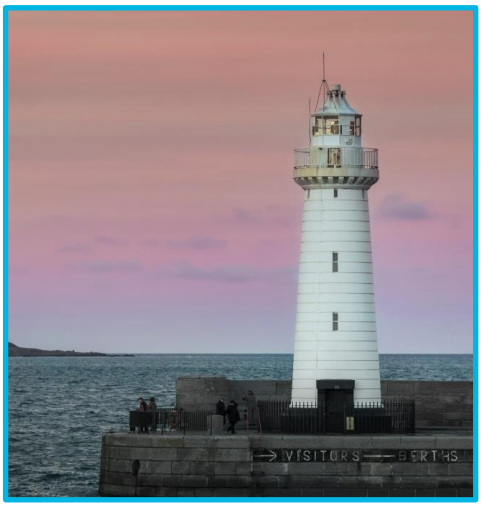
Move That Lighthouse!

Lesson Focus

Lesson focuses on how engineers have to evaluate multiple structural, economic, and environmental factors when moving a building.

Lesson Synopsis

The "Move That Lighthouse!" activity explores how engineers work in a team to solve problems. Students learn how structural, economic, and environmental factors must be evaluated when planning to move a lighthouse or other building. Students work in teams to plan the safe and efficient move of a tower of materials on a desk in a classroom, execute their plan, and evaluate the strategies employed by other student teams.



Age Levels

8-18.

Objectives

- Learn how the environment impacts civil engineering.
- Learn how structures can be moved.
- Learn how engineering teams address problem solving.
- Learn about teamwork and working in groups.

Anticipated Learner Outcomes

As a result of this activity, students should develop an understanding of:

- structural engineering and design
- problem solving
- teamwork

Lesson Activities

Students learn how structural, economic, and environmental factors must be evaluated when planning to move a lighthouse or other building. Students work in teams to plan the safe and efficient move of a tower of materials on a desk in a classroom, execute their plan, and evaluate the strategies employed by other student teams.

Resources/Materials

- Teacher Resource Documents (attached)
- Student Worksheets (attached)
- Student Resource Sheets (attached)

Alignment to Curriculum Frameworks

See attached curriculum alignment sheet.

Internet Connections

- TryEngineering (www.tryengineering.org)
- Wikipedia: Structural Moving (https://en.wikipedia.org/wiki/Structure_relocation)
- Belle Tout Lighthouse (www.belletout.co.uk/information/history/)

Recommended Reading

- Out of Harm's Way: Moving America's Lighthouse (ISBN: 1885457154)
- Cape Hatteras: America's Lighthouse (ISBN: 158182033X)
- Moving a House With Preservation in Mind (ISBN: 0759109575)

Optional Writing Activity

- Write an essay or a paragraph describing the factors engineers had to consider when approaching the move of the Cape Hatteras Lighthouse.

For Teachers: Teacher Resource

Lesson Goal

Explore engineering problem solving by working in teams to determine a plan for moving a tower of materials on a desk across the classroom. This mimics real world engineering challenges in moving structures such as homes, oil rigs, space shuttles, and lighthouses when necessary due to environmental or other situations.

Lesson Objectives

- Students learn how structures are engineered, and the stress that motion can cause.
- Students learn about evaluating information and data.
- Students learn how engineers must consider design, environmental, and economic factors when building or moving a structure.
- Students learn about teamwork and working in groups.

Materials

- Student Resource Sheet
- Student Worksheet
- One set of materials for each group of students:
  - Blocks, weighted milk cartons, stacks of books
  - Standard desk or small table
  - Strips of cardboard
  - Tape, string, pencils
  - optional materials such as rollers, castors, plastic sheets, fan

