days more, 12 showers.

5. Multiply, 8.33 x 6 = 49.98 pounds of water, 49.98 x 90 = 4,498.20 pounds of water for ninety days.

6. Divide, 24/1.5 = 16 orbits each 24 hours. Every 90 minutes there is 45 minutes of darkness and 45 minutes of sunlight. In 24 hours there would be 16 periods of darkness and 16 periods of sunlight.

7. Multiply, 24 x 90 = 2,160 hours.

8. Multiply, 90 x 8 = 720 hours.

9. Multiply, 12 x 90 = 1,080 hours.

10. Subtract, 12 - 8 = 4.

11. Subtract, multiply, 12 - 8 = 4, 90 x 4 x 6 = 2,160 hours.

12. Add, subtract, multiply, 12 + 8 + 2 = 22, 24 - 22 = 2, 90 x 2 = 180 hours.

13. Multiply, 2 x 90 = 180 hours of exercise.