



The Phone's for You From Space!

Lesson Development

GRADES 9-12



Apollo capsule (Image: NASA)



Earth (Image: NASA)



"Black Eye Galaxy" M64 (Image: NASA)

INSTRUCTIONAL OBJECTIVES

Students will

- experience how space voice communication worked early in the space program;
- discover the importance of giving specific oral directions;
- verify observations and deepen their understanding of the space shuttle and communications through Internet resources; and
- create a video timeline of space communication technologies.

BACKGROUND

Early in the space program, it was necessary to rely entirely on voice communication to give and receive instructions. Good communication requires a person give precise and clear instructions, listen with care and follow given instructions carefully. This is important on Earth and for astronauts living and working in space.

Today, signals via satellites transmit information to many different places around the world and out to space. Communications between the shuttle and Mission Control are sent via satellite. Signals from Mission Control at Johnson Space Center are sent to a radio antenna 18 meters high at White Sands, New Mexico. These signals are relayed to a pair of tracking and data relay satellites in orbit 35,888 kilometers above the Earth.

The signals are then picked up by one of two systems providing communication access between the space shuttle and Earth. The S-band system is part of the microwave band of the electromagnetic system used by weather radar and some communications satellites. S-band waves range from 2 to 5.2 GHz. and are responsible for voice commands, telemetry and data files. A second system, the Ku-band, is a high bandwidth system ranging from 11.7 to 12.7 GHz for downlink frequencies and from 14.0 to 14.5 GHz for uplink frequencies. Video and two-way data files are transferred over Ku-band frequencies. GHz, or gigahertz, is a unit of alternating current or electromagnetic frequency. Data sent from the shuttle are received by the satellites, relayed to White Sands, and back to Mission Control at Johnson Space Center.



STS-1 Space Shuttle Columbia landing (Image: NASA)

NATIONAL EDUCATION STANDARDS

National Science Education Standards

- **Science as Inquiry**
Abilities necessary to do scientific inquiry
Understandings about scientific inquiry
- **Physical Science**
Motions and forces
Interactions of energy and matter
- **Science and Technology**
Abilities of technological design
Understandings about science and technology
- **Science in Personal and Social Perspective**
Science, technology in local, national and global challenges

National Educational Technology Standards

- Creativity and Innovation
- Communication and Collaboration
- Research and Information Fluency
- Critical Thinking, Problem-solving & Decision Making
- Digital Citizenship
- Technology Operations and Concepts

National Council of Teachers of Mathematics

- Geometry
- Data Analysis & Probability
- Problem Solving
- Communication
- Connections
- Representation





Apollo capsule (Image: NASA)



Earth (Image: NASA)



Space Shuttle Endeavor
(Image: NASA)

ENGAGE

Use the Discovery Now audio clip, First Flight Shuttle, to help your students develop an understanding about the space shuttle. The clip can be found at: <http://www.discoverynow.us/2008/nasa50.html>

These questions can help guide your discussion:

- How long has the shuttle been flying?
- What are some of the benefits from space shuttle flights?
- What will replace the retiring space shuttle?

EXPLORE

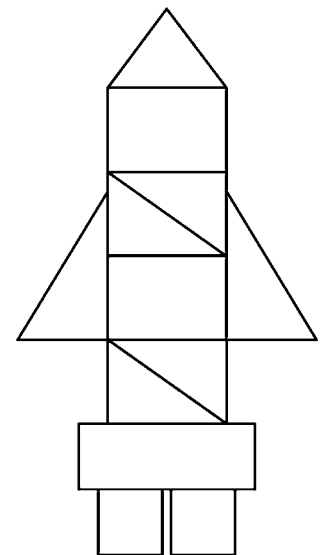
When astronauts are tasked with repairing or replacing malfunctioning equipment in space, they must follow instructions very carefully.

Remind students that during the early days of the space program, spacecraft did not carry cameras. Mission control and astronauts communicated without seeing each other and had to rely solely on voice communication.

During this EXPLORE activity, your students will experience how voice communications worked early in the space program. They will discover the importance of giving specific oral directions.

A. Speak Up!

1. Prepare for the lesson:
 - Organize students into teams of three.
 - Move three student desks together to form triangular tables.
 - Number the geometric shapes found on Student Handout 1.
 - Using heavy card stock, make two copies of Student Handout 1 for each team of students.
2. Gather these materials for each team:
 - Scissors
 - Stopwatch
 - Manila file folder
 - Note paper
 - Pen or pencil
 - 2 Small envelopes
3. Ask each student to sit at the table.
4. Distribute two copies of Student Handout 1 to each team.
5. Instruct students to cut out the numbered pieces found on Student Handout 1 and place one set in each envelope.
6. Have student teams decide who will be the mission control officer, the astronaut, and the mission recorder.
7. Place envelopes containing Tangram pieces in front of the students representing mission control and the astronaut.
8. Place a file folder upright between mission control and the astronaut. Make sure that mission control and the astronaut cannot see one another's Tangram pieces.
9. Ask mission control to create a shape using the pieces of the Tangram.
It's possible to create a rocket, but mission control may create any shape as long as all pieces are included.



Assembled Tangram Pieces



Apollo capsule (Image: NASA)



Space Shuttle Endeavor Landing
(Image: NASA)



"Black Eye Galaxy" M64
(Image: NASA)

10. Instruct mission recorder to time two minutes for mission control to create this shape.
11. After the shape is created, mission control will give the astronaut step-by-step directions to create exactly the same shape.
12. Distribute pen and paper to the mission recorder. Mission recorder will record all instructions and time this session.
13. Instruct the astronaut to remain silent while receiving directions from mission control during construction of the shape.
14. Document the time it took to complete the task.
15. Instruct students to switch roles and repeat steps 9-14 until all students have completed the activity.
16. Ask the students to repeat steps 9-14, this time allowing the astronaut to talk with mission control.
17. Record the time it took to complete the task.
18. Use the differences in time to lead your students in a discussion about communication and the importance of giving specific directions.

EXPLAIN

Use these questions to help lead a discussion with your students about the EXPLORE experience:

- What role did teamwork play in helping you perform your duties?
- What are some limitations to having limited, or one-way communication?
- What have you learned about the importance of communication and giving or receiving specific instructions?

ELABORATE

A. Share these resources with your students to deepen their understanding of the space shuttle and how astronauts communicate with Mission Control.

1. Space Shuttle
 - STS-1
<http://spaceflight.nasa.gov/shuttle.archives-1/index.html>
 - STS-1 First Space Shuttle Mission Press Kit
<http://www-pao.ksa.nasa.gov/kscpao/presskit/sts1.htm>
 - Space Shuttle
http://www.nasa.gov/mission_pages/shuttle/main/index.html
 - STS-123
http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts123/mission_overview.html
 - Return to Flight: How Does This Work (Video Gallery)
<http://www.nasa.gov/returntoflight/multimedia/index-how-it-works.html>
 - Countdown 101
http://www.nasa.gov/mission_pages/shuttle/launch/countdown101.html
 - Communications
<http://science.ksc.nasa.gov/shuttle/technology/sts-newsref/sts-jsc-comm.html>

B. Challenge your students to create and present a video timeline focusing on changes in communication technologies. The students may use Windows Movie Maker for this timeline and may find it helpful to review this resource:

- Movie Maker
<http://www.microsoft.com/windowsxp/using/moviemaker/default.mspx>

Encourage your students to review this Nortel LearnIT site to generate ideas about their projects:

- Connecting with Communication Technology
http://nortellearnit.org/resources/Trainer_Resources



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Before you begin, you may also want your students to use a storyboard to help them plan and organize their projects. One example of a storyboard can be found at:

- Video Productions
http://www.nortellearnit.org/technology/Video_Productions/

Encourage your students to put a descriptive title screen, credits and references at the end of the project. Please remind students to use only images that they have permission to include. Review copyright and copywrongs by watching the Nortel LearnIT video tutorial at: http://nortellearnit.org/technology/Digital_Ethics/

Remember to get a signed release form from everyone who appears on camera. Click on the following link to get a copy of the Nortel Release form or use as a template: <http://www.nortellearnit.org/resources/Handouts/>



Space Shuttle Atlantis atop its Carrier Aircraft (Image: NASA)

EVALUATE

Through discussion and the results of the EXPLORE experience, determine if your students have an accurate and deeper understanding of the importance of communication and the communication devices used in space.

To evaluate Video presentations, use a rubric found at the Nortel LearnIT site:

- <http://www.nortellearnit.org/resources/Handouts/>

EXTEND

These activities may be used to extend or continue your students' exploration.

A. Encourage your students to listen to these additional Discovery Now audio clips from previous seasons:

- The Space Shuttle Facts <http://www.discoverynow.us/2007/shuttle.html>
- A Shuttle Simulated <http://www.discoverynow.us/2007/shuttle.html>
- NASA Supercomputer <http://www.discoverynow.us/2007/science.html>

Once they've listened to the clips, challenge them to write and record video clips to accompany the above Discovery Now radio spots.

It may be helpful for your students to review Nortel LearnIT video tutorials for help in creating their videos. They can be found at: http://nortellearnit.org/technology/Video_Productions/

B. Challenge your student to see how a space shuttle is made ready for flight or launch a space shuttle by clicking on this interactive multimedia link: <http://imedia.ksc.nasa.gov/index1.html>



"Black Eye Galaxy" M64 (Image: NASA)



Tangram pieces

