



SETI INSTITUTE

## Mission 2 A Message from Earth

### Voyager Carries Our Message to the Stars

## Notes

*In Mission 1, students learned that SETI scientists are trying to detect a message from an extraterrestrial intelligence that might exist beyond our solar system. Students learned that, even after decades of space exploration, we have not found any evidence of life beyond Earth. Yet we are still “listening,” i.e. collecting data, and we continue to explore Mars for evidence that life once existed elsewhere in our solar system. But have we ever attempted to send our message out to distant ETs?*

## Overview

In Mission 2.1, students are introduced to the two *Voyager* spacecraft and their on-board messages. They select 10 pictures from magazines to create collage messages depicting the human experience and Earth. In Mission 2.2, students exchange these collage messages with one another and try to understand them. In Mission 2.3, students see a PowerPoint slide show similar to the message from Earth that was put aboard each *Voyager* spacecraft. In all, students consider: Who should speak for Earth?

## Mission 2.1

### Materials

#### For a Class of 30

- Data projector, computer PowerPoint file
- *Project Haystack* video “The Message Sent By *Voyager*” (Part 1) segment
- “The Message Sent By *Voyager*” (Part 1) PowerPoint script (page XX)
- Magazines with pictures
- Selection of different kinds of computer clip art
- (optional) Black paper decorated with “stars” for bulletin board

#### For Each Team

- Scissors
- Glue or tape
- Large sheet of butcher paper (*optional*: chart paper or poster paper)
- Notebook paper

## For Each Student

- “Sending a Message to the Unknown” worksheet
- (optional) “Diagram of the *Voyager* Record” and “Description of the *Voyager* Record” sheets
- Pencil

## Getting Ready

1. Plan ahead so that you have enough magazines for all your classes. A week or so before you begin, have students bring in old magazines with lots of pictures. Tell them that these will not be returned to them. Scan them for appropriate content, looking for a multicultural representation. The pictures should show all aspects of life on Earth: landscapes, people, wildlife, technology, and aspects of civilization. *Note:* [www.clipart](http://www.clipart)
2. Prepare a place in the classroom where messages to “intelligent extraterrestrial life” can be posted. Optionally, create a bulletin board covered with black paper decorated with stars to represent “deep space.”
3. Copy the “Sending a Message to the Unknown” worksheet for each students, as well as the optional sheets “Diagram of the *Voyager* Record” and “Description of the *Voyager* Record” sheets, if they are to be used.
4. Set up the data projector. Go to the “The Message Sent By *Voyager*” (Part 1) PowerPoint file. Have the script handy.

## Classroom Action

1. **PowerPoint Images of *Voyager*.** Play “The Message Sent By *Voyager*” (Part 1). A script has been provided that introduces the *Voyager* missions and attempts to send a message to the stars. It can be used as is to accompany “The Message Sent By *Voyager*” PowerPoint script or its information can be paraphrased.

Hand out the sheets “Diagram of the *Voyager* Record” and “Description of the *Voyager*”, if they will be used. You may wish to spend an entire class period discussing the complex message on the record cover.

Because some of the science involved in the search for extraterrestrial intelligence may be too advanced for your class, present this idea to students: People are sometimes discouraged because it takes time and hard work to understand a message. But it took years to decode the Egyptian hieroglyphics. Extraterrestrials who find *Voyager* may have to work hard to understand its record. But they would be strongly motivated to do so (just as we would be if we received such an obvious message) and they would be greatly rewarded if they made the effort.

2. **Discussion.** Hand out the “Sending a Message to the Unknown” worksheet to each student. Tell students that they will have 30 minutes to put together a selection of only 10 magazine

pictures that best describe Earth and its inhabitants; *suggest* that teams might first agree on the message they wish to convey.

The *Voyager* spacecraft had a limited amount of room for photographs, and the scientists had a limited amount of time to choose images. Those persons who were asked to choose the music and pictures to go on the *Voyager* record were only given six weeks to complete their task. Even more astounding is the fact that DVD and digital camera technology had not yet been invented, so the technical problem of putting pictures on a phonograph record also had to be dealt with. Giving students a limited amount of time to do this activity simulates the pressure on those persons who were asked to complete this Herculean task.

