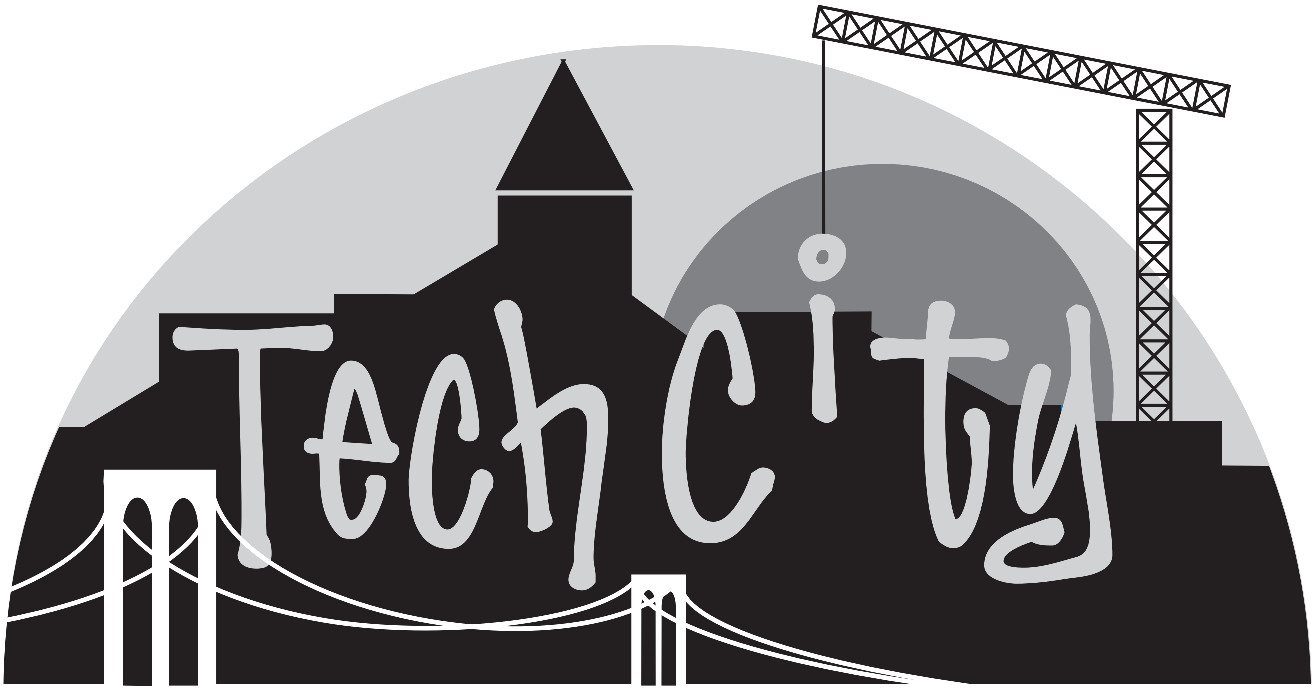


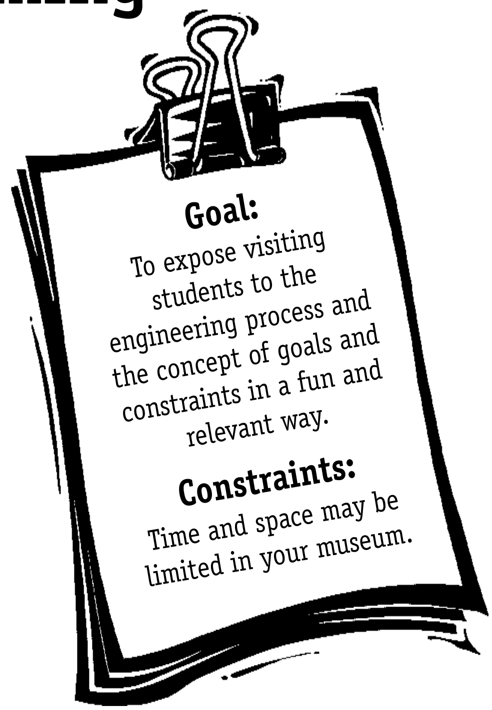
Museum
Hands-on Programming

Sciencenter

This project was supported, in part,
by the
National Science Foundation

Museum Hands-on Programming

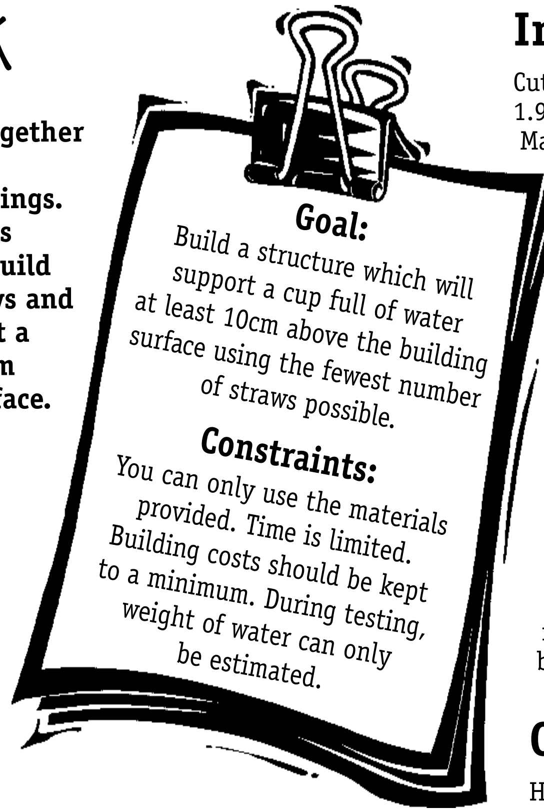
The following activities were developed as a 45-minute program for museum educators to present to groups of students visiting the museum. This program will allow students to experiment and design like an engineer. They will work to achieve a goal and they will have certain constraints under which to work. So let's begin!



Almost everything you see and everything you use has been influenced by engineers. They are involved in every job you can imagine — from agriculture to aerospace and beyond. But what does an engineer do? They imagine new things and design them. They build things. They test them. They figure out how to make things better. They solve problems. An engineer sets a goal and works to achieve that goal. Often there are constraints (limits) on budget, space, materials, or the engineer's time.

Frame Work

Civil engineers work together to build structures like bridges, roads, or buildings. In this activity students will work in teams to build a structure out of straws and tape which will support a small cup of water 10cm above the building surface.



Materials

Straws
(about 10 – 15 per team)

Scotch tape
