CREW ASSEMBLY

A NASA Train Like An Astronaut Mission Handout – Instructor Guide

Learning Objectives

Students will:

- assemble a puzzle quickly and correctly to demonstrate the importance of dexterity and hand eye coordination while also improving communication and problem-solving skills; and
- record observations about improvements in dexterity and hand-eye coordination during this skill based experience in the Mission Journal.

Introduction

Astronauts go through rigorous training to prepare for a mission. Many NASA team members work together to train astronauts for the challenges of space. Teamwork is essential! All NASA team members, whether in space or on Earth, work together to ensure each mission's success.

Astronauts are required to assemble devices and place objects in position as part of their missions .Although already assembled and in orbit, the satellites, and the Hubble Space Telescope need repairs. They are also required to manipulate small objects during the assembly of the International Space Station (ISS). Periodically, astronauts have to do space walks, or Extra-Vehicular Activities (EVAs), to accomplish these tasks. Routinely, assembly and maintenance EVAs are carried out on the ISS. Astronauts perform a number of scheduled repairs and routine maintenance to restore and upgrade the ISS.

Assembly and maintenance in space requires astronauts to have good dexterity and hand-eye coordination. While in space they must also be able to manipulate tools and objects while wearing a pressurized spacesuit which includes gloves that completely cover their hands. These thick bulky gloves are worn to protect astronauts from the brutal space environment. They are specially made so astronauts on an EVA can move their fingers as easily as possible. A bearing connects the glove to the sleeve allowing the astronaut's wrist to turn.

Pre-mission training to help astronauts prepare for working in a spacesuit and manipulating objects during an EVA takes place in the Neutral Buoyancy Lab (NBL). The NBL is a large swimming pool but it contains equipment similar to what an astronaut would experience in space. It is 40 feet deep, 202 feet long, 102 feet wide, and holds 6.2 million gallons of water. The primary use of the NBL is to train astronauts for EVAs by simulating microgravity conditions.

The instructors at the NBL are certified divers. These NBL instructors train suited astronauts how to open hatches, use tools, and move in a simulated weightless environment. The astronaut's suit is a training version of the EVA spacesuit designed to be worn underwater. Astronauts only have 6-7 hours of life support during an EVA, so timing, efficiency and teamwork is critical while working in space. Dexterity and hand-eye coordination also play a major role in performing training tasks effectively. As astronauts practice manipulating tools quickly and accurately in their spacesuits, they are improving their dexterity and hand-eye coordination for a space mission.

Administration

Follow the outlined procedure in the Crew Assembly Mission Handout. Students will assembly a jig saw puzzle one level at a time beginning with the outside pieces. The duration of this physical activity will vary, but will average **30-45 minutes** per class.

Location

This activity will be best conducted indoors on a flat surface such as a table or the floor.

Instructor Set-up

Puzzle preparation (This can take place 2–5 days before day of lesson):

- Assemble a puzzle of at least 25 pieces on a piece of cardboard.
- Once assembled, lay an additional piece of cardboard on top the puzzle.
- Next you will flip the puzzle by placing one hand below the bottom piece of cardboard under the puzzle and the other hand on top of the cardboard placed on top of the puzzle. Hold the cardboard pieces together and rotate. The top piece of cardboard is now resting where the bottom piece of cardboard used to be.
- Remove the top piece of cardboard. You should see the back of the puzzle.
- Using a permanent marker, label all the pieces of the outer ring {the end pieces} of the puzzle with the letter “A”.
- Moving toward the center of the puzzle, label the next layer with the letter “B”.
- Continuing to move toward the center of the puzzle labeling the next layer with the letter “C”.
- You will continue to move toward the center of the puzzle and label each consecutive layer with the corresponding letter until all the puzzle pieces have been labeled.
- Disassemble the puzzles, putting each puzzle into its own separate container
- Repeat the steps above with all of the puzzles.
- Each puzzle prepared should have the same number of pieces.