Tell students that their collections of pictures will become collage messages to be put aboard an imaginary space probe. This probe will fly by some nearby planets and moons, and then drift off into deep space in the same manner that the two *Voyager* (and *Pioneer*) spacecraft have done. Their picture collections must show the most important facts about being human because if the space probe ever is intercepted by intelligent life somewhere in the cosmos, these pictures will be all the extraterrestrials have for learning about us.

Teams should sequence their 10 pictures in any way they wish (*e.g.*, in a chronological order to provide an historical perspective) on butcher paper. The only rule is that they may not write anything on the butcher paper. Extraterrestrials cannot read English. Allow students to create and define symbols to use, such as numbers and scaling units. In fact, students may want to attempt to teach their extraterrestrial audience to read English. Let students use binary numbers using a scale set by the hydrogen atom, because this scheme is used on the *Voyager* record cover.

3. **Activity.** Divide the class into teams of three to four students each. Give each team a pair of scissors, a sheet of butcher paper, and glue or tape. Give each team a selection of different kinds of magazines (*e.g.*, natural history, teen, sports, auto, news, ethnic). (*This task can become quite difficult for students who cannot agree on which pictures to choose.*) Stress that individuals in teams should work cooperatively, with some give and take. Have teams make their collage messages.

Team members write a brief paragraph on their “Sending a Message to the Unknown” worksheet stating the message that they are trying to convey with their pictures, and how they think an extraterrestrial would interpret their message. One team member should copy this paragraph to notebook paper. (*This notebook-paper copy will be hidden behind the collage message after it is completed; it should not be written onto the collage message itself.*) Team members write their names on the English message.

At the end of the 30 minutes (be strict about the time limit-and give a 5-minute warning), teams fold up their notebook paper paragraphs, seal them shut with tape or glue, and attach them to their collage messages. The collage messages should be rolled up and sealed securely to the back of the collage with glue or tape. Collect the collage messages, or ask students to pin them to the bulletin board covered with black, star-filled paper.

4. **Homework.** Students complete the “Sending a Message to the Unknown” (page xx) worksheet in class or as homework.

## Mission 2.2

### Materials

#### For Each Team

- Collage messages from Mission 2.1
- *(optional)* Smart phones

#### For Each Student

- “Did You Get Our Message?” worksheet (page xx)
- Pencil

### Getting Ready

1. If you will be doing the optional smart phone activity (below), allow students to use their own phones.
2. Copy the “Did You Get Our Message?” worksheet for each student.

### Classroom Action

1. **Discussion.** Reassemble the class into their teams from Mission 2.1. Tell students that they will now play the roles of extraterrestrials who have intercepted a spacecraft carrying some sort of message—each team will now receive a collage message from another team. If you have more than one class, perhaps exchange collage messages between classes. Hand out the collage messages or have student teams “intercept” a collage message from a “deep space” bulletin board. Each team's challenge is to see what kind of sense (if any) they can make of their message.
2. **Activity.** If you will be using tape recorders, go to step 3 below. Hand out the “Did You Get Our Message?” worksheet to each student. Teams should now break the first seal and unroll their collage message, but they must not open the sealed notebook-paper paragraph yet.

Teams must put themselves in the place of the intelligent life that has found the collage message and attempt to figure it out based only upon the pictures. Remind students that they know nothing about Earth. They must decide what the collage message is trying to convey. Ask students to answer the questions on their “Did You Get Our Message?” worksheet as they determine this. (*Note that this worksheet does not have a teacher's key because student responses will vary; accept all reasonable attempts.*) Next, teams should break the seal on the notebook-paper paragraphs and read the written description to see how their interpretation compares.

3. **Optional Activity with Smart Phones.** For recording first impressions, use a smart phone for each team. Teams use smart phones to record when they open the first seals and begin talking about what they think the collage message means. The voice memos records their spontaneous discoveries, first ideas, and first impressions. At the end of 10 minutes (or less), the smart phones should be turned off. Teams should then break the seal on the notebook-paper paragraphs and read the accompanying written descriptions to see how their interpretation compares. Have students answer the questions on their “Did You Get Our Message?” worksheet.

