



## Mission X: Mission Handout

### YOUR MISSION: **PEAKE LIFTOFF!**

You will perform an activity that is designed to promote a combination of muscular strength, agility, coordination and endurance. This activity blends together squats, pushups, and jumping in the air, so get ready for Peake Liftoff! You will comment on your activity during this physical experience in your Mission Journal.

Being physically active is an important way to keep your muscles strong and your heart and lungs healthy. To produce the complex motions we need in life, it is important to work many muscles together. As you move during the day, such as to and from class at school, your muscles, heart, and lungs benefit. They get stronger by being worked for long periods of time. Many movements also require a coordinated effort between the brain and different muscles to perform complex actions. Muscle flexibility can help reduce risk of injury and activities from jumping can help strengthen bones. Put it all together in a Peake Liftoff!!!

**MISSION QUESTION:** How could you perform a series of physical activities that would improve your lungs and heart, and increase muscular coordination and endurance?



Building muscular endurance and coordination is an important foundation to making complex motions. Performing a series of physical motions over time increases heart and lung health while allowing you to increase your ability to move yourself and other objects without experiencing exhaustion.

### MISSION ASSIGNMENT: **Full Body Training**

- Move more than an arms-length away from others to make a safe Touchdown and Liftoff area
- Start in the standing position
- Drop to a squatting position, with your hands touching the floor in front of you, and yell “5”
- Move your feet behind you, to the beginning of a pushup position, and yell “4”
- \*\*Once in the pushup position, pay attention to your form and keep your back straight\*\*
- Lower your chest to the floor and yell “3”
- Raise your chest back to the beginning push up position and yell “2”
- Slide your feet back under you to a squat with your hands touching the floor and yell “1”
- Jump high in the air and yell “LIFTOFF!”
- Repeat 10 times, maintaining proper form

Record observations before and after this skill-based experience in your Mission Journal.



### Strength Training:

Physical activities which use resistance to increase muscle and bone strength, and help improve overall health and fitness.

### Crew (crew members):

People working together on a common activity or for a common purpose; a term for astronauts who share their mission with each other.

## It's a Space Fact:

There are many reasons astronauts must have strong muscles and bones. In a reduced gravity environment, muscles and bones can become weak, so astronauts must engage in strength training to counter the weakening effect of zero gravity. Also, when working on the ISS and exploring in space, astronauts have to be fit to perform spacewalks or move objects that are hundreds of kilograms! How do they do all of that? Before, during, and after living in space astronauts work closely with exercise specialists to train hard and keep their muscles and bones strong for exploration missions and discovery activities. Activities that exercise the whole body are important to prepare for the challenges involved with living and working in space.

## Fitness Accelerations

- Do five burpees and for the last burpee, do a “tuck jump.” Instead of jumping straight up into the air on “LIFTOFF!” tuck your knees into your chest as you jump up. Complete three sets of five burpees with a tuck jump, rest for twenty seconds between each set.
- For this one you will need more space, so make sure you are in a wide open area, like your backyard or the school gym with your classmate or friend at least ten feet away from you. You will do one set of eight burpees, adding a lateral (sideways) jump at the end. Like the tuck jump, instead of jumping straight up into the air, you will do a different jump, called a lateral jump. When you jump and “LIFTOFF!” from the ground, jump to the side.



### Repetition:

A motion (such as a body-weight squat or a push-up) that is repeated and usually counted.

### Resistance:

An opposing force (through gravity, weight, including your own bodyweight or equipment).

By doing exercises that use your own body weight, you can increase the strength of your muscles and bones. Lack of physical activity can increase the chances of injury because your muscles and bones may be weak. Even easy physical tasks might seem hard!

### Think Safety

- Astronauts carefully practice proper strength training on Earth so they can safely strength train in space.
- Make sure there is plenty of room around you to avoid hitting your crewmates during liftoff!
- It is important to do these activities slowly and correctly to avoid injury.
- Remember that drinking plenty of water is important before, during, and after physical activities

## Mission Explorations:

- Count how many burpees you can properly do in 30 seconds.
- Teach someone else how to do a burpee.
- Jump as high as you can during the burpee and land softly, trying to make little noise as you land.
- Learn how to say, “5, 4, 3, 2, 1 Liftoff!” using another language and perform it together with others.



