



April-May 2019

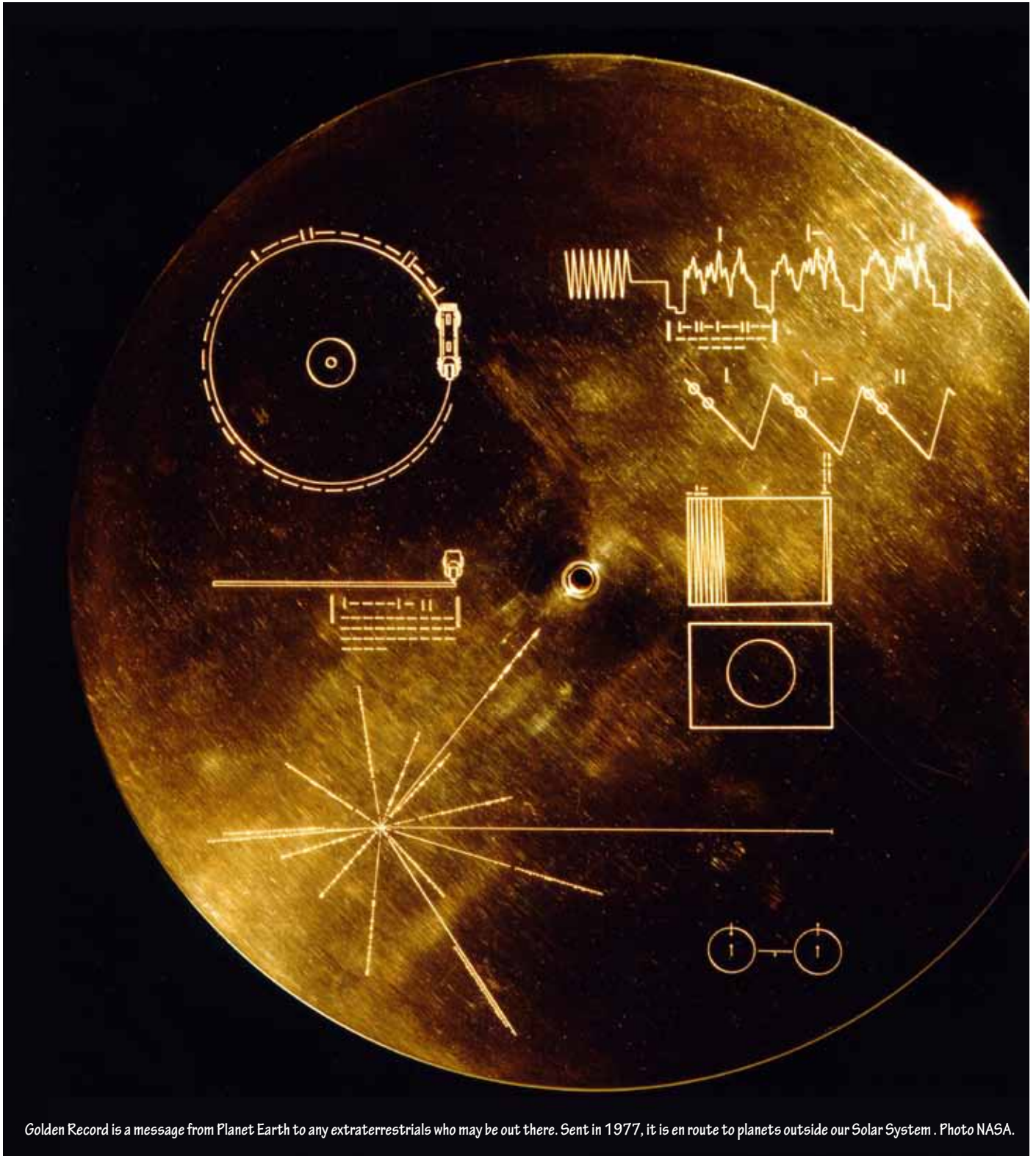
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Bon Voyage Voyagers



Golden Record is a message from Planet Earth to any extraterrestrials who may be out there. Sent in 1977, it is en route to planets outside our Solar System. Photo NASA.

In this issue: Voyagers 1 & 2

Zoom in on America

The Voyager Mission

The year 1977 was a special year for space exploration. In August and September, twin spacecraft Voyager 1 and Voyager 2 left planet Earth and began their space missions. They will turn 42 this year (2019), and while some would say they're no longer youngsters, they are still quite active! The Voyagers have enough electrical power and fuel to keep the science instruments onboard, operating until at least 2020. By that time, both spacecraft will be billions of miles from the sun. If all goes well, in about 40,000 years from now Voyager 1 will drift some 1.6 light-years, towards the constellation Ophiuchus, and in about 296,000 years, Voyager 2 will pass a "mere" 4.3 light-years from Sirius - the brightest star in the sky, which means that you may generously call both Voyagers just toddlers. They will continue to wander the Milky Way for hundreds of thousands of years, perhaps eternally.

