Originally published in The Technology Teacher*, October 2000, by the International Technology Education Association*

Note to Teacher:

This space technology related activity invites you and your students to design and build your own model spacecraft from found objects. This activity can be simple or complex. Younger children can poke Popsicle® sticks through a juice box and glue on construction paper solar panels. Cotton swabs or toothpicks can be booms (supports for other instruments) and sensors. Egg carton cups can be communication antennas. Aluminum foil can be a space blanket. More ambitious spacecraft designers can fashion realistic looking parts from paper, cardboard, balsa wood, styrofoam, discarded CDs, wire coat hangars, and plastic objects of all sorts. Technology meets art meets imagination in this activity.

For inspiration, the article shows artists' renderings of some real, highly successful spacecraft, and describes Jason-1 as an example of how one spacecraft meets the basic spacecraft subsystem requirements. Jason-1 is an Earth-orbiting spacecraft which NASA will soon launch to study the oceans. Introducing Jason-1 provides an opportunity to talk not just about spacecraft and their essential parts, including observing instruments, but also about oceans.

Here's hoping you and your students have fun designing your own spacecraft. Perhaps you will end up with beauties for display in your classroom.

This article was written by Diane Fisher and Sue Digby of NASA's Jet Propulsion Laboratory (JPL). Diane is a science and technology writer and master of The Space Place at **http://spaceplace.jpl.nasa.gov**, a fun and educational web site for children. Sue is the outreach lead at JPL for TOPEX/Poseidon and Jason-1, two missions that help us unravel the mysteries of the oceans. Sue is the writer of her missions' educational web site at **http://topex-www.jpl.nasa.gov/education/education.html**.

The research described in this article was carried out by the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, under a contract with the National Aeronautics and Space Administration.

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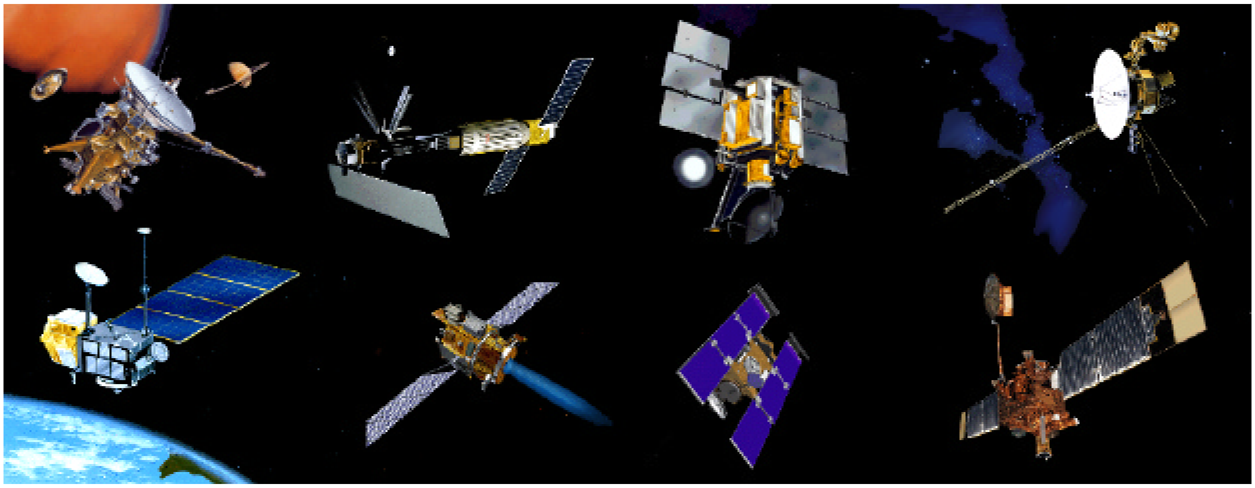
Design and Build Your Own Spacecraft



Design and build your own model spacecraft. Make it out of any materials and objects you find. We'll give you a few suggestions.

