ScienceCube

Principles of the Lever

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1. **Compare the magnitude of force based on the distance between the effort point and the fulcrum.**
2. **Explain how force and work are affected when using a lever.**

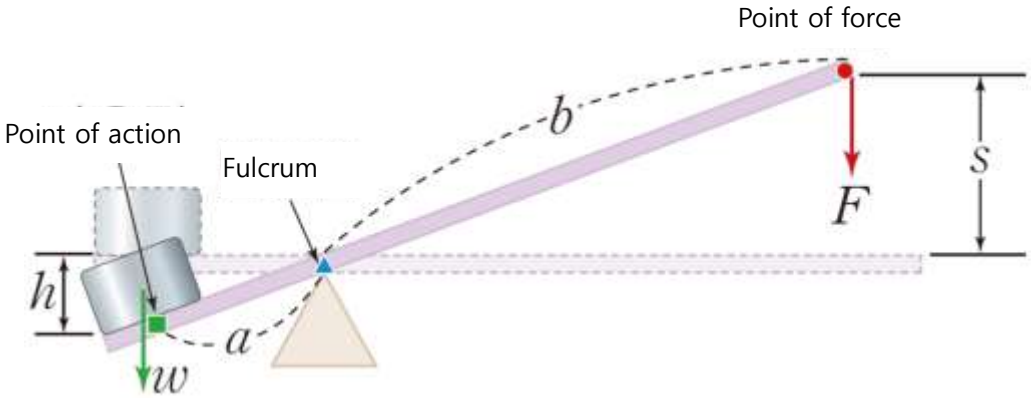
Fundamental Concept

1. Principles of the Lever

1) Effort Point: The point where force is applied to the lever.

2) Fulcrum: The pivot point that supports the lever.

3) Load Point: The point where the lever applies force to the object.



2. Magnitude of Force

$$w \times a = F \times b \qquad F = w \times \frac{a}{b}$$

⇒ If $a<b$, there is a mechanical advantage.

3. Distance Moved

$$a : b = h : s \qquad s = h \times \frac{b}{a}$$

⇒ If $a<b$, the distance moved increases (there is a disadvantage in distance).

4. Amount of Work

$$W = F \times s = (w \times \frac{a}{b}) \times (h \times \frac{b}{a}) = w \times h$$

⇒ Work done by a person = Work done by the lever (= Work done by directly lifting without a lever)

⇒ If there is a mechanical advantage, the distance moved is increased, so there is no advantage in the amount of work.

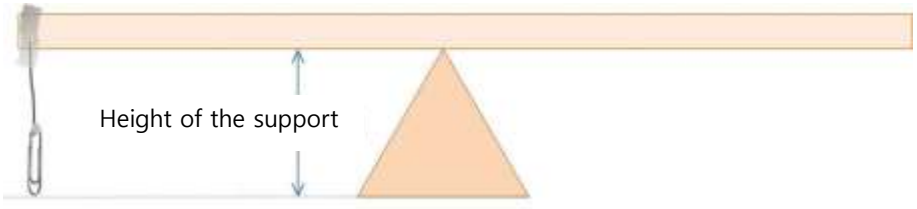
Experiment

Materials Needed

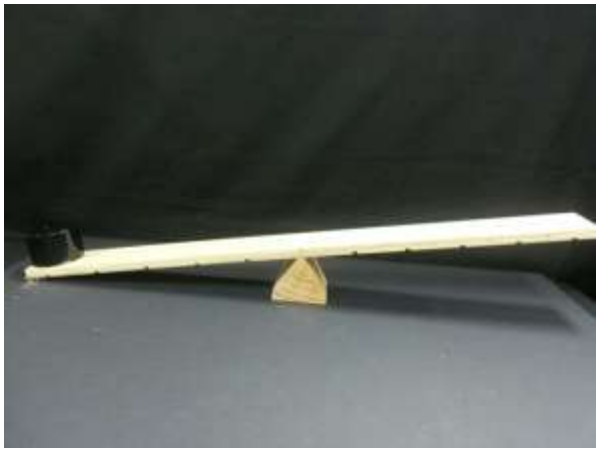
Interface, Science# Program, Force Sensor, 500g Weight, Lever (50 cm), Ruler, Clip, Thread (Paper), Cellophane Tape, Double-sided Tape, Scissors

Preparation of Experimental Setup

1. Mark points at 5 cm intervals up to 25 cm from the center of the lever.
2. Measure and record the height of the fulcrum stand. (Record in table 2)
3. Attach a clip to the thread, cut the thread to the same height as the fulcrum stand, and fix it to the lever with cellophane tape.