How is it possible that two comparatively small spacecraft launched from Earth would be able to reach to the outermost areas of our solar system and fly by the farthest planets? Call it an astounding achievement of human imagination or a technological feat, which they unquestionably are. But, there is also an element of luck. In the summer of 1965, a once in a lifetime alignment was discovered. Calculations revealed that it would be possible for a spacecraft launched in the late 1970s to visit all four, giant, outer planets, using the gravity of each planet to swing the spacecraft onto the next. Such an alignment occurs only once every 176 years!

In the 1960s and early 1970s, NASA, together with Jet Propulsion Laboratory in Pasadena, California, ran the space program Mariner, which involved sending robotic interplanetary probes in the direction of Venus, Mars, and Mercury, in order for humans to take a closer look at Earth's closest neighbors. Later, it became vital to fly further towards the heretofore-unexplored planets, Jupiter and Saturn. Therefore, in 1977, a plan for a new Mariner Jupiter/Saturn program was soon underway. Before launching, its name was simplified to VOYAGER.

Two identical spacecraft, Voyager 1 and Voyager 2 were constructed with the goal to flyby Jupiter and Saturn. On August 20, 1977, Voyager 2 launched from NASA's Kennedy's Space Center. Even though it was launched first, the spacecraft is given the number 2, as it would reach Jupiter and Saturn after its twin sibling. Approximately two

weeks later, on September 5, Voyager 1, followed suit and left the surface of the Earth.

Two years into the mission, Voyager 1 made its closest approach to Jupiter. Important discoveries were made -- the Jovian ring system, two moons (Thebe and Metis) and volcanoes on the surface of Jupiter's moon. Scientists observed a Great Red Spot, which turned out to be a huge, cyclone-like storm. The phenomena, like volcanoes, lightning and storms, are not connected exclusively with our planet -- they occur in the solar system, as well.

A few months later, Voyager 2 came close to Jupiter and captured the first images of Jupiter's ring system, discovered a third moon, Adreastea, and approached the moon Europa. Linear features visible on its surface may be a sign of a liquid water ocean. The volcanoes observed by Voyager 1 are still erupting.



Image of Voyager. Photo NASA

On November 9, 1980, Voyager 1 made its closest approach to Saturn and its largest moon Titan, whose atmosphere is rich in nitrogen like Earth's. Three moons are discovered -- Atlas, Prometheus, and Pandora. Flying away from Saturn, Voyager 1 began its trip out of the solar system.

Voyager 2 encountered Saturn on August 25, 1981, and took a closer look at several of Saturn's icy moons. Having bid the sixth planet goodbye, it flew on in the direction of Uranus.

On its approach to the seventh planet from the Sun, Voyager 2 found it the coldest one in the solar system and discovered 11 moons, which derive their names from Shakespeare's characters: Puck, Juliet, Portia, Cressida, Desdemona, Rosalind, Belinda, Perdita, Cordelia, Ophelia, and Bianca.

This distant voyage also initiated NASA's Deep Space Network (DSN) communication, where the antennas were arranged to improve the ability to capture the weak radio signals. The dishes at the communication complexes in California, Spain, and Australia were expanded from 64 to 70 meters in width.

This was an important modification, since Voyager 2 flew on to even more distant cosmic terrain, towards Neptune, the windiest planet.

Before leaving the last planet of the solar system behind, Voyager 2 sent us the images of Triton, Neptune's fractured moon, with a polar cap and geysers erupting from pinkish nitrogen ice.

There is now nothing else to steer to in the solar system. Time to head on into interstellar space. It is time to turn off



