Less Work or Easier Work?—Investigating Levers

SKILLS MENU

- ☐ Questioning
- ■ Hypothesizing
- ■ Predicting
- ■ Planning
- ■ Controlling Variables
- ■ Performing
- ■ Observing
- ■ Analyzing
- ☐ Evaluating
- ■ Communicating

We often say that doing something with a machine requires less work. Do machines really reduce the amount of work required or do they merely make work easier to do? In this Investigation, you will determine whether the use of levers will reduce the work required to perform a specific task.

Testable Question

Can levers reduce the work needed to perform the task of lifting a given mass a distance of 15 cm?

Hypothesis/Prediction

Make and record your hypothesis to the Testable Question. Your hypothesis should include a prediction and the reasons for your prediction.

Experimental Design

SKILLS HANDBOOK 2.B.2., 2.B.4.

Working with a partner or in a small group, decide which class of lever to use for your experiment. Determine what your dependent and independent variables will be. Then, plan how you will proceed.

Equipment and Materials

- rigid piece of wood to use as lever
- object to act as fulcrum (for example, triangular prism, wood across desks or chairs)
- spring scale
- mass (for example, standard mass, washers on a loop of string)
- ruler or metre stick
- scissors
- string
- tape
- paper clips

rigid piece of wood

triangular prism or other fulcrum

spring scale

standard mass or washers

ruler or metre stick

scissors

string

tape

paper clips

Procedure

1. Design a procedure for your experiment. The following questions may help guide you:
   - Which class of lever will you use?
   - How will you arrange your materials? Making a sketch is often helpful.
   - Where along the lever will you place the load? Where will you apply the input force?
   - How often will you change the length of the effort arm and the load arm?

- How often will you repeat a test at each new location?
- You will need to compare your experimental results with a control. The control here is the work needed to perform the task without using levers. How will you determine this value?
- What variables will you need to control?
- What will you measure? Remember that you are being asked to find the amount of work done.
- How will you record your observations?

2. When you are satisfied with your procedure, make a diagram of your experimental setup.
3. Make note of any safety considerations, then submit your plan for your teacher's approval.
4. Once you have your teacher's approval, carry out your experiment.

Analyze and Evaluate

SKILLS HANDBOOK 2.B.7.

(a) How much work was required to complete the task without the lever?

(b) Review the Testable Question and your hypothesis. Tell whether your results support your hypothesis. Remember to state your evidence.

(c) Using your observations, make a generalization that describes the relationship between the force required to move the load, and the distance over which the input force needs to be applied.

Apply and Extend

SKILLS HANDBOOK 3.D., 3.I.

(d) Mechanical systems employing levers have many diverse uses—from surgery to the Canadarm, from grand pianos to airplanes. Choose a subject in which you are interested and describe three uses of levers related to that subject.

(e) Linkages are a series of levers that are connected together (Figure 1). Moving one set of levers transfers the motion to all the other levers. List three devices that use linkages. You may want to search print and electronic resources to assist you.

Go to Nelson Science

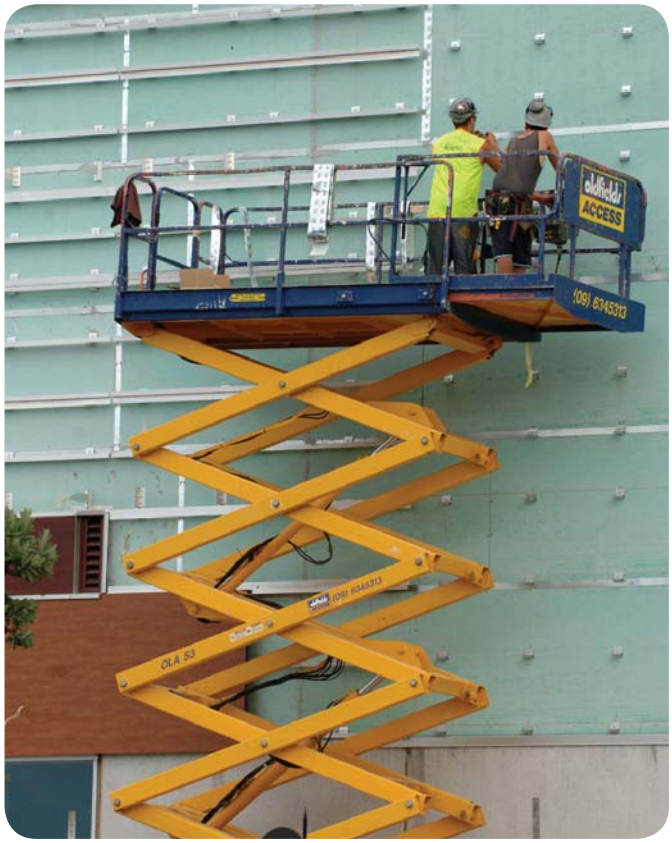

Figure 1 This linkage device elevates workers high off the ground.

Unit Task How can you apply your new knowledge and skill regarding levers and linkages to the challenges in the Unit Task?