EXPLORE AND DISCOVER

Learning Objectives

Students will:

- safely carry weighted objects from the Exploration Area back to your Base Station to improve aerobic and anaerobic fitness; and
- record observations about improvements in aerobic and anaerobic fitness during this physical experience in their Mission Journal.

Introduction

Have you exercised your heart today? Most students exercise their heart and don't even know it. If students have played soccer, basketball, hopscotch, jumped rope, gone swimming, or rode their bike to school, they have exercised their heart. The heart is a muscle that works better when it is strong. The heart can become stronger with regular physical activity and exercise. It is important to get involved in physical activity in order to get, and keep, the heart and other muscles physically fit. Get your body moving and make your heart stronger.

Exercise is essential to maintaining cardiovascular health, bone strength, and strong muscles. There are two types of exercise: aerobic and anaerobic. Aerobic and anaerobic exercise work together to give you a healthy heart and body. Aerobic exercise involves the use of oxygen to produce energy, whereas anaerobic exercise makes the body produce energy without oxygen. You may be asking yourself which of these two types of exercise is most important for the body.

The literal meaning of aerobic is oxygen. An aerobic exercise includes any activity that uses the large muscles of the body such as your arms and legs. These muscles should be moving in repetitive motions for an extended period of time. The ideal activity should last at least 20 minutes and have constant movement. Aerobic activity helps reduce stress, increase blood circulation, strengthen the heart and lungs, as well as help build up endurance. It also helps strengthen bones, burn fat, and lower blood sugar. Find a fun aerobic activity you enjoy doing for at least 20 minutes a day and you will find you have more energy and feel healthier.

Anaerobic activities build agility as well as strengthen and tone muscles. However, anaerobic activities are not as beneficial to the heart and lungs as aerobic activities. Anaerobic activity has been shown to increase your longevity. For example, resistance training increases bone mass, reduces muscle loss, and improves balance.

It is important to have an exercise routine that incorporates both aerobic and anaerobic activities; this will balance your fitness regimen. Both types of exercise will help maintain muscle, improve bone density, and optimize the cardiovascular system. This will provide benefits of optimal physical fitness.

Exercise is important to people on Earth, but it is essential for astronauts who travel into space. Astronauts don't feel the effects of gravity; therefore, astronauts don't have to use their muscles as much during normal everyday activities in space. On Earth, every time you take a step, you lift the weight of your body using your muscles.

In space, astronauts experience microgravity. This makes them feel weightless. Moving around is an effortless task in a microgravity environment. Imagine floating around the room and moving objects around with one small push. It sounds like you would need to possess extraordinary strength, but in reality, astronauts begin to lose strength and their muscles become weak. Astronauts also experience decreased bone density, loss of muscle mass, heart and blood vessel changes, and shifts in fluids.

To counteract these changes, astronauts must continue their aerobic and anaerobic exercises in the space environment. Keeping physically fit during their stay in space will help them adapt to Earth's gravity upon their return. An astronaut does not want to return to Earth with limited use of his or her muscles; therefore, every astronaut follows a series of exercises based upon their individual fitness needs and goals. Both the space shuttle and International Space Station (ISS) are equipped with exercise equipment adapted to work in the microgravity environment of space. Astronauts follow an exercise schedule to do aerobic and anaerobic exercises to countermeasure the effects of microgravity on their bodies.

Next time you have to move large bulky objects around the house or in your classroom, imagine what it would be like to move that object if you had just spent six months in space without working on your aerobic and anaerobic fitness. Do you think that would be an easy task?

As students plan their fitness activities for the day, encourage them to include both aerobic and anaerobic activities in their plan. Here is a list of examples of aerobic and anaerobic activities.

Aerobic Activities	Anaerobic Activities
Brisk walking	Baseball
Dancing	Sprinting
Jogging	Tennis
Bicycling	Weightlifting
Skating	Leg lifts
Swimming	Arm circles
Snow shoveling	Sit-ups
Leaf raking	
Lawn mowing	
Jumping rope	

Administration

Follow the outlined procedure in the Explore and Discover Mission Handout. The duration of this activity can vary, but will average **30-45 minutes**. In order for students to perform at their maximum potential, positive reinforcement should be used throughout the activity.