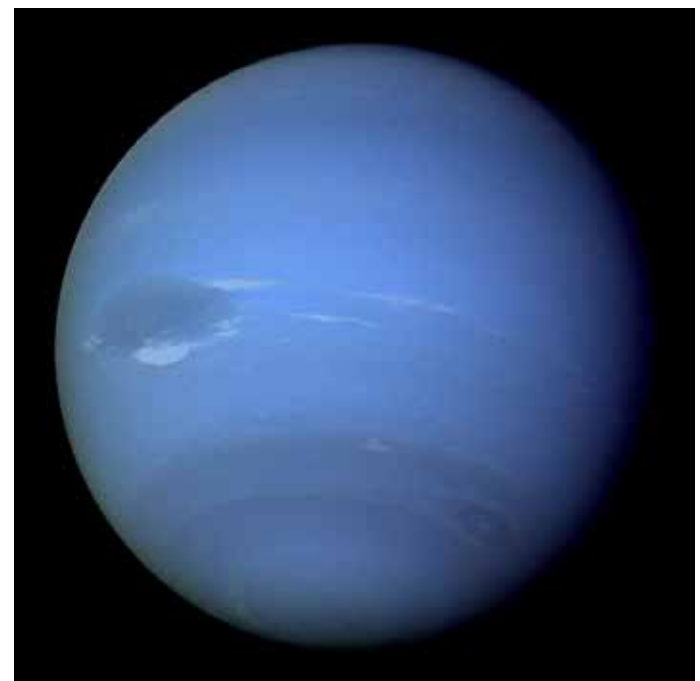
Closeup of Jupiter's Great Red Spot. Photo NASA



Saturn by Voyager 2. Photo NASA



Voyager 2 shows crescent of Uranus. Photo NASA



Voyager image of Neptune. Photo NASA

the cameras and save power for other instruments that keep on working while the spacecraft traverses the empty spaces. Empty, yet full of other interesting phenomena such as the solar wind, which continues to be analyzed.

In August 2012, Voyager 1 made the historic entry into interstellar space; the region between stars, filled with material ejected by the death of nearby stars millions of years ago. In other words, it flew beyond the heliopause or the boundary where the Sun's solar wind encounters opposing interstellar winds; which are due to the Sun's motion through the galaxy. Voyager 2 entered interstellar space on November 5, 2018. Both spacecraft are still sending scientific information about their surroundings through the DSN.

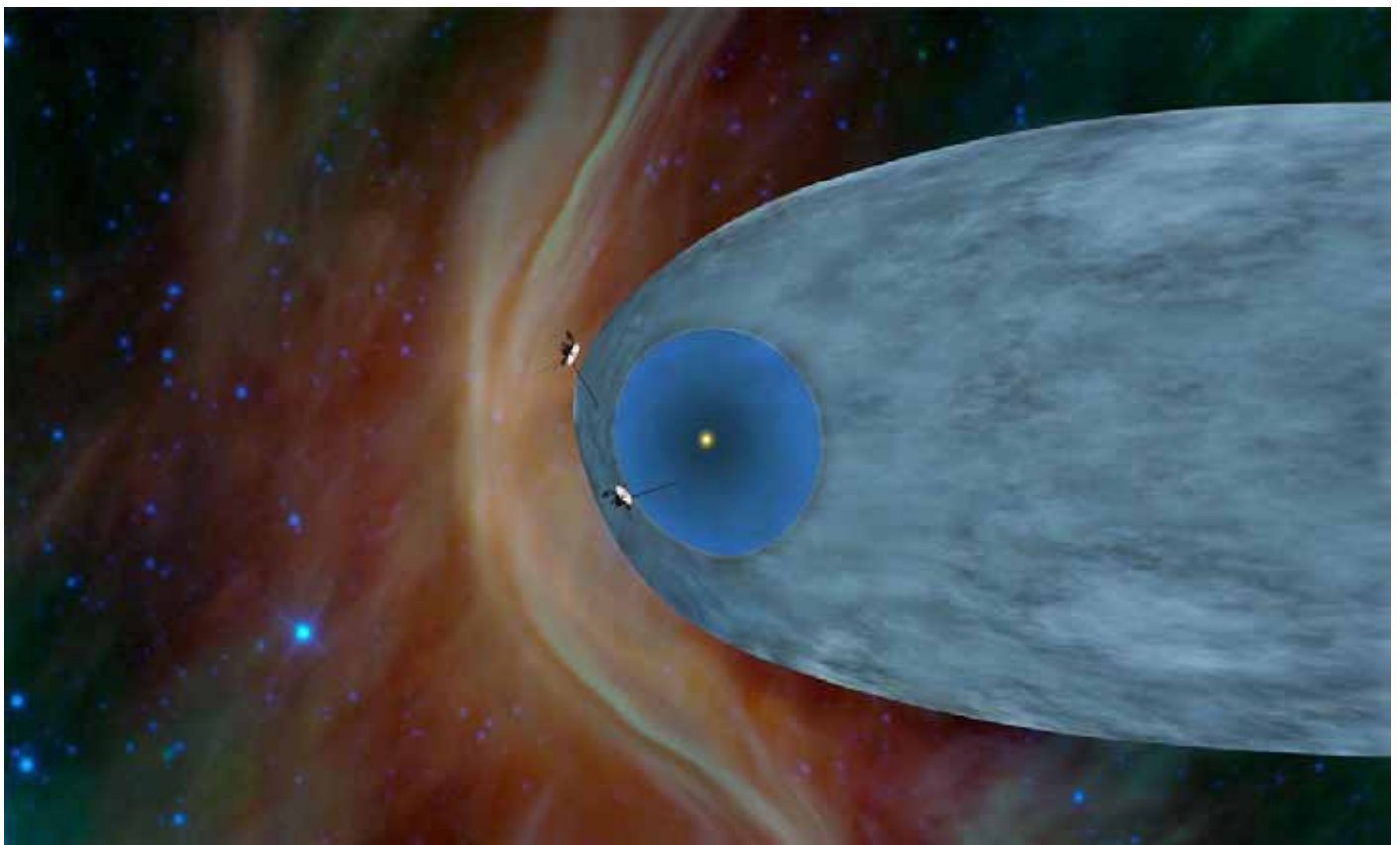
Mission goal transforms into the Voyager Interstellar Mission (VIM). It researches the outermost edge of the Sun's domain. And beyond.