Game preparation:

- Designate a home base {starting area} and an assembly area for each crew.
    - Label each area accordingly.
    - The distance between home base and the assembly area for all crews should be at least three meters in length
    - The assembly areas should be clean, flat surfaces suitable for puzzle construction.
- Divide the students into teams or Crews of two students per crew.
- Each team selects a crew name related to space.
- All crew members will wear two pairs of gloves while taking part in the mission. The first pair of gloves should tightly cover the hands. The second pair of gloves will be worn on top of the first pair and should be thicker, for instance ski gloves.
- Teacher will direct students to beginning locations.
- A container of puzzle pieces will be given to each crew. Instruct the crews to divide the pieces equally among the crew members, making sure all the same letter pieces go to the same crew member.
- During the activity, make sure the crew members are assembling the puzzle face up, not letters up.

- Each team will have a time keeper with a stop watch to time the official puzzle construction from start to finish.
- All puzzle pieces should remain at home base until it is time for a crew member to transport them to the assembly area for assembly. Crew members should not be holding the extra pieces of the puzzle.
- Crew members are not allowed to help each other with the assembly. They must wait at home base until it is their turn to go to the assembly area.

Equipment

- Mission Handout
- Mission Journal and pencil
- Containers large enough to hold at least 25 labeled pieces of one floor puzzle
- Two pairs of gloves per team member: tight fitting children's gloves and adult size working gloves
- Two pieces of cardboard large enough to cover the completed puzzles
- Marker
- Watch or stopwatch for each team, or a clock with a viewable second hand in the room

Note: If funds do not allow for purchase of gloves for each team member, they can share by switching the gloves when it's their turn. This may extend the times of the relay. Make sure if you plan on sharing gloves that the students wash their hands before and after putting on the gloves with antibacterial soap.

Safety

- Astronauts must practice assembling devices on Earth so they can successfully assemble objects in space.
    - Keep all your puzzle pieces together.
    - Avoid uneven surfaces.
    - Use communication skills properly.

Monitoring/Assessment

Ask the Mission Question before students begin the skill-based activity. Have students use descriptors to verbally communicate their answers.

Use the following open-ended **questions before, during and after** practicing the skill-based activity to help students make observations about their own skill level and their progress in this skill-based activity:

- Was your crew successful at completing the puzzle?
- How well did your crew assemble the puzzle?
- How could your crew improve on the assembly of the puzzle?
- How well did you communicate with other crew members?
- How well did your team communicate as a whole?
- What could you do to improve communication among crew members?
- What did you do to work together as a crew?
- What challenges did the crew face?

- What are some challenges an astronaut could face in assembling an object in space?
    - fatigue from assembling for hours
    - poor lighting
    - difficulty moving hands in space glove
    - communication can be lost with the ground crew or with crew members

Some quantitative data for this physical activity may include:

- length of time to complete the puzzle
- total number of puzzle pieces placed correctly

Some qualitative data for this physical activity may include:

- description of successful communication/teamwork
- puzzle completion (Did the crew complete their puzzle? If not, how many pieces did they have left?)

Collect, Record, and Analyze Data

Students record observations about their experience in their Mission Journal before and after the activity. They should also record their goals and enter qualitative data for drawing conclusions.

- Monitor student progress and safety through the activity asking open-ended questions.
- Time should be allotted for the students to record observations about their experience in their Mission Journal before and after the skill-based activity.
- Graph the data collected in the Mission Journal on the graph paper provided, letting students analyze the data individually then share graphs with the team.

Students should practice the Mission Handout skill-based activity several times before progressing or trying the related Fitness Acceleration and Mission Explorations.

Fitness Acceleration

- Increase the amount of puzzles pieces per puzzle to 50, 100, 200 or 250.
- Construct your puzzle while your crew members are in another room giving you instructions through radio communication.
- During the relay, trade puzzles with another group and continue their work; completing a puzzle that is different from your original puzzle.
- Create different scenarios by adding creative new rules:
    - Ground communication was lost and now no one may speak to each other.
    - Due to a suit malfunction, only the left hand can be used to place puzzle pieces.
    - There is a limited amount of space in the space vehicle; therefore only one piece can be placed at a time.
    - Lighting is unstable. Everyone must close an eye.

