Let's Get to Work	Grade 8 Systems in Action

Lesson Plan

Safety Notes

Choose an object that is heavy enough for you to feel its weight but not so heavy that you struggle to lift it.

Description

In physics the term "work" means something different than the way we use it in everyday life. In this activity you will learn what we mean when we use the term in physics and will explore how to calculate it.

Materials

- Heavy object (e.g a book, large full water bottle, small dumbbell weight etc.)
- Kitchen, bathroom or luggage scale
- Ruler
- Let's Get to Work Handout

Science Background

In physics terms, we only accomplish work when we move an object. Work is calculated as force times distance and is measured in a unit called joules (J). As an equation, this looks like W=F(d). In this equation, the force used to move the object is measured in Newtons (N). The distance that the object moves as a result of the force that was applied is measured in meters.

Most people do not have the tools at home to directly measure force, but with the help of a second formula it is possible to calculate force if the mass of an object is known or can be measured. This formula is force equals mass times acceleration due to gravity or F=m(g). Force is measured in newtons (N), mass is measured in kilograms (kg), and acceleration is measured in meters per seconds squared (m/s^2). On Earth, if we are moving an object straight up and down, we know that acceleration is 9.8 m/s^2 .

Activity Procedure

Part 1: Are We Doing Work?

1. Take your heavy object and hold it steady out in front of you at arm's length
    - Do you think you are doing any work?
    - The answer is no! Although you are putting in effort to hold the object up (your arm might be getting tired!) the object isn't moving. Since the object is not moving, the distance value in the W=F(d) formula equals 0m and so W also equals 0 and no work is being done
2. Place your heavy object on the desk/table/floor in front of you and then pick it up to hold it out in front of you again.
    - Do you think you are doing any work this time?

- The answer is yes! You applied a force to the object and it moved from one position (on the desk) to another (held out in front of you)

Part 2: Calculating Work

1. Your handout has 2 questions to help you practice calculating work using the W=F(d) formula. Work through question 1 by following the steps below and then try question 2 on your own.
    a. In the answer space write out the formula you are going to use: W=F(d)
    b. List which of the 3 values you know and which you are trying to find : F= 20N, d= 20m, W=?
    c. Plug the values you know into your formula: W=20N(20m)
    d. Calculate, don't forget to include units on your final answer: W=400J

Part 3: Calculating Work Using F=m(g)

1. Weigh your heavy object using a kitchen, bathroom, or luggage scale and record the value on your handout for Trial 1
    - Remember to record your value in kg! If your scale can only measure in lbs. divide the mass in pounds by 2.205 to the get the mass in kg (e.g. 2.205lbs divided by 2.205 is 1kg)
2. Calculate the force required to lift the object straight up using F=m(g)
    - Remember: we know acceleration due to gravity on Earth is 9.8 m/s^2
3. Hold the ruler upright in one hand so that the end with the 0 mark touches the desk/table
4. Place the object you weighed on the desk beside the ruler to start and then lift the item straight up until the bottom of the item is at the 15cm mark on the ruler and record the distance the object travelled on your handout
    - Remember to record distance in m. You will need to convert cm to m by dividing by 100 (e.g. 1cm = 0.01m)
5. Calculate the work done to move the object using W=F(d)
6. Repeat steps 1 to 5, this time lifting until the bottom of the item reaches the 30cm mark. Record your results in Trial 2
    - What do you notice about the relationship between work and distance? Could you feel this?

Debrief

Work isn't the only term used in science that has a different meaning in everyday language. For example, force, energy and efficiency also have two different meanings. It's always a good idea to make sure it is clear what meaning of a term you are using!

Work and distance are directly related. This means that, as long as we are moving the same object, when one value increases, the other value increases too. We saw this in Part 3 of our

activities today. When we doubled the distance the object travelled, the amount of work done also doubled. If we tripled the distance, the value of work would also triple. Did you feel like you put in more effort to carry out the second trial than you did for the first? The heavier your object is the more likely it is that you felt the difference!

Calculating Work

1. If it takes 20N to move an object 20m how much work has been done? Show your calculations.

2. Assume it takes 40N of force to carry a bowling ball from one end of a soccer field to the other. A soccer field is 120m long. How much work do you do to move the bowling ball? Don't consider the work to lift the object, only the work to move it across the field.

Calculating Work Using *F=m(g)*

	Mass (kg)	**Acceleration due to gravity (m/s^2)**	**Force (N)** ***F=m(g)***	**Distance (m)**	**Work (J)** ***W=F(d)***
Trial 1					
Trial 2					