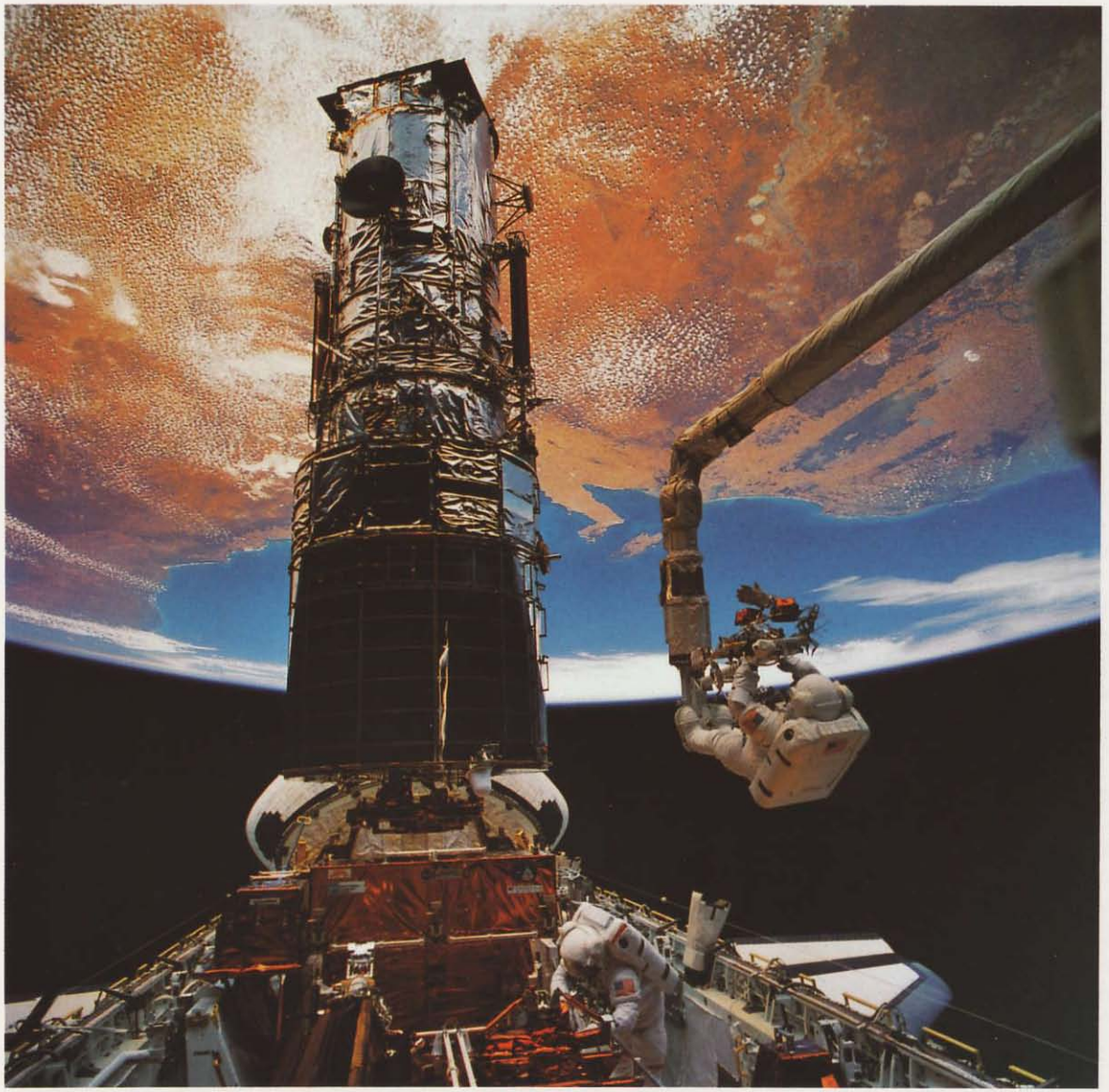
National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

Hubble Space Telescope
First Servicing Mission



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

Hubble Space Telescope First Servicing Mission

On the front: Astronaut F. Story Musgrave, anchored on the end of the Remote Manipulator System (RMS) arm on the Space Shuttle Endeavour, prepares to be elevated to the top of the towering Hubble Space Telescope (HST) to install covers on magnetometers. Astronaut Jeffrey A. Hoffman, at bottom, teamed up with Musgrave to perform final servicing tasks on the telescope.

