Building Trusses

Teacher Overview:
Students will learn about the truss beam of the International Space Station and how to design a lightweight but strong and rigid structure that employs geometric forms.

Next Generation Sunshine State Standards:

SC.6.N.1.1: Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.6.N.1.4: Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

SC.6.N.1.5: Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.

SC.6.N.2.3: Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.

SC.6.N.3.4: Identify the roles of models in the context of the sixth grade science benchmarks.

SC.6.P.13.1: Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.

SC.6.P.13.3: Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both.

Space Knowledge:
The International Space Station consists of approximately 100 major components. They are joined together to produce a habitat for teams of up to seven astronauts to live and work in space for months at a time. The largest components of the ISS are the truss beam and solar panels. The truss beam extends to the right and left of the station as it orbits around Earth. It is joined to the U.S. Destiny Module, a cylindrical laboratory in which astronauts do their work. Attached to the ends of the beam are large solar panels for making electricity from sunlight. Also attached are thermal radiators for exhausting waste heat from the modules into space. The truss beam also holds the robotic system that can travel its length.

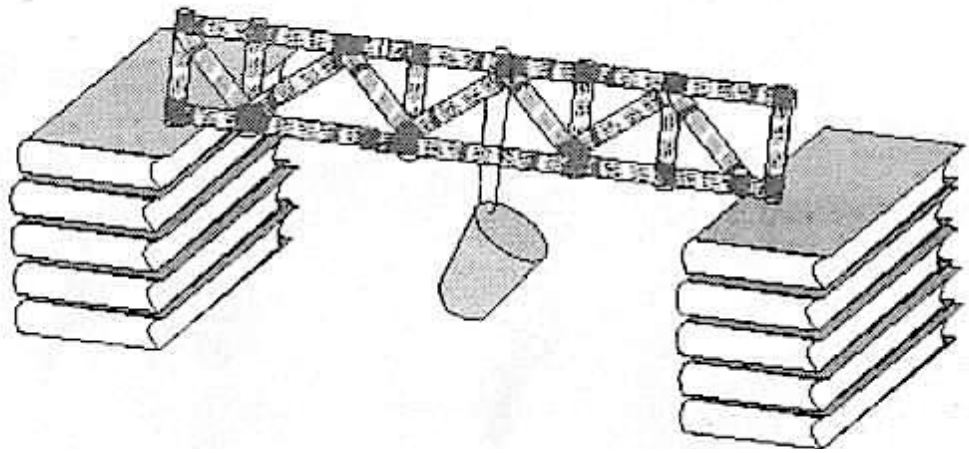
The truss beam consists of an open structure of girders that are arranged in the shape of a hexagonal prism. Diagonal girders crisscross the structure to form many rigid triangles. It is 100 meters long. The open structure reduces the weight of the truss beam and the triangles give it strength to maintain its shape. Strength is important for the beam but not because of the weight of the structures it has to support. In space, these structures are virtually weightless. However, the structures still have mass and mass resists changes in motion. The beams have to be able to maintain the position of the solar panels and other structures during thruster firings when the ISS orbit or attitude is changed.

Materials:

- old newspaper
- paper cup
- weights such as coins or washers
- masking tape
- string

Procedure:

1. Roll and tape newspaper girders for truss beams.
2. Tape girders together to be 1 meter (39 inches long).
3. Place ends of truss beams on equal stacks of books.
4. Punch hole in paper cup. With string, hang from center of truss beam.
5. Add weights until truss beam falls. Record weight in journal.
6. Rebuild and try again.



Journal: _____

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Get Connected!

Details, diagrams, and photography of the ISS truss beam are available at this web site:

www.nasa.gov/mission_pages/station/main/index.html

Teacher Suggestions:

1. This is a Science Technology Engineering and Math (STEM) activity and can be used as a center.
2. Students can experiment with different length trusses and compare the maximum amount of weight that can be supported.
3. Challenge pairs of students by allowing them only 5 large sheets of paper and 2 meters of masking tape for each of their constructions. (They will probably ask for more paper and tape for "do-overs" as they get ideas from others or see their design doesn't work.)
4. Have the students design a sign showing the name and logo for their engineering company. Have them present their truss in front of the class, placing their truss on the stand and decide where the cup will hang; before adding the weights to the cup. Award the NASA contract to the strongest truss design.