We all love the Voyagers and keep our fingers crossed for their continuing space quest. Why? One reason is that they have flown to spaces we cannot even dream of reaching on our own. Also, they may one-day encounter extraterrestrials we have so long dreamed to know. Finally yet importantly, they have used this ONCE-IN-A-LIFETIME opportunity. So, Bon Voyage, Voyagers!



Text: Krakow AIRC based on NASA's Voyager website.

Above: John Casani, Voyager project manager in 1977. In the background stands Voyager 2 before it headed to the launch pad. Photo NASA/JPL-Caltech. AP Images.



Artist's concept shows the general locations of NASA's two Voyager spacecraft. Voyager 1 (top) has sailed beyond our solar bubble into interstellar space, the space between stars. Its environment still feels the solar influence. Voyager 2 (bottom) is still exploring the outer layer of the solar bubble. Photo NASA

Golden Record



The Golden Record. Photo NASA

The cover of the Golden Record (see cover page) displays a drawing of the phonograph record and the stylus carried with it. The instructions on how to play the record for those who may find it, are written in the language of mathematics, including the correct time of one rotation of the record (3.6 seconds) and the time to play one side of it (about an hour), as well as how they can see the pictures. Other drawings on the cover are the map with the location of the solar system and a depiction of the hydrogen atom. Electroplated onto the record's cover is an ultra-pure source of uranium-238, which can tell extraterrestrials the elapsed time since when the radioactive coating was placed until the moment it will be found.

Carl Sagan, Planetary Scientist of Cornell University was entrusted with the task to chair a committee that carefully assembled images, natural sounds, selected music pieces and greetings that were cut on the record. Dr. Sagan and his associates assembled 115 images and a variety of natural sounds, such as those made by surf, wind, and thunder, birds, whales, and other animals. To this, they added selected music pieces from different cultures and eras, and spoken greetings from the people of Earth as well as messages from President Carter and U.N. Secretary General Waldheim.

Greetings to the Universe are recorded in 55 different languages and it is thrilling to listen to them. You may visit the NASA JPL website for that experience: <https://voyager.jpl.nasa.gov/golden-record/whats-on-the-record/greetings/>

The greetings are short and they vary from language to language. For example, the greetings in Polish read: "Witajcie istoty z zaświatów", in Hebrew: "Shalom," and in English, a child is heard saying: "Hello from the children of planet Earth." The story behind the creation of the "interstellar message" is chronicled in the book, *Murmurs of Earth*, by Carl Sagan.

The images on the Golden Record include: human anatomy, birth, a father and daughter, a family portrait, a school of fish, dolphins, Bushmen hunters, a Thailand craftsman, the Great Wall of China, a train, an airport, Snake River and Grand Tetons - a photograph by Ansel Adams, and many others. You can see these images on the NASA JPL Voyager website: <https://voyager.jpl.nasa.gov/golden-record/whats-on-the-record/images/>

Music from Earth might have been the most difficult selection to make, as there are so many different genres and rhythms and tastes. What Carl Sagan and his committee finally decided upon includes Bach's Brandenburg Concerto No. 2, percussion music from Senegal, an initiation song "Pigmy girls" from Zaire, Chuck Berry's "Johnny B. Goode", Louis Armstrong, Mozart, Stravinsky, a night chant by Navajo Indians, Chinese, Indian and many other pieces. You can see the whole list on this page: <https://voyager.jpl.nasa.gov/golden-record/whats-on-the-record/music/>



Astronomer Carl Sagan who chaired a committee that selected the content of the Golden Record. Photo NASA

Let us take a closer look at the famous Golden Record - our introduction and message to extraterrestrials. It is a 12-inch gold-plated disk with information about Planet Earth as of 1977. To see where the Golden Record is on Voyager, please take a look at the image on page 2.

