



## MISSION X: MISSION HANDOUT

### YOUR MISSION: **Building An Astronaut “Core”**

You will perform the Commander Crunch and Pilot Plank to improve the strength in abdominal and back muscles. As you train like an astronaut, record your observations about improvements in core muscle strength during this physical experience in your Mission Journal.

**MISSION QUESTION:** How can you perform a physical activity that will improve abdominal and back muscles?

### MISSION ASSIGNMENT: **Core Strength Training**

You will do the following activities with a partner. A warm-up/stretching and cool-down period is always recommended.

#### ☐ **Commander Crunches**

Starting position

- ⇒ Lie on your back, knees bent, feet flat on the floor.
- ⇒ Chin should be pointed to the sky, arms crossed over your chest.

Procedure

- ⇒ Using only your abdominal muscles, lift your upper body until your shoulder blades leave the ground. Put one hand on your abdomen to feel your muscles working as you raise your shoulders off the floor.
- ⇒ Lower your shoulders down using only your abdominal muscles to complete one crunch.
- ⇒ At your partners command, begin to complete as many crunches as possible in one minute, timed or counted by your partner.

#### ☐ **Pilot Plank**

Starting position

- ⇒ Lie down on your stomach.
- ⇒ Resting on you forearms, make a fist with each hand, place your knuckles on the floor shoulder width apart.
- ⇒ Using only your arm muscles, push your body off the floor supporting your weight on your forearms and toes.
- ⇒ Your body should be straight as a board from your head to your feet.

Procedure

- ⇒ Using the muscles in your abdomen and back, stabilize your body by tightening these muscles.
- ⇒ Try to keep this position for at least 30 seconds.

Switch places with your partner and follow the same procedure.

- ☐ Record observations before and after this physical experience in your Mission Journal.

**Follow these instructions to train like an astronaut.**



Back and abdominal muscles are known as the core muscles. They protect your spine, maintain proper posture, and transfer energy through your body for powerful movements such as swinging and throwing. These muscles work together as you sit up or lie down in bed, turn your body, pick up an object, and stand still. Core muscles also work together to maintain posture while wearing a heavy backpack.

By improving the strength of your core muscles, you will find it easier to stabilize your body, maintain proper posture, and prevent injury. With strong core muscles, you may find that you have better posture, can balance extra weight easier, and you might have better agility for sudden movements during sports activities.

## It's a Space Fact:

Just like on Earth, astronauts in space must be able to twist, bend, lift, and carry things. They must have strong core muscles so they can perform their tasks efficiently and avoid injury. During missions in space they need to bend their body and hold it straight for extended periods of time. Astronaut's muscles get smaller and weaker over time in a microgravity environment. In order to maintain muscle strength they practice core-building activities before, during, and after their missions. Here on Earth, these activities may include swimming, running, weight training, or floor exercises. In space, they use specialized equipment similar to what you would find here on Earth to keep an exercise routine that will keep their core muscles fit for the job.



### Core:

The muscles that stabilize, align, and move the trunk of the body; the abdominal and back muscles.

### Stabilize:

To keep something at the same level; to maintain that level.

### Posture:

A position the body can assume; standing, sitting, kneeling, or lying down.

### Repetition:

A motion that is repeated and usually counted.

### Forearm:

The part of the human arm extends from the elbow down to the wrist; lower arm.

### Spine:

Consists of the spinal cord, vertebrae and discs; supports an animal's body.

## FITNESS ACCELERATION: Test Yourself!

- ☐ Increase the number of Commander Crunches in one minute.
- ☐ Increase the time in which the Commander Crunches and Pilot Plank are performed.
- ☐ Repeat the Commander Crunch activity only this time do not cross your arms. While holding the medicine ball over your abdomen, do as many crunches as possible in one minute.  
*Safety: Do not rest the medicine ball on your abdomen. Also, be sure your partner is close by in case you need assistance.*
- ☐ Repeat the Pilot Plank activity only this time, extend one leg to the side. Hold your leg out for 30 seconds. Repeat this activity with the opposite leg. Alternate extending each leg to the side.
- ☐ Try the Mission Specialist Side Heel-Touches as instructed by your teacher.

## Think Safety!

Astronauts know that it is important to safely strengthen their core muscles in order to protect themselves from injury.

- ☐ Breathe normal throughout these physical activities.
- ☐ Concentrate on the core muscles when performing each exercise.
- ☐ Move carefully until you become acquainted with the movement.
- ☐ STOP immediately if you experience any pain or discomfort.
- ☐ Avoid uneven surfaces. To avoid injury, perform these activities on a soft but firm surface.

