Science Unit: ***Structures***

Lesson 9: ***Bridge Across Two Chairs Building Challenge***

Summary:	In this lesson, students work in groups to construct the longest possible "bridge" structure spanning a space between two chairs. Students use exploration skills, teamwork and creativity to build a unique structure using any combination of the materials provided (e.g., chopsticks, paperclips, straws, tape, pipe cleaners, etc.).
Science skills:	Technical manipulation, exploring materials, curiosity, inferring, concluding
School Year:	2013/2014
Developed for:	Champlain Heights Annex Elementary School, Vancouver School District
Developed by:	Ingrid Sulston (scientist); Mona Francis and Ramona Smith (teachers)
Grade level:	Presented to grades 2/3; appropriate for grades K – 7 with age appropriate modifications
Duration of lesson:	1 hour and 20 minutes
Notes:	This is a good activity to follow the "Testing bridges" activity in Lesson 7 (Structures and Loads) of the Structures unit, Scientist in Residence Program: www.scientistinresidence.ca/pdf/physical-science/Structures/SRP_Structures_Lesson_7.pdf

Objectives

Students will be able to:

- Explore the differing strengths and flexibilities of various common materials.
- Creatively join materials to make one strong structure.
- Work as a team, listening to and incorporating everyone's ideas.

Background Information

Structures such as buildings and bridges are built using a wide range of materials, depending on the purpose of the structure and the local availability and cost of materials.

Appreciating the versatility and strength of materials used in building structures is best learned by hands-on exploration. Through this kind of activity students frequently find their own creative uses for materials.

Vocabulary

Architect:	A person who plans, designs and oversees the construction of buildings.
Engineer:	A person who understands materials well and can advise on and how they can be best used in a building design.

Materials

For each group of three or four students (equivalent materials can be substituted):

- two chairs across from each other with their backs facing inwards
- two clothes pegs
- one chopstick
- three pipe cleaners
- two labels/pieces of tape
- two index cards
- one cork
- six toothpicks
- two sheets of letter sized paper
- three straws
- two paper clips
- a ziplock bag to contain all the materials

In the Classroom

Introductory Discussion

1. Ask students what they think the roles of the architect and engineer might be in making a new structure, such as a bridge. Starting with students' ideas, discuss the process of designing a structure (the architect's specialty) with knowledge of the properties of the materials to be used (the engineer's specialty).
2. Tell students that they will be both architects and engineers in this lesson. They will be working in teams, using a collection of materials given to them to build the longest bridge they can between two chairs.
3. Processes of science that the students will focus on: technical manipulation, exploration, curiosity, inferring, concluding, prediction and hypothesis testing.

Science Activity

Building Challenge

Purpose of Activity: Manipulate and combine materials in creative ways to solve a building challenge.

Set-up prior to experiment:
Prepare a set of materials in their own bag for each group of students. (Alternatively, ask the students to gather their own materials from a common bin by referring to a list.)

Methods and Instructions:
This activity was modified from ref. 2.
Students will work in groups of three or four.

1. Arrange pairs of chairs for each student group, spaced about a meter apart with their backs facing each other, with enough space around them for students to work.

2. Once student groups are at their chairs with their materials, instruct students on their building challenge:

   Use the materials given to build the longest bridge you can between the two chairs. Investigate and manipulate the materials to see the different ways they can be used. Think about how the properties of each material might be useful in helping make the longest bridge. Materials can be opened up, torn or broken if needed. Work in teams, listen to each other's ideas, and try them out - sometimes materials can be used in new and surprising ways.

3. Allow students at least half an hour to work on their bridges. Longer is better, to allow group dynamics to settle, and for the teacher to wander by and help the students coordinate (though not to give them ideas on how to build their bridge).
4. After a period of working on their bridges, ask each group in turn to present to the class how they used their materials, and what challenges and successes they have come across so far. The teacher can also highlight creative ways that materials have been used to make the bridge longer or fasten materials together etc.
5. Tell students that they will return to their own bridges, and that they are encouraged to use other groups' ideas on their own bridges. Engineers and architects use each other's ideas all the time.
6. Once students are done with their bridges, measure them to find out which one is the longest. Also give credit for: creative ways that materials have been used; efficient use of materials or use of only a few materials; a particularly appealing design etc.
7. Ask students to dismantle their bridges, returning any intact materials to the bag and recycling the rest. They may also be asked to refill the bag to make a complete kit for future use.
8. Optional: read the book "Iggy Peck Architect" (ref. 1).

References

1. Beaty, Andrea. 2007. Iggy Peck, Architect. Harry N. Abrams Publisher.
2. Destination Imagination Instant Challenges written by volunteers. 2006. All Cooked up Smorgasbord. BC Original Minds Association.
3. Caney, Steven. 2006. Steven Caney's Ultimate Building Book. Running Press Kids. Wonderful inspiration for other classroom projects on building structures, using a wide variety of materials.

Extension of Lesson Plan

Many other building challenges can be done in the same lesson, or run as separate lessons. Ref. 2 and other *Destination Imagination* "*Instant Challenges"* found in books or online are a good source of ideas that can be modified, although they are as easy to create yourself once you have done them once or twice with students.

For example:

1. Build a structure as high as you can. Materials for each group: 15 sheet of paper.
2. Build a freestanding tower that is as tall as possible. Materials for each group (adapt if necessary): 10 toothpicks, 4 plastic spoons, 4 pieces of tape, 60cm string, 2 elastic bands, 6 paper clips, 2 paper cups, 2 pieces of paper, 4 chopsticks/pencils, 1 piece of foil, 4 straws.
3. Build a structure with a solid roof and at least one solid side, that one team member can get inside. Materials: 20 sheets of newspaper, 5 pieces of tape, 5 paperclips.