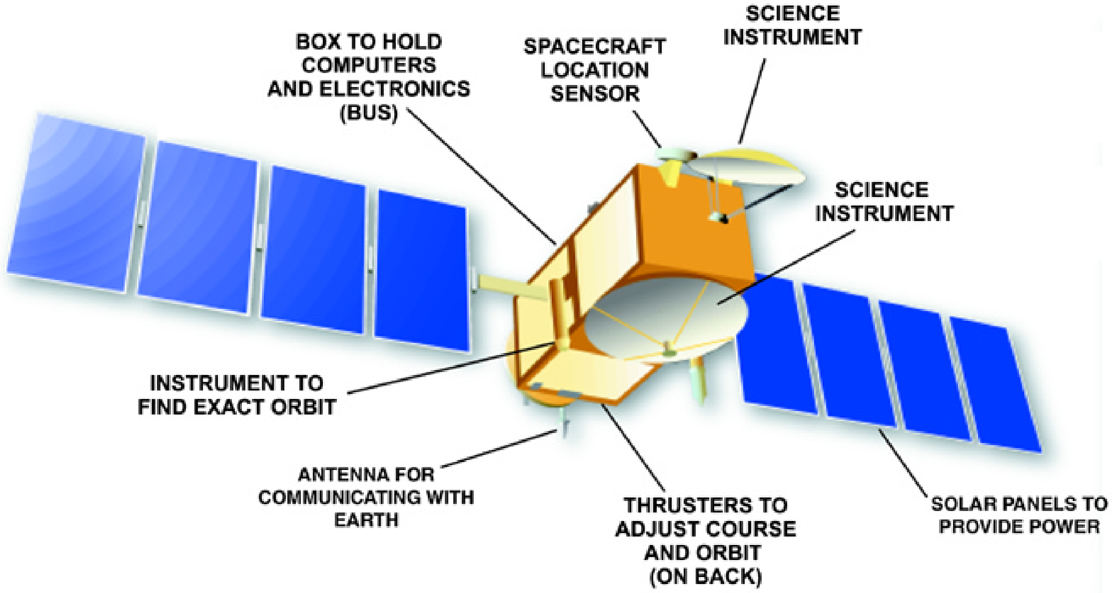
Most spacecraft have parts that do certain jobs. Here are some of the parts and jobs they do:

- A container (like a box) to be the body of the spacecraft and hold the computer and electronics. This part is called the spacecraft "bus."
- Something to keep the computer and electronics warm out in cold space (for example, a space blanket).
- Something to supply electric power (for example, solar panels).
- Some instruments to make science measurements or take pictures.
- Some way to communicate with Earth (both to send data and to receive commands).
- Some way to slow down, speed up, or change the direction of the spacecraft (like thrusters) to keep it on course or in the right orbit.
- Something to let the spacecraft know where it is and where it is going (for example, a star finder camera; for Earth orbiters, it might be a receiver for signals from the network of Global Positioning Satellites).

There are many other parts, but the ones above are some of the basics.

The spacecraft you design can be small or large. Here are some examples of materials you might use. This list is just a start. Use anything you can find.

- Juice box, gelatin or pudding box, shoe box, large cardboard box or carton, cardboard tube.
- Aluminum foil, foil gift wrap paper, construction paper, butcher paper, any kind of paper colored with paint or crayon, flat pieces of cardboard, transparent colored plastic film (for example, mylar).
- Popsicle® sticks, wooden skewers, wooden chopstick, yardstick; bamboo plant stakes, pencils, any kind of sticks.
- Styrofoam or paper egg cartons, small styrofoam balls, clay, paper cups.
- Paper bowls and plates, plastic bowls, Frisbee® disks.
- Cotton swabs, screws, bolts, paper clips.



This is the Jason-1 spacecraft. It will be launched early in 2001. It will orbit Earth and study the oceans. It will join its older sibling, the TOPEX/ Poseidon spacecraft. TOPEX/Poseidon has been studying the oceans since 1992.