## Mission Explorations:

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

**Status Check:** Have you updated your Mission Journal?



# Train Like an Astronaut: Adapted Physical Activity Strategies

## Building an Astronaut Core

### YOUR MISSION

You will perform the Commander Crunch and Pilot Plank to improve the strength in abdominal and back muscles. As you train like an astronaut, record your observations about improvements in core muscle strength during this physical experience in your Mission Journal.

### LINK TO SKILLS AND STANDARDS

**APENS:** 3.10.10.01 Understand the use of statics, dynamics, kinematics, body axes, planes, balance, and equilibrium for studying and planning movement activities for individuals with unique needs

#### *Activity Specific Terms/Skills*

Core, muscle strength, endurance, plank, balance

### SPACE RELEVANCE

Astronauts in space must be able to twist, bend, lift, and carry massive objects. They must have strong core muscles so they can perform their tasks efficiently and avoid injury. In order to maintain muscle strength while in space, astronauts practice core-building activities before, during, and after their missions. Here on Earth these activities may include swimming, running, weight training, or floor exercises. In space, astronauts use specialized equipment to maintain an exercise routine to keep their core muscles fit for the job.

### WARM-UP & PRACTICE

#### **Warm-up**

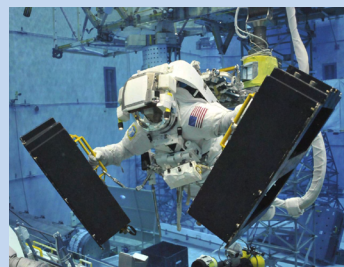
- 🚩 Wall push-ups
- 🚩 Toe or knee touches
- 🚩 Hold push-up position while stacking cups (see image)
- 🚩 Modify push-ups (on knees)
- 🚩 Demonstrate animal, yoga poses: 'seal' or comic book 'Superman' position
- 🚩 Use a core ball, knees @ 90 degrees; squeeze abdominal muscles

**Practice:** Practice skills separately and build complexity



#### SUGGESTED ADAPTED EQUIPMENT:

- 🚩 RIGID BALL
- 🚩 STURDY CHAIR OR TABLE





# Building an Astronaut Core

## LET'S "TRAIN LIKE AN ASTRONAUT!"

Adjust steps and procedures as appropriate for participants

Instructions for play: You will do the following activities with a partner.

### Commander Crunches

- ▲ Starting position: Lie on your back, knees bent, feet flat on the floor.
- ▲ Chin should be pointed to the sky, arms crossed over your chest.

### Procedure

- ▲ Using only your abdominal muscles, lift your upper body until your shoulder blades leave the ground. Put one hand on your abdomen to feel your muscles working as you raise your shoulders off the floor.
- ▲ Lower your shoulders down using only your abdominal muscles to complete one crunch.
- ▲ At your partners command, begin to complete as many crunches as possible in one minute, timed or counted by your partner.

### Pilot Plank

- ▲ Starting position: Lie down on your stomach.
- ▲ Resting on you forearms, make a fist with each hand, place your knuckles on the floor shoulder width apart.
- ▲ Using only your arm muscles, push your body off the floor supporting your weight on your forearms and toes.
- ▲ Your body should be straight as a board from your head to your feet.

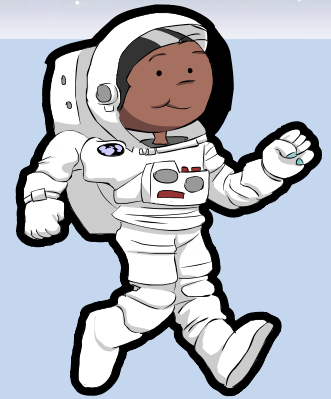
### Procedure

- ▲ Using the muscles in your abdomen and back, stabilize your body by tightening these muscles.
- ▲ Try to keep this position for at least 30 seconds.
- ▲ Switch places with your partner and follow the same procedure.

Record observations before and after this physical experience in your Mission Journal.

## TRY THIS! *Some ideas for Adapted Activity*

- ▲ In wheelchair, place hands on arm rests and lift up using arms
- ▲ Lift legs and hold. Legs straight or bent.
- ▲ In chair, lean forward 45 degrees
- ▲ Lay on the floor and lift feet or legs,
- ▲ Elevated plank (various levels - using a table, a stool, bench, bar, steps- no wheels)
- ▲ Isometric: squeeze abs, or lean or push against wall.
- ▲ Use stopwatch to get baseline and progress by adding time.
- ▲ Place ball between stomach and floor and while in plank position using hands to walk out and back
- ▲ While in push up position, alternate right and left hand crossing midline to touch opposite shoulder, keeping plank
- ▲ Peer assistance, visual cues





## 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 45° and no greater than 90°.
    - 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](http://www.nasa.gov).

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>

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](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

NASA Johnson Space Center

<http://www.wylelabs.com/services/medicaloperations/ascr.html>

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<http://hacd.jsc.nasa.gov/projects/ecp.cfm>