Useful Links

Thanks to NASA Jet Propulsion Laboratory's great website (<https://voyager.jpl.nasa.gov/>), we can check the position and distance from the sun and earth of Voyager 1 and 2 in real time. The website is a true goldmine of information, including the history of the mission, latest news, the building of the spacecraft, the contents of the Golden Record and much more.

NASA's Jet Propulsion Laboratory also provides an app, which allows the user to ride along with the Voyager spacecraft in real-time, at any point during the mission. You can "watch all of the historic first encounters, like Voyager 2 arriving at Neptune, or go to the moment Voyager 1 left our solar system behind to enter the vast region of interstellar space in 2012. Learn about all the instruments, check out the gallery of some of Voyager's most amazing pictures, or watch the amazing video of Jupiter's Great Red Spot!" Isn't it exciting? See the website for more information and links to the app: <https://eyes.jpl.nasa.gov/eyes-on-voyager.html>

Last but not least, the a/m website offers free 40th Anniversary posters.

Carl Edward Sagan, (November 9, 1934 – December 20, 1996), chair of the committee for the contents of the Golden Record, was an American astronomer, cosmologist, astrophysicist, astrobiologist, and writer. Above all, he was a gifted speaker with the ability to communicate and explain science to the general public. His television series *Cosmos: A Personal Voyage* has been seen by at least 500 million people, which makes it the most widely watched series in the history of American public television. He published books, some of which were made into movies (e.g. *Contact*) and conducted scientific research. Sagan argued the now accepted hypothesis that the high surface temperatures of Venus can be attributed to the greenhouse effect. You can listen to his moving and powerful 3-minute speech about the place of planet Earth in the universe, "A Pale Blue Dot", here: <https://youtu.be/wupToqz1e2g>



Neptune and Triton 3 days after flyby. Photo NASA

ACTIVITY PAGE

April-May 2019
TRIVIA QUESTION

Who was in charge of selecting content for the Golden Record?

Send the answer (with your home address) to:
KrakowAIRC@state.gov

The 1st, the 5th and 10th sender of the correct answer will be awarded with a book prize.

Deadline June 15, 2019

February-March 2019
Answer:

10 poems

The winners are:

Damian from Szczecin and Franciszek from Pilchowo
CONGRATULATIONS!!!

The prizes will be sent to you by mail.



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Exercise 1. Writing and Vocabulary Study.

You likely wanted to be an astronaut when you were a child. This is one of the top kids' dream jobs "When I grow up..." But, in reality, this is no easy career to pursue. How can one become an astronaut? What does this job require?

Write a paragraph of 200-250 words describing the requirements of an astronaut's job.

You could start like this:

Even though a career of an astronaut is among the most fascinating jobs one can imagine, it involves a lot of ...

Here are some words and expressions, which you might find useful:

good knowledge of science, a bachelor's degree, physical fitness, ability to stay calm in stressful situations, stamina, resourcefulness, ability to work in a team, responsibility,

Exercise 2. Speaking

Work with another student. Read the sentences below and decide if they are true about you. Then compare your answers with the other student and see if they would be a good companion for holiday. Why? Why not?

1. When you are planning a holiday trip, you:

- a. Take a map/guidebook, which you have purchased in advance and studied.
- b. Ask locals about the place's attractions, including the ones that are not so popular.
- c. Search YouTube channel for videos about the place before going.
- d. Spend a lot of your time shopping and dining.
- e. Book a hotel closest to a beach or some other main attraction of the place so you don't have to walk to your destination very far.
- f. Take many pictures of places you see as you travel.
- g. Take a lot of pictures, but mostly selfies.
- h. Spend most of your time on the beach, in restaurants or cafes because holiday is the time to rest and be idle.
- i. Visit all or most of the museums in the area.
- j. Collect leaflets, museum tickets, photos and other souvenirs from the places you have visited and come back to them to reminisce, once in a while.
- k. Forget about the place you visited the moment you close the door upon returning from the trip and start planning a new one since there are so many new destinations to visit.

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The Voyager 2 spacecraft, which was the first of the two Voyagers to launch, is seen at the Spacecraft Assembly and Encapsulation Facility 1 at NASA's Kennedy Space Center in Cape Canaveral, Florida. This archival photo is from August 1977. The spacecraft was put into this shroud on August 2, 1977, to protect it during flight through the atmosphere. Photo NASA/JPL-Caltech, NASA/JPL-Caltech Photojournal