Just a Little Bit of Effort: Exploring Levers

Student Activity Page 2A

Activity Introduction:

How many times have you used a broom, rake, pair of pliers, wheelbarrow, pry bar or played on a see saw? Each of these items involves a simple machine; the lever. Simple machines are designed to make work easier in some way, so they are good to have around!

Activity Background:

A lever is a rigid bar moving about a fixed point (fulcrum). More specifically, a lever consists of an ***effort force, resistance force*** (also called load) **,** ***rigid bar*** and a ***fulcrum***. The ***effort*** in a lever is a force applied to the lever in a specific direction and will cause movement in the lever if not balanced by an opposing force. The ***resistance*** in a lever is the force that opposes the effort force. The ***fulcrum*** in a lever is the support around which the lever pivots. Levers are classified according to the ***position*** of the fulcrum, resistance, and effort relative to each other. The combination of these relative locations results in ***first class, second class*** and ***third class*** levers.

First class lever (EFR)- The ***Effort (E)*** and ***Resistance (R)*** are located on opposite sides of fulcrum as shown in ***Figure 1: First Class Lever*** below. Examples of a first class lever include pry bars, see saws, crowbars.

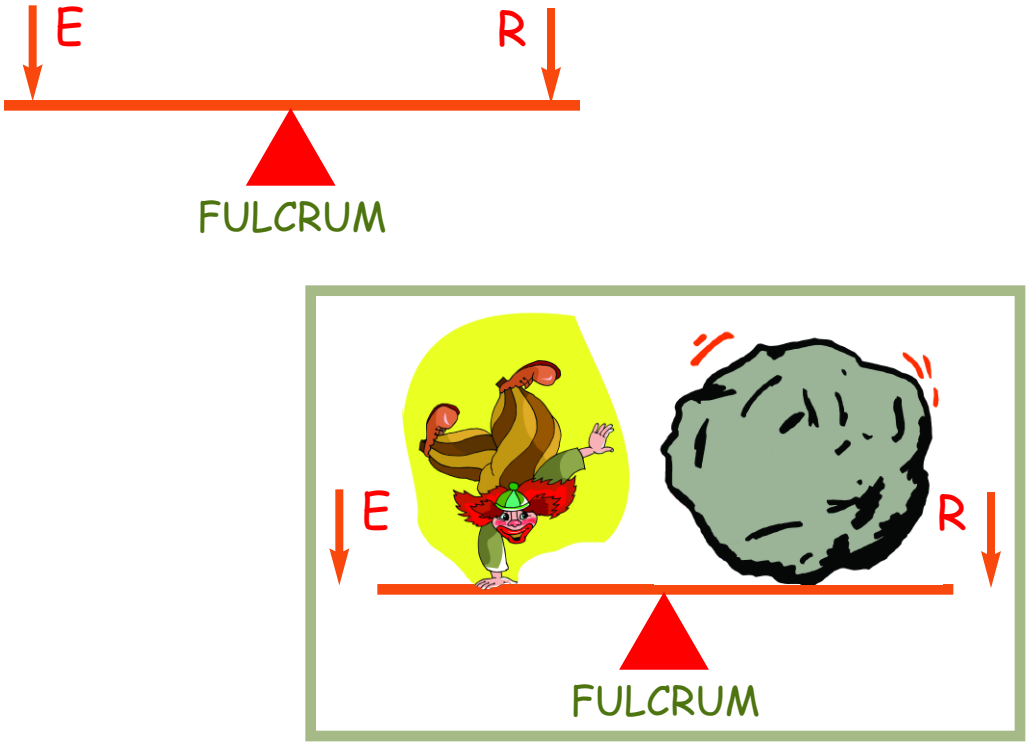

Figure 1 First Class Lever

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Discrepant Design

Second Class lever (FRE) - The *Effort (E)* and the *Resistance (R)* are located on the same side of fulcrum and the *Resistance (R)* is between fulcrum and *Effort (E)* as shown in *Figure 2, Second Class Lever* below. An example of a second class lever is a wheelbarrow.

