



Marshall Space Flight Center

Environmental Control and Life Support System

Earth's natural life support system provides the air we breathe, the water we drink and other conditions that support life. For missions in space, it is essential to preserve as many natural resources as possible. Quick resupply of air and water is not possible, given the distances involved.

To mitigate this problem, a regenerative life support system that mimics Earth's natural processes is needed aboard spacecraft. NASA's Marshall Space Flight Center in Huntsville, Alabama, is responsible for most of the design, construction and testing of this regenerative life support hardware for the International Space Station, known as the Environmental Control and Life Support System (ECLSS).

ECLSS is a life support system that provides or controls atmospheric pressure, fire detection and suppression, oxygen levels, proper ventilation, waste management and water supply. ECLSS includes three key components — the Water Recovery System, the Air Revitalization System and the Oxygen Generation System. These systems were jointly designed and tested by the Marshall Space Flight Center and industry partners. They are packaged into four refrigerator-sized racks in the U.S. Tranquility module on the station.

The Water Recovery System provides clean water by reclaiming wastewater (including water from crew members' urine), cabin humidity condensate, and water from the hydration system inside crew members' Extra Vehicular Activity suits. The recovered water must meet stringent purity standards before it can be used to support crew, extravehicular and payload activities.

Water produced by the urine processor is combined with all other waste waters and delivered to the water processor for treatment. The water processor sends the water through a series of multi-filtration beds and a catalytic oxidizer for purification. The water purity is checked by electrical conductivity sensors in the systems. Unacceptable water is reprocessed, and clean water is sent to a storage tank, ready for the crew to use. Currently, the Water Recovery System is capable of recovering and recycling about 98 percent of the water on station.

Each astronaut needs about a gallon of water per day for consumption, food preparations and hygiene — brushing teeth and shaving.

The Environmental Control and Life Support System performs several functions:

- Provides oxygen for breathing
- Removes carbon dioxide from the cabin air
- Recovers and recycles oxygen from carbon dioxide to resupply the crew
- Filters particulates and microorganisms from the cabin air and maintains cabin pressure, temperature and humidity levels
- Removes volatile organic trace gases, such as ethanol, that are colorless, odorless and can build up over time
- Distributes cabin air between each room, or module, of the station;
- Provides potable water for consumption, food preparation and hygiene
- Purifies recycled water from multiple sources back to potable water

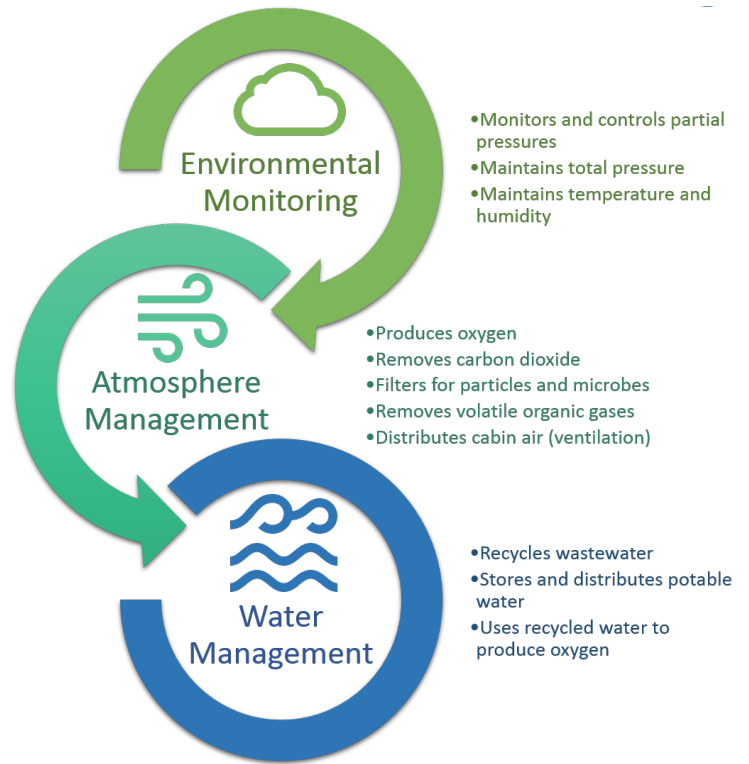
The **Air Revitalization System** is dedicated to cleaning the circulating cabin air. This involves removing trace contaminants produced by electronics, plastics and human off-gassing, including carbon dioxide exhaled by the crew during normal respiration. Trace contaminants are removed by flowing cabin air through three separate units including an activated charcoal bed, a catalytic oxidizer and a lithium hydroxide bed. Carbon dioxide is removed using molecular sieves, materials that separate and capture gases based on their size.

The **Oxygen Generation System** produces oxygen for the crew to breathe. The system consists of the oxygen generation assembly and the carbon dioxide reduction assembly. The oxygen generation assembly is composed of the cell stack, which electrolyzes, or breaks apart, water

provided by the Water Recovery System, yielding oxygen and hydrogen as byproducts. The oxygen is delivered to the cabin atmosphere while the hydrogen is either vented into space or fed to the carbon dioxide reduction assembly. The assembly uses that hydrogen along with carbon dioxide exhaled by the crew in a Sabatier reactor. The byproducts of that process are methane (which is released into space) and water for use by the crew.

ECLSS Facts

- The Environmental Life Support System for water recycling has been operating on the space station since 2008.
- Astronauts need to drink a half gallon of water each day — we all do!
- Oxygen on the ISS comes from a process called “electrolysis,” which involves using an electrical current generated from the station’s solar panels to split water molecules into hydrogen and oxygen gas.
- ECLSS reclaims 98 percent of all astronaut sweat and urine.
- This technology has been adapted on Earth to aid remote locations or places devastated by natural disaster that do not have access to clean drinking water.



National Aeronautics and Space Administration

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