Mission Explorations

- Build larger objects using building blocks or connecting pieces.
- With adult supervision, use tools to assemble a bicycle or glue to assemble a model.
- Create something new from recyclable materials such as milk jugs, food containers, or empty boxes.

- Assign country names to the teams working together, modeling after the International Space Station partners. Create a flag to replicate your team's country flag and provide five facts about your team's country on the back of your flag.
    - *This exploration will help students understand how countries work in teams and collaborate to build the space station. Students study the different countries and learn the flags from these countries.*
    - *The International Space Station partners are USA, Russia, Japan, Canada, France, Germany, Italy, United Kingdome, Spain, Belgium, Netherlands, Switzerland, Sweden, Denmark, Ireland, Norway, Austria, Finland Portugal, Greece, Luxembourg, and the Czech Republic.*

National Standards

National Physical Education Standards:

- Standard 1: Demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities.
- Standard 2: Demonstrates understanding of movement concepts, principles, strategies, and tactics as they apply to the learning and performance of physical activities.
- Standard 3: Participates regularly in physical activity.

National Health Education Standards (NHES) Second Edition (2006):

- Standard 4: Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.
    - 4.5.1. Demonstrate effective verbal and non-verbal communication skills to enhance health.
- Standard 6: Students will demonstrate the ability to use goal-setting skills to enhance health.
    - 6.5.1 Set a personal health goal and track progress toward its achievement.

National Science Education Standards:

- Standard F: Science in Personal and Social Perspectives
    - Personal health (K-8)
- Standard B: As a result of the activities in grades K-4, all students should develop an understanding of:
    - Properties of objects and materials
    - Position and motion of objects

National Initiative

The *Local Wellness Policy*, Section 204 of the Child Nutrition and WIC Reauthorization Act of 2004 and may be a valuable resource for your Student Health Advisory Council in implementing nutrition education and physical activity.

Resources

For more information about space exploration, visit www.nasa.gov.

To learn about exercise used during past and future space flight missions, visit http://www.nasa.gov/centers/johnson/slsd/about/divisions/hacd/index.html

NASA spacesuits http://www.nasa.gov/audience/forInstructors/spacesuits/home/index.html

Access fitness-related information and resources at www.fitness.gov.

View programs on health and fitness:

Scifiles™ The Case of the Physical Fitness Challenge
http://www.knowitall.org/nasa/scifiles/index.html.

NASA Connect™ Good Stress: Building Better Bones and Muscles
http://www.knowitall.org/nasa/connect/index.html.

NASA Connect™ The Right Ration of Rest: Proportional Reasoning
http://www.knowitall.org/nasa/connect/index.html

NASA Connect™ Better Health From Space to Earth
http://www.knowitall.org/nasa/connect/index.html

For information on kids health and fitness:

Kids Health Staying Healthy
http://kidshealth.org/kid/stay_healthy/index.html

PBS Parents-Fitness
http://www.pbs.org/parents/fitness

Action for Healthy Kids
http://www.actionforhealthykids.org

Healthy Kids Challenge
http://www.healthykidschallenge.com

For more information on Robonaut:

http://robonaut.jsc.nasa.gov

Credits and Career Links

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Bruce Nieschwitz, ATC, LAT, USAW
Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists
NASA Johnson Space Center
http://www.wylelabs.com/services/medicaloperations/ascr.html

David Hoellen, MS, ATC, LAT
Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists
NASA Johnson Space Center
http://www.wylelabs.com/services/medicaloperations/ascr.html

Linda H. Loerch, M.S.
Manager, Exercise Countermeasures Project
NASA Johnson Space Center
http://www.nasa.gov/centers/johnson/slsd/about/divisions/hacd/project/exercise-countermeasures.html
http://www.nasa.gov/centers/johnson/home/treadmill.html