## Mission X: Mission Handout - EDUCATOR SECTION

# Your Mission: **PEAKE LIFTOFF!**

### Learning Objectives

Students will:

- perform a series of burpees to improve agility, coordination, as well as cardiovascular and muscular endurance; and
- record observations and improvements about this experience in the Mission Journal



### Introduction

Are you looking for a series of movements that do not require weights or equipment, yet increase cardiovascular and muscular strength and endurance? Burpees may be your answer. The burpee is an exercise that has long been used in different athletic and military training programs because of those same reasons: they can be done almost anywhere in a fairly small space, they increase cardiovascular output, and they work major muscle groups without a need for weights or equipment.

When we play sports or engage in physical activity, we are improving our health and demanding our bodies to work hard. Even simply performing our daily activities such as when walking on Earth or standing while we brush our teeth, our muscles work to provide support and motion. In space, however, astronauts are floating and have very small loads on their bodies throughout the day. In fact, without exercise astronauts would lose a significant amount of muscle and bone density while in space. To counteract these potential losses, astronauts exercise on the International Space Station (ISS) for about two hours per day. Those two hours is the allotted time for cardiovascular exercises on the bicycle or treadmill ergometer, as well as strength training, to maintain muscle and bone. Thus, it is crucial to their health and muscular-skeletal system to exercise in an efficient manner.

To help the astronauts stay healthy and get ready for space travel, space agencies have astronaut trainers to prepare the astronauts for the rigors of living and working in space. The goal of the astronaut trainers is for astronauts to return to Earth healthy. In fact, ideally the astronauts would return in as healthy of a state as when they launched. These experts in training astronauts use a wide variety of exercises and activities to create an individual plan for each astronaut. Many of the activities the astronauts do to prepare for space travel are similar to ones we can all do in our schools and homes! One example is the burpee.

Burpees are a good example of a high-intensity exercise that works many parts of the body. Research has found that high-intensity activities can be more beneficial than lower intensity activities. In fact, a recent study known as Integrated Resistance and Aerobic Training, or iRAT (<http://www.nasa.gov/content/i-sprint-for-exercise-nasa-irat-study>) was funded by NASA's Human Research Program and found that three days of high intensity training by astronauts in space - as well as test subjects on Earth - will do more to protect their muscles and bones compared with six days of exercise at a lower intensity and higher volume.

Basically, the studies showed that shorter duration of high intensity exercise was better than longer duration of easier exercise. Additionally, cardiovascular function improved by alternating days of high intensity exercise with

days of continuous, lower intensity, exercise. What does this mean to us on Earth, and what can we share with our Train Like an Astronaut participants? Every other day, encourage them to increase the intensity of their exercise and work really hard for a short amount of time. Then, on the other days, they can exercise for a longer time at an easier level of effort.

Burpees are great activities to do as part of a high intensity workout because they target muscular strength as well as get the heart pumping. Also, nearly all the muscles in the body are engaged in this whole body exercise. Do the astronaut trainers suggest astronauts do full-body activities, such as burpees, to prepare for being in space? Yes. Astronauts are very healthy and most have been fit for many years as they prepared for spaceflight. In fact, ESA astronaut Tim Peake even did burpees before becoming an astronaut when he served in the military in the UK. Other astronauts also did burpees growing up as part of training for sports or in physical education in school. The astronaut trainers will customize the workout prescription for each astronaut based on their needs, and burpees are included in the menu of possible activities the trainers will prescribe. If you want to Train Like an Astronaut, add some burpees to your exercise plans. Keep in mind that astronauts don't do burpees while in space. Why don't they? The reduced gravity environment and hardware restrictions of the exercise equipment on the ISS make the actions of burpees impossible to perform.

Are there other reasons to do some burpees? Well... yes. Astronauts and cosmonauts currently live in space for six months to a year, and they experience physical changes that have noticeable effects once they return to Earth's gravity. These changes include alterations to vision, balance, coordination, blood pressure, and the ability to walk; all of which impact their ability to perform basic tasks. A mission to Mars, for example, would extend their time in space even longer and may have additional recovery schedules and challenges. Currently, crews land on Earth with immediate access to medical assistance and rehabilitation facilities. These medical experts greatly assist in the recovery and return to pre-flight conditions. Activities such as burpees are far too complex and require too many coordinated movements for astronauts to perform initially upon return to Earth. However, given some time, they may be quite useful for astronauts to train aspects of their bodies and brains. Check out this video to learn more about astronauts and cosmonauts issues upon returning to gravity and the challenges of a trip to Mars <https://www.youtube.com/watch?v=04lrZeQOpNI> and to read the story <https://www.nasa.gov/content/walk-the-line-nasa-studies-physical-performance-after-spaceflight>.