(1 – 2 rolls per team)

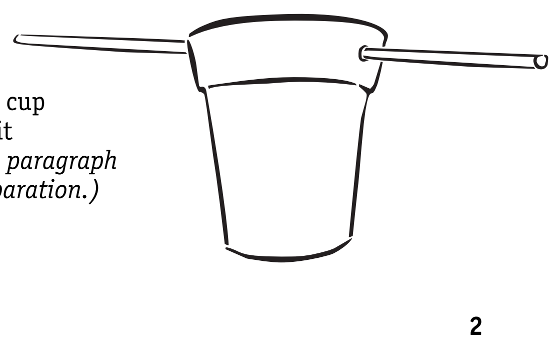
Metric ruler
(1 per team)

Scissors
(1 pair per team)

Water
(1 cup per team)

Small pitcher

Pre-prepared plastic or Styrofoam drinking cup with a straw through it
(1 per team) *(See first paragraph of instructions for preparation.)*



Instructions

Cut a small hole on either side of a drinking cup about 1.9cm below the rim. Put a straw through the hole. Make one cup for every team.

Each team receives **a cup with a straw through the top, a handful of straws, a pair of scissors, a ruler, and tape**. They will have **20 minutes** to design, build, and test their structure before the final challenge. Each **straw** they use **costs** them and the contractor **$1,000**. To keep costs at a minimum, the designs should use as few straws as possible. While building their structures, only *half* a cup of water can be used to test the designs. This will allow students practice at estimation, a skill which engineers must develop as they work with somewhat unknown variables.

After time is called, test each structure with a full cup of water to determine if the goals were achieved. The structure holding the water using the fewest number of straws would be the least expensive to build. Real-world builders would prefer that one!

Questions for discussion

How could you improve your design?

Which designs work best? Are there any similarities?