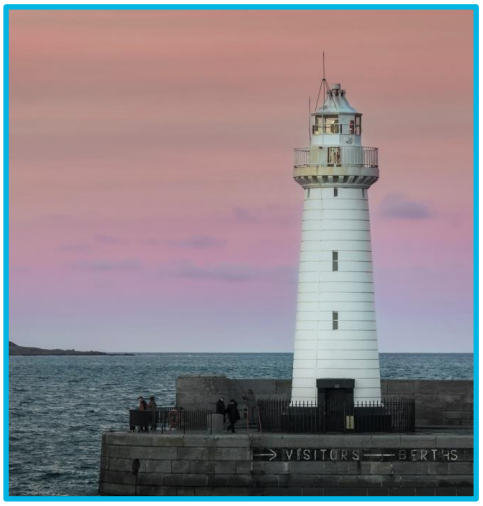
Procedure

1. Show students the various Student Reference Sheets. These may be read in class, or provided as reading material for the prior night's homework.
2. Divide students into groups of 2-3 students, providing a set of materials per group.
3. Explain that students must construct a two foot tower of materials on their desk -- their lighthouse (you may choose to have them use books, blocks, weighted milk containers, cans of soup -- but each team must use the same materials).
4. The students are then posed with the problem of having to move their desk ten feet without having the lighthouse fall.
5. Students meet to develop a plan for securing the lighthouse, agree on materials they will need, write or draw their plan, and then present their plan to the class.
6. Teams may revise their written plan after presentations based on feedback from class.
7. Student groups next execute their plans to secure the lighthouse (which may include tape, cardboard, string, pencils) and move their desks.
8. Teachers may consider adding challenges to the lighthouse move by bringing a fan into the classroom to add a "weather" element.
9. Each student group evaluates the results (did the lighthouse fall? why?), completes an evaluation/reflection worksheet, and presents their findings to the class.

Time Needed

Two to three 45 minute sessions

Student Resource: Lighthouses on the Move



An aid for navigation and ships at sea, a lighthouse is a tower building or framework sending out light from a system of lamps and lenses or, in older times, from a fire. Lighthouses also provide coordinate location for small aircraft traveling at night. More primitive navigational aids were once used such as a fire on top of a hill or cliff.

Because of modern navigational aids, the number of operational lighthouses has declined to less than 1,500 worldwide. Lighthouses are used to mark dangerous coastlines, hazardous shoals away from the coast, and safe entries to harbors.

Lighthouses are built very close to the coastline, so they are frequently victims to erosion as the sea takes back coastal land. All over the globe, lighthouses have been torn down or lost to the sea -- and many have been rescued through engineering plans which move the lighthouse further back on land. In many cases, engineers have made sure that a lighthouse move was done in such a way that the lighthouse could be moved again -- as the sea tears more land away.

The Belle Tout lighthouse at Beachy Head in Sussex, United Kingdom was moved in 1999. The company who engineered the move -- Abbey Pynford -- moved the 160-year-old lighthouse because it was threatened with destruction by the rapidly eroding cliffs where it stood. The building weighs 850 tonnes and had to be moved 17 metres using sliding techniques. The most difficult aspect of the project was in successfully moving the lighthouse without the cliffs giving way. The slope of the cliffs also presented a tough challenge being higher at the edge than they were further back -- so a new one-story building had to be constructed for the lighthouse to stand on.

Find out more about the Belle Tout move at www.abbeypynford.co.uk/19th-anniversary-belle-tout-lighthouse-move/.

Student Worksheet: Build and Move

◆ You are a team of engineers which has to tackle the challenge of moving a lighthouse without damaging the original structure!

◆ Construction Steps
1. Review the various Student Reference Sheets.
2. Your team has been provided with some "building materials" by your teacher. These are to be made into a tower at least two feet tall -- your lighthouse. It must sit on top of a desk without tumbling over. You should consider reinforcement options to protect your lighthouse during the move.

◆ Moving Plans
3. Now, meet with your team and devise a way of securing your lighthouse on top of a desk and then move the desk ten feet without having the lighthouse fall. You may use limited materials (tape, pencils, string, cardboard) and you may move the desk using your hands.
4. Write or draw your plan in the box below, and present your moving plan to the class. You may choose to revise your teams' plan after you receive feedback from the class. Give some consideration to the speed at which you plan to move the desk, the method you will use (push, pull, with or without additional tools), and what you think you need to do to make sure your lighthouse does not fall.