*Astronaut and Mission X 2015 Ambassador Samantha Cristoforetti is helped out of the Soyuz spacecraft just minutes after landing from Expedition 43, marking the beginning of her recovery from the effects of living in space.*



## Administration

Follow the outlined procedure in the Peake Liftoff Mission Handout. The duration of this physical activity will average less than 15 minutes. It is important to make sure participants are warmed up and ready for physical activity. Positive reinforcement should be used and, to recognize the complex nature of this activity, the activity may best be introduced one step at a time. For steps, watch the video of Tim Peake introducing Peake Liftoff found here <http://trainlikeanastronaut.org/media>.

Safety. Make sure the students are spread out and the area is clear. Move more than an arms-length away from others to make a safe Touchdown and Liftoff area. Remember, before becoming an astronaut, Tim Peake was a test pilot for helicopters. Just like spinning helicopter rotors, make sure the students don't collide with each other!



- Start in the standing position
- Drop to a squatting position, with your hands touching the floor in front of you, and yell “5”
- Participants should be careful with their hands if the floor surface is rough.
- Move your feet behind you, to the beginning of a pushup position and yell “4”
- Lower your chest to the floor and yell “3”
- Raise your chest back to the beginning push up position and yell “2”
- Slide your feet back under you to a squat with your hands touching the floor and yell, “1”
- Jump high in the air and yell, “LIFTOFF!”
- Repeat 10 times, maintaining proper form

## Location

Because participants will have their hands on the ground as well as jumping into the air, this physical activity is best performed on a non-slip flat surface such as a gym floor, outside in dry grass, on an athletic track surface. Make sure the participants are spread out more than arm length apart.

## Equipment

- No special equipment is necessary, although make sure the surface is suitable for the safety and comfort of the participants.

## Safety

- Avoid obstacles, hazards, and uneven surfaces.
- Make sure participants use proper form.
- Ensure ground surface is safe for participants' hands.
- Students must wear the appropriate clothes and shoes that allow them to move freely and comfortably.
- Proper hydration is important before, during, and after any physical activity.
- Be aware of the signs of overheating.
- A proper warm-up and cool-down period is always recommended.
- For information regarding warm-up and cool-down activities, and general fitness suggestions for schools, families and communities please reference the President's Council on Physical Fitness and Sports at <http://www.cdc.gov/healthyschools/physicalactivity/guidelines.htm>.

## Monitoring/Assessment

- Ask the Mission Question before students begin the physical activity.
- Have students used descriptors to verbally communicate their answers.
- Before beginning, stress the importance of using proper form. Additionally, remember that some participants may find the complex actions difficult. Therefore, begin with each step and allow proper completion of each step to be a success. Only then should the movements be completed together.
- 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:
  1. How do you feel?
  2. Are you getting more tired each time you complete a burpee?
  3. Is your form improving or getting worse each time you perform a burpee?
  4. How do you know you are getting better?
  5. What do you think would be more difficult for an astronaut: completing a burpee right after returning from space on a 2-day mission or a six-month mission? Why? **An astronaut working in space for a six-month mission will have a more difficult time completing the agility course when they return to Earth. During longer missions, an astronaut's body has been exposed to the microgravity environment for a longer period of time. Because of this, the body will take longer to adapt to the Earth environment. Astronaut trainers are experts at working with the astronauts before, during, and after they fly to space in order to for them to remain as healthy as possible.**
  6. Do you think an astronaut could successfully complete a burpee the day they landed from a 6-month mission? A week later? A month later? **Humans respond to changes in gravity slightly different from each other. Generally, a week or so after returning from a six month mission space, an astronaut would likely be able to partially complete a burpee with limited success. As time goes on their performance will improve. The astronaut's body will become better adapted to Earth's environment each day they are back on Earth. The astronaut will begin to perform as they did before spaceflight and in some cases even better than when they went into space. Being healthy and fit upon their return to Earth will help the astronaut regain their strength and agility faster.**

## Collect, Record, and Analyze Data

Students should record observations about their physical experience in skill with movement, coordination, and form 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.
- Students can record how many burpees they can do in a 60 second time period. To encourage proper form and help prevent injury, only count the burpees done with proper form.

