BUILDING AN ASTRONAUT "CORE"

Learning Objectives

Students will:

- perform the Commander Crunch and Pilot Plank to improve abdominal and back muscle strength; and
- record observations about improvements in core muscle strength during this physical experience in the Mission Journal.

Introduction

Did you know astronauts began training for missions as infants? As an infant, your first job in motor control was to stabilize your core. You needed a strong upper body to keep yourself sitting up. As an infant, even rolling from your back onto your belly required strength. Astronauts, just like dancers and athletes, rely on their core strength every day.

Why is it important to have a strong core? Core strength is important because it powers all of your movements. For example, the abdomen and back muscles work together to support the spine when you sit, stand, bend over, pick things up, and exercise. It's important to your physical well-being as a child and as an adult to have strong core muscles.

Astronauts must have strong core muscles in order to move in the microgravity environment of space. These core muscles allow astronauts to move equipment and supplies around the International Space Station (ISS) and perform Extra-Vehicular Activities (EVAs) known to most of us as spacewalks. During an EVA, astronauts are working in their spacesuits for 6 or more hours. They must be able to move easily inside the suit as they twist, bend, and lift objects to build and repair the ISS. EVAs are physically demanding on an astronaut's body. Having a strong core will aid the astronaut in completing the EVAs successfully.

It is important for astronauts on the ISS to have a workout regimen that helps keep core muscles strong and their bones healthy. This is critical for ISS crew members because their bodies are experiencing different conditions in space than on Earth. Humans on Earth are always moving against the force of gravity, their muscles and bones support their body. In the microgravity environment of space, the body does not need the support of the muscles and bones since there is no force of gravity. Due to lack of use the bones and muscles become weaker.

To keep their muscles and bones physically fit during their stay in space, astronauts must follow an exercise program. Exercise is one thing astronauts can do to prevent the body from becoming weak. This is especially important while an astronaut is in space for long duration missions, as well as when they return to Earth. Astronauts who travel to the ISS and stay for several months work out a minimum of six days a week for at least two hours a day. Specialized equipment has been designed by NASA and is used by the crews to exercise on the ISS. Two of these are the Advanced Resistive Exercise Device (ARED) and the Combined Operational Load-Bearing External Resistance Treadmill, or COLBERT. For strength training, astronauts on the ISS using the ARED can experience similar effects to using weights here on Earth. Each astronaut has a customized work out on the ARED to exercise the upper and lower body.

The COLBERT is a new generation treadmill on the ISS. It is designed to work out the walking and running muscles that would otherwise go unused in space. COLBERT has data collection devices that will allow researchers and scientists to see how well exercising on the treadmill can reduce the amount of bone and muscle loss in microgravity. Astronauts are lacing up their running shoes and getting some very important exercise time on the COLBERT.

Although space shuttle crews may require less exercise in space, exercise is still important to keep the astronauts healthy. Space shuttle crew members stay in space for 12 to 14 days. Even though their missions are shorter than an astronaut living on the ISS, they are still at risk of losing bone density and muscle mass. Space shuttle crew members must also follow an exercise routine to counteract the effects of microgravity on the body. They exercise on a cycle called an ergometer, which is similar to an exercise bike here on Earth. They also use a theraband and theratubing for strength training. These create resistance to work out the muscles, similar to lifting weights here on Earth. Although space shuttle missions are shorter than an ISS mission, it is extremely important for astronauts to follow their exercise plans to keep the bones and muscles healthy for their return to Earth. Exercise in space is essential to an astronaut's health whether in space for a six days or six months.

Administration

Follow the outlined procedure in the Building an Astronaut "Core" Mission Handout. The duration of this physical activity can vary, but will average **10-15 minutes** per class. 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 free of rocks, dirt, or other obstacles.

Set-up

Students should be at least an arms length apart from each other.