Choose one (or more) of the recordings at random and play it for the class. Ask the team that created the collage message to respond. Ask if they got across what they wanted? If not, what message did they wish to communicate?

4. **Discussion.** Did the extraterrestrials understand the messages or not? Students will find that there are problems in communication. Pose a few questions: Why do you think a breakdown in communication happened? What would you do differently to improve communication? How many of the messages got across? Take a quick class survey. Which messages were more successfully understood? Why were they understood? Which messages were too difficult? Why? How could the messages be improved? If you were able to repeat this exercise, could you send a clearer message?

Would it be harder for true extraterrestrials to understand a message from Earth than for Earth students to understand a message sent by other Earth students? What effect does sharing a common culture have? What would it be like if students in the United States made and exchanged collage messages with students in other countries?

What might we have in common with intelligent extraterrestrials? *(Try to steer the class toward unambiguous, universal concepts, such as mathematical operations, prime numbers, the structure of hydrogen and carbon atoms, or the properties of the electromagnetic spectrum. We have the physical universe in common, which provides a basis for communication. The extraterrestrials could also learn about engineering principals and materials used by humans by examining the Voyager spacecraft. Natural phenomena such as rocks, clouds, and oceans are likely to have extraterrestrial counterparts—water is necessary for life as we know it.)*

## Mission 2.3

### Materials

#### For a Class of 30

- Data projector, computer, PowerPoint file
- The *Project Haystack* PowerPoint: “The Message Sent By *Voyager*” (Part 2) PowerPoint
- “The Message Sent By *Voyager*” (Part 2) PowerPoint script (page xx)

## For Each Student

- “Who Speaks for Earth?” worksheet (page xx)
- Pencil

## Getting Ready

1. Copy the “Who Speaks for Earth?” worksheet for each student.
2. Just before the lesson, set up the data projector. Go to the “The Message Sent By *Voyager*” (Part 2) in the PowerPoint file. Have Part 2 of the script handy.

## Classroom Action

1. **PowerPoint Images of *Voyager*.** Show the “The Message Sent By *Voyager*” (Part 2) segment. A script has been provided that introduces the *Voyager* missions and our attempts to send a message to the stars. It can be used as is to accompany “The Message Sent By *Voyager*” segment, or its information can be paraphrased. The PowerPoint file includes a representative sample of images similar to the 118 that were sent into space with *Voyager*.
2. **Discussion.** Tell students about the group of people who decided which pictures and which music went on the *Voyager* message. Encourage students to talk about this decision process. The *Voyager* group didn't do it all by themselves—they contacted wise people to get ideas about what should go on the message. Invite students to brainstorm who could best put together the perfect message. As a class, create a list of people to whom students could write (or telephone) for ideas. Student lists can include people such as grandmothers too.
3. **Activity.** Hand out the “Who Speaks for Earth?” worksheet to each student. Students complete their worksheet in class or as homework. (*Note that this worksheet does not have a teacher's key because student responses will vary; accept all reasonable attempts.*)

## Going Further

### Activity: Who Am I?

Ask students to assemble picture collages of their lives that could tell a stranger about who they are and what is important to them. Their collages might include pictures of their hobbies, their heroes, their extracurricular activities, their family, and much else. Limit collages to 10 pictures. Ask students to share their collages before the class.

### Multidisciplinary Studies: Social Science

Ask students who should “speak” for Earth when information is put onto a spacecraft that will be leaving our solar system to perhaps someday be intercepted by an intelligent civilization. This

question could also be addressed in social science classes, and it might provide an opportunity to team up with another teacher. There are many historical-social issues here for students to ponder. Should we tell extraterrestrials about war, hunger, and disease?

### **Activity: Multilingual Greetings**

Ask students to create an audiovisual or written greeting from their school that could be included in a message sent out of the solar system. For example, greetings could be given in all the languages that are represented at your school. This is a marvelous multicultural activity. Students may write and/or act out a greeting of their choice.

