INNOVATION AT PLAY

VIDEO TOPIC SERIES ACTIVITY

ERGO-LIFTING

Have you ever thought about how some careers are sedentary, while others require almost constant activity?

Find a teammate and step into the world of manual labor as you explore the science that powers it!

STEP 1: CONNECT

Many people have careers that are physically demanding—such as mechanics, construction workers, firefighters, fishers, and sanitation workers just to name a few! Share with your teammate: How do you think these professionals are able to lift materials throughout the day without tiring quickly?

STEP 2: INVESTIGATE

There are techniques for lifting objects that are safer and easier on the body than others.

Visit https://tinyurl.com/safe-lifting-at-work. Read the tips provided and watch at least one of the videos to learn more about safe lifting techniques. Jot down the new ideas that you learn.

STEP 3: DISCUSS

Share with your teammate some of the new lifting tips that you discovered. Then discuss:

- What specific construction tasks might be most prone to lifting-related injuries, and how could safety measures be tailored for these jobs?
- What factors could affect how much energy is required to lift a heavy object, and how could lifting be made more efficient?
- Could alternative lifting methods like the golfer's lift, lunge lift, and/or deadlift (all mentioned in the resource you just read) be useful in construction? Why or why not?

STEP 4: MATERIALS

Let's take a closer look at the ergonomics (or how to design tasks so they are safe for the human body) behind lifting.

You'll need:

- Device with internet access
- Empty box (shoebox size or larger)
- Smart phone with a motion capture app such as MobileCap
- Measuring tape
- Stopwatch
- Calculator
- Scale

STEP 5: THE CHALLENGE

Follow these steps as you demonstrate how to safely lift a box above your head *and* investigate the science behind it:

First, weigh your box and record its weight in grams.

Then select a team member to be the box lifter. Apply what you've learned as you collaborate to determine how they can ergonomically lift the box above their head. As they practice, measure how far the box is from the ground when it is at its highest point. Then use the Motion Capture App to record the full lifting motion.

Now explore the science of energy transformation. Energy transformation is the process by which energy changes from one form to another. For instance, there is potential energy (or stored energy) when the box is held directly above the lifter's head. This energy is then converted into kinetic energy (or energy of motion) as the box is lowered.

Use the app's video replay option and the formulas in the sidebar to calculate the box's potential energy and kinetic energy, and record them here:

PE= _____ KE=_____

Repeat these calculations for *fictional* loads of various other sizes, assuming that the box's velocity remains the same:

Box weight: 2,000 grams PE = _____ KE =_____

Box weight: 50,000 grams PE = _____ KE =_____

Box weight: _____ grams PE = _____ KE =_____

Then reflect: Considering the weight of the load and the concepts of energy transformation and conservation, why is ergonomics important in labor-intensive tasks?

FIGURE IT OUT!

To calculate potential energy, PE = m x g x h

m= the mass of the object in kilograms

g= acceleration due to gravity: 9.81m/2

h = the height of the box in meters at its highest point

To calculate kinetic energy, KE = ½ x m x v2

m = the mass of the object in kilograms

v = the velocity of the box in meters per second

Energy Conservation Connections

Energy conservation is the idea that the total amount of energy in a closed system should remain constant as it is transformed from one form to another. However, factors like friction, air resistance, or inefficient human movements can cause some energy to be lost.

How does this connect to the concept of ergonomic lifting?

STEP 6: SHARE

Now that you better understand the principles behind ergonomic lifting, create a short video that describes how to lift heavy things safely and explains the science behind it. Be sure to support your explanation with a demonstration using the empty box. Post your video with the hashtags #InnovationatPlay and #HeavyLifting so others can learn from you too!

NGSS STANDARDS

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

- Disciplinary Core Idea: Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.

COMMON CORE ELA STANDARDS

- CCSS.ELA-LITERACY.CCRA.SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.