Equipment

- Mission Journal and pencil
- Watch or stopwatch

  If a watch or stopwatch is unavailable, introduce a counting technique for record keeping, for example:
  - Repeat each of the following words to equal one second of time:
    - One Mississippi, two Mississippi, three Mississippi, etc
    - One hippopotamus, two hippopotamus, three hippopotamus, etc
  - Keep cadence with a metronome
    - Sync the metronome with the second hand on a stopwatch, clock, or watch
    - Lightly tap your thigh to the beat of the metronome
    - Each tap, or beat, will equal one second

Safety

- Remind students to continue breathing normally while conducting each part of the physical activity.
- Always stress proper technique while performing exercises. Improper technique can lead to injury.
- Avoid uneven surfaces.
- Wear appropriate clothes and shoes that allow you to move freely and comfortably.
- 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?
- What muscles do you feel you are working?

  The most appropriate answers would include:
  - abdominal muscles
  - leg muscles
  - back muscles
- Which part of the physical activity seems most difficult? Why?
- What are your abdominal and back muscles together commonly called?
  - core muscles
- What happens to muscles in space?
  - muscles weaken
- Why might astronauts need strong core muscles in space?

  The most appropriate answers would include:
  - To perform spacewalks, or EVAs.
  - Movement or maneuvering through hatches or modules.
  - Lifting, bending, twisting, turning, and carrying during EVAs or daily tasks in spaceflight.

Some quantitative data for this physical activity may include:

- number of crunches performed
- amount of time the plank is held

- rate of perceived exertion (on a scale of 1-10)

Additional qualitative data for this physical activity may include:

- identifying soreness in body parts
- identifying shakiness
- sweating
- shortness of breath
- ability to complete tasks

Collect, Record, and Analyze Data

Students should record observations about their physical experience with improving abdominal and back muscle strength 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 analyze the data individually. Share graphs with the group.

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 number of Commander Crunches performed in one minute.
- Increase the time in which the Commander Crunches are performed. Increase the time in which the Pilot Plank is performed.
- Try the Commanders Crunch activity again. This time do not cross your arms. Pick up a medicine ball and do as many crunches as possible in one minute holding the medicine ball over your abdomen, but do not rest the medicine ball on your abdomen.
- During the Pilot Plank, take one leg and extend to the side. Hold your leg out for 30 seconds. Try this with both legs, one leg at a time.
- Try the Mission Specialist Side Heel-Touches.
    - Mission Specialist Side Heel-Touches
        - Starting position
            - Get in the same starting position as the Commander Crunch. This time have your arms out by your side and your knees bent no less than 45º and no greater than 90º.
        - Prep position
            - Tighten your abdominals and raise your shoulder up slightly.
            - Use the same technique as in doing a Commander Crunch.
        - Procedure

        - Hold this height and bend sideways slightly to the left.
        - Bring your left hand off the floor and touch your left heel.
        - Come back to center.
        - Replace your left hand on the floor.
        - Hold this height and bend sideways slightly to the right.
        - Raise your right hand off the floor.
        - Touch your right hand to your right heel.
        - This is one completed repetition.
        - Do as many repetitions as possible for one minute, timed or counted by your partner.
    - Switch places with your partner and follow the correct procedure to complete Mission Specialist Side Heel-Touches.
- Record observations before and after this physical experience in your Mission Journal. Follow these instructions to **train like an astronaut**.

Mission Explorations

- Explore a jungle gym, placing emphasis on climbing, swinging from a bar, or hanging from a ladder and following the rungs to the opposite side.
- Play a team sport such as kickball or soccer to build core strength.
- Participate in activities that concentrate on the core muscles such as yoga, Pilates, gymnastics, and diving.

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 Health 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 Initiatives and Other Policies

The *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.

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 maintaining good posture:

http://www.spine-health.com/topics/conserv/posture/posture02.html

For guidelines for fluid replacement and exercise:

National Athletic Trainer's Association (NATA)

http://nata.org/

- Fluid Replacement for Athletes (Position Statement): http://www.nata.org/statements/position/fluidreplacement.pdf

For information on warm-up and cool-down stretches, visit:

American Heart Association (AHA)

- Warm-up and Cool-down Stretches: http://americanheart.org/presenter.jhtml?identifier=3039236

For information about rate of perceived exertion (RPE), visit:

Centers for Disease Control and Prevention (CDC)

- Perceived Exertion: http://www.cdc.gov/nccdphp/dnpa/physical/measuring/perceived_exertion.htm

Credits and Career Links

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

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Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists
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