

76: How to Lift an Engineer

Classroom Activity: Lecture and demonstration of mechanical advantage

Grade(s): 4 and 8

Strand(s): Understanding Structures and Mechanisms (Grades 4 and 8)

This task addresses the following grade 4 overall expectations:

- investigate ways in which pulleys and gears modify the speed and direction of, and the force exerted on, moving objects;
- demonstrate an understanding of the basic principles and functions of pulley systems and gear systems.

and the following grade 4 specific expectations:

- follow established safety procedures for working with machinery;
- use scientific inquiry/experimentation skills to investigate changes in force, distance, speed, and direction in pulley and gear systems;
- use technological problem-solving skills to design, build, and test a pulley or gear system that performs a specific task;
- use appropriate science and technology vocabulary, including pulley, gear, force, and speed, in oral and written communication;
- use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes;
- describe the purposes of pulley systems and gear systems;
- distinguish between pulley systems and gear systems that increase force and those that increase speed;
- identify pulley systems and gear systems that are used in daily life, and explain the purpose and basic operation of each.

This task addresses the following grade 8 overall expectations:

- investigate a working system and the ways in

which components of the system contribute to its desired function;

- demonstrate an understanding of different types of systems and the factors that contribute to their safe and efficient operation.

and the following grade 8 specific expectations:

- follow established safety procedures for working with apparatus, tools, materials and electrical systems;
- use scientific inquiry/experimentation skills to investigate mechanical advantage in a variety of mechanisms and simple machines;
- use technological problem-solving skills to investigate a system that performs a function or meets a need;
- use appropriate science and technology vocabulary, including mechanical advantage, input, output, friction, gravity, forces, and efficiency, in oral and written communication;
- use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes;
- identify the purpose, inputs, and outputs of various systems;
- identify the various processes and components of a system that allow it to perform its function efficiently and safely;
- calculate the mechanical advantage (MA=force needed without a simple machine divided by force needed with a simple machine) of various mechanical systems.

Assessment Categories:

- Knowledge and Understanding
- Thinking and Investigation
- Communication
- Application

Type of Activity: Classroom

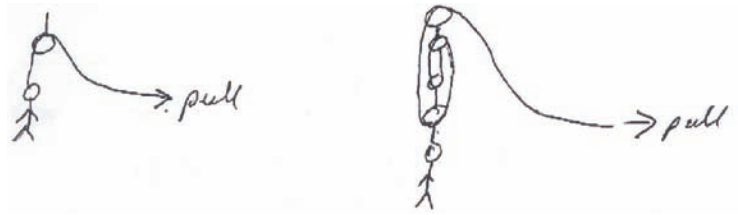
Preparation: (approx 40 minutes)

- Find an area within the school where an overhead

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structural member is strong enough to support the weight of the engineer.

- Build two pulley systems to compare and analyze the results after weighing the EIR



Materials/Resources for teachers:

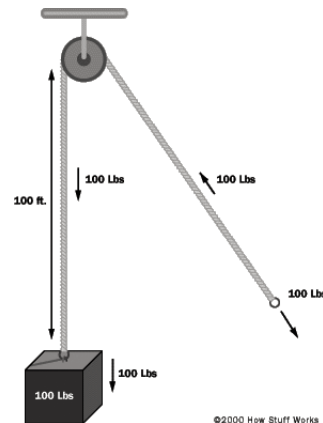
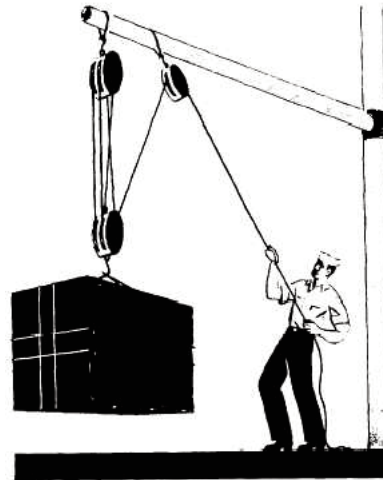
Engineer will require hard hat and a harness

Materials/Resources for students

Thick rope that kids can't wrap around their hands Block and tackles

Activity Description:

- Discuss as with the class the idea of mechanical advantage by using a ruler as a lever to balance two different weight books.
- Proceed to discuss the idea that the work (force x distance) must remain the same.
- An example that can explain the idea is to compare the amount of work needed to buy a case of pop at the supermarket by asking the questions; if I take a Volvo station wagon to the store and load 4 cases of pop into it, would it be the same amount of work as if I take my monster truck and load 1 case (lifted over head) and place into the truck. (The students seem to like the example)
- After the discussion, proceed to the staging area (usually the gym) where two block and tackles are set-up. One is a single sleeve (fig.1) and the other is a four sleeve block and tackle (fig.2).
- The Engineer then puts on a harness and hard-hat while the kids see how many of them it takes to lift him/her off the floor using each system. The results are discussed after the experiment



Classroom Questions

Compare the results gathered from observations of both block and tackle systems.

Tips for teachers/EIRs

This activity must be carefully designed to ensure the safety of the children, as well as the EIR. For example: Find an overhead structural member strong enough to support the weight of engineer/teacher, Use large diameter rope so that children can't wrap the ropes around their hands.