The nearly flawless 11-day mission to service Hubble included a record-breaking five spacewalks in which astronauts performed a number of tasks designed to improve the telescope and extend its life.

COSTAR

To compensate for HST's blurred vision, astronauts installed a phone booth-size device called the Corrective Optics Space Telescope Axial Replacement (COSTAR). Using 10 corrective mirrors ranging in size from a dime to a quarter, COSTAR improved the quality of data from three instruments: the European Space Agency (ESA) Faint Object Camera (FOC), the Faint Object Spectrograph (FOS) and the Goddard High Resolution Spectrograph (GHRS).

WIDE FIELD/PLANETARY CAMERA II

Astronauts also installed a second-generation camera known as the Wide Field/Planetary II Camera. This camera, already under construction when Hubble was launched on April 24, 1990, included its own corrective optics as well as a number of technological improvements. It replaced the original Wide Field/Planetary Camera I.

OTHER ENHANCEMENTS

Also replaced were ESA's two solar arrays, which gather sunlight to power Hubble; a Solar Array Drive Electronics (SADE) unit, which transmits commands to the array wings; two magnetometers, which measure the spacecraft's relative orientation to Earth's magnetic field; two gyroscope packages, which help point HST and track targets; a kit to improve the reliability of the Goddard High Resolution Spectograph; a 386 co-processor to augment the telescope's onboard DF-224 computer; and fuse plugs for the gyros and science instruments.

The STS-61 HST First Servicing Mission was carried out from the Endeavour following its flight into space December 2, 1993, from Kennedy Space Center in Florida. Endeavour returned to Earth on December 13, 1993. The seven-member crew included Richard O. Covey, commander; Kenneth D. Bowersox, pilot; Musgrave, payload commander; Hoffman, mission specialist; ESA's Claude Nicollier, the mission specialist who operated the RMS arm; and Tom Akers and Kathryn C. Thornton, mission specialists who formed the second spacewalking team.

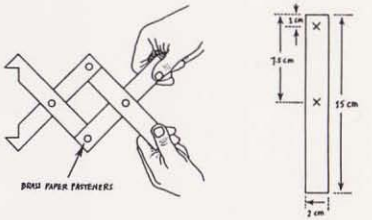
Hubble is managed by Goddard Space Flight Center in Greenbelt, Md., for the Office of Space Science at NASA Headquarters in Washington, D.C.

For The Classroom

Scientists working in space and deep under the ocean often use remote manipulator arms. These manipulator arms come in different shapes and sizes. Have students construct a manipulator arm to help them understand how one works.

Materials:

Poster board
Scissors
Ruler
Brass Paper Fasteners
Hole punches
Scrap paper
Marbles



Procedure:

1. Distribute the materials.
2. Cut the poster board into four strips, each 15 centimeters long by 2 centimeters wide.
3. Make two holes in each strip of poster board. Place one hole in the center of the strip. Center the other hole about one centimeter from one end of the strip.
4. Use brass fasteners to assemble the accordion-like model as shown in the illustration.
5. Students will find that the manipulator does not grasp unless they cut "teeth" at the end as shown in the illustration.
6. Crumple several pieces of scrap paper into small balls and drop them onto the floor randomly.
7. Have students take turns using their manipulator arms to arrange the crumpled paper into a square and then into a circular pattern. Repeat the exercise using marbles. Students may need to redesign their manipulator arm to pick up the marbles.

Adapted by permission from *The Jason Core Curriculum*