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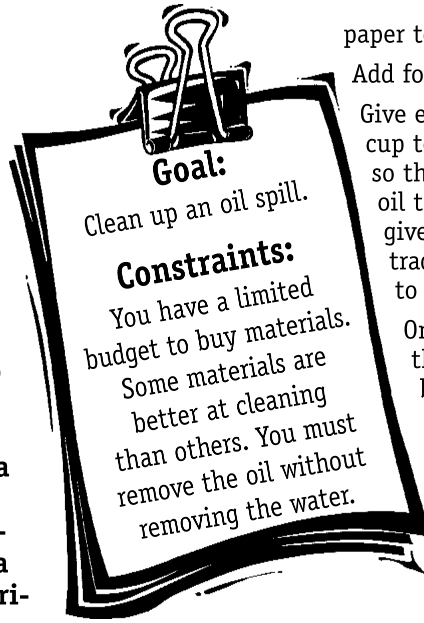
Once students have experienced the engineering process of designing, building, testing, and re-building, they have experienced some of what it's like to be an engineer. The next activity will demonstrate how to improve on a process rather than a structure, but it also uses the basic engineering concepts of goals and constraints.

Icky Slick!

Oil spills and their impacts on nature are (unfortunately) very common problems that environmental engineers must try to solve. They must determine how best to clean up the oil (and the animals!) while disturbing the natural environment as little as possible. Vacuuming up the ocean is not an option!

Students will attempt to clean up a simulated oil spill using their choice(s) from a variety of materials. Materials will be available on a point system so students can experience how cost affects decision-making. They will also measure the volume of water before and after the clean-up attempt to get a sense of the efficiency of their clean-up method. They can work alone or with a partner or group.



Materials

Clear plastic lids (at least 12 – 14" long and 2 – 4" deep) (such as lids from deli/vegetable platters or large Rubbermaid containers) (1 per team)

Small plastic cups

Jugs or pitchers for water (1 – 2 per class)

Blue food coloring (1 or 2 small bottles per class)

Bottles of cooking oil (1 per class)

Poker or bingo chips (10 per team)

Cotton balls (1 bag)

Paper towels (1 roll)

Strips of newspaper (50 strips per team)

Straws (about 5 per team)

Measuring cups (4 cup size at least) (1 set per team)

Measuring spoons (1 set per team)

Containers for holding straws, paper towels, cotton balls and newspaper

Signs indicating point values for above (based on availability and how well they work — see suggested values in *"Instructions"* section)

Large plastic tub (to hold discarded water/oil mixtures)

Large trash can

Paper towels for cleaning splashes

Vinyl or plastic coverings to protect floor or tables

Instructions

Place the cotton balls, straws, paper towels and newspaper strips in individual containers. Place a sign in front of each container indicating the point value for each item. (Suggested values: cotton balls — 7 points each; newspaper — 1 point for 10 strips; straws — 2 points each; paper towels — 5 points per sheet)

Add food coloring to the jugs or pitchers of water.

Give each team a plastic lid. Have them use a measuring cup to measure the amount of water they add to the lid so that it is 1/3 full. Add 1 – 2 tablespoons of cooking oil to the water in the lid. For each simulated oil spill, give each team **10 poker or bingo chips**. They may trade the chips in for materials to use in attempting to remove the oil from the surface of the water.

Once they have either used all their chips or feel their oil spill is clean, have them pour the water back into the measuring cup to measure **how much water (water/oil combination) is left in the lid**.

When finished, have students pour liquid from the lid into the bucket and throw clean up materials into the trash. (Lids can be reused if not too oily.)

Questions for discussion

How did you use the materials?

If you were not able to clean up the spill entirely, how successful were you?

If you feel you needed more material, how much and which type was needed?

Which was the most effective oil remover?

Which material removed the most water along with the oil?

Which material was the cheapest to use?

Was it still cheaper when you consider how much of it was needed to be effective?

Would you change your strategy for clean up if you were to try it again?

Would your clean up strategy work on a large scale oil spill in the open ocean?

Note: *The oil spilled from tankers is a thicker oil than cooking oil. There are obviously other considerations during the physical clean up including weather, water movement, risk to humans, etc. There are also issues of the impact to organisms in the area who may be coated with the oil and/or ingest it. An environmental engineer working on a problem like this in real life would have to consider all of these factors too!*

Conclusion

Now that the students have had the opportunity to experiment with the engineering process, they can learn even more about how these processes apply to and within the many fields which engineering encompasses. They can do this by visiting the Tech City exhibition, by experimenting further with these concepts using the school visit guide, and by checking out engineering books and websites on their own.

Suggested Resources

Earth Book For Kids: Activities to Help Heal the Environment, 1990; Linda Schwartz; Learning Works; 184pp.

I Want to Be… An Engineer, 1997; Catherine O'Neill Grace; Harcourt Brace & Company, San Diego, CA; 48pp.

Science Is…, 1991; Susan V. Bosak; Scholastic Canada Ltd., Ontario; 515 pp.