

# What is Work?

<b>Standard 3240-04</b>	Students will construct various machines and compare the work done by them.	<i>Topic:</i> Changes in force, motion and energy <i>Course:</i> 3240-04
<b>Objective 3240-0401</b>	Construct simple machines and use them to measure and analyze work done by them.	
<b>ILO's</b>	<b>1a</b> Make observations and measurements. <b>2a</b> Identify variables and describe the relationship between them. <b>2d</b> Collect and record data using procedures designed to minimize error.	

## Description of Activity:

*Title of Activity:* What is work?

*Activity Overview:* Students will understand the scientific definition of work. They will learn that in order to determine the amount of work done, measurements must be made and a calculation completed. Students will devise ways to decrease the amount of force needed to move an object a set distance by using a simple machine, the inclined plane.

*Duration of Activity:* 50 minutes

*Materials, Facilities, and Resources:* wood boards (ranging in size from .25 meters to 4 meters) spring scale, resistances (a brick, or similar object) string, meter stick, wax, vaseline (to reduce friction)

**Background Information:** Work can be calculated by using the formula:  $\text{Work} = \text{force} \times \text{distance}$ . An inclined plane will reduce force but increase the distance the object must be moved. Friction between the object and the inclined plane will reduce efficiency but can be lessened by using wax or oil on the plane. The longer the inclined plane, the less the force needed to move the brick.

## Teaching and Learning Strategies:

*Ensure Inquiry:* DO NOT tell the students the formula for work. DO NOT tell the students that inclined planes reduce the force needed to move objects. This should be discovered by the students.

*Prerequisite instruction:* Students need to know how to use and read a spring scale.

## Invitation to Learn:

Show the students the object that is to be moved. Tell them that they will need to devise a way to move the object from the floor to their chair using the least amount of force. Demonstrate lifting the object with a spring scale from the floor to the chair. This will be the maximum amount of force needed. Challenge the students to use less force than you did. They may use any of the materials provided to reduce the force. Remind the

students that they will need to keep track of all their data on their activity sheet. Organize the students into groups of 2-4. Have the students begin the activity.

*Activity Described as a problem:* How can you reduce the amount of force necessary to move the object from the floor to the seat?

Give the students 15-20 minutes to work, then stop and summarize which groups have got the lowest amounts of force. Have students look for similarities between those having the lowest force. The idea that the length of the inclined plane was important should come out in discussion. Work, then is some relationship between force and distance. Post on the board the force and distance for several of the inclined planes. Have students interpret the results mathematically and generate the formula:  $\text{work} = \text{force} \times \text{distance}$ .

### **Summary of Learning:**

*Assessment of Learning:* Evaluate the students' activity sheets.

*Multiple Choice Questions:*

1. Which distance is used to calculate the work done in the lab?
  - a. length of the board
  - b. length of the ground between the chair and the furthest end of the board
  - c. height of the chair
  - d. length of the board/height of the chair

answer: a

2. A 250 lb. object is dragged up an incline plane to a height of 2 feet. If the incline plane was 10 feet long, how much work was done?
  - a. 25 ft. lbs.
  - b. 125 ft. lbs.
  - c. 250 ft. lbs.
  - d. 500 ft. lbs.
  - e. 2500 ft. lbs.

answer: d

## Student Work Sheet

Title: What is Work?

Purpose: To see if we can reduce the amount of force needed to lift an object from the floor to the chair seat.

Prediction: (How little force might it take?)

Materials: wood boards, spring scale, resistances (a brick, or similar object ) string, meter stick, wax or vaseline

Watch as your teacher lifts the object. What force was used? \_\_\_\_\_

With your group, devise a plan to make it easier to lift the object. You must use the spring scale to lift with and may not "help" the object with your hands. Record all data. Write the steps here:

Procedure:

Data:

Analysis:

1. How much did your group reduce force by?
2. What are two ways to reduce force?
3. What is the formula for work?
4. Did the amount of work change in any of the experiments? Why?

Conclusion: