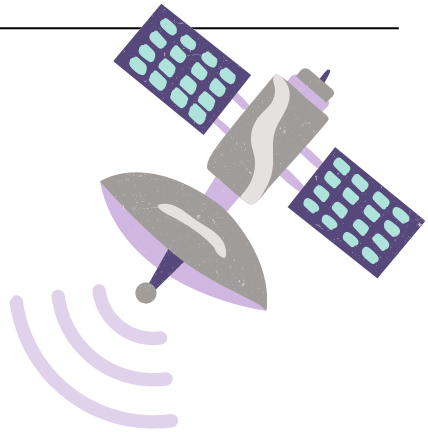
LESSON 7:

INTERPLANETARY COMMUNICATION

SUPPLIES



MAIN BIN

- Plastic Cup - 2 per student, 30 total

HANDOUTS FOLDER

- Construction Paper

BIN ZIPLOCK

- String
- Paperclips -30
- Straws - 30

PENCIL BOX

- Tape
- Scissors
- Pencils

OBJECTIVES

- ☑ Understand how communication works over long distances with radio waves.
- ☑ Build and use simple string telephones to simulate the Deep Space Network.

HOOK

3-5 min

- How do you communicate with a friend who is in the same room? Usually, you can talk directly to them, and they can hear you.
- If your friend is miles away in another room, you could call them on the phone.
- But what if your friend is on another planet, millions of miles away?

INTRODUCTION

5 min

Just like we can't see electricity moving through the air but can see its effects, we can't see radio waves, but we know they are there because of what they do. Radio waves are used by satellites to send messages across vast distances in space.

In order for Earth to communicate with spaceships and satellites that explore distant planets and moons, scientists and engineers use something called the Deep Space Network, or DSN. The DSN is made up of a system of huge antennas located in three places around the world: California in the United States, Madrid in Spain, and Canberra in Australia. These antennas are like giant ears and mouths that can send and receive signals far away in our solar system!

When a spacecraft like the Mars Rover takes pictures or collects data, it sends that information back to Earth using radio waves. Radio waves are a type of invisible wave that travels through space much faster than any car or plane! The DSN's large antennas focus and collect these radio waves, making it possible for us to receive messages from spacecrafts millions of miles away. The antennas are spaced out around the world so that as the Earth rotates, at least one of them is always in contact with the spacecraft, no matter where it is.

INTERPLANETARY COMMUNICATION

ACTIVITY DIRECTIONS

35 - 40 min

Hypothesis:

- Before starting, have students guess how well they will be able to hear someone speaking quitely into a cup on the other side of the room.

1. Have one student volunteer to be the "satillite." This student will go to the far end of the room. The other students will be the listeners, or "receivers." Have them stand at the other end of the room.
2. Have the "satellite" speak quietly into the cup. If they aren't sure what to say, ask them to list every planet that they know!
3. The listeners will rate how well they can hear the satellite on a scale of 1-10 (1 = cannot hear at all, 10 = very clear).

- After students have determined that it is difficult to hear the "satellite" speaking, explain that they will be making a string telephone to model how satellites communicate with earth from very, very far away.

TEACHER TIP

- Monitor and Assist: Circulate among the students as they work. Offer guidance and answer questions to ensure students understand the process and stay on task.
- Encourage Quiet: Remind students to keep noise levels down to ensure accurate hearing tests. Emphasize that being quiet helps everyone hear better and get accurate results.

Prepare the Materials

Students will each make their own string telephone. They will need the following materials:

- Plastic cup (2 per student)
- Paper clips (2 per student)
- String (10 feet per student)
- Pencil (1 per student)
- Piece of construction paper
- Straw (2 per student)
- Tape to share

Build the String Telephone:

1.
- Instruct each student to carefully poke a hole in the bottom of both of their cups. Aim for the center! The hole should be large enough to poke the string through. If students are having issues with this step, they can just tape the string to the bottom of the cup.
- Feed each end of the string through the cups, so that there is a cup on either end.
- Tie both ends of the string to a paper clip and pull so that the paper clip is resting tightly against the inside bottom of the cup.

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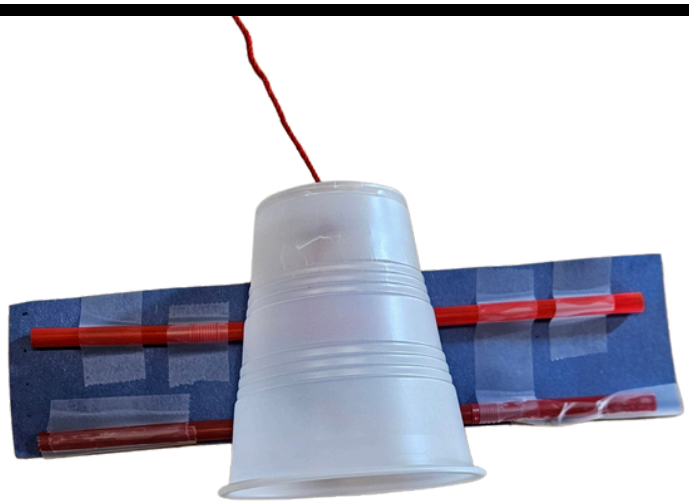
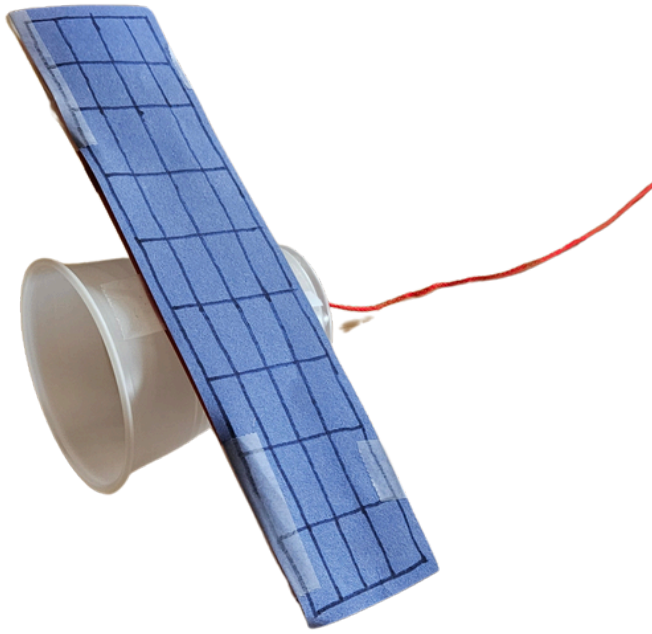


2. Build the Satellite

- One end of the string telephone will be decorated as a Satellite.
- Instruct students to tape two onto the side of the cup, about 1 inch apart. The ends of the straw should stick out on either side. See photo for reference.
- Once the straws are attached, cut out a construction paper rectangle about 8 inches by 1.5 inches.
- Have students draw a grid on one side of the paper to represent a solar panel array. Or, if they prefer, they can decorate it however they like!
- Once decorations are complete, students can tape the construction paper onto the straw. This will complete the satellite!



3. Use the String Telephone to Communicate!

- Pair students up by two's. One student will be the satellite, one will be earth!
- Instruct students to stand across the room from one another, far enough apart that the string is pulled tight. If there is slack in the string, it will be hard to hear!
- One by one, have the "satellites" speak into the cup, closing it around their mouth. If they aren't sure what to say, ask them to again list every planet that they know! Have the "Earth" hold the cup tight against their ear. Remind the other students to stay silent so that their sound waves aren't impacting the experiment.
- The "Earth" will rate how well they can hear the satellite on a scale of 1-10 (1 = cannot hear at all, 10 = very clear).
- Repeat the experiment, but switch rolls.
- Students can all take home their Satellite String Telephone!

DISCUSSION

3-5 min

- "How did using string telephone change the way you heard the sound?"
- "In what ways are our homemade satellites similar to real satellites used in space communication?"

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OBSERVATION AND EXPLANATION

10 min

Sending Signals:

- When NASA wants to send messages to a rover on Mars or a satellite floating in space, they use huge dishes to send strong radio signals. The cup-like shape helps focus these signals into a narrow beam that can travel far through space.

Receiving Signals:

- Remember how you listened for sound with your string telephone? Spacecrafts send signals back to Earth, but these signals are very weak because they travel millions of miles. The DSN's large dishes collect and focus these very quiet signals so scientists can hear them clearly, just like your satellites helped you hear better. The DSN isn't just one dish. It's a network of stations in the U.S., Spain, and Australia. As the Earth rotates, there's always a station in contact with the spacecraft, making sure we can always communicate with our space missions.
- Of course, there isn't a big string connecting satellites to the radio dishes on earth! The strings represent the radio waves, and help amplify the sound. The sound travels down the string and vibrates the cup as you hold it against your ear.
- When you talk into the cup, your voice sends sound waves into the cup, vibrating the bottom and the paperclip. The vibrations move along the string, across the string, and into the other cup. The sound waves become vibrations inside the second cup, transferring the sound of your voice.

How Big Is A Satellite?

How big do you think a satellite is? The answer varies depending on what the satellite is used for!

Some of the smallest satellites, used for gathering specific information, can be the size of a lunchbox.

The largest satellites, on the other hand, carry massive telescopes, solar panels, and other equipment, and can be as big as a football field! The largest satellite, the **International Space Station**, or I.S.S, can even hold a crew of astronauts!