



Drexel-SDP GK-12 ACTIVITY

Activity: Space Station Solar Panel Truss

Subject Area(s) Earth and Space

Associated Unit Astronomy, module 2

Associated Lesson Fabrication Lesson: Space Station Solar Panel Truss

Activity Title Activity: Space Station Remote Manipulator Arm

Header

Grade Level 6 (3-7)

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Activity Dependency None

Time Required 30 minutes

Group Size 3

Expendable Cost per Group \$0

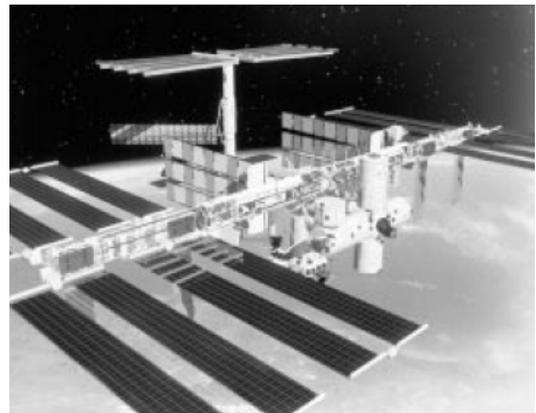


Image 1

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 the preceding lesson, students briefly learned 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.

Engineering Connection

Engineers who work in the mechanical and electrical fields have a big role to play in the design of structural supports on the International Space Station (ISS). The ISS gets its energy from solar panels on the vessel's outer surfaces. These solar panels have 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. These supports are designed, and more importantly, tested by teams of engineers.

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.

Pre-Requisite Knowledge

Familiarity with the concepts of mass, motion and inertia

Learning Objectives

After this activity, students should be able to:

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

Materials List

Each individual needs:

- Gram weights on a hook to test the strength of the truss
- Three sheets of newspaper
- Tape

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.)

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

Procedure

Before the Activity

- Present the Fabrication Lesson: Space Station Solar Panel Truss
- Gather the materials in the materials list

With the Students

Step 1: Each team gets three sheets of newspaper and some tape.

Step 2: Each team gets 20 minutes to construct a lightweight but strong truss of **at least 1 meter in length**.

Step 3: The teams' trusses will be tested in competition to determine how many pennies can be suspended from the mid-point of the truss as depicted in the figure below.

Step 4: Discuss with the students what aspects of their design were successful and which could be improved. Ask them, if they were engineers, how they would modify their testing procedures in the future. Do the students think it matters if all the weight is suspended at one point in the design, or distributed across the entire truss. How?

Image

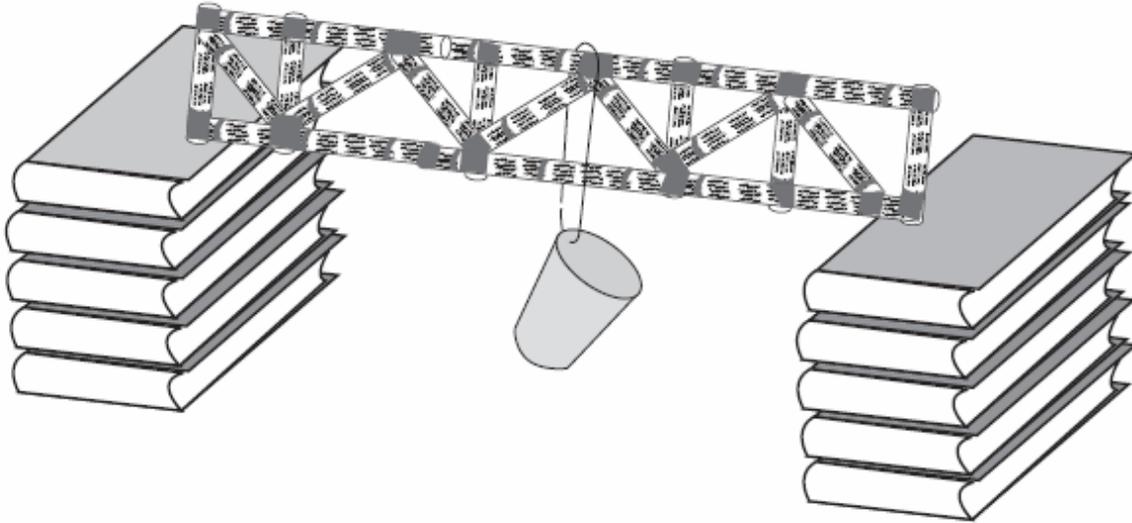


Image 2

ADA Description: Picture shows student-made truss supporting a weight

Caption: Student-made truss supporting a weight

Image file name: img2.pdf

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Attachments

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

Safety Issues

- Supervise students for proper use of materials

Troubleshooting Tips

Try packing tape instead of Scotch tape for better adhesion to the newspapers. Advise the students to handle their newspapers as little as possible to avoid frustration with limp newspapers.

Investigating Questions

Question 1: How many grams will your truss support? What is the mass of one gram weight? Calculate the mass of the number of gram weights your truss supports.

Question 2: How can we improve the design? What materials could we use? Where are the weak points in your structure? What are the strong points?

Question 3: What would you do differently next time?

Assessment

Observe the students during the activity and evaluate them on the criteria within the rubric below.

Students will be evaluated on a scale from 0 to 4 on:

Task Completion

Design meets specifications

Participation in discussion

Activity Extensions

More activities for children from the Kennedy Space Center:

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

Additional Multimedia Support

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

References

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Version: Mar 2007