### **Activity: Writing a Letter**

As a homework assignment, have students write a letter to someone (grandparent, community leader, artist, *etc.*) asking what they think a message from Earth should contain. Or, students can conduct a telephone interview and write up their findings. Students share their letters of reply or their write-ups with the class. If your school has the ability to log on to the Internet, link up your students with a class in another country.

### **Activity: A Message Through Time**

People carve their “I was here” message in hundreds of ways during the brief time they inhabit Earth. People have put messages on walls of caves, in monuments, onto pages of books, in photographs, and elsewhere. Students can research the great monuments that are meant to send a message to our descendants. Mankind has always sent such messages in the form of tombs, inscriptions, works of literature, and so forth. Ask students to decide upon a suitable monument that will send a message about their school into the future. Students may also make a time-capsule message to be opened after five years—perhaps even bury the time capsule for future excavation.



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## **Mission 2 A Message from Earth**

### **Sending a Message to the Unknown— Teacher's Key**

1. Answers will vary. Included might be cave drawings, monuments, time capsules, graffiti, books, Cds, DVDs, PowerPoint files, Stonehenge, and so on.
2. Photos, movies, books, carving your name into a tree, and so on.
3. 1977.
4. The Neptune flyby was in 1989; *Voyager* will get to the heliopause, the outer boundary of the solar system, around 2012.
5. To explore the outer gas giant planets, Jupiter, Saturn, Uranus and Neptune, their composition, rings, and moons.
6. A phonograph record that contained music and photographs depicting the history of life on Earth prior to 1977; instructions in graphic form on how to play the record; and a stylus for doing so.
7. Answers will vary.

## **Script for PowerPoint Images**

### **“The Message Sent by *Voyager*” (Part 1)**

#### **Introduction**

#### **Image # 2.1: *Voyager* Spacecraft**

On August 20, and again on September 5, 1970, *Voyager* spacecrafts were launched from Earth. After exploring the solar system and researching the outer gas giant planets, the two spacecraft headed toward the stars. They are now beyond the orbit of Pluto and are traveling out into deep space. Almost as an afterthought, NASA attached a phonograph record with music and pictures to the *Voyager* spacecrafts before launch as a message to any extraterrestrial intelligence that might someday encounter the probes in space. The message is intended to tell the extraterrestrials about ourselves and our culture. The *Voyager* spacecraft and the two *Pioneer* spacecraft that have left our solar system probably will last longer than any other object built by human beings. In the cold, quiet darkness of outer space, they will not rust or fall apart. A collision with a drifting rock, ice ball, or comet nucleus would certainly smash them, but these objects are so rare in interstellar space that the *Voyagers* will almost certainly escape destruction. Over the ages, tiny drifting grains of dust will chip the paint, dull the surface, or inflict

microscopic dents. But, despite this slow sandpapering of their surfaces, the spacecraft will remain recognizable as machines from an intelligent civilization for several billion years.

The *Voyager* will never land on another planet. If, billions of years from now, one of them enters another planetary system and is dragged down by gravity to the surface of a planet, the spacecraft will burn up as it drops through the atmosphere. The only way these messages will ever be found is for an extraterrestrial spaceship to detect and recover the *Voyager* in space. Today, we will see images from the *Voyager* spacecraft. A total of 118 images were included on the original record.

### **Image # 2.2: *Voyager* Record Cover**

This is the *Voyager* spacecraft as it would appear if it were well-illuminated in outer space. An extraterrestrial spacecraft approaching *Voyager* a billion years from now and shining a great spotlight upon it would see something like this, although the spacecraft very likely would have a number of dents and scratches. It is not a huge machine. The big antenna is only about two meters in diameter.

If you were a scientist from an extraterrestrial civilization, could you guess what it is and what it does, just by looking at it? Could it be a weapon? Are there extraterrestrials on board? What can be said about its creators and their civilization?