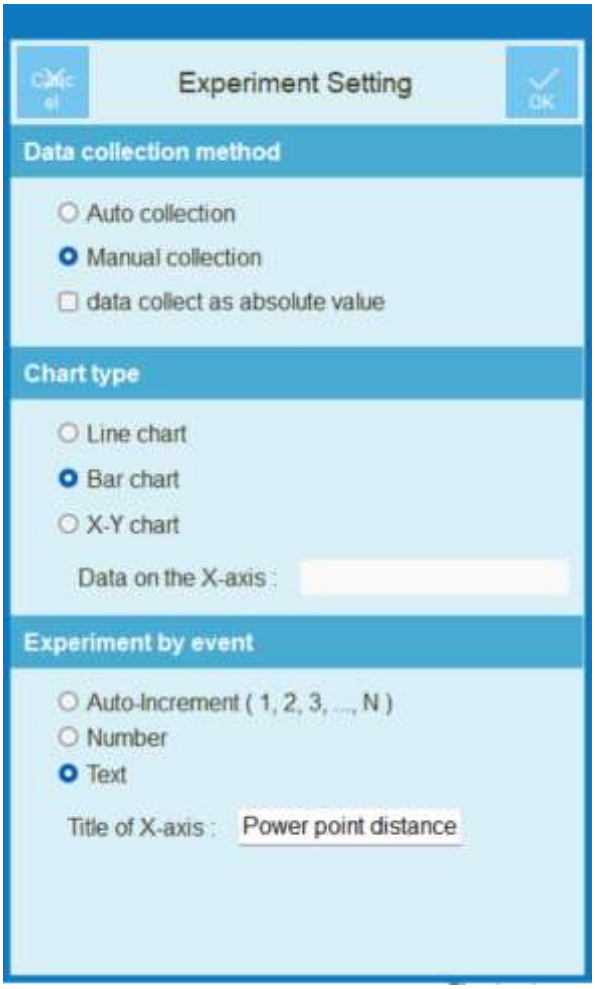


4. Attach double-sided tape to a point 25 cm left from the fulcrum and place the 500g weight on it.



Interface Setup

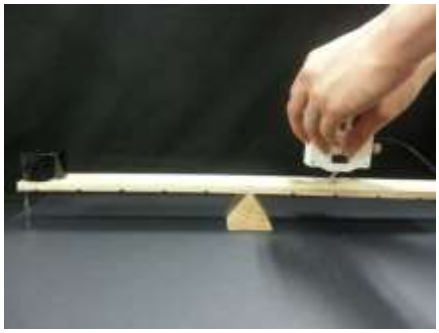
1. Launch the Science# program.
2. Connect the force sensor to the interface.
3. Press to set up the experimental environment as shown below, or use the automatic setting option.



4. Press  to zero the force sensor.
5. Press  to invert the sign..

Data Collection

1. Press  and measure the force by pressing  the force sensor at points 5 cm apart from the fulcrum while keeping the lever horizontal. Record the distance (between the fulcrum and the effort point) in the X-axis input box. (Adjust the force while watching the clip to ensure the lever is horizontal when the clip's end touches the ground.)
2. Measure and record the force at 5 cm intervals up to 25 cm from the fulcrum using the same method.
3.  Press to end the experiment..



Data Analysis

Recording Data

1. Plot a bar graph showing how the force changes as the distance from the center of the lever increases, and record it in table 4.

2. Measure and record the mass of the weight and the height of the fulcrum stand in the table.

. Mass of the Weight (g)	
Height of the Fulcrum Stand (cm)	

3. Calculate the distance (s) the lever moves to become horizontal and record it in table 4

$$a : b = h : s$$

4. Calculate the work done by the lever on the weight and the work done by the person,

and record it in the table (round to two decimal places)

w X h = Work done by the lever on the weight

F X s = Work done by the person

(h : The height from the ground to the point where the lever becomes horizontal = height of the fulcrum stand.)

Distance from Center (cm)		F	s	Work done by the person (J)	Work done by the lever (J)
Distance from center to object (a)	Distance from center to effort point (b)	Force applied	Distance lever moved (cm)		
25	5				
25	10				
25	15				
25	20				
25	25				

Data Application

1. Explain how the magnitude of the force and the distance moved to achieve balance change as the effort point moves farther from the center of the lever.

2. Compare the amount of work done when using a lever to the amount of work done without using a lever.

3. Find and describe examples of using the principles of the lever..


Report
(For Teachers)
Report
(For Students)