Experiment #1

79319

Balancing the Balance

Objectives: Investigate how the closeness of the resistance to the fulcrum affects the effort needed to achieve a state of balance.

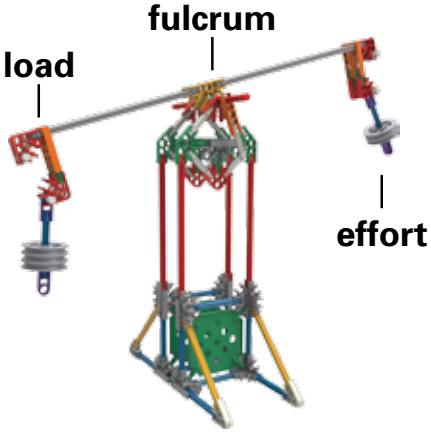
Materials You Will Need:

- built **BALANCE** model
- 10 washers or small paper clips
- Small stickers or pieces of masking tape
- A small object such as a binder clip, an eraser or a piece of chalk
- paper or notebook
- ruler

PROCESS:

1. Build the **BALANCE** model by following the step-by-step building instructions.

2. Using small stickers or pieces of masking tape, identify the **fulcrum**, **load**, and **effort** of the balance model.



3. Identify which class of lever the balance belongs to and why.

   a. Remove the gray trays (gray pulley wheels) from the model. Push the red and orange hangers to the end of the balance arms. Once the two arms are stationary, observe and describe, using the correct vocabulary, what the model is doing.

   b. What happens when one end of the model is given a small push/has a force applied? Explain your observations.

c. Why does the balance remain stationary, or at rest, until a force acts on it?

4. Replace the hanging trays (gray pulleys) so that there are two (2) pulleys on one side and one (1) pulley on the other. Push both of the hanging trays (gray pulleys) to the end of the balance arms.

a. What happens to the balance? Why does this happen?

b. What do you need to do to balance the forces in the model?

5. Go back to your unbalanced model with 2 pulleys on one side and 1 pulley on the other. Find a different way to balance the model without adding or removing pulleys. **Tip:** Try sliding the hanging trays, one at a time, closer to the center.

a. What happens?

b. Why does this happen?

6. Copy the table below to record your findings for the next steps in your notebook.

Effort Arm		**Load/Resistance Arm**	
Number of washers/paperclips (weight)	Distance from fulcrum	Object	Distance from fulcrum

a. Change the balance so that there is one pulley on each hanging tray. Make sure each tray is the same distance from the fulcrum. Measure that distance and record it in the table.

b. Place a small object on the load tray. Use washers or small paper clips as the weights on the other tray. Add washers or paper clips to the effort tray until the balance is level.

c. Count how many washers/paperclips it takes to balance the balance. Record your result in the table.

7. Move the load closer to the fulcrum. Balance the load by changing the amount of the effort force (weight).

   a. Record the measurements in the table.

   b. What do you notice about the length of the effort arm and the length of the resistance (load) arm?

   c. Did you add or remove weight? Why?

   d. Repeat this, moving the load and balancing it again. Record the measurements in the table.

   e. Make a drawing of the balance in your notebook to show the positions of the fulcrum, effort and load and the directions in which the forces are acting.

8. Move the effort closer to the fulcrum. Balance the load by changing the amount of the effort force.

   a. Record the measurements in the table.

   b. What do you notice about the length of the effort arm and the length of the resistance (load) arm?

   c. Did you add or remove weight? Why?

   d. Repeat this, moving the effort and balancing the load again. Record the measurements in the table.

   e. Make a sketch of the balance in your notebook to show the positions of the fulcrum, effort and load and the directions in which the forces are acting.

Extension Activity

1. Use gram weights and a ruler to determine the mathematical relationship involved in balancing the lever. Balance the lever with gram weights on both hanging trays. Use the ruler to measure the distances of the load and the effort from the fulcrum when the lever is balanced.

The Principle of Levers states that for a lever to be balanced:

Effort x its distance from the fulcrum = Resistance (load) x its distance from the fulcrum

or

E x EA = R x RA

Where: **E** = Effort force **R** = Resistance

EA = Length of Effort Arm **RA** = Length of Resistance Arm