Follow Set-up procedures to prepare the mission samples and the Exploration Area.

- Before students start their mission, instruct students how to take a proper heart rate (Appendix A).
  - Students should lie on the floor and relax for five minutes.
  - At the end of five minutes, have students stand up and take their pulse rate using the following instructions:
    - Use the pads of your index and middle fingers to find the pulse on your left wrist. With your left hand turned upward, feel for the base of your thumb with your right fingers. Move your fingers to just about an inch below the thumb base and press down lightly until you feel an intermittent "throbbing" sensation in your wrist; that's your pulse. You can also take your pulse on the side of your neck by lifting your chin slightly and feeling for your pulse in the "soft spot" on your throat (just to the side of the "Adam's apple"). Feel around until you detect a pulsing sensation.
    - Once you've found your pulse, look at a clock or watch with a second hand and count the number of beats for a period of 10 seconds. (Begin the count with zero.) Multiply the number of beats by six to find out your "heartbeats per minute."
  - Find the student's Target Heart Rate (THR) and have them enter it in their Mission Journal.
    - (220-your age)0.7 = THR

        - Your heart is a muscle that pumps blood throughout your body. It is your body's engine. Your heart rate is a measurement of how many times it beats in a minute. The more your heart beats, the more it is working. Target heart rates let you measure your initial fitness level and monitor your progress in a fitness program.
- Explain to the students how they will take their heart rate before and after Exploration Mission One and Exploration Mission Two.
- Divide students into teams of two. The students should keep the same roles in both Exploration Mission One and Exploration Mission Two. This is important to keep a constant variable and see results.
    - There will be two students working at each Base Station. This makes 12 students total exploring at one time. If your class is larger than 12 students have the remaining students sit on the sidelines as mission controllers.
        - The mission controllers will be observing and making sure each team is following directions carefully. The mission controllers will write their observations about each exploration mission. These observations include:
            - Are the teams working well together?
            - Are they following all the instructions?
            - Are they walking, starting at the Base Station, and standing to squeeze the stress balls?
        - They will also make observations about the team's aerobic and anaerobic activity. What is the difference between the two in the activity?
        - Finally they will write about how they think the heart rate will change.
            - Do the heart rates of the explorers go up as they explore?
            - Why is the heart rate rising?
- Have students perform Exploration Mission One.
- Remind students to record their heart rate in their Mission Journal after Exploration Mission One. The mission control medic is responsible to collect this data.
- Have students perform Exploration Mission Two.
- Once each team completes their missions, have them come back to their Mission Journal and write an observation about their own mission, answering similar questions as the mission controllers did about the mission's they observed.
- If time permits in your schedule, allow students to change positions and start the activity again. This time the explorer becomes the mission control medic.
- To stress the aerobic system, instruct students to continue to move around the entire time including between Exploration Mission One and Exploration Mission Two. Do not allow time to rest until all the mission samples are found and both Exploration Mission One and Exploration Two are completed.
- Focus students on working together and practicing being safe while lifting and carrying.

Location

- This activity may be conducted indoors in a large area such as a gym with a basketball court or an outdoor activity area.

  To measure distance traveled, educators may wish to provide students with a wearable pedometer.

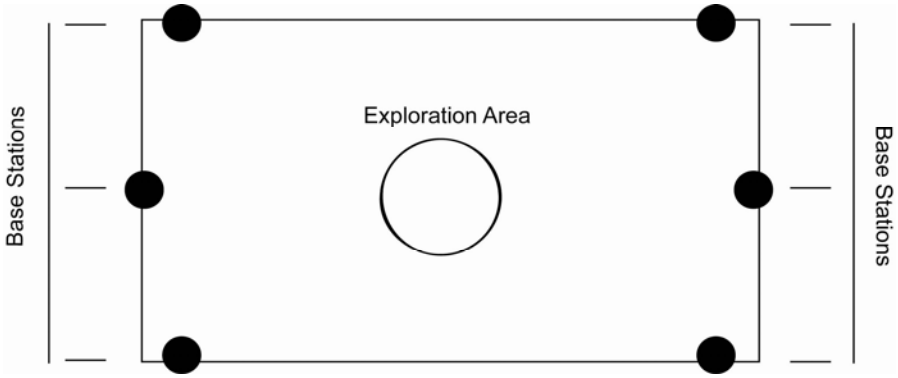
Set-up

Preparing the Mission Samples:

- Collect 30 balls (mission samples) in five different weights and sizes. These balls will represent mission samples collected by explorers.
- Optional: Use the tape and markers to label the balls as various space objects such as, rocks, meteorites, comets, asteroids, space debris, and satellites.

