Interactive Projects - JETS, NTN, OM

Part of your Discover"E" objective is to make learning, and engineering, fun. Challenge kids to "Topple-A-Tug." Dare them to drop a light bulb and keep it from breaking. Dig into the following creative problem-solving activities provided by the Junior Engineering Technical Society PETS), National Talent Network (NTNI and Odyssey of the Mind (OM).

The problems are divergent and suited for teamwork. Divergent means there is more than one answer. Some solutions though may be more "elegant" than others. Divergent problems require students to use their creativity and apply what they know to open-ended situations. In other words, these problems show exactly what engineering teams face on a daily basis. They also demonstrate the broad range of skills needed by engineers ... academic knowledge, creative thinking, ability to communicate clearly and work in groups and a sure knowledge of "how things work."

The Problems

1. "Leaves of Gold" (Brainstorming) "Do we have to rake the leaves again?" A familiar cry in most parts of the country each year. What kind of product can the students conceive, design and build that will convert deciduous leaves into a useful product and make this chore more enjoyable or easier, and make effective use of the resultant collection? This is the practice problem for the National Engineering Design Challenge (NEDC) for 1989. The NEDC is a joint project of the National Society of Professional Engineers. JETS and NTN and is funded by the National Science Foundation. "Leaves of Gold" is very open-ended but the brainstorming portion of the problem solving process can be completed in one period. You may wish to work with the students on such a project over a longer period of time. (NEDC Activity)

2. "Topple-A-Tug" (Hands-On) Why do boats made from steel, aluminum or concrete float? Why can some boats carry more weight than others? "Topple-A-Tug"

teams design, build and test a boat made from a single sheet of aluminum foil to learn about the concepts of buoyancy and the effects that changes in design parameters can have on the final product. (JETS Activity)

3. "Decision Package" (Hands-On) Why do some things break when they are dropped and others don't? Sometimes it may be luck but it is more likely to be the way in which the item or its packaging is designed. "Decision Package" encourages students to use provided materials creatively to determine how to package a light bulb so that it doesn't break when dropped. (OM Activity)

4. "A Base for a Statue" (Computation) Why don't the holding chambers on top of a large water tower break the narrow base on which it stands? How can buildings stand up when the first two floors are open and without outside walls? When building a base for a large statue what factors will the students have to consider?

Finding the Solutions

1: "LEAVES OF GOLD"

The Problem: Each fall millions of homeowners and municipalities spend time, energy and money disposing of leaves. Yet these leaves represent raw natural materials that should have a useful purpose. Design a product that will convert deciduous leaves into a useful product. You may not compost or burn them and the resultant product must be practical, cost-effective, safe and user-friendly.

To The Engineer: Obviously there is not enough time during a single class period to actually complete this activity. However, a brainstorming session during which students are encouraged to list as many solutions to the problem as they can think of, is very possible and can be done in as little as 15 minutes. It is important that all answers are accepted and listed... no comments or criticisms of each idea yet

If time permits you may have the students pick their personal best five ideas and put them in rank order, take a quick poll to see if there is agreement and then discuss with the students what about one or two of the ideas made them stand out as "good ideas."

The problem can also be expanded by providing each team with the following items and allow them to build a mock up of their own idea. Provide each team with a cardboard box (all the same size but the size doesn't matter, a newspaper (to cut into strips representing leaves, tape, scissors. string, wire, glue. stapler and other construction fastening materials. The quantities or types of the items are unimportant as long as each team has the same items.

The problem can be expanded further by encouraging the students to pursue a real solution and test it under actual conditions.

2:'T0PPLE-A-TUG"

The Problem: Design and build a boat, using only the provided materials, which will hold the greatest number of pennies without sinking.

To The Engineer: Provide each team with: I sheet of aluminum foil 12 “square, $3 in pennies (or washers. etc.), a dishpan with about 4" of water in it and an 18" string or strip of paper for measuring purposes.

The students may use only the materials provided and may not add anything such as glue, tape or paperclips to their design. Students may elect not to use the full amount of aluminum foil allocated or they may wish to cut up the foil and fold it together in ways that would not be possible if they just floated a single sheet. Teams may sketch out their design on paper first or create a boat from paper as a design study prior to building their working model from the aluminum foil.

The pennies must be dropped from a height of 18" or more above the water line into the boat. A boat is considered sunk when any water enters the boat the boat sinks or the boat bottom expands and touches the bottom of the bucket. A team may stop dropping pennies at any point they wish and the team with the largest number of pennies in their boat prior to sinking wins.

Many modifications of this problem can be done. For example, some of the parameters of the design change if three pennies are dropped together or 9 pennies are dropped in the water at the same time to create waves, etc. Further, if a large enough pan is available you can pull the boat through the water. You might allow two sheets of aluminum, glue or other items to be used. A small change in conducting the problem can have a large change in the results.

3: "DECISION PACKAGE"

The Problem: Create a package that will prevent a light bulb from breaking when it is tossed into a target box and then the box is dropped on the floor.

To The Engineer: Each team should be provided with a light bulb. In addition, in an envelope there should be one mailing label or computer label, one piece of 8 1/2" x 11” paper, one rubber band, one 12" piece of string, one paper dip and one 1" piece of tape that keeps the envelope closed. One box approximately 15" square is needed. One light socket into which the "thrown bulb" can be inserted for testing is also needed. This problem works best if the test site floor is uncarpeted.

Students can complete their packaging design in about 10 minutes. Testing and discussion will fill the rest of the period.

After the students complete their packaging, have each team toss their bulb into the box. The box should be on the floor 8' from the tossing line. If the bulb misses the box it must be tossed again. Once the bulb is in the box, and if it is not visually broken, test it. If it lights put it back into the box and have the students drop the box with the bulb in it onto the floor from a height of 5 feet.

Many adaptations of this problem can be used and scoring systems can be devised for each. For example the students may wish to use some of the "packaging materials" on the bulb and some on the box. The "dropping height" can be changed; different types of bulbs can be used, including delicate decorative bulbs, regular bulbs and outdoor bulbs, etc. Each change allows for new discussion of why the bulbs did or didn't break.

4: "A BASE FOR A STATUE"

The Problem: Build a concrete base for a town square statue that will weigh 50 tons have a square base, be in soil that has a bearing capacity of 1,500 pounds per square foot and a frost line at 3 feet, and requires a safety factor of 1.5.

To The Engineer: Begin this activity by presenting the students with a sketch or picture of the statue. This will provide them with some idea of the size and shape of the object and will therefore provide a starting point. Part of the-activity, depending on time, might include having the students design the type of base they would like to use and discuss why that particular design might enhance the appeal of the statue.

Once the students have selected their base they can compute the amount of concrete that will be required, the weight of the concrete (150 pounds per cubic yard) and how many yards of concrete would be needed and related information.

Discussion may focus on the need for internal structural members and the types that are available. Including some information related to structural integrity under different conditions, e.g.: earthquake vs. non-earthquake or tornado vs. non-tornado regions, would add relevance to the discussion. Whatever combination is selected, be sure to have verified computations ready to use to check the students' work.

If you would like more Information about the organizations providing these activities write:

JETS,
1420 King Street.
Alexandria, Virginia 22314

NTN,
700 Hollydell Court,
Sewell, New
Jersey 08080

OM,
P.O. Box 27,
Glassboro, New Jersey
08028