Name_____ Period _____ Date _____

Machines

STEM Sims

Lesson 1: Lifting Lever

Is it possible for you to lift up something that weighs much more than you do? It is! One of the simplest ways to do this is by using a type of machine called a lever. A lever is a stiff plank or bar with an object or point that the plank rests on. Lift yourself up and start this simulation.

Here are some definitions to help you in your investigation.

Machine -	a device that can change the force on, the distance moved, and/or the speed moved of an object
Lever -	a simple machine made up of a plank and a fulcrum
Fulcrum -	a point or object a lever rests on
Plank -	a long, flat piece of wood or other similar material
Force -	any push or pull on something
Newtons (N) -	a unit of measure of force
Effort Force -	a force that is applied by a person on an object. This is also called the lifting force.
Load -	something that is being lifted or moved. Also called the resistance force because the load resists moving.
Balanced Forces -	two or more forces that cancel each other out. The forces are opposite in their direction, but equal in size.
Mass -	the amount of matter in an object
Kilograms (kg) -	a unit of measure of mass

Work - the transfer of energy by a force acting on an object that is being moved

Part I. First Class Lever

A first class lever is one where the fulcrum is in the middle of the effort force and the load or resistance force.

Doing the Science

1. Start the Machines Simulation by clicking on the "Simulation" tab.

2. Click the "Levers" button at the bottom of the screen.

3. Make sure that the number "1" (first class lever) is selected from the three numbered buttons at the bottom of the screen.

4. Use the Newton Converter button at the bottom right-hand corner of the screen if you need help converting the hanging mass from kilograms to newtons for the Force on Mass column.

5. Click the green "Pull" button on the Force Device on the right side of the screen.

6. Note and record in Table 1 the height the 1.0-kg mass lifts off the ground, the applied force, and height moved that is displayed on the Force Device.

7. Click the "Reset" button.

8. Click the left red arrow to move fulcrum to the 3-meter mark on the plank.

9. Repeat steps 4 - 7, making sure to note and record your data in Table 1.

10. Click the right red arrow to move the fulcrum to the 5-meter mark on the plank.

11. Repeat steps 4 - 7, making sure to note and record your data in Table 1.

12. Click on the 2.0-kg mass to replace the 1.0-kg mass on the plank. Repeat the entire experiment with the 2.0-kg mass.

Table 1. Forces and Height Moved

Fulcrum Position (m)	Mass (kg)	Force on Mass (N)	Height Mass Lifted (m)	Applied Force (N)	Height Force Device Moved (m)
4	1				
3	1				
5	1				
4	2				
3	2				
5	2				

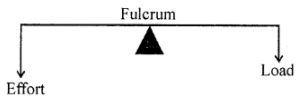
Do You Understand?

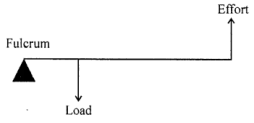
1. In what direction was the effort force applied?

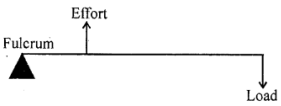
2. In what direction was the load force?

3. What was supplying the force on the load?

4. Which of the following images shows a first class lever?

a. 

b. 

c. 

5. State how position of the fulcrum in the simulation affected the lifting force required by the Force Device.

6. Describe how the height lifted by the Force Device in the simulation changed based on the fulcrum position.

7. If you could have moved the fulcrum in the simulation left to the 2.0-meter position, what would have happened to the:

   a. amount of effort force required to lift the load?

   b. height the load was lifted?

8. If you could have moved the fulcrum in the simulation right to the 6.0-meter position, what would have happened to the:

   a. amount of effort force required to lift the load?

   b. height the load was lifted?

Part II. Second Class Lever

Doing the Science

1. Click the number "2" to select the second class lever from the three numbered buttons at the bottom of the screen.

2. Use the Newton Converter button at the bottom right-hand corner of the screen if you need help converting the hanging mass from kilograms to newtons for the Force on Mass column.

3. Click the green "Pull" button on the Force Device on the right side of the screen.

4. Note and record in Table 2 the height the 1.0-kg mass lifts off the ground, the applied force and height moved that is displayed on the Force device. Please note that the Force Device remains at the 8.0-meter mark throughout the investigation.

5. Click the "Reset" button.

6. Click the red arrow to move the 1.0-kg mass to the 2-meter mark on the plank.

7. Repeat steps 2 - 5, making sure to note and record your data in Table 2.

8. Move and test the 1.0-kg mass at the following positions on the plank: 3, 5, and 6-meter marks.

9. Make sure to note and record your data in Table 2.

10. Click on the 2.0-kg mass to replace the 1.0-kg mass on the plank. Repeat the entire Part II experiment with the 2.0-kg mass.

Table 2. Forces and Height Moved

Fulcrum Position (m)	Mass (kg)	Force on Mass (N)	Mass Position (m)	Height Mass Lifted (m)	Applied Force (N)	Height Force Device Moved (m)
0	1		4			
0	1		2			
0	1		3			
0	1		5			
0	1		6			
0	2		4			
0	2		2			

0	2		3			
0	2		5			
0	2		6			

Do You Understand?

1. In what direction was the effort force applied?

2. In what direction was the load force?

3. State how the position of the hanging mass affected the lifting force required on the Force Device.

4. Describe how the height moved by the Force Device changed based on the hanging mass position relative to the effort force.

5. Work In is defined as the effort force times the height the effort force was lifted. Calculate the Work In for Mass = 1 kg at a mass position of 4 m.

6. Work Out is defined as the load force times the height the load force was lifted. Calculate the Work Out for Mass = 1 kg at a mass position of 4 m.

7. How did the Work In value compare to the Work Out value?

8. Is it correct to say that you got more work out of the machine (lever) than you put into it since you used a smaller force to lift the heavier hanging mass? Please explain your response.