

SUGGESTED REFERENCES

- *NASA's official International Space Station website*
www.nasa.gov/mission_pages/station/main/index.html
- *A History of Human Spaceflight including Soviet and Russian spacecraft*
http://spaceflight.nasa.gov/history/
- *History of Space Exploration*
www.solarviews.com/eng/history.htm
- *The Space Place - a space history from rockets to the space shuttle*
www.thespaceplace.com/history/space.html
- **A History of Space Exploration**, by Tim Furniss
- **International Space Station: Cooperation in Orbit** (Apogee Books Space Series), by David Shayler

NATIONAL SCIENCE EDUCATION STANDARDS

Grades 5 - 8

Earth Science

Earth in the Solar System

Science and Technology

Understandings about Science and Technology

Grades 9 - 12

Physical Science

Motions and Forces

Science and Technology

Understandings about Science and Technology

*Source: *National Science Education Standards, 1996, National Academy Press*

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HIGH HOPES "Space Stations" & WHITHER? "Manned Spaceflight"



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SYNOPSIS

The history of space flight has been marked by great disasters and even greater achievements. The International Space Station is the largest man-made structure in space. Students will learn the history behind the space station, as well as get a chance to see what it is like to live there.

Looking a little farther back in time, students will experience some of the milestones of space flight history, from the first man to orbit the Earth, to the first manned landing on the moon. Beyond the space station, students will get a chance to ponder where we will go next and how we will get there.

CURRICULUM UNITS

- ASTRONOMY
- BIOLOGY
- INTEGRATED SCIENCE
- PHYSICAL SCIENCE
- PHYSICS

RUNNING TIME

20:00

BACKGROUND

Is the International Space Station (ISS) a nightmare or a dream come true? It is the largest structure ever assembled in Earth-orbit, and the station was to be a springboard to the Moon and Mars. Since construction began in 1998, progress has been slow.

The main problem has been ferrying crews and materials from Earth. America's Space Shuttle was to do most of the work. Students will see an animation of the shuttle returning to Earth. Slowing down from 27,000 kilometers/hour to a stop on a runway, the spacecraft becomes a glider, using the friction of the Earth's atmosphere to slow it down and bring it in for touch down.

This has been a hazardous operation. The shuttle Challenger was lost in 1986 due to an accident after lift off. In 2003, the shuttle Columbia was lost during reentry, causing work on the ISS to grind to a halt.

ISS was not the first space station. The United States launched Skylab in 1973. In 1986, the Russians launched the highly successful Mir space station. It was the first permanently manned space station and orbited Earth for 14 years.

Launched in 1998, the ISS is supposed to grow module by module, serviced by the space shuttle, but the Russians have been behind schedule on delivering their promised modules and the space shuttle fleet has had difficulty keeping up with its delivery schedule. To help, Russia dusted off its Soyuz rockets and kept the ISS manned and supplied. ISS should be complete by the end of the decade.

For an Astronaut, a mission to the ISS can be a dream come true. The reality of living on the station is quite different. The station is noisy and the crew has difficulty sleeping. Taking a shower without water can be a real chore and brushing your teeth usually means swallowing the paste.

In weightless conditions, humans rapidly suffer muscle and bone loss. The only way to reduce the effects is to exercise often.

Man has been trying to escape the pull of gravity for thousands of years. The Chinese invented fireworks and rockets. Robert Goddard launched the first liquid-fueled rocket in 1926, while the Germans developed the first rockets used as weapons during World War II.

At the end of the war, the man behind the German rocket program was captured by the United States and helped start the U.S. space program. However, it would be the Soviet Union's space program that would have the first real successes in space. Led by Sergei Korlev, the Soviet Union launched Sputnik 1 in 1957. This was followed in 1961 when they put the first man, Yuri Gagarin in space.

The United States suffered a series of early failures in their space program, but eventually, through Project Apollo, made it to the moon in 1969. By 1972, the last Apollo mission was completed, and no one has been back since.

America wanted to develop a reusable space vehicle and the space shuttle debuted in 1981. The goal of the program was to reduce the cost of getting satellites and other scientific equipment into low earth orbit. The Soviet Union stuck with rocketry. With this technology, they built the first permanently manned space station, the Mir. Later they worked with the international community to develop the ISS.

A space station is the key factor in the development of future space travel. Launching from the space station to the moon, Mars or deep space will take a fraction of the energy of lifting off from Earth. Delivering materials to the space station will probably be a lightweight space plane that can take off like a conventional plane and kick in conventional rockets once in deeper space.

Some scientists also think that a space elevator may be the most effective way to get man and materials into orbit. Arthur C. Clarke envisioned such a structure that would rise thousands of miles into space. Regardless of how they get there, once in space, man will colonize both the moon and Mars, and look to send the first astronauts out of the solar system.

ADVANCED ORGANIZERS

Prior to viewing this program, students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 4: The Physical Setting

Section G - Forces of Nature

Know by Grade 8

- Every object exerts gravitational force on every other object. The force depends on how much mass the objects have and on how far apart they are. The force is hard to detect unless at least one of the objects has a lot of mass.

Know by Grade 12

- Gravitational force is an attraction between masses. The strength of the force is proportional to the masses and weakens rapidly with increasing distance between them.

Benchmark 3: The Nature of Technology

Section A - Science and Technology

Know by Grade 8

- Technology is essential to science for such purposes as access to outer space and other remote locations, sample collection and treatment, measurement, data collection and storage, computation, and communication of information

Section B - Design and Systems

Know by Grade 8

- Design usually requires taking constraints into account. Some constraints, such as gravity or the properties of the materials to be used, are unavoidable. Other constraints, including economic, political, social, ethical, and aesthetic ones, limit choices.

**Benchmarks can be found at www.project2061.org/tools/benchol/bolintro.htm*

CRITICAL THINKING EXERCISES

- DESCRIBE how a rocket works.
- EXPLAIN why humans in space lose muscle and bone mass.
- EXPLAIN how it might be possible to build a space elevator that reaches thousands of miles into space.
- DESCRIBE what life would be like for a person who is colonizing the moon.
- DESIGN a spaceship capable of traveling to the nearest star and returning to Earth in less than 100 years.
- DISCUSS the risks and benefits of manned and unmanned space flight.

VOCABULARY

| | |
|-----------------|----------------|
| Biosphere | Microgravity |
| Colonize | Orbit |
| EVA | Rocket |
| Gravity | Space elevator |
| Low Earth Orbit | Spacewalk |

CAREER POSSIBILITIES

- ASTRONAUT
- ENGINEER
- ASTRONOMER
- EXOBIOLOGIST
- ASTROPHYSICIST
- PHYSICIST