Preparing the Exploration Area:

Activity Area



- Identify a large area free of obstacles to perform this activity.
- In no particular order, place the mission samples in the Exploration Area. Use the hula hoops to keep the mission samples in the Exploration Area. Teams may not go out of this area to find mission samples.
- Designate six Base Stations on the outside of the activity area evenly spread at an equal distance from the Exploration Area. These areas will be the Base Stations for the teams.

Equipment

- Mission Journal and pencil
- 12 stress balls (a small object or ball students can squeeze in their palm)
- 30 balls in five different weights and sizes, such as:
  - six tennis balls
  - six softballs
  - six soccer balls
  - six basketballs
  - six large yoga balls
- three hula hoops, these will keep the balls from rolling away from the Exploration Area.
- a watch, six stopwatches, or clock with a second hand to take heart rate.

Optional equipment:

- heart rate monitor
- pedometer
- markers to write space object names on balls
- masking tape to write space object names on balls.

If any of the data collection devices listed is new to the students, consider familiarizing the students with that instrument a few days before the physical activity begins.

Safety

- It is important that the students walk, not run, at all times during this activity.
- While objects may be located in or near the path of the students, every attempt should be made to keep the area safe for students to walk.
- The weight of all objects should not exceed 15 pounds.
- Always stress proper technique while performing exercises. Improper technique can lead to injury.
- Proper hydration is important before, during, and after any physical activity.
- Be aware of the signs of overheating.
- A warm-up 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?
- Did it get harder as you found more mission samples?
- When did you feel your heart beat fastest?
- When did you feel yourself breathing hardest?
- What muscles did you use to lift the mission samples?
  - upper and lower back muscles
  - arm muscles
  - leg muscles
  - abdominal muscles
- What made this activity aerobic?
- What made this activity anaerobic?
- What other activities might be aerobic or anaerobic?
- What challenges did you face exploring for the mission samples?
- What are some challenges astronauts may face in exploring for objects?
  - the microgravity environment of space
  - no atmosphere
  - wearing a bulky space suit with limited movement
  - limited time for exploration
  - not having the right tools for exploration
- What challenges did you face in getting the mission samples to the Base Station?
- What are some challenges astronauts may face in safely returning objects or samples?
  - not having the proper equipment for exploration
  - objects may be too bulky to carry
  - objects may be contaminated with other material

- How well did you work with your team?
- Would it be easier working alone? Why?
- Would it be easier for astronauts to explore without their crew members? Why?
- Would these objects weigh the same on the Moon or Mars?
    - The mass, amount of material that makes up an object, will always be the same. The weight of an object will be different on each planet due to gravity. Each planet has a different gravitational pull. The greater the gravitational pull, the more an object will weight. The weaker the gravitational pull, the less and object will weigh. Take the Moon and Mars for example:
        - The Moon's mass is about one-eightieth of the Earth's mass. Because the force of gravity at the surface of an object is the result of the object's mass and size, the surface gravity of the Moon is only one-sixth that of the Earth. The force gravity exerts on a person determines the person's weight. Even though your mass would be the same on Earth and the Moon, if you weigh 132 pounds (60 kilograms) on Earth, you would weigh about 22 pounds (10 kilograms) on the Moon.
        - The gravity on Mars is much lower than on Earth, In fact the gravity on Mars is 38% the gravity on Earth. If you weight 220 pounds (100 kilograms) on Earth, you would only weigh 84 pound (38 kilograms) on Mars.

Some quantitative data for this physical activity may include:

- number of mission samples found
- length of time for all mission samples to be found
- size of the area explored
- monitoring heart rate (beats per minute)
- steps taken (using a pedometer)
- rate of perceived exertion (on a scale of 1-10)

Some qualitative data for this physical activity may include:

- identifying challenges in communication
- identifying soreness in body parts

Collect, Record and Analyze Data

Students should record observations about their physical experience in their Mission Journal before and after the 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 Accelerations and Mission Explorations.

