DOCUMENT RESUME

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AUTHOR	Rushton, Erik; Ryan, Emily; Swift, Charles
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ABSTRACT

Towers have been a part of developing society for centuries. In this activity, students investigate towers that serve a variety of purposes. Student groups build three types of towers, engineering them to hold an egg one foot high for 15 seconds. This activity requires a 60-minute time period for completion. (Author/SOE)

Activity: **Tower Investigation and the Egg**

GRADE LEVELS: 6-8

SUMMARY:

Towers have been a part of developed society for centuries. Towers serve a variety of purposes, as a lookout to a cellular tower. In this activity student groups will build three types of towers, engineering them to hold an egg one foot high for 15 seconds.

LEVEL OF DIFFICULTY [1 = Least Difficult: 5 = Most Difficult]

3-average

TIME REQUIRED

60 minutes

COST

$10 per class

STANDARDS:

II. Engineering Design

2.1 Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.

2.2 Demonstrate methods of representing solutions to a design problem, e.g., sketches, orthographic projections, multiview drawings.

2.4 Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.

2.5 Explain how such design features as size, shape, weight, function and cost limitations (i.e., ergonomics) would affect the construction of a given prototype.

V. Construction Technologies

5.1 Describe and explain parts of a structure, e.g. foundation, flooring, decking, wall, roofing systems.

5.3 Explain how the forces of tension, compression, torsion, bending and shear affect the performance of bridges.

WHAT WILL THE STUDENTS LEARN?

Engineering Design Process (egg holder at top of tower)

Parts of a structure

Types of towers and comparisons

Safe usage of tools and machines

Forces that must be taken into consideration when building structures

BACKGROUND INFORMATION:

The ENGINEERING DESIGN PROCESS has the following steps: identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.

TOWERS are usually classified into three categories: guyed or cable supported, free-standing or self-standing, and monopole. The self support and monopole towers are both similar in that neither require guy wires or any other support structure. Also, most engineers choose the guyed type because it is the most inexpensive route.

As a general rule there are three main specifications needed to choose a tower site: site selection, tower type, and tower specification knowledge (or tower code) within the community.

Also, see fairly fundamental facts about FORCES, George and Prime

MATERIALS:

Pictures or examples of towers

Internet locations of tower information (see links under REFERENCES)

Cardboard tubes and sheet material. Cardboard sheets can be purchased from local paper suppliers or donated from local printers. An allotted amount should be provided to each team of students for each tower problem.

Materials readily available in the classroom such as straws, tape, hot glue, string, etc.

Note: Where available, sturdier towers can be built with small wooden dowels and plastic tubing. This would enable students to be exposed to a variety of hand and power tools

PREPARATION:

Find materials, websites. Provide photocopies of tower diagrams if desired.

DIRECTIONS:

1. Introduce the topic of towers, perhaps facilitate a discussion on different types of towers and there uses. Talk about the design process, including a discussion on the benefits of sketches, multiview drawings, and orthographic projections.
2. Organize students into small groups.
3. Explain criteria for the tower design and construction. Each group will design and make one of each of the following: a guyed tower (cable supported), a self-standing tower, and a monopole tower. Each tower must be able to support the weight of an egg for 15 seconds
4. Students will test and measure the three types of towers by evaluating height, strength (ability to hold an egg), and the amount of material usage
5. Students will participate in the presentation of the group solutions to the class.

6. Students will present comparisons or advantages and disadvantages of the different types of towers

INVESTIGATING QUESTIONS:

What is the purpose of towers? Why is one type of tower preferable to another?

How can an egg be held and supported at the top of a tower?

How can we build models to represent the three recognized types of towers?

What is meant by tension, compression, torsion and shear in construction?

What are the parts of this structure (tower) that are similar to those found in bridge design?

REFERENCES:

Sturdivant, Peter. So You Want to Build a Tower? http://www.angelfire.com/me/blkstrpra/aug98.html. August 9, 2001. [online].

Tower Photographs. http://www.pre-engineering.com/resources/towers.htm August 9, 2001. [online]. (Used with the permission of Pre-Engineering Software Corporation.)

Rubric for Performance Assessment

Activity Title: Tower Investigation and the Egg

Grade Level:6-8

	1	2	3	4		
Criteria	Beginning	Developing	Proficient	Advanced	Weight (X factor)	Subtotal
DESIGN	Fails to do any drawings on paper. Does not think about choice of materials.	Drawing is uninformative and does not match tower.	Design shows some thought and is drawn. Design resembles tower. Design is of intended type of tower. Materials are chosen for good reasons.	Design is well thought out and neatly drawn. Design closely matches tower.		
CONSTRUCTION	Tower is not a foot high or will not stand up.	Tower is tall enough but will not hold the egg. Tower does not closely match intended tower type.	Tower is of intended type, and holds egg.	Tower is very sturdy, holds the egg, matches intended type		
PRESENTATION OF TOWER TYPES	Failure to compare types in discussing towers.	Students explain a few strengths and weaknesses of each type of tower.	Students explain several strengths and weaknesses of each type of tower, and explains what situations merit each type of tower.	Students explain cost, weather resistance/strength, tower code, and more for each type of tower		
					Total:	

Teacher Comments:

Directions: Tower Investigation and the Egg

Read documents on tower types. You will find them online or your teacher will provide them.
You are required to build 3 towers to hold an egg a foot high for 15 seconds. You will have to build a guyed tower(cable supported), a self-standing tower, and a monopole tower. Your teacher will have a selection of materials from which to choose. Be sure to draw designs of your tower on paper, labeling the type and the chosen materials, and writing why it is designed the way it is. Be sure to consider the forces to which the tower will be subjected.
Build the towers and test them by putting an egg on them for 15 seconds.
You will be asked to present to the class the strengths and weaknesses of each type of tower, based on your experiments and the articles you have read.