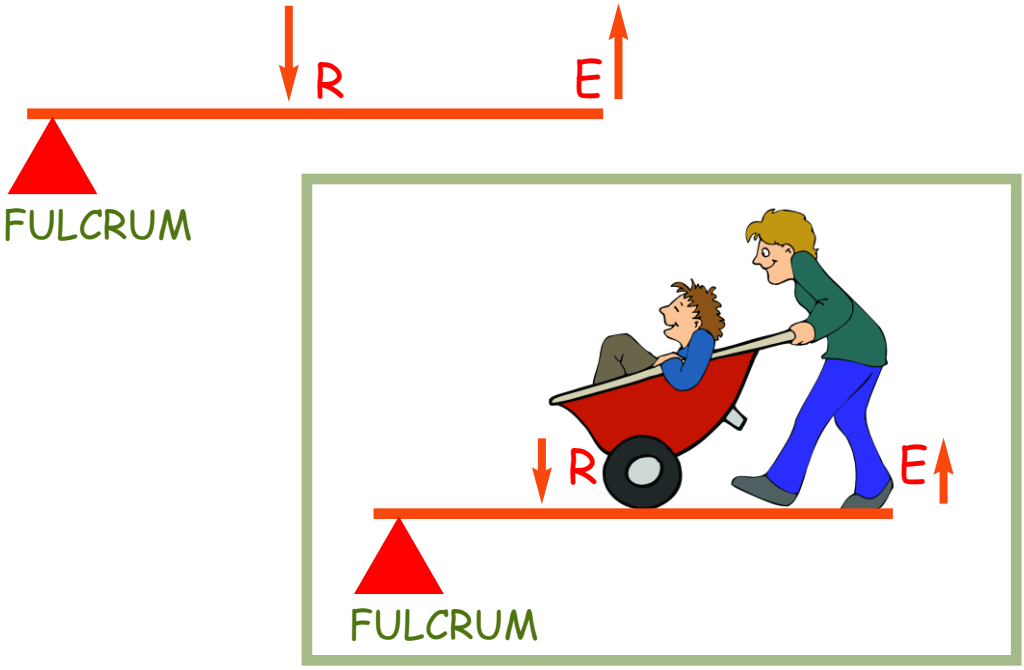


Figure 2 Second Class Lever

Third class lever (FER) - The *Effort (E)* and *Resistance (R)* are located on the same side of fulcrum, but the *Effort (E)* acts between fulcrum and the *Resistance (R)* as shown in *Figure 3 Third Class Lever* shown below. Examples of a third class lever include a shovel and a broom. Large effort gains speed of motion in this type of lever. It is the most common lever type in the human body.

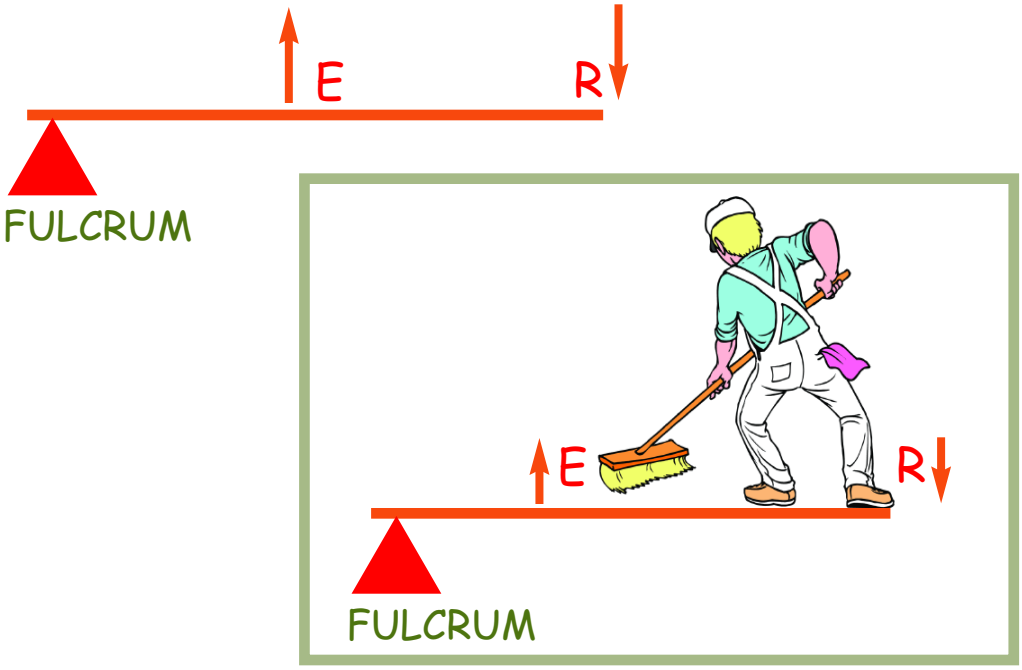


Figure 3 Third Class Lever

Activity Materials: (per group)

- Copy of ***Student Activity Page*** Packet
- 1 Copy of ***Student Data Page*** Packet ***per student***
- Wooden stand with hook inserted
- Wooden ruler
- 3 Binder clips 1 1/4″ wide, 5/8″ capacity
- Hanging weight set
- Spring scale – measurement scale needs to match that of hanging weight set

Instructions: (Read each instruction and check off each step as it is completed.)

1. Observe the diagrams of each class of lever in the background on this ***Student Activity Page***. Be sure you can define each part of a lever and that you can describe how each class of lever is constructed.
2. ***First Class Levers***

❒ a. Using the wooden stand with hook and wooden ruler, construct a first class lever. Place one binder clip onto the ruler so it will hang at its' center point on the hook of the wooden stand. Attach a second binder clip so it is centered over the ***2 cm*** mark on the wooden ruler. Place a 1 N weight so that it hangs from a third binder clip placed at ***28 cm*** on the wooden ruler. ***See Figure 1 Constructing a First Class Lever***.