◆ The Big Move!
5. Give it a try! Execute your plan and move the desk and lighthouse!
6. Evaluate your teams' results, complete the evaluation worksheet, and present your findings to the class.

Student Worksheet: Evaluation

◆ Use this worksheet to evaluate your teams' results in your challenge of moving a lighthouse without damaging the original structure!

1. Did you succeed in moving the desk without damaging the lighthouse?

2. What percentage of time did you spend planning the movement of the desk versus the reinforcement of the lighthouse? Why?

3. In a real world application, why would reinforcement of the structure during a move be important? What safety issues would this address?

4. What method did you choose to move the desk? Push? Pull?

5. If you had to do it all over again, what would you do differently? Why?

6. What designs or methods did you see other teams try that you thought worked well?

7. Did you find that there were many ways to solve this challenge? If so, what does that tell you about the construction of buildings, homes, boats, cars, and other things in real life?

8. Do you think you would have been able to achieve your goal of moving the lighthouse if you were working alone? Why? Why not?

9. What reinforcements do you think would be needed to secure the contents of the lighthouse during a move?

10. What safely procedures would you impose if your school building was to be moved, so that the contents of your classroom were not damaged? Think about animals, fragile items, stacks of books, other items that would be at risk.

For Teachers: Alignment to Curriculum Frameworks

Note: Lesson plans in this series are aligned to one or more of the following sets of standards:

- U.S. Science Education Standards (http://www.nap.edu/catalog.php?record_id=4962)
- U.S. Next Generation Science Standards (http://www.nextgenscience.org/)
- International Technology Education Association's Standards for Technological Literacy (http://www.iteea.org/TAA/PDFs/xstnd.pdf)
- U.S. National Council of Teachers of Mathematics' Principles and Standards for School Mathematics (http://www.nctm.org/standards/content.aspx?id=16909)
- U.S. Common Core State Standards for Mathematics (http://www.corestandards.org/Math)
- Computer Science Teachers Association K-12 Computer Science Standards (http://csta.acm.org/Curriculum/sub/K12Standards.html)

◆National Science Education Standards Grades K-4 (ages 4 - 9)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of the activities, all students should develop an understanding of

- Properties of objects and materials
- Position and motion of objects

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop

- Changes in environments
- Science and technology in local challenges

◆National Science Education Standards Grades 5-8 (ages 10 - 14)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of their activities, all students should develop an understanding of

- Properties and changes of properties in matter

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop

- Populations, resources, and environments
- Natural hazards
- Risks and benefits

◆National Science Education Standards Grades 9-12 (ages 14-18)

CONTENT STANDARD B: Physical Science

As a result of their activities, all students should develop understanding of

- Structure and properties of matter
- Interactions of energy and matter

For Teachers: Alignment to Curriculum Frameworks

◆National Science Education Standards Grades 9-12 (ages 14-18)

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- Abilities of technological design
- Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop understanding of

- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

CONTENT STANDARD G: History and Nature of Science

As a result of activities, all students should develop understanding of

- Historical perspectives

◆Next Generation Science Standards Grades 2-5 (Ages 7-11)

Matter and its Interactions

Students who demonstrate understanding can:

- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Engineering Design

Students who demonstrate understanding can:

- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2.Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3.Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

◆Next Generation Science Standards Grades 6-8 (Ages 11-14)

Engineering Design

Students who demonstrate understanding can:

- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

◆Standards for Technological Literacy - All Ages

The Nature of Technology

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.
- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

For Teachers: Alignment to Curriculum Frameworks

◆Standards for Technological Literacy - All Ages

Technology and Society

- Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.
- Standard 5: Students will develop an understanding of the effects of technology on the environment.
- Standard 7: Students will develop an understanding of the influence of technology on history.

Design

- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Abilities for a Technological World

- Standard 13: Students will develop abilities to assess the impact of products and systems.

The Designed World

- Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.
- Standard 20: Students will develop an understanding of and be able to select and use construction technologies.