



# THE SPEED OF LIGHT

## Learning Objectives

Students will:

- perform a time reaction activity using a ruler to practice your concentration and improve your hand-eye reaction time; and
- record observations about improvements in this skill-based experience in the Mission Journal.

## Introduction

Have you ever played a quick moving sport such as basketball, tennis, or racquetball? As in most sports, these physical activities require you to be quick on your feet and stay focused. Thinking quickly about your next move takes a lot of practice and dedication to improve your game.

Each time you practice a sport or engage in physical activity, you are improving your reaction time. Reaction time is how fast you can respond to a stimulus. A stimulus can be a noise or something you feel or see. Astronauts practice their mission duties on Earth to improve reaction time and concentration and be prepared for their mission

NASA has a variety of environments where astronauts train for their missions. They often simulate unforeseen situations and events to help the astronauts practice reaction time and concentration in space. Astronauts preparing for Extra-Vehicular Activities (EVAs) or robotic arm operations test their skills in the Virtual Reality Laboratory (VR) at Johnson Space Center (JSC). In a virtual reality microgravity environment, astronauts, wearing special gloves, video display helmets, chest packs, and controllers, learn how to orient themselves in outer space. In space, up and down are not recognized and even a minor tweaks with a thruster can send someone spinning off into space. In the VR Lab, astronauts can safely practice dangerous events such as self-rescue techniques during an EVA. Practicing their reaction time here on Earth will help the EVA astronauts have successful EVAs in space.

The Jake Garn Training Center at the Johnson Space Center is a training facility where astronauts prepare for space shuttle operations. A motion-based trainer simulates the vibrations, noise, and views that the astronauts experience during a space shuttle launch or landing. The Jake Garn facility also houses a functional space station simulator, which familiarizes astronauts with the laboratory systems of the International Space Station (ISS). Space shuttle and ISS trainers and instructors in this facility introduce the astronauts to various situations that they may face during their missions. Space shuttle pilots know the importance of reaction time and concentration, because they are required to land the space shuttle safely. Pilots practice on Earth in space shuttle simulators for many hours. They are presented various landing situations and they must practice to be able to land the space shuttle successfully. Therefore, astronauts must depend on their reaction time and concentration in order to have a successful shuttle landing.

## Administration

Follow the outlined procedure in The Speed of Light 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. It could be done in the classroom with limited distractions.

## Set-up

- If sitting, position two chairs directly across from each other. One chair for each student in a team of two.
- Give each student their mission handout either on a clip board or have them sit close to a desk to place their mission handout on while they are engaged in the activity.
- Print or display a copy of the Distance and Time Chart. (Appendix A)

## Equipment

- Mission Journal and pencil
- Metric rulers – wood, hard plastic, or metal

## Safety

- Sit or stand in a comfortable position during the activity
- Use tools and equipment in the appropriate manner for this activity.
- Avoid obstacles, hazards, and uneven surfaces.
- Wear appropriate clothes and shoes that allow you to move freely and comfortably.

## Monitoring/Assessment

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

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

- Are your trial scores improving as you are practicing?
- Was your first and last trial different? If they were, what do you think played a factor in making both trials different?
- If your reaction time did not increase, what can you do to make your reaction time faster?

Some quantitative data for this physical activity may include:

- changes in trial scores
- how many trials were performed over the course of the class

Some qualitative data for this physical activity may include:

- environmental factors
- student fatigue level
- identifying soreness in body parts

### **Collect, Record, and Analyze Data**

Students should record observations about their skill-based experience in their Mission Journal before and after the activity. They should also record their skill-based goals and enter qualitative data for drawing conclusions.

- Monitor student progress throughout the skill-based 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 skill-based 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.
- Find a mean, median, and mode of your reaction times.

*Apply mathematics! Convert the centimeters to millimeters.*

[http://www.onlineconversion.com/length\\_common.htm](http://www.onlineconversion.com/length_common.htm)

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

### **Fitness Acceleration**

- Squeeze a stress relief ball 30 seconds and then try the Speed of Light activity. Did this affect your reaction time? Explain.
- Ride in an elevator while doing the ruler catch activity. Did this affect your reaction time? Explain.
- Do twenty jumping jacks, and then try the Speed of Light activity. Did this affect your reaction time? Explain.

### **Mission Explorations**

- Practice a video or computer game that requires quick decision making.
- Participate in quick-moving sports such as volleyball, tennis, table-tennis, or racquetball.
- Visit an internet site approved by your teacher that has a reaction time test. Some involve changing lights, sounding buzzers, and even driving cars.

## 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:

- 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

*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).

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>

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>

## Credits and Career Links

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Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists

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

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

<b>Distance</b>	<b>Time</b>
5 cm (2 in)	100 ms (0.10 sec)
7.5 cm (3 in)	120 ms (0.12 sec.)
10 cm(4 in)	140 ms (0.14 sec)
12.5 cm(5 in)	160 ms(0.16 sec)
15 cm(6 in.)	180 ms (0.18 sec)
17.5 cm(7 in)	190ms (0.19sec)
20 cm (8 in)	200 ms (0.20 sec)
22.75 cm (9 in)	220ms(0. 22 sec)
25.5 cm (10 in)	230 ms (0.23 sec)
27.5 cm (11 in)	240 ms (0.24 sec)
30.5 cm. (12 in.)	250 ms. (0.25 sec.)