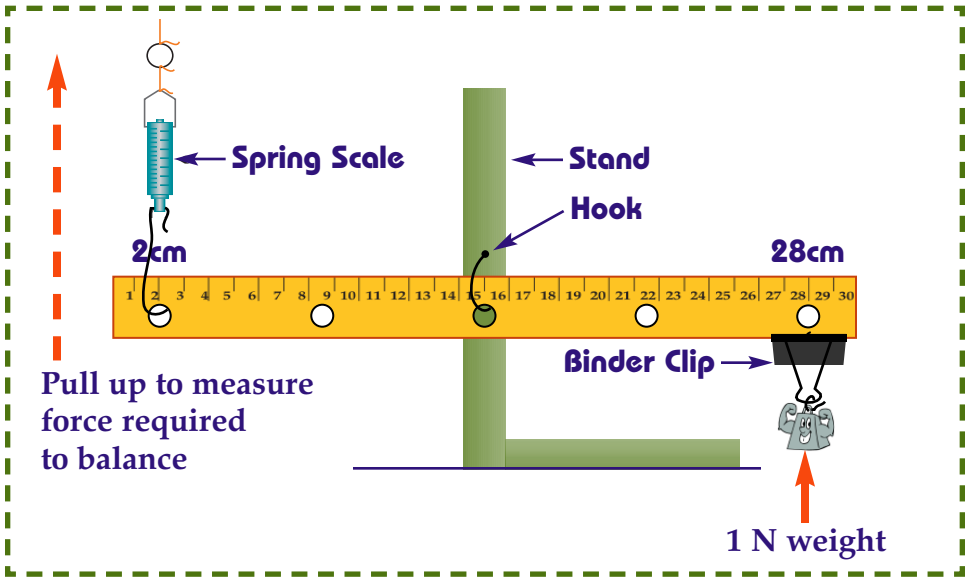


Figure 1 Constructing a First Class Lever

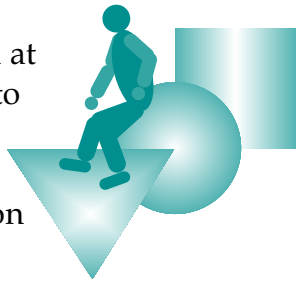
❒ b. Pull on the spring scale until the wooden ruler is level; the lever now is balanced and is in ***equilibrium***.

❒ c. Read the force you are applying ***(Effort)*** in Newtons on the spring scale and record it in ***Table 1, Exploring First Class Levers*** on your ***Student Data Page***.

❒ d. Repeat ***steps a – c*** placing the hanging weight (Resistance) at ***4 cm*** and the spring scale to measure the Effort in Newtons at ***28 cm***.

❒ e. Repeat ***steps a – c***, using the locations for the Effort and Resistance provided in ***Table 1, Exploring First Class Levers***. Record your measurements in ***Table 1, Exploring First Class Levers*** on your ***Student Data Page***.

3. ***Second Class Levers***



❒ a. Create a second class lever on the wooden stand. Place the fulcrum at ***2 cm***, the hanging weight (Resistance) at ***6 cm*** and the spring scale to measure the Effort force in Newtons at ***28 cm***. Balance the lever so the wooden ruler is level and read the amount of force you are exerting to keep the lever in equilibrium. Record this information in ***Table 2 Exploring in a Second Class Levers***.

❒ b. Repeat ***step a*** using the locations for the Resistance and Effort and recording the data in ***Table 2 Exploring Second Class Levers***.

4. ***Third Class Levers***

❒ a. Create a third class lever on the wooden stand. Place the fulcrum at ***2 cm***, the hanging weight (Resistance) at ***6 cm*** and the spring scale to measure the Effort force in Newtons at ***28 cm***. Pull on the spring scale to balance the lever so that the ruler is level and thus in equilibrium. Read the amount of force you are exerting to keep the lever in equilibrium and record all data in ***Table 3 Exploring Third Class Levers***.

❒ b. Repeat ***step a*** using the other locations for the Resistance and Effort and recording the data in ***Table 3 Exploring Third Class Levers***.

5. ***The Great "Little Bit of Effort" Contest***

❒ a. After you have explored the three classes of levers and have "processed out" the information to be sure you understand levers, you are ready to enter ***The Great "Little Bit of Effort" Contest***.

❒ b. In this contest, you and your group members will apply what you have learned about levers and will design a ***first class lever*** that can move the greatest amount of weight with the least amount of effort.

❒ c. When you are ready for the judging, raise your hand so your teacher can come to your work area and verify the results. While you are waiting for the teacher to verify your results, make a ***drawing*** of your lever design on the contest entry form. Be sure to label the fulcrum, effort and resistance and l***abel the locations of each in cm***.

❒ d. Repeat ***steps b – c*** for your second class lever design.

❒ e. Repeat ***steps b – c*** for your third class lever design.

❒ f. When you finish with all three parts of the contest, you will complete ***Table 4, "The Little Bit of Effort" Contest***, including calculating the ratio of ***Resistance Force ÷ Effort Force*** for each class of levers you design. The ratio you calculate is called the ***mechanical advantage*** of your lever system.

❒ g. When you finish Table 4, fill out the ***"Little Bit of Effort" Contest Entry Form*** and wait for the results!