1-13-2015

Theme B: Day 7 Plan

Purdue University College of Education

THEME B

Becoming a Spacewalker: My Journey to the Stars by Astronaut Jerry L. Ross

DAY SEVEN STEM EXTENSION TO ACCOMPANY DAY SEVEN SHARED READING OF *TRY, TRY AGAIN*

To Ponder: After Jerry Ross was selected as an astronaut, he and other engineers helped design and build the International Space Station. Part of the design process was thinking like an engineer and discovering which bridge design would be the strongest in space. I wonder what part of the structure of a bridge on earth, where there is gravity, was critical to the construction of the International Space Station, where there is no gravity? Let's investigate.

To Set the Stage: For what we are going to do today, check out the 45 ft truss from Space Shuttle *Atlantis*: View Space Shuttle Flight 23, STS 61B in November 1985 at: https://www.youtube.com/watch?v=8JwvIpvzy8Y (Total Time 19:48; Truss Viewing Time begins at 8:46)

SCIENCE/TECHNOLOGY/ENGINEERING/MATHEMATICS (STEM) ACTIVITIES:

Science Investigation: To investigate the structural design of a beam bridge, arch bridge, and truss bridge, and compare live load weight and structure strength

Vocabulary: spacewalk, astronaut, engineer, space station, habitable, structure, force, resistance, colossal, extreme, Shuttle

Goal: To compare bridge design strength of a beam, arch, and truss bridge and to explore live load on a beam bridge, arch bridge, and truss bridge.

Purpose of Science Activity: To develop an understanding of why bridge strength is so important on earth and in space

Materials: 8 ½" × 11" cardstock or construction paper (7–10 pieces), 5-ounce transparent plastic cups, pile of pennies, 2 same-size empty cereal boxes, (If you have 4 or 6 same-size boxes, you can test all 3 bridge designs at once), scissors, tape or glue, tabletop or flat surface, computer/Internet capabilities, predictions/results lab

Before Activity:

- *Activate prior knowledge:* Have you ever traveled across a bridge? What do we know about bridges? What purposes do they serve?
- *Prompts to encourage prediction:* Knowing what we do about bridges, what can you tell me about a beam, arch, or truss bridge? What about the (payload/live load) weight being carried from one point to another?
- *Draw on personal experience:* Have you ever walked across a balance beam in gymnastics? How did it feel? What did you notice about your body weight? Have you ever seen arches? What do they look like? What purpose do you think the design serves? Are you familiar with a truss bridge?

- *Set a purpose for experiment:* Let's explore what the three bridge designs have in common and what is different. Which design will support the heaviest live load the best?
- *Draw or write predictions for each bridge in predictions/results lab*

During Activity:

Divide students into three groups. With cereal boxes/paper/cup/pennies, the educator briefly models all three bridges. Educator explains that each student will predict how many pennies in the cup they think it will take before the bridge collapses—alone prediction/partner share/group prediction in science notebook. Each group will be building and investigating one of the bridges. Educator guides each group to build a beam bridge. Explain predictions alone, in partner share, or in a group (Group 1 will build and test beam bridge; Group 2 will build and test arch bridge; Group 3 will build and test truss bridge). As students work, educator can record group observations in "T" chart. (column 1: Beam Bridge, column 2: Arch Bridge, column 3: Truss Bridge)

1. *Build bridges*—For all bridge models, stand 2 boxes up vertically so that inside edges are 6 inches (approximately 15 cm) apart. Each group will need one transparent 5 oz cup and several pennies.
   a. Group 1 Beam Bridge: Place 8 ½" × 11" cardstock piece horizontally, across the tops of the two cereal boxes, making a bridge between them. Place cup on top in center of roadway.
   b. Group 2 Arch Bridge: Place 8 ½" × 11" cardstock piece horizontally across the tops of the two cereal boxes, making a bridge between them. Tape or glue 3 pieces of paper together to make a long piece. Curve the long piece like an upside down U to make an arch. Place the arch between the two boxes. The top of the arch curve should be as high as the top of the boxes. The arch will be added to support the roadway above. Place cup on top in center of roadway.
   c. Group 3 Truss Bridge: Fold one piece of paper lengthwise in an accordion fold. Glue flat piece both on the top and the bottom of the fold sheet. Place cup on top in center of roadway.
2. Prediction Time: Each student thinks alone to predict how many pennies it will take before his or her bridge collapses. Record prediction on predictions/results lab.
3. Partner Share—Share predictions with partner. Record partner's prediction in predictions lab.
4. Group Share—Share predictions in group. Record group's prediction in predictions lab.
5. Add a penny, one at a time, to transparent cup until the roadway collapses under the live load.
6. Count pennies and record group's data on results lab.
7. Write down how many pennies each bridge could hold.
   1) How many pennies did the beam bridge hold **before** it collapsed? _____pennies
   2) How many pennies did the arch bridge hold **before** it collapsed? _____pennies
   3) How many pennies did the truss bridge hold **before** it collapsed? _____pennies
8. Discuss in large group. Summarize student observations and class results.
9. Go to the following website and add your class's data to see how your data compares: http://static.lawrencehallofscience.org/kidsite/activities/bridges/
10. Press "Submit."
11. Using a large computer screen or SmartBoard, analyze and interpret data. Print out page (one page for each group). Allow students time to analyze and compare each group's data. Compare

"Your Result" with "Average of All Kids' Results." Interpret results and record/attach to predictions/results lab.

After Activity: What does your evidence show? Take some alone time to think about what happened in the experiment today.

- *The bridge builders experiment shows that* _____.
- *My conclusions about my predictions, the experiment, and the final results are* _____.
- *Reflections: As an engineer and an astronaut in space, Jerry Ross was living his dream in helping to build a habitable structure known as the International Space Station. Now when he looks up in the sky, he can view his handiwork and its impact on the world. When you look up, what do you see?* _____.

Extensions: The World of Exploration and Discovery

Resources:
On Earth and In Space: A Beautiful Sight
Bridge Builders
http://www.lawrencehallofscience.org/kidsite/activities/bridges

Space Shuttle Flight 23 (STS-61B) Post Flight Presentation
https://www.youtube.com/watch?v=8JwvIpvzy8Y