

Name \_\_\_\_\_

## Work

**Problem:** To investigate the scientific definition of work.

**Background information:** **WORK** is done when a force causes an object to move in the direction of the force. For work to be done, two things must occur. First, you must apply a force to an object. Second, the object must move in the same direction as the force you apply. **If there is no motion, there is no work.** This is very different from the way we use the word work in everyday life.

Work can be calculated with this formula:

$$\text{Work} = \text{Force} \times \text{Distance}$$

$$W = F d$$

The units of force are **Newtons** and the units of distance are **meters**.

The answer is in **Newton-Meters**. These units are referred to as **Joules**.

**Materials:**

4 Books	Spring Scale	Meter Stick
3 Different Objects		

**Procedure:**

1. Stand and hold your arms out in front of you at waist level, palms up.
2. Have your partner stack two books on your hands, one on each hand.
3. Lift the books to about shoulder level, then lower them.
4. Now try raising them overhead. When your hands are overhead, are you working harder than when you raised them to shoulder level? Describe your observations.
5. Lower the books again. Have your partner put two more books on each of your hands, so you're holding four books. Try to raise them to shoulder level. Are you pushing harder (using more force) than when you were holding only two books? Describe your observations.
6. Hold the four books at shoulder level until your arms get tired. Are you exerting force? Do you think you are doing work in these situations? What is the work being done on? Describe your observations.
7. Attach one of the objects to the spring scale.
8. Slowly lift or pull the object straight up. Record how much force you used to pull or lift the object (Newtons).

9. Use the meter stick to measure the distance you moved the object. Record the distance in meters.
10. Find out how much work you did by using the formula,  
**work = force x distance** the object moved. Record your answer.
11. Repeat steps 2-5 with the other objects.

Data:

<b>Observations of step 4:</b>

<b>Observations of step 5:</b>

<b>Observations of step 6:</b>

Calculations of work			
Object	Force (N)	Distance (cm)	Work (J)

**Questions:**

1. Using a force of 50 N, you push a cart 10-m across a classroom floor. How much work did you do?
  
  
  
  
  
  
  
  
  
  
2. What is a Joule?
  
  
  
  
  
  
  
  
  
  
3. Were you doing work when you were holding the books? Explain your answer.
  
  
  
  
  
  
  
  
  
  
4. Were you doing work when you were lifting object with the spring scale? Explain your answer.
  
  
  
  
  
  
  
  
  
  
5. In Greek mythology, Atlas held the world on his shoulders. Did he do any work? Explain your answer.