The message to extraterrestrials is on a gold coated aluminum phonograph record in a gold coated aluminum cover on the outside of the central instrument bay. There are some scientific symbols etched on this cover. If you were a scientist from an extraterrestrial civilization, could you understand what these symbols mean? Even if you cannot decipher the individual images, can you deduce what they must mean?

The scientific symbols that are etched on the cover include instructions for playing the record. A cartridge and stylus illustrated on the cover are neatly tucked into the spacecraft. The record is ready to play, although it is necessary to explain to the extraterrestrials which direction the phonograph rotates and the fact that the stylus is played from the outside of the record to the inside. It contains 118 photographs of Earth, humans, and civilization; almost 90 minutes of music; an evolutionary audio essay on the “Sounds of Earth”; and greetings in almost 60 human languages. There are even salutations from the President of the United States and the Secretary General of the United Nations, and the songs of humpback whales.

### **Image # 2.3: School of Fish with Human Diver**

One of the *Voyager* pictures shows a diver with fish, and it resembles this picture. If you were a scientist from an extraterrestrial civilization, you might look at this image and conclude: “Here is a creature with appendages that flatten out into large structures at the ends. It is crawling or running. It seems that the creature is falling apart with pieces flying away from it in all directions.” Why is this description *not* totally ridiculous from the point of view of other intelligent life? What is intended to be communicated? What is the main message of Earth people? Why was a photograph like this one included on the *Voyager* spacecraft?

This is what the people who created the message were trying to communicate: The most direct means of showing the underwater world is to have a diver present. The air bubbles rising from the diver show clearly that this is an aqueous environment. The diver also shows that human beings are interested in exploring and adapting to different environments. There are potential problems in trying to communicate with extraterrestrials using pictures.

## **Stop and Assess “The Message Sent By Voyager”**

1. Back up and take a second look at various images if students want to study them.
2. Ask: Do you think that the scientists' message will ever be received by anyone? If so, will it be understood by any other intelligent life form that may encounter *Voyager*?
3. Ask: Can *you* make a message using only pictures that someone else will be able to understand?

## **Script for PowerPoint Images**

### **“The Message Sent By Voyager” (Part 2)**

#### **Introduction**

Humans have sent a message about themselves into space beyond our solar system in hopes that there might be other intelligent life with whom we could communicate. Even though it is highly improbable that a spacecraft carrying a message from Earth would ever be intercepted and the message discovered, in our need to communicate something about ourselves we have made such a message, attached it to the *Voyager* spacecrafts, and sent them away. The images you see today are similar to those carried on board the *Voyagers* on their journeys to the stars.

#### **Image # 2.4: Solar Spectrum**

The *Voyager* record includes a spectrum of our star, the Sun, as a key to the colors in the other images on the record. Extraterrestrial astronomers would be able to determine the colors emitted by our Sun, and use that information to figure out the colors for the other images.

#### **Image # 2.5: The Planet Earth**

Extraterrestrial beings will recognize this as a planet, even though they have never seen it before. Other solar systems should have giant gaseous planets like Jupiter and Saturn, barren rocky balls like Mercury, and perhaps even beautiful blue water-covered worlds like our Earth. This photograph provides a reference point for the pictures that follow.

## **Image # 2.6: Closer to the Surface of Earth**

Closer to the surface of our blue planet, another color photograph shows more details of the planet we live on.

## **Image # 2.7: Human Anatomy**

Several pictures that emphasize human anatomy were sent on *Voyager*. This drawing shows the silhouettes of a man and a woman, and a view of a fetus developing inside the woman's body. Male and female labels show that the two beings are different; a scale shows their size, and the label "20y" shows their ages. An extraterrestrial must learn the meaning of "20y" from other information on the record.

## **Image # 2.8: Nursing Mother**

Another *Voyager* photograph shows a picture like this one, a mother nursing her infant. The picture shows a special relationship between human women and children, comparable to that shown in the earlier diagram of a man with a pregnant woman.

