# Scientific Balloons

Balloons have been used for decades to conduct scientific studies. While the basics of ballooning have not changed, balloon capabilities have increased and their dependability has improved greatly.
Scientific Balloons...

1. can be launched from locations worldwide to suport scientific needs.
2. can be readied for flight in as little as six months.
3. offer a low-cost method of conducting science investigations.
4. provide a stable platform for longer flight durations.

Scientists use scientific data collected during balloon flights to help answer important questions about the universe, atmosphere, the Sun and the space environment. Questions such as "How did the universe, galaxies, stars, and planets form and evolve?" and "Are there Earth-like planets beyond our solar system?" are being answered by NASA with the help of experiments flown on scientific ballons.

Standard NASA scientific balloons are constructed of polyethylene film; the same type material used for plastic bags. This material is only 0.002 centimeters (0.0008 inches) thick, about the same as an ordinary sandwich wrap. The film is cut into banana-peel shaped sections called gores and heat sealed together to form the balloon. Up to 180 gores are used to make NASA's largest balloons. These standard, zero-pressure, balloons are open to the atmosphere at the bottom to equalize the internal pressure with the surroundings. The balloon system includes the balloon, the parachute and a payload that holds instuments to conduct scientific measurements.

Helium, the same gas used to fill party balloons, is used in NASA balloons. These very large balloons can carry a payload weighing as much as 3,600 kilograms (8,000 pounds), about the weight of three small cars. They can fly up to 42 kilometers (26 miles) high and stay there for up to two weeks.

The Balloon Program's capabilities are being expanded with the development of an Ultra Long Duration Balloon (ULDB). The ULDB is made of advanced materials and uses a new pumpkin-shaped balloon design to achieve flights of up to 100 days. The ULDB is completely sealed and pressurized in order to maintain constant altitude night and day. The ULDB payload consists of a solar power system, radio receivers and transmitters, computers, batteries and other systems required for science experiments.

The balloon is launched by partially filling it with helium and launched with the payload section suspended beneath it. As the balloon rises, the helium expands, filling the balloon until it reaches float altitude in two to three hours.

After the science measurements are complete, flight controllers send a radio command that separates the payload from the balloon. The payload floats back to the ground on a parachute where it can be retrieved and flown again. Payload separation creates a large tear in the balloon material, which releases any remaining helium. The balloon also falls to the ground, where it s retrieved and discarded. The balloon and payload land approximately 45 minutes after separation.

(Special thanks to the Balloon Program Office at Wallops Flight Facility.)

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## Types of Ballooning

**Conventional Ballooning**
Conventional missions typically use direct line-of-sight electronics for command and data with flight durations ranging from a few hours to days.

**Long Duration Ballooning**
A Long Duration Balloon (LDB) mission normally traverses between continents or around the world for one circumnavigation. LDB flights may last up to three weeks and satellite-based electronic systems are utilized for command and data.

**Ultra Long Duration Ballooning (ULDB)**
The superpressure pumpkin balloon has been designed to increase flight durations up to one hundred days. This new balloon will significantly increase the amount of data that can be collected in one balloon mission.

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**NASA Standard Design Balloon Load/Altitude Curves (English Units)**

**NASA Standard Design Balloon Load/Altitude Curves (Metric units)**

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