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

### **Fitness Acceleration**

- Try having the students learn the countdown steps in other languages.
- Do five burpees and for the last burpee, do a “tuck jump.” Instead of jumping straight up into the air on “LIFTOFF!” tuck your knees into your chest as you jump up. Complete three sets of five burpees with a tuck jump, rest for twenty seconds between each set.
- Do one set of eight burpees, adding a lateral (sideways) jump at the end. For this one you will need more space, so make sure you are in a wide open area, like your backyard or the school gym with your classmate or friend at least ten feet away from you. Like the tuck jump, instead of jumping straight up into the air, you will do a different jump, called a lateral jump. When you LIFTOFF! the ground, jump to the side instead of straight into the air. Repeat the burpee with a lateral jump eight times.
- Increase the strength training and perform several pushups before you rocket back into the air!

### **Mission Explorations**

- Teach your parents how to do a burpee and try it together before dinner. When preparing for a mission, astronauts train and prepare for hours every day. Exercising outside of the classroom gives you more time to train like an astronaut!
- Think of your own variation for the “BLASTOFF!” jump, like a leg split. \*Remember to stay safe and ask a parent, guardian or educator before trying it.\*

### **National PE standards:**

SHAPE America Physical Education, Grade Level Outcomes

**S1.E8 Demonstrates competency in a variety of motor skills and movement patterns.** Weight Transfer

Example Grade 4: Transfers weight from feet to hands, varying speed and using large extensions.

**S2.E2 Applies knowledge of concepts, principles, strategies, and tactics related to movement and performance. Pathways and Levels.**

Example Grade 5: Combines spatial concepts with locomotor movements for small groups in gymnastics, dance, and games environments.

### **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>

To learn more about astronauts and cosmonauts issues upon returning to gravity and the challenges of a trip to Mars:

<https://www.youtube.com/watch?v=04lrZeQOpNI> and to read the story <https://www.nasa.gov/content/walk-the-line-nasa-studies-physical-performance-after-spaceflight>

For guidelines to prevent heat-related illnesses:

American College of Sports Medicine (ACSM) Exertional Heat Illness during Training and Competition <http://www.acsm-msse.org/pt/pt-core/template-journal/msse/media/0307.pdf>

Centers for Disease Control and Prevention (CDC) Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety [http://www.bt.cdc.gov/disasters/extremeheat/heat\\_guide.asp](http://www.bt.cdc.gov/disasters/extremeheat/heat_guide.asp)

## **Credits and Career Links**

ESA Principia mission page: [http://www.esa.int/Our\\_Activities/Human\\_Spaceflight/Principia](http://www.esa.int/Our_Activities/Human_Spaceflight/Principia)

How to become an ESA Astronaut (for grown-ups): [http://www.esa.int/Our\\_Activities/Human\\_Spaceflight/Astronauts/How\\_to\\_become\\_an\\_astronaut](http://www.esa.int/Our_Activities/Human_Spaceflight/Astronauts/How_to_become_an_astronaut)

How to become an ESA Astronaut (for kids):  
[http://www.esa.int/esaKIDSen/SEM6TIWJD1E\\_LifeinSpace\\_0.html](http://www.esa.int/esaKIDSen/SEM6TIWJD1E_LifeinSpace_0.html)

Exercise in space (for kids):  
[http://www.esa.int/esaKIDSen/SEM1CO6TLPG\\_LifeinSpace\\_0.html](http://www.esa.int/esaKIDSen/SEM1CO6TLPG_LifeinSpace_0.html)

ESA interactive brochure GETTING READY FOR SPACE : [http://esamultimedia.esa.int/multimedia/publications/Getting\\_ready\\_for\\_space\\_EN/](http://esamultimedia.esa.int/multimedia/publications/Getting_ready_for_space_EN/)

The Challenges of Astronaut Training: [http://www.esa.int/Our\\_Activities/Human\\_Spaceflight/Astronauts/The\\_challenges\\_of\\_astronaut\\_training](http://www.esa.int/Our_Activities/Human_Spaceflight/Astronauts/The_challenges_of_astronaut_training)

ESAs Career Portal: [http://www.esa.int/About\\_Us/Careers\\_at\\_ESA](http://www.esa.int/About_Us/Careers_at_ESA)

## **Contributors**

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This activity was also developed with the assistance of educators Tim Vigorito and June Kelly. At the time of publication, Tim was an educator from Height's Elementary School in Sharon, Massachusetts in the USA and June was an educator at the Temple Primary School in Manchester, England in the United Kingdom.

We value the experience and knowledge of our educators, astronauts and trainers, and it is only with their assistance that such activities are of high quality for students around the world. Thank you to Tim, June, Tim and Patrick.