



## MISSION: CONTROL!

### *A NASA Train Like An Astronaut Mission Handout – Educator Guide*

#### Learning Objectives

Students will

- perform throwing and catching techniques on one foot to improve balance and spatial awareness.
- record observations about improvements in balance and spatial awareness during this physical experience in the Mission Journal.

#### Introduction

On Earth, we use a variety of cues to sense the position of our bodies, while stationary or moving. We use touch and pressure cues (such as weight on our feet) and visual cues (such as location of ceiling and floors) to determine orientation. On Earth, our sense of upright is determined by the pull of gravity as sensed by the balance organs of the inner ear. Our brains integrate all this sensory information to allow us to detect our body orientation and permit us to move within our environment.

However, in an environment with less gravity, the brain needs to relearn how to use these sensory signals. In space, astronauts free-float, so there are no pressure cues to the bottom of the feet. Their visual system can be fooled because there may be no distinct floor or ceiling in a spacecraft. In addition, information from the balance organs of the inner ear needs to be reinterpreted by the brain so astronauts can move in weightless or low gravity conditions. As the brain relearns how to interpret sensory information in space, astronauts sometimes experience disorientation and nausea at least for the first few days in space.

Even though crew members eventually become adapted to their weightless environment, at some point they must return to Earth. This requires relearning the cues given on Earth and limiting some physical activities such as driving a car or flying a plane, until their balance and spatial orientation is restored.

Balance and spatial awareness, along with overall fitness, can be improved by just practicing simple exercises involving balance and movement. Use the information below to help administer the Train Like An Astronaut Mission Handout and help your students **train like an astronaut**.

#### Administration

Follow the outlined procedure in the Mission: Control! Mission Handout. The duration of this physical activity can vary, but will average **15 minutes**. In order for students to perform at their maximum potential, positive reinforcement should be used throughout the activity.

#### Location

This physical activity should be conducted on a flat, dry surface with access to a flat, solid wall, suitable for rebounding tennis balls.

## Set-up

Practice: Students should be at least arms length apart from the wall and each other.

Game:

- Students should be more than arms length apart.
- At least six players per group is optimal.

## Equipment

- Mission Journal and pencil
- Practice
  - tennis ball (one per student)
  - watch or stopwatch (one per student)
- Game: gym ball or similar sized/weighted ball (at least one per group)

*For physical activity, students should wear loose-fitting clothing that permits freedom of movement.*

## Safety

- Inform students of the importance of a safe environment when balancing.
- If dizziness is experienced, the activity should be stopped.
- Provide support for stability (i.e. hand support, back of chair) if necessary.
- Proper hydration is important before, during and after any physical activity.
- Be aware of the signs of overheating.
- A warm-up/stretching and cool-down period is always recommended.

*For information regarding warm-up/stretching and cool-down activities, reference the *Get Fit and Be Active Handbook* (ages 6-17) from the President's Council on Physical Fitness and Sports at <http://www.presidentschallenge.org/pdf/getfit.pdf>.*

## Monitoring/Assessment

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

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

- How do you feel?
- How long were you able to balance?
- How hard or easy was it to balance?
- Did it get harder or easier as you practiced? Why?
- Did you ever lose your balance? Why?
- What organs do you use to help you gain your balance?
- What is an ideal setting to practice balancing? What setting is not ideal? Why?
- What might happen if you get really dizzy?

- Which of the following do you think is more difficult? Why?
  - One foot vs. two feet on the ground
  - Flat foot vs. raised foot
  - Head up vs. head tilted back
  - Eyes open vs. eyes closed
  - Touching nothing with your hands vs. touching the back of a chair
  - Standing on a smooth, even surface vs. standing on a rough, uneven surface
- Do you think astronauts get dizzy in space?
- How come astronauts who stay in space a long time can't "practice" their balance until they return to Earth?

Some quantitative data for this physical activity may include:

- Practice
  - how many tries it took to balance 60 seconds
  - the improvement (in seconds) for each try
- Game: how many times the student was able to pass the ball

Some qualitative data for this physical activity may include:

- technique performance (foot raised behind at least level with knee)
- identifying amount of stability

### Collecting and Recording Data

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

- Monitor student progress throughout the physical 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 physical activity.
- Graph the data collected in the Mission Journal on the graph paper provided, letting students interpret the data individually. Share graphs with the group.

### Progression

- Practice on the dominant foot, then the non-dominant foot. Throw with the dominant hand, then the non-dominant hand.
- Students may step back further from the wall.
- Game:
  - Move further away from each other.
  - Increase the number of balls being passed or the speed at which the balls are passed.
  - Use different sized, lightly weighted balls (less than 3 lbs) for variation.
  - Using one foot, raise the heel slightly.

Students should practice the Mission Handout physical activity several times before progressing or trying the related Mission Explorations.

## 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.
- Standard 8: Students will demonstrate the ability to advocate for personal, family and community health.
  - 8.5.1 Express opinions and give accurate information about health issues.

## National Initiatives and Other Policies

Supports 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](http://www.nasa.gov).

To learn about exercise used during past and future space flight missions, visit <http://hacd/jsc.nasa.gov/projects/ecp.cfm>.

Access fitness-related information and resources at [www.fitness.gov](http://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>.

For more information on the neurovestibular system, visit:

NASA's Web of Life

- The Effects of Space Flight on the Human Vestibular System  
<http://weboflife.nasa.gov/learningResources/vestibularbrief.htm>

## Credits and Career Links

Lesson development by the NASA Johnson Space Center Human Research Program Education and Outreach team. Special thanks to the subject matter experts who contributed their time and knowledge to this project.

*National Aeronautics and Space Administration (NASA) contributors:*

David Hoellen, MS, ATC, LAT

Bruce Nieschwitz, ATC, LAT, USAW

Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists  
NASA Johnson Space Center

Jacob Bloomberg, Ph.D.

Neuroscience Laboratory  
NASA Johnson Space Center  
<http://hacd.jsc.nasa.gov/labs/neurosciences.cfm>

Linda H. Loerch, M.S.

Manager, Exercise Countermeasures Project  
NASA Johnson Space Center  
<http://hacd.jsc.nasa.gov/projects/ecp.cfm>

*President's Council on Physical Fitness and Sports (PCPFS) contributors:*

Thom McKenzie, Ph.D.

President's Council on Physical Fitness and Sports Science Board Member  
Emeritus Professor of Exercise and Nutritional Sciences at San Diego State University  
[http://www.presidentschallenge.org/advocates/science\\_board.aspx#Thom](http://www.presidentschallenge.org/advocates/science_board.aspx#Thom)

Christine Spain, M.A.

Director, Research, Planning, and Special Projects  
President's Council on Physical Fitness and Sports, Washington, D.C.