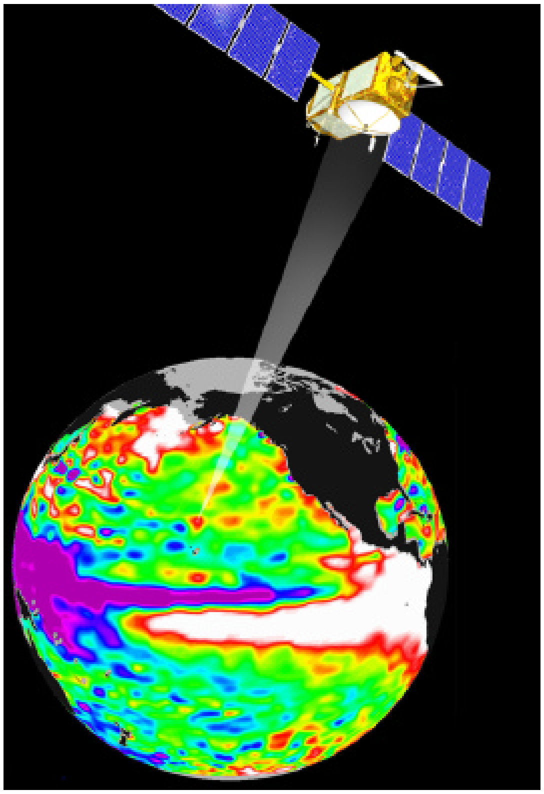
- Metal soup spoons or soup ladles.
- Push pins, thumb tacks, loose leaf brads, wood screws.
- Fishing line, thread, or string to hang model spacecraft in "space."
- Scissors.
- Tape.
- White glue.
- Poster Tac® (reusable plastic adhesive), plasticene clay, or some other sticky stuff to attach parts.

A Special Spacecraft to Study the Oceans

Most Earth-orbiting spacecraft look similar to one another because they all need to communicate with Earth, make power, and carry instruments. Countries all over the world work together to build these spacecraft and study the data they send back. Earth is very complex, so using a view point from space, we are measuring many types of things, including clouds, the amount of sun reaching Earth, the temperature of the land and the ocean, sea surface height, and ocean color. Collecting information over the oceans is especially important.

The oceans are very, very important to life on Earth, because more than three-fourths of Earth's surface is ocean. Not only are oceans the source of all our water and much of our food, they greatly affect the air we breathe and the weather.

Because the oceans are so enormous, we use spacecraft in orbit around Earth, as well as ships and buoys, to collect information. Jason-1 will measure the height of the sea surface. To do this, it uses an instrument called an altimeter (al-TIM-uh-ter). The altimeter works by sending down a signal to the ocean. The signal bounces off the surface of the water and returns to the spacecraft. Since we know the height of the spacecraft very precisely, if we



The information gathered by Jason-1 will help us understand the oceans and how they affect worldwide weather patterns. If you could see this map of Earth in color, the coldest parts of the oceans would appear purple, the next coldest blue, then green, yellow, red, and, finally, white for the very warmest ocean waters.

measure how long it takes the bounced signal to return to the spacecraft, we know the height of the ocean. Water in the air (for example, the water in clouds) slows down this signal. So we need to correct the measurement with information from another instrument called a radiometer (ray-dee-AH-muh-ter), which measures the amount of water in the air. These two instruments work together to give a measurement accurate to within 4 centimeters (about 1-1/2 inches).

Why do we care how high the ocean surface is? The surface height of the ocean tells us how warm or cold the water is below the surface. Warmer water expands a bit, making the ocean surface higher. Where Jason-1 detects a rise in the ocean surface of 1 centimeter (4/10 inch), the top 50 meters (164 feet) of ocean is 1 degree Celsius (1.8 degrees Fahrenheit) warmer than the surrounding water.

These ocean "hills and valleys" tell us how the heat is moved around the oceans. Large amounts of heat moving from one place to another can affect the weather. We get more evaporation from hot water than from cold water, so with hot water comes increased rainfall. In the Gulf of Mexico, people watch the movement of warm eddies very carefully, because if a hurricane goes over one of these warm eddies, the wind speeds in the hurricane can actually get even faster!

This spacecraft will join several other ocean-watching spacecraft. They will help us understand how the oceans change over time and how those changes affect the climate and weather everywhere on Earth.

To learn more:

El Niño: Stormy Weather for People and Wildlife, by Caroline Arnold. Houghton-Mifflin, 1998.

The Jason-1 spacecraft: *http://topex-www.jpl.nasa.gov/jason1/*

Oceanography: *http://topex-www.jpl.nasa.gov/education/education.html*

A fun activity about the El Niño condition and how it affects weather: *http://spaceplace.jpl.nasa.gov/topex_make1.htm* .