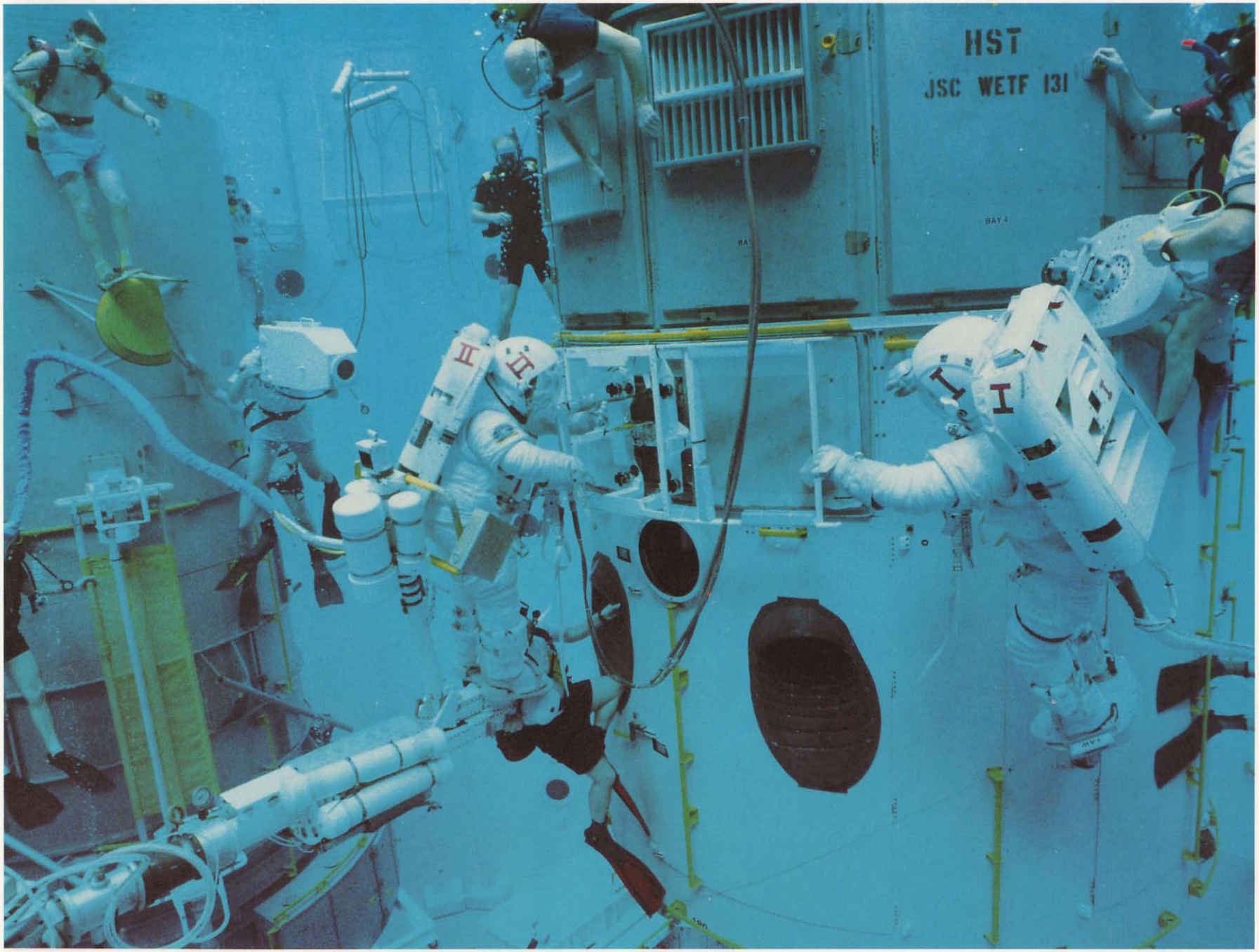
National Aeronautics and
Space Administration
Goddard Space Flight Center

Astronauts Training for Hubble Space Telescope Servicing Mission



Astronaut Training for Hubble Space Telescope Servicing Mission

Astronauts Tom Akers (I) and Kathy Thornton (II) prepare to remove a mockup of a Wide Field/Planetary Camera (WF/PC) from a full-sized model of NASA's Hubble Space Telescope (HST) while training in the Neutral Buoyancy Simulator at the Marshall Space Flight Center, Huntsville, Alabama. Akers and Thornton, along with astronauts Story Musgrave and Jeff Hoffman, make up the teams of Extra Vehicular Activity (EVA) spacewalkers scheduled to provide servicing to the HST during a mission scheduled for late 1993 or early 1994. The STS-61 mission with Space Shuttle Endeavour is planned for eight days, during which time the astronauts are scheduled to make three six-hour spacewalks.

