CREW ASSEMBLY

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 must go through rigorous training to get in shape for being in space. It takes many NASA team members working together to help train astronauts for the challenges of space. Teamwork is essential and all NASA team members, whether in space or on Earth, work together to make sure each mission is successful.

Astronauts are required to put many objects and devices together as part of their missions. Sometimes large objects in space, such as satellites or the Hubble Space Telescope, are already assembled but require repairs. There are also small objects that astronauts must manipulate during the assembly of the International Space Station (ISS). Sometimes astronauts have to do space walks, or Extra-Vehicular Activities (EVAs), to accomplish these tasks. EVAs are carried out on the ISS for continued assembly and maintenance of the vehicle. Astronauts perform a number of planned repairs and maintenance to restore and upgrade the ISS.

When assembling or maintaining objects in space, astronauts must have good dexterity and hand-eye coordination and work as a team. They must also be able to manipulate tools and objects while wearing a pressurized spacesuit that includes gloves over their hands. These gloves, worn to protect astronauts from the space environment, can be thick and bulky. They are made so astronauts on an EVA can move their fingers as easily as possible. A piece called a bearing connects the glove to the sleeve allowing the wrist to turn. They must learn to work with their gloves on to handle both large and small objects.

To help prepare astronauts for working in a spacesuit and manipulating objects during an EVA, they train in the Neutral Buoyancy Lab (NBL). The NBL is a large pool containing equipment and mock-ups similar to what an astronaut would experience in space. The NBL is 40 feet deep, 202 feet long, 102 feet wide, and contains 6.2 million gallons of water. It is primarily used to train astronauts for EVAs by simulating microgravity conditions.

Astronauts work with certified divers who are instructors at the NBL. These NBL instructors train suited astronauts how to open hatches, use tools, and move in a simulated weightless environment. Dexterity and hand-eye coordination play a major role in performing the training tasks effectively. During NBL training the EVA astronaut wears 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 very important while working in space. 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. The duration of this physical activity can vary, but will average **15-30 minutes** per class. In order for students to perform at their maximum potential, positive reinforcement should be used throughout the activity.

Location

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

Set Up

Puzzle preparation:

- Assemble a puzzle of at least 25 pieces on a piece of cardboard.
- Once assembled, lay an additional piece of cardboard on top of the puzzle.
- Place one hand on each cardboard piece. Flip the completed puzzle over upside-down. The top cardboard is now resting on the bottom piece of cardboard.
- Remove the cardboard that is now on top. You should see the back of the puzzle.
- With a permanent marker, label the pieces of the outer ring of the puzzle with the letter “A”.
- Then, mark each puzzle piece within the next inner ring with the letter “B”.
- Continue labeling each ring of puzzle pieces with subsequent letters of the alphabet until all the pieces are labeled. During the activity, make sure the crew members are assembling the puzzle face up, not letters up.
- Repeat the steps above with all of the puzzles.
- Disassemble the puzzles, putting each puzzle into its own separate container.

Game preparation:

- Designate a starting area, or home base, and an assembly area for each crew.
    - The distance between home base and the assembly area should be at least three meters and should be the same distance for all crews.
    - The assembly areas should be clean, flat surfaces for puzzle construction.
- Divide the students into two teams having two students per crew.
- Each team should decide on a space related crew name.
- All crew members will wear two pairs of gloves while conducting the mission. The first pair of gloves should fit tight on the hands. The second pair of gloves should be thick gloves, like working gloves or skiing gloves.
- Distribute a container of puzzle pieces 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.
- Each team will have a stop watch to time their official puzzle construction time from start to finish.
- Crew members are allowed to hold several puzzle pieces with different letters, but can only assemble one letter at a time.
- 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 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

  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.
- Two pieces of cardboard large enough to cover the completed puzzles
- Marker
- Watch or stopwatch for each team, or a clock viewable in the room

Safety

Astronauts must practice assembling devices on Earth so they can successfully assemble objects in space.

- It is important to 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 skill-based 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:

- changes in crew member positions

- description of successful communication/teamwork
- puzzle completion

Collect, Record, and Analyze Data

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

- Monitor student progress throughout the skill-based activity by 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. Share graphs with the team.

Students should practice the Mission Handout physical 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, 250, etc
- 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
- Add creative new rules:
  - Ground communication was lost and now no one may speak to each other.
  - Because of a suit malfunction, only the left hand can be used to place puzzle pieces.
  - Not enough room 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 are working in teams and collaborating to build the space station. Along with this, students can study about the different countries their teams are from. Students may also learn about the different flags from these countries.*
  - *International Space Station partners: 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.
- Standard 4: Achieves and maintains a health-enhancing level of physical fitness.
- Standard 5: Exhibits responsible personal and social behavior that respects self and others in physical activity settings.
- Standard 6: Values physical activity for health, enjoyment, challenge, self-expression, and/or social interaction.

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

- Standard 1: Students will comprehend concepts related to health promotion and disease prevention to enhance health.
    - 1.5.1 Describe the relationship between healthy behaviors and personal health.
- 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 5: Students will demonstrate the ability to use decision-making skills to enhance health.
    - 5.5.4 Predict the potential outcomes of each option when making a health related decision.
    - 5.5.6 Describe the outcomes of a health related decision.
- 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.
- Standard 7: Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.
    - 7.5.2 Demonstrate a variety of healthy practices and behaviors to maintain or improve personal health.

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

Local Wellness Policy, Section 204 of the Child Nutrition and WIC Reauthorization Act of 2004 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://hacd.jsc.nasa.gov/projects/ecp.cfm

NASA spacesuits

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

Access fitness-related information and resources:
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

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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Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists
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http://www.wylelabs.com/services/medicaloperations/ascr.html

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