Fitness Acceleration

- In a large defined area search for five hidden mission samples. Try to find and return five objects to your Base Station in two minutes. Make sure to check your heart rate before and after the exploration.

  The teacher will hide various items in a large defined area. These items can be from around the classroom that students can lift such as a stapler, tape dispenser, etc. Time the students.

- Each group should try to find a specified amount of mission samples in a given amount of time. These mission samples must have a combined weight of at least 15 lbs. For example, you have five minutes to find four mission samples that have a combined weight of 15 lbs.

  Have a scale available to students to find the weight of their mission samples. Use various objects other than balls such as clip boards, staplers, or different objects in the classroom.

Mission Explorations

- Create a class graph that includes the heart rates of each explorer at the beginning of their mission and the end of their mission. Compare your data with the class. How did the heart rate change throughout this Train Like an Astronaut mission?
- Create a list of clues for finding a hidden object of your choice. Give these clues to other class members and have them explore for that hidden object

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

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.

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.

For more information on proper lifting technique:

http://www.mayoclinic.com/health/back-pain/LB00004_D

For more information on aerobic and anaerobic systems:

http://www.americanheart.org/presenter.jhtml?identifier=3003065

For guidelines to prevent heat-related illnesses:

National Athletic Trainers' Association (NATA)

- Exertional Heat Illnesses (Position Statement)
  http://www.nata.org/statements/position/exertionalheatillness.pdf
- How to Recognize, Prevent & Treat Exertional Heat Illnesses
  http://www.nata.org/newsrelease/archives/000056.htm

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

For guidelines for fluid replacement and exercise:

National Athletic Trainer's Association (NATA)

- 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

For guidelines on heart rate and exercise, visit:

Centers for Disease Control and Prevention (CDC)

- Target Heart Rate and Estimated Maximum Heart Rate
  http://www.cdc.gov/nccdphp/dnpa/physical/measuring/target_heart_rate.htm

American Heart Association (AHA)

- Target Heart Rates
  http://www.americanheart.org/presenter.jhtml?identifier=4736

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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Finding your Heart Rate

Pulse

What is your pulse? Your pulse is your heart rate, or the number of times your heart beats in one minute. Your pulse rates may be different than your classmates. Your pulse is lower when you are at rest and increases when you exercise. Your pulse goes up because more oxygen-rich blood is needed by the body when you exercise.

Finding your pulse on your wrist:

1. Place the tips of your index, second, and third fingers on the palm side of your other wrist, below the base of the thumb.
2. Move your fingers to just about an inch below the thumb base and press down lightly until you feel an intermittent "throbbing" sensation in your wrist; that's your pulse.
3. Use a stopwatch, watch with a second hand, or look at a clock with a second hand.
4. Count the beats you feel for 10 seconds. Multiply this number by six to get your heart rate (pulse) per minute.

Finding your pulse on your neck:

1. Place the tips of your index and second fingers on your lower neck, on either side of your windpipe or Adams apple.
2. Press down lightly until you feel an intermittent "throbbing" sensation in your wrist; that's your pulse.
3. Use a stopwatch, watch with a second hand, or look at a clock with a second hand.
4. Count the beats you feel for 10 seconds. Multiply this number by six to get your heart rate (pulse) per minute.

Finding your resting heart rate and target heart rate:

Find the student’s Target Heart Rate (THR) and have them enter it in their Mission Journal.

(220-your age)0.7 = THR

Mission One:

1. Resting Heart Rate: _____ X 6 =_____

   (Beats in 10 seconds) (You're Pulse)

2. Target Heart Rate: 220 - _____ = _____ (Target Heart Rate)

Did your heart rate increase? YES ☐ NO ☐

If yes, how much did your heart rate increase? _____

Mission Two:

1. Resting Heart Rate: _____ X 6 =_____

   (Beats in 10 seconds) (You're Pulse)

2. Target Heart Rate: 220 - _____ = _____ (Target Heart Rate)

Did your heart rate increase? YES ☐ NO ☐

If yes, how much did your heart rate increase? _____

What is a normal pulse?	
Age Group?	**Normal Heart Rate at Rest**
Children (Ages 6-15)	70-100 beats per minute