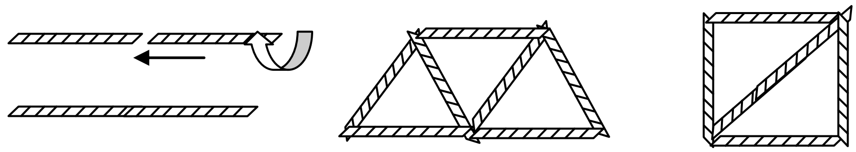
Designing Design Challenges

Building the skills needed to succeed at tasks in the 21st century



Examples of a physical design challenge using tubes from the ***Wrap It Up*** idea sheet

A design challenge involves teams of students working on a task with limited time and materials. In the process, students learn to brainstorm, to work toward a shared goal, to persist by learning and redesigning based on earlier attempts, and to take on the various team roles involved in accomplishing a task as a group.

Design Challenge Considerations

1. Decide if the challenge will be a **conceptual** or a **physical** challenge.
   a. A **conceptual challenge** involves designing a theoretical solution to a school, local, or world problem. The issue that is to be addressed could be selected by the students. The teams work to create a media product such as a report, poster, skit, song, poem, and/or banner related to solving the problem.
   b. A **physical challenge** involves building a structure or a model that can have many possible solutions, such as a tower or a model of a portable lemonade stand, which must satisfy one or more specific conditions.
2. Decide on a **measurable, subjective,** and/or **competitive** goal or goals.
   a. **Measurable** goals could involve the structure's height, weight bearing capacity, length, or other measurable attribute. Having a set minimum allows every team with a structure that meets the goal to be a winner (for example the tower touches the ceiling or the structure supports a fixed weight).
   b. **Measurable** goals could also involve building a device to accomplish a task such as watering a plant, delivering an item, or creating a work of art.
   c. **Subjective** goals could include creativity, artistic expression, and practicality.
   d. **Competitive** goals would include creating the tallest or strongest structure, for example. To create more than 1 winner, reward teams based on additional criteria such as the lightest, cheapest, least use of materials, most recyclable, easiest to disassemble, most portable, sturdiest when placed in front of a fan, completed the quickest, and/or some other definable aspect of the challenge.
   e. Challenge specifications could include a reward/penalty point system related to on-time completion of the task to encourage teams to finish on time.
   f. To prevent the teams from using a single or common approach to problem unique conditions may need to be added on how the goal can be accomplished.
3. Decide on the materials and the quantities to be provided or to be made available.
   a. Inexpensive materials for physical challenges include paperclips, straws, craft sticks, toothpicks, paper, skewers, string, masking tape, and index cards.
   b. Recycled or recyclable materials include newspapers, scratch paper, file folders, cardboard, business cards or other clean, consistently sized materials, which are free. (The cleanup process could involve recycling the items.)
   c. Using reusable or recyclable fasteners such as string, paperclips, and binder clips have the advantage of allowing the finished products to be disassembled instead of becoming trash. Requiring the structure to be held together by gravity alone would be another possibility, making for easier disassembly.

Topics: Design, Forces, Engineering, Creativity, Teamwork

Materials List

✓ The materials needed for a challenge will vary depending on the specifics of the challenge. See the **Design Challenge Considerations** section to the right

This activity can be used to teach:
Next Generation Science Standards:

- Forces & Motion (Middle School, Physical Science 2-2; High School, Physical Science 2-1)
- Compare Multiple solutions (Engineering Design, Grades 3-5, 1-2; Middle School, 1-2, 1-4)
- Test variables & Design Criteria (Grades 3-5, Engineering Design, 1-1, 1-3)
- Science & Engineering Practices (Grades 4-12)

Written by Michael Pollock (RAFT)

4. Decide on how much time the teams will have to work on the challenge. Allow time after the challenge for the teams to complete clean up, and to move or to dismantle what was created.
5. Decide what tools will be provided or allowed, such as scissors or rulers.
6. Decide on the rules for the teams. For example, will cutting or breaking the materials be allowed? Can available furniture or other items be used? Instead of having lots of rules, a lack of defined limits could provide new opportunities for a team that is willing to think "outside the box" in seeking possible solutions.

To Do and Notice

1. Divide the students into teams so that students from different backgrounds, interests, and friendship groups are intermixed
2. Provide each team with instructions regarding the challenge's goals, measures of accomplishment, and rules.
3. Provide team access to the materials and tools that can be used to accomplish the goal.
4. Specify the time allowed for the challenge. Have a clock or other timing device visible to the teams. Periodic announcements could be made on how much time is left.
5. Announce when the time is "up". Note which teams stop working.
6. Assess each team's efforts by using the challenge's specified criteria. Judging could be done by the teams ranking each other or by consensus voting.
7. Discuss the results noting:
    a. How the different teams developed different approaches to accomplish the same goal.
    b. How did working on a task as part of a team differ from working independently?
    c. Were initial designs modified or scrapped as flaws were discovered and partial solutions evolved?
    d. How can the act of not succeeding at the task (all or part of) be beneficial?
    e. If a condition of the challenge was not met, what could have been done differently so that the condition would have been satisfied?
    f. What real world connections can be made to the goal of the Design Challenge?

The Science Behind the Activity

How were the ancient wonders of the world created? Building pyramids, cathedrals, domed structures, and ways to transport water long distances no doubt took teamwork and creativity. In addition the knowledge gained from past attempts that collapsed or did not quite make the grade must have been considered. These same skills will be needed to tackle the issues, large and small, that the world's civilizations will face in the future. Working on design challenges will give students the opportunities to gain and to practice real world skills while working as part of a team.

Many school lessons tend to be convergent, with a single right answer provided by an individual student, while design challenges are divergent, with many possible solutions that evolve based on creativity and team effort.

Design challenges can aid teachers by helping to engage students' attention with hands-on tasks that can involve the practical uses of basic math and science concepts. Implementing design challenges might seem easier to do in an after school setting. However there are ways to incorporate design challenges, or aspects of the processes involved, into the regular school day. Team projects, brainstorming activities, and mini design challenges could be added to ongoing lessons.

Web Resources (Visit www.raft.net/raft-idea?isid=626 for more resources!)

- Design Squad's teacher resources - http://pbskids.org/designsquad/parentseducators/index.html
- Tech Museum's Design Challenge resources - https://www.thetech.org/educators/design-challenge-learning