PreK-12 ENGINEERING

Activity Evaluation Form

www.k12engineering.org

Activity Name: _____

Grade Level the Activity was implemented at: _____

Was this Activity effective at this grade level (if so, why, and if not, why not)?

What were the Activity's strong points?

What were its weak points?

Was the suggested Time Required sufficient (if not, which aspects of the Activity took shorter or longer than expected)**?**

Was the supposed Cost accurate (if not, what were some factors that contributed to either lower or higher costs)**?**

Do you think that the Activity sufficiently represented the listed MA Framework Standards (if not, do you have suggestions that might improve the Activity's relevance)**?**

Was the suggested Preparation sufficient in raising the students' initial familiarity with the Activity's topic (if not, do you have suggestions of steps that might be added here)**?**

If there were any attached Rubrics or Worksheets, were they effective (if not, do you have suggestions for their improvement)**?**

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I. DOCUMENT IDENTIFICATION:

Title: PreK-12 Engineering Activities

1) Touch and Discover, Grades PreK-2
http://www.prek-12engineering.org/data/d2/Touchdiscover.pdf

2) Invent a Backscratcher from Everyday Materials, Grades PreK-2
http://www.prek-12engineering.org/data/d28/Backscratcher.pdf

3) Compare Human-Made Objects with Natural Objects, Grades PreK-5
http://www.prek-12engineering.org/data/d34/HumanvsNatural.pdf

4) Do Different Colors Absorb Heat Better?, Grades PreK-2
http://www.prek-12engineering.org/data/d37/Absorbheat.pdf

5) Which Roof is Tops?, Grades PreK-2
http://www.prek-12engineering.org/data/d44/RoofTops.pdf

6) Make Your Own Recycled Paper, Grades PreK-2
http://www.prek-12engineering.org/data/d56/Recycle.pdf

7) Build an Approximate Scale Model of an Object Using LEGOs, Grades 3-5
http://www.prek-12engineering.org/data/d3/LegoScaleModel.pdf

8) Design Weather Instruments using Lego Sensors, Grades 3-5
http://www.prek-12engineering.org/data/d4/LegoWeather.pdf

9) Space Shelter, Grades 3-5
http://www.prek-12engineering.org/data/d5/SpaceShelter.pdf

10) Build a Bird House, Grades 3-5
http://www.prek-12engineering.org/data/d6/BirdHouse.pdf

11) Ball Bounce Experiment, Grades 3-5
http://www.prek-12engineering.org/data/d6/BallBounce.pdf

12) Make an Alarm!, Grades 3-5
http://www.prek-12engineering.org/data/d11/MakeAlarm.pdf

13) Design Packing to Safely Mail Raw Spaghetti, Grades 3-5
http://www.prek-12engineering.org/data/d17/MailSpaghetti.pdf

14) Disassemble a Click Pen, Grades 3-5
http://www.prek-12engineering.org/data/d33/clickPen.pdf

15) Construct And Test Roofs for Different Climates, Grades 3-5
http://www.prek-12engineering.org/data/d35/ClimateRoof.pdf

16) Compare Fabric Materials, Grades 3-5
http://www.prek-12engineering.org/data/d36/Fabric.pdf

17) A House is a House for Me, Grades 3-5
http://www.prek-12engineering.org/data/d52/House.pdf

18) Water Filtration, Grades 3-5
http://www.prek-12engineering.org/data/d53/Water Filtration.pdf

19) What is the Best Insulator: Air, Styrofoam, Foil, or Cotton?, Grades 3-5
http://www.prek-12engineering.org/data/d54/BestInsulator.pdf

20) Design a Recycling Game!, Grades 3-5
http://www.prek-12engineering.org/data/d55/Recycling.pdf

21) Tower Investigation and the Egg, Grades 6-8
http://www.prek-12engineering.org/data/d7/TowerEgg.pdf

22) Wimpy Radar Antenna!, Grades 6-8
http://www.prek-12engineering.org/data/d10/WimpyAntenna.pdf

23) Portable Sundial, Grades 6-8
http://www.prek-12engineering.org/data/d30/PortableSundial.pdf

24) An Introduction To Loads Acting on Structures, Grades 6-8
http://www.prek-12engineering.org/data/d31/IntroLoads.pdf

25) Design Your Own Rube Goldberg Machine, Grades 6-8
http://www.prek-12engineering.org/data/d32/RubeGoldberg.pdf

26) Building Tetrahedral Kites, Grades 6-8
http://www.prek-12engineering.org/data/d38/tetrakites.pdf

27) Do as the Romans: Construct an Aqueduct!, Grades 6-8
http://www.prek-12engineering.org/data/d39/Aqueduct.pdf

28) Build an Earthquake City!!, Grades 6-8
http://www.prek-12engineering.org/data/d40/EarthquakeCity.pdf

29) Design a Parachute, Grades 6-8
http://www.prek-12engineering.org/data/d41/Parachute.pdf

30) The Squeeze is On, Grades 6-8
http://www.prek-12engineering.org/data/d42/Squeeze.pdf

31) Stop The Stretching, Grades 6-8
http://www.prek-12engineering.org/data/d43/StopStretching.pdf

32) Speaker Project, Grades 9-10
http://www.prek-12engineering.org/data/d13/Speaker.pdf

Author(s): Erik Rushton, Emily Ryan, Charles Swift

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Signature: Margaret E Newell

Printed Name/Position/Title: Margaret Newell, Associate Provost for Research

Organization/Address: Tufts University
136 Harrison Avenue, Suite 75K-401
Boston, MA 02111

Telephone: 617-636-6550
Fax: 617-636-2917
E-mail Address: peter.wong@tufts.edu

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