Plans call for the astronauts to replace the observatory's solar arrays, install a Corrective Optics Space Telescope Axial Replacement (COSTAR) instrument to correct much of the "spherical aberration" in the telescope's primary mirror much as eyeglasses would correct an imperfection in human vision, install a second generation Wide Field/ Planetary Camera (WF/PC), replace some gyro assemblies, make a modification on the Goddard High Resolution Spectrograph and install a co-processor to restore computer memory capacity.

The telescope was designed for servicing in space and, because of that opportunity, to remain in operation for 15 years.

The mission specialist astronauts train in neutral buoyancy simulators, which are large water-filled tanks, at Marshall and at Johnson Space Center, Houston, Texas. The tanks provide an environment that somewhat resembles the zero gravity environment the astronauts find on their space flights. The astronauts also will train at the Goddard Space Flight Center, Greenbelt, Maryland, where the servicing mission is managed. Goddard has one of the world's largest cleanrooms, and the astronauts will train there to familiarize themselves with the power tools and other special devices they will use during the mission.

The Hubble Space Telescope was launched from the Space Shuttle Discovery in April 1990. No research mission in NASA history had generated higher scientific expectations than HST, designed to be the most powerful astronomical telescope ever built and far surpassing the capabilities of ground-based optical telescopes for many kinds of research. The key to HST success is its operation in space—above the blurring, obscuring and absorbing effect of the Earth's atmosphere.

Two months after launch, scientists and engineers determined that there was an optical defect, or spherical aberration, in the primary mirror that blurred the telescope's focus. Actions have been taken to alleviate that flaw and, as a result, astronomers have made a number of significant discoveries with the observatory.

Other crew members for the Hubble servicing mission are Richard O. Covey, commander; Kenneth Bowersox, pilot, and European Space Agency (ESA) astronaut Claude Nicollier, mission specialist. Musgrave will serve as payload commander.

For the Classroom

1. The astronauts chosen for the Extravehicular Activity (EVA) to service the Hubble Space Telescope practice for their mission at least one year in advance. Name and discuss some reasons for this long preparation.

2. While outside of the shuttle, the astronauts will be wearing a sophisticated spacesuit called the Extravehicular Mobility Unit (EMU). List the problems astronauts encounter in the outer space environment that must be addressed by spacesuit designers.

3.* Divide the class into cooperative learning groups to research and present findings of the evolution of the spacesuit. Possible topics:

- Project Mercury Spacesuits
- Project Gemini Spacesuits
- Project Apollo Spacesuits
- Skylab Spacesuits
- Soviet Cosmonauts' Spacesuits
- High-Altitude Aircraft Pressure Suits
- The Current Extravehicular Mobility Unit

Plan to have the students display and discuss the results of their research.

4.* A spacesuit contains a nonexpandable but flexible layer that contains oxygen to provide adequate pressure for astronauts on spacewalks. The oxygen that is fed into this layer is under pressure, and the pressure is exerted on the astronaut. The pressure makes the suit stiff. Predict some of the problems caused by this fact.

- To understand this problem, inflate a long balloon.
- Try to bend it.
- What can be done to make the balloon easier to bend?
- Think about the human arm. What helps it to bend easily?
- Inflate a second long balloon but this time, use plastic or metal rings or heavy rubber bands to pinch off the balloon like sausage links.
- The rings or bands provide joints that make bending easier.

5.* Because spacesuit gloves are inflated they can be stiff and hard to work in. To help students understand the problems astronauts will encounter when servicing the Hubble Space Telescope, have students try to do simple tasks while wearing thick insulated ski gloves, such as:

- Assemble a structure with construction toys
- Write a message
- Use a screwdriver
- Use needle-nose pliers
- Screw a nut onto a bolt
- Thread a needle

*From: "Suited for Spacewalking – A Teacher's Guide With Activities" available at NASA Teacher Resource Centers