Classroom Teacher Preparation

Engineering 3: (Re)-Building a Bridge

Please use the following to prepare for the next SfS lesson.

Description:

Students are presented with the engineering design challenge to build a bridge that will transport a defined number of people, modeled by weights. Students design, build, and test prototype bridges. During testing, they identify the failure points of their models and use these results to improve their designs, rebuild, and retest.

Lesson Objectives – SWBAT ("Students Will Be Able To…"):

3rd-8th

- Construct a functional prototype to solve a problem, according to the given constraints
- Test the prototype and identify failure points in order to improve and retest the design

Disciplinary Core Idea (DCI)

ETS1 Engineering Design - ETS1.B Developing Possible Solutions

- (3rd-5th) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved
- (6th-8th) A solution needs to be tested, and then modified on the basis of the test results, in order to improve it

Science & Engineering Practice (SEP)

Constructing Explanations and Designing Solutions

- (3rd-5th) Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution
- (6th-8th) Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints
- (6th-8th) Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing

Crosscutting Concepts (CCC)

Systems and System Models

- (3rd-5th) A system can be described in terms of its components and their interactions
- (6th-8th) Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems

Preparation:

Students should be familiar with following vocabulary:

- **Constraint** – a limiting factor to consider when designing a solution
- **Criteria** – specific requirements of a design solution

Room Set Up for Activities:

Students will work in groups of 3-4 at their desks to build model bridges (8 groups maximum). There will also need to be a central location for the students to pick up building materials, as well as a central and visible location for the weight testing of the bridges. It is important that all of the students be able to see the bridges during testing.

Safety:

There are no safety precautions.

Related Modules

This lesson may be taught as part of a sequence or group of related modules on **Engineering and Design**. Modules include:

Engineering 2: Rover Restraint - This module gives students a hands-on, team-oriented introduction to engineering within the context of space exploration. They learn about NASA's Mars rovers as examples of the challenges engineers face in balancing competing goals, while creating a lander for a mock rover to be tested in an egg drop.

Engineering 4: Engineering Redesign (with Legos!) – Focuses on the redesign step of the Engineering and Design process. Students must redesign a flawed prototype based on certain constraints (i.e., redesign and rebuild a Lego bookcase in order to easily transport it from classroom to classroom).

For other module sequences and groups, look here: www.sciencefromscientists.org/sequences

Standards Covered:

Please click the following link to our website to review the standards covered by this lesson, listed by state: www.sciencefromscientists.org/standards/

Lessons are matched to both national NGSS and local state standards.

After Our Visit:

Extend this lesson by challenging the students to turn a pizza box into a solar oven.

Access this Extension activity by visiting the Classroom Post found on our website at sciencefromscientists.org/cohorts. Use the name of your school/cohort and password to log in.

To help Evaluate, check out our Open Response questions online at sciencefromscientists.org/open-response-questions. They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

Additional Resources:

- The Engineering and Design Process: http://www.sciencebuddies.org/engineering-design-process/engineering-design-process-steps.shtml
- University of Arizona Engineering Department--Solar Oven Throwdown: https://www.youtube.com/watch?v=C4cP06Gmcgg
- Solar Cooking with a Parabolic Mirror: https://www.youtube.com/watch?v=wyXsYkumHcw