Drexel-SDP GK-12 LESSON

Fabrication Lesson: Space Station Solar Panel Truss

Subject Area(s) **Astronomy, Mechanical Engineering**

Associated Unit **Astronomy, module 2**

Lesson Title **Fabrication Lesson: Space Station Solar Panel Truss**

Grade Level 6 (3-7)

Lesson # 2 of 4

Lesson Dependency None.

Time Required 15 minutes

Heading

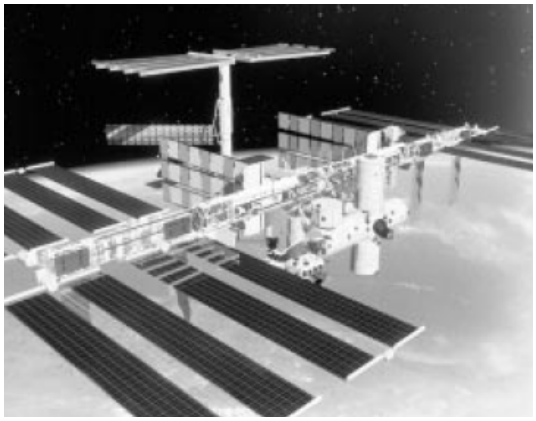

Image 1

ADA Description: Picture shows the International Space Station with solar panels on trusses

Caption: International Space Station with solar panels on trusses

Image file name: international-space-station.jpg

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Summary

In this lesson, students will briefly learn about the role of a solar panel truss in space research missions. The objective is to expose students to some of the mechanical devices designed by engineers to assist scientists and astronomers with space exploration and space research, plus

some discussion on issues of mass on forces of inertia in a weightless environment, and on the role of mechanical engineers and electrical engineers. Following this lesson, in the accompanying activity, students will follow a design plan to fabricate and test a solar panel truss.

Engineering Connection

In this lesson, we will learn about the role that engineers play in the design of trusses (external supports) on the International Space Station. These engineers play a vital role in ensuring that the ISS has a sturdy framework to support all the solar panels that capture the sunlight that is converted to electrical power on the ISS. Following this lesson, we will engage in an activity where it is your job to act as an engineer, designing and testing your own weight-bearing trusses.

Keywords

Astronomy, electrical engineer, international space station, mechanical engineer

Educational Standards (PA)

- Science: Technological Devices – Instruments 3.7.B, Physical Science, Chemistry and Physics – Astronomy 3.4.D
- Math: Measurement and Estimation 2.3, Geometry 2.9

Pre-Requisite Knowledge

Familiarity with the concepts of mass, motion and inertia

Learning Objectives

After this lesson, students should be able to:

- **Explain what an electrical engineer does**
- **Explain what a mechanical engineer does**
- **Describe what the ISS is and that it is used for space research**
- **Describe how mechanical engineers are involved in the design of structural supports on the International Space Station (ISS)**

Introduction / Motivation

The role of support structures (trusses) for solar panels on the ISS: The ISS must support solar panels of considerable mass. Although the environment is virtually free from the effects of gravity, the structures having mass still resist the forces of motion. Therefore, trusses must be strong enough support solar panels during the forces of motion, but light enough so as not to contribute too much to the mass. The trusses on the ISS have open space to reduce the mass, and hexagonal prisms formed by the support bars to add strength.

This activity will be conducted after some discussion about the role of structural supports on the International Space Station (ISS), plus some discussion on mechanical engineers and electrical engineers.

Lesson Background & Concepts for Teachers

International Space Station (ISS): The ISS is a multi-national effort to construct a working research laboratory that orbits the earth. On it, astronauts will perform research (following the experimental process - just like students have learned) in a variety of areas. These areas include: human biology: the effects of the space environment on space travelers (e.g., muscle atrophy, bone loss, fluid shifts); biotechnology: a microgravity environment has enabled researchers to grow three-dimensional tissues that have characteristics similar to body tissues; materials science: in low gravity, differences in weight of liquids used to form materials do not interfere with the ability to mix these materials opening the door to a whole new world of composite materials; combustion science: the reduction of gravity allows scientists to simplify the study of complex combustion (burning) processes. Since combustion is used to produce 85 percent of Earth's energy, even small improvements in efficiency and reduction of soot production (a major source of pollution on earth) will have large economic and environmental benefits; earth science: Space scientists will use the location above the atmosphere to collect and search for cosmic rays, cosmic dust, anti-matter and "dark" matter. Earth scientists can obtain global profiles of aerosols, ozone, water vapor, and oxides in order to determine their role in climatological processes.

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Mechanical Engineering: Mechanical engineering involves the application of principles of physics for analysis, design, manufacturing, and maintenance of mechanical systems. It requires a solid understanding of key concepts including mechanics (action of forces), kinematics (motion without consideration of mass and force), thermodynamics (relations between heat and mechanical energy or work) and energy. Mechanical engineers use these principles and others in the design and analysis of automobiles, aircraft, heating & cooling systems, buildings and bridges, industrial equipment and machinery, and more.

Electrical Engineering: Electrical engineering involves the study and application of electricity, electronics and electromagnetism. There is some distinction between electrical engineers and electronics engineers: electrical engineers are usually concerned with using electricity to transmit energy, while electronics engineers are concerned with using electricity to transmit information. The entire field covers a range of sub-disciplines including those that deal with power, optoelectronics, digital electronics, analog electronics, computer science, artificial intelligence, control systems, electronics, signal processing and telecommunications.

Vocabulary / Definitions

Word	Definition

Solar panel truss	A structure designed to support the mass of the ISS solar panels that capture energy to be converted to electricity
Mass	The property of a body that causes it to have weight in a gravitational field
Motion	A change in the position or location of a body
Inertia	Resistance to a change in motion
International Space Station (ISS)	An in-space research laboratory that orbits the Earth
Mechanical engineering	The study and design of systems having moving parts or involving motion
Electrical engineering	The study and design of systems and components that utilize or generate electrical power

Associated Activities
Fabrication Activity: Space Station Solar Panel Truss

Lesson Closure
Follow with the Fabrication Activity: **Space Station Solar Panel Truss**

Assessment
Lesson Summary Assessment
Ask to see the students' notebooks to ensure they have recorded the lesson notes.

Lesson Extension Activities
More activities for children from the Kennedy Space Center:

http://www.kennedyspacecenter.com/PDF/KSCEdGuide6-8.pdf

References
http://www.kennedyspacecenter.com/PDF/KSCEdGuide6-8.pdf

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