## **Image # 2.9: A Family**

One of the *Voyager's* images is a photograph showing a father and his child. This photograph, not included on the spacecraft, shows the feature that the *Voyager* images tries to convey. To human beings, we see the pride of parenthood. To an extraterrestrial, the photograph shows human age differences and many details: ears, fingers, teeth, and eyes. The direction in which the people are looking provide clues that eyes are organs of vision and are used for primary detection and examination of objects.

## **Image # 2.10: Group of Children**

One of the *Voyager* images is a photograph like this one, showing young people of several racial types and nations. The picture illustrates hands and arms in different positions. Seeing human bodies from different directions like this should give the extraterrestrials a good sense of the proportion of the human form.

## **Image # 2.11: States**

One *Voyager* image shows the rugged geology of the American Southwest in color. This photograph resembles the one on the *Voyagers*. Extraterrestrials may see some familiar geologic features in a picture like this.

## **Image # 2.12: Forest Scene**

One *Voyager* image shows tree trunks and a secondary growth of bushes and shrubs. This gives a sense of the environment of a forest. Perhaps trees are rare in the universe. If extraterrestrials had no trees on their planet, this image might be very amazing to them.

### **Image # 2.13: Fallen Leaves**

This photograph resembles one of the *Voyager's* in which leaves are changing colors and falling from trees. The *Voyager* image also shows people raking up the leaves. The *Voyager* photograph was one of about twenty images sent in color, and the fact that the leaves have changed from green to red and orange may lead extraterrestrials to understand that there are different photosynthetic pigments, and that the planet has seasonal variations in its vegetation.

### **Image # 2.14: A Tree in Winter**

An image like this one, on the *Voyager* spacecraft, shows trees with small human figures to indicate size. In the *Voyager* image, an inset shows a snowflake. Water is a common substance throughout the galaxy, and its crystal form should be known and recognized, even by extraterrestrials. The *Voyager* image shows that things live naturally on Earth where temperatures fall below freezing.

### **Image # 2.15: Flowering Plants**

One *Voyager* image shows a small, flowering plant next to a tree to demonstrate the different sizes of plants on Earth.

### **Image # 2.16: Human Diver and School of Fish**

The clearest way to show an underwater scene is to have a human diver present. The air bubbles from the diving equipment provide evidence that the person and the fish are in water. The presence of the diver also shows that humans are interested in exploring and adapting to many environments on Earth.

### **Image # 2.17: Zoo Keeper and Chimpanzee**

One of the *Voyager* photographs shows scientists with chimpanzees to offer a glimpse of animals that are quite similar to human beings in their appearance, yet quite different as well. Imagine looking at this photograph through the eyes of an extraterrestrial and wondering about the relationship between the larger being wearing clothes and the smaller one with only fur. Would you think the small one is the woman's baby? Why, or why not?

### **Image # 2.18: House Interior**

Humans have constructed artificial environments in which to live and work. This photograph shows the interior of a house. Subsequent pictures show other human-made environments. What would an extraterrestrial think about the objects in this room?

### **Image # 2.19: A City by Night**

On a larger scale, this photograph shows how we light our cities. This city could be from any industrial country on Earth. It represents global humanity, not just Western culture.

### **Image # 2.20: A Factory Interior**

People manufacture many objects. Here, we see a bottling factory with humans present. Would extraterrestrials be able to interpret this photograph? Would technological extraterrestrials have factories?

### **Image # 2.21: Astronaut in Space**

This image shows an astronaut floating in space near the Shuttle. The *Voyager* record included an image of James McDivitt on a space walk from a *Gemini* orbital flight. In both photographs, the man's hand is visible which reveals that this is a human figure.

### **Image # 2.22: Sunset**

The *Voyager* photographs included a sunset to simply show how lovely our planet is. The color of the sky, the reddening of the light, and the presence of clouds reveal information about our atmosphere.

## **Stop and Assess “The Message Sent by *Voyager*”**

1. Back up and take a second look at various images if students want to study them.
2. Ask students if they think that the scientists made good choices for images to send? Do you agree with the message that each image was meant to send? Do they work? Would other images have been better?
3. How did the collection of images differ from the collection that you assembled? How were they the same? What would you do differently if you had the same assignment again?

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