

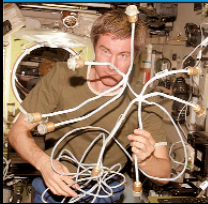
LIVING & WORKING IN SPACE



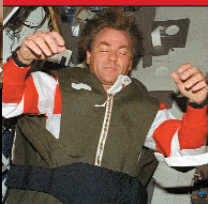
EXERCISING



WORKING



SLEEPING



PREPARING FOOD



WASHING HAIR



BACKGROUND INFORMATION FOR

Only in the past four decades—after centuries of studying the Solar System from Earth—have humans developed the technology to travel to space and to experience and explore it firsthand. Humans have walked in space and on the Moon. We have launched giant telescopes into space and sent people there to service them. We are building a permanent space station 322 kilometers (200 miles) above the Earth. Today, people live and work in space for months at a time. But the everyday experience of living and working in space is very different from that on Earth.

EARTH VS. SPACE

Beyond Earth's atmosphere, space becomes a hostile environment that cannot sustain human life. The following chart shows why by comparing environmental conditions on Earth with those in space.

	EARTH	SPACE
OXYGEN	Our atmosphere contains sufficient oxygen to support human life.	The level of oxygen is too low for humans; without protection, they would quickly perish.
AIR PRESSURE	Atmospheric gases push on our bodies from all directions. This pressure counterbalances the pressure of air and fluids pushing out from inside our bodies.	Space is a vacuum with virtually no gases or air pressure. The air inside an unprotected human being's lungs would expand, leading to unconsciousness within 15 seconds.
GRAVITY	Gravity holds humans securely to the Earth.	In the reduced gravity—or microgravity—of space, humans feel weightless. They are in a state of free fall—similar to the feeling of racing down from the top of a roller coaster.
TEMPERATURE	Atmospheric gases distribute heat from the Sun and balance global temperatures.	With no protective atmosphere, the temperature of objects in space varies widely. Near the Earth and Moon, it ranges from -156°C (-250°F) in the shade to 121°C (250°F) in sunlight.
RADIATION	The atmosphere filters out harmful radiation.	With no protective atmosphere, electrically charged particles and high energy radiation from the Sun pose a major danger to humans.
METEORIDS	The atmosphere slows down meteoroids and disintegrates all but the largest.	With no atmosphere to slow them down, meteoroids are a hazard. Even tiny ones (micrometeoroids) can easily penetrate a spacecraft, spacesuit, or human skin.
FOOD AND WATER	Both occur naturally and in abundance on Earth.	There is no evidence of either in space.

SURVIVING IN SPACE

INSIDE A SPACECRAFT

While in space, humans must protect themselves against the extreme conditions described to the left, and they must bring with them everything they need to survive. Spacecraft like the Space Shuttle have a shell that provides protection from temperature extremes, solar radiation, and micrometeoroids. Inside the Shuttle, the air pressure and oxygen levels are controlled, just like on an airplane, and there are supplies of food and water. Astronauts wear regular clothes—including shorts and t-shirts. The only major environmental condition to which they must adapt is microgravity. Here are several ways astronauts meet the challenge of microgravity while inside the Space Shuttle:

- **Eating:** Astronauts eat most food directly from sealed packages, not from open plates or bowls. Velcro attaches the packages to trays and keeps them from floating away. Silverware has magnets to keep it in place.
- **Sleeping:** Astronauts spend the night in sleeping bags strapped to the wall so they don't float around.
- **Bathing:** Astronauts take sponge baths using wipes, or soap and wet cloths.
- **Working:** Space tools are specially designed to attach to astronaut clothing and equipment with Velcro or cords.
- **Going to the bathroom:** Special toilets with funnels and suction ensure that what comes out goes down, not up.

OUTSIDE A SPACECRAFT

Today astronauts travel to space to service the Hubble Space Telescope (which orbits the Earth more than 480 kilometers, or 300 miles, away) and to help assemble the International Space Station (located 322 kilometers, or 200 miles, above Earth). Both of these missions require astronauts to leave the shuttle and work in the vacuum of space. These spacewalks are called EVAs—or Extravehicular Activities. They require a spacesuit specifically designed for this purpose. With its protective layers enabling humans to survive in an otherwise hostile environment, a spacesuit is like a personal spacecraft. It provides everything needed for human survival for about eight hours. Without one, astronauts would quickly die.

Spacesuits are complex devices. Technically known as Extravehicular Mobility Units (or EMUs), they are usually made up of 11 layers—each of which serves a different purpose. Here are some major features:

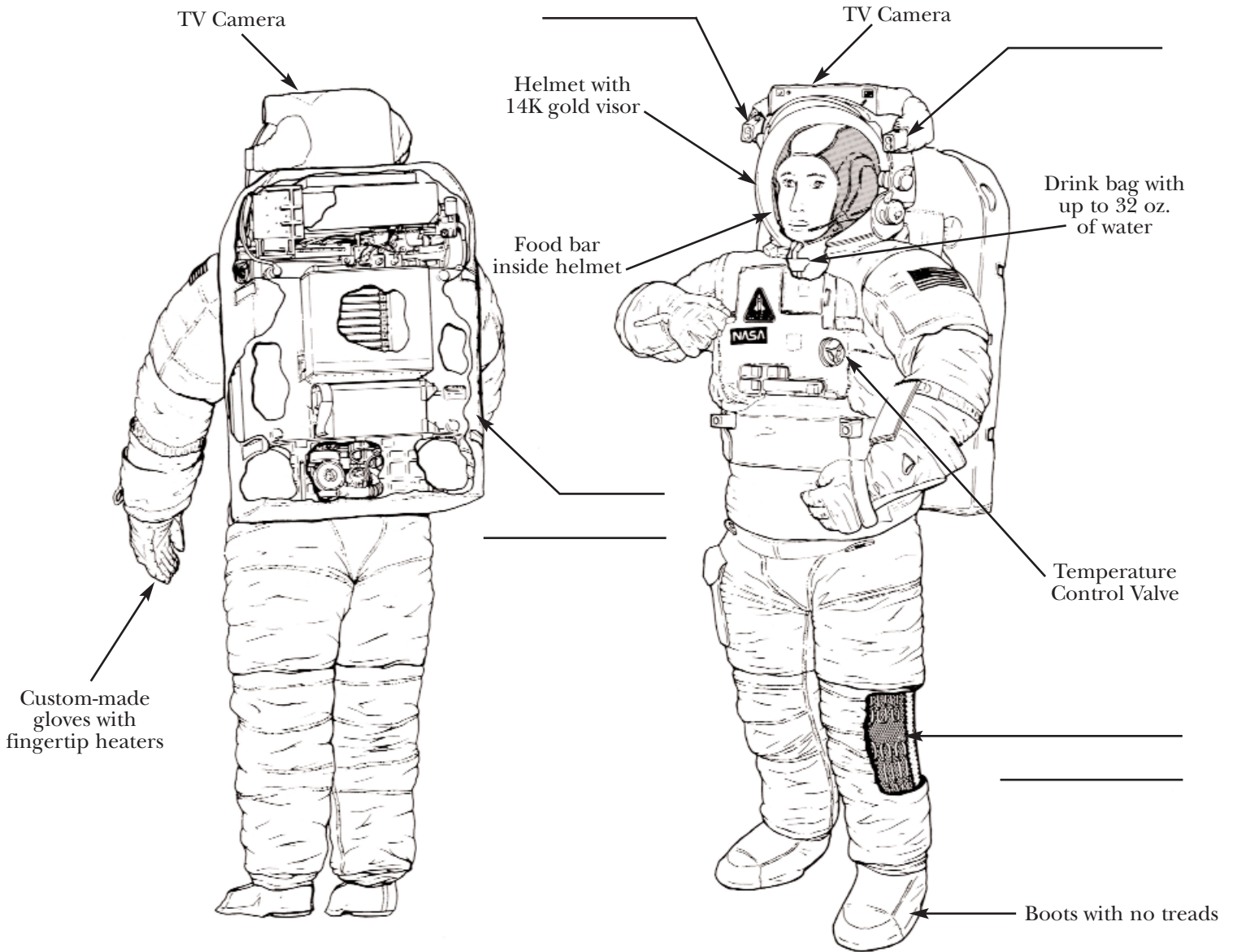
- **Maximum Absorption Garment (MAG):** The first item astronauts put on is this adult-size diaper. When astronauts have to “go” when they’re outside in space, they can just “go” in their MAG.
- **Liquid Cooling and Ventilation Garment:** This long underwear-like garment contains 91.5 meters (267 feet) of plastic tubing. Cooling water circulates through the tubing to keep the astronaut at a comfortable temperature.
- **Pressure Bladder Layers:** Two layers contain the spacesuit’s atmosphere and provide air pressure. The inner layer seals in the air. The outer layer prevents the suit from ballooning.
- **Thermal Micrometeoroid Layers:** Nine layers of foil, mesh, and durable rip-stop cloth provide temperature insulation and protect against micrometeoroid penetration.
- **Life-Support System:** This backpack contains oxygen, equipment to remove carbon dioxide, electrical power, and other life-support needs.
- **Helmet:** The helmet itself is a clear bubble that encloses the astronaut’s supply of air. A visor covered with 14K gold reflects sunlight. Under the helmet, the astronaut wears a cap with earphones and a microphone.
- **Headlights:** Located high on the astronaut’s backpack, they provide light during the dark half of every 90-minute orbit.
- **Gloves:** These are the only component of modern spacesuits custom-made to fit each astronaut.
- **Boots:** Since astronauts in orbit never set foot on land, the boots don’t need treads.
- **Drink Bag:** A water-filled plastic pouch—with a straw—is mounted inside the upper part of the suit.
- **Food:** A high-nutrient food bar, with an edible rice paper cover, is located in the helmet—right near the mouth.
- **Tether:** Attached to the spacecraft is a retractable cord, somewhat like a leash, that prevents the astronaut from floating away. (visible in poster image)

SPACE SHUTTLE SPACESUIT

BLACKLINE MASTER #2

LABEL THESE PARTS:

- Headlights (2 places)
- Liquid Cooling and Ventilation Garment
- Life-Support System



Maximum Absorbency Garment

