PRESENTED BY: girlstart

deSTEMber

SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH

Heavy Lifting

Have you ever noticed how materials are lifted up to build a tall building? How would you lift wood and supplies to make a tree house? Explore how simple machines can help make a challenging task easier. Design a crane, using simple machines, to test how heavy a load your crane can lift!

TEKS:

6.8E Investigate how inclined planes and pulleys can be used to change the amount of force to move an object.

How To:

1. First, let's explore how cranes work by building a simple crane arm. Cut a piece of string about 2 ft. long and tie one end around the center of a pencil. Stick the other string end through a hole at the end of a ruler, then tie a paperclip here so that when you pull the pencil and string, the paperclip stops the string from falling out of the hole.
2. Hold the ruler at an upright 45-degree angle facing away from you. The pencil should lay perpendicular across the base of the ruler with the string running up along the center of the ruler to the hole with the paperclip hanging from the string straight down from the hole. If you start rolling the pencil between your fingers, you will notice the paperclip move up or down. This is very similar to how real cranes work. The arm (ruler) needs to be stiff so that it can hold the heavy load while the take-up reel (pencil) winds the cable to actually lift it.
3. Now, examine the materials you have available to build your crane and brainstorm how you would like to design your own. Think about the simple model we just created and what materials you could use for the arm and take-up reel of your crane.

Materials:

- Cardboard box (shoebox size or bigger)
- 3 strips of corrugated cardboard (2"x11" or 5cm x 28cm per strip)
- Paperclips
- Large plastic cup
- 3 sharpened pencils
- Spool
- Scissors
- Smooth string (e.g. fishing line or kite string)
- Ruler
- Scotch tape
- Weights (e.g. batteries, pennies, marbles, or gravel)

31 Days of STEM Fun!

How To (continued):

4. Think about these questions as you design your crane:
    - *How will you keep the crane's arm from breaking off the box as it lifts a heavy load?*
    - *How will you stop a heavy load from pulling the arm to the left or right?*
    - *How will you wind and unwind the cable so the hook can go up and down?*
5. Design your crane, then test it by seeing if it can pick up various weights!
6. If your crane does not work exactly as you had planned, redesign and test your crane until it does.

The STEM Explanation:

Simple machines are tools that are used to make work easier. They require less input to create a bigger output. For example, by using an inclined plane or ramp, you can push a heavy cart to a higher location with less force. A crane can be made using a combination of three simple machines – a lever (the arm), a pulley (the arm's crosspieces), and a wheel and axle (the take-up reel). These simple machines work together against forces, like gravity, that are affecting how hard it would be to lift the load in the cup. Other simple machines are wedges (chisel), screws (jar lids), and inclined planes (ramp).

Career Connection:

Structural engineers are concerned with the design and construction of all types of structures such as bridges, dams, tunnels, power plants, offshore drilling platforms, and space satellites. Structural engineers research the forces that will affect the structure and then develop a design that allows it to withstand these forces.

Resource:

- http://www-tc.pbskids.org/designsquad/pdf/parentseducators/DS_NASA_06HeavyLifting_LN_CS.pdf

