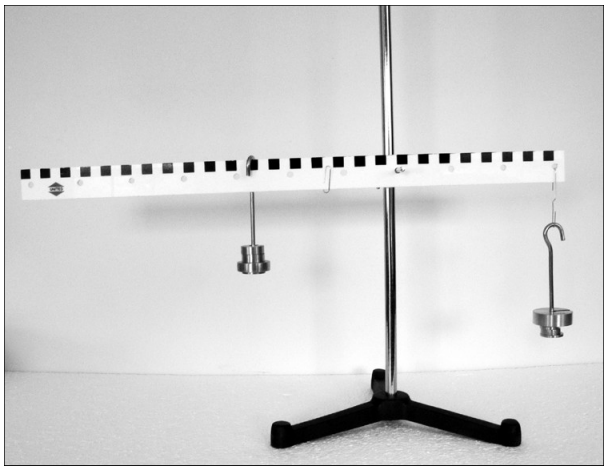
LAB ACTIVITIES MANUAL

AND SETUP INSTRUCTIONS

Basic Simple Machines Kit

FSMKIT02-E



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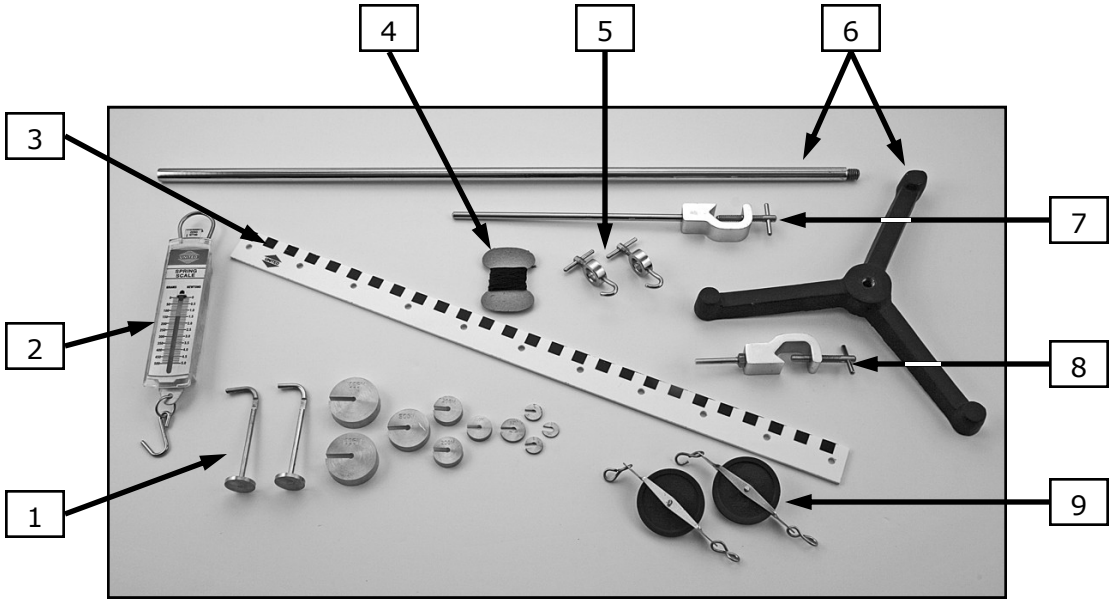
AND SETUP INSTRUCTIONS



Simple Machines Set

LIST OF PARTS IN THE SET

Refer to the keyed illustration above

1. Slotted weight set: 2 hangers (20g each), 2 x 100g, 50g, 2 x 20g, 10g, 5g, 2 x 2g, 1g
2. Spring scale, 0—5N
3. Lever with cm block scale; 52cm long with 11 pivot holes
4. Pulley cord, 10m
5. Hook collars, 1/2", 2 each
6. Support rod (24" x 1/2") and tripod base (5" legs)
7. Support rod with clamp,; rod 19.5cm long x 6mm diameter
8. Pivot rod for lever, with clamp; pivot rod 2.9cm long x 4.5mm diameter
9. Single pulleys, 2 each

You need to supply:

Ruler with a metric scale
Paper clips

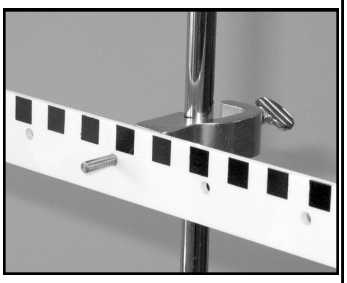
DESCRIPTION

The Simple Machines Set offers six activities designed to introduce students to the basic physical laws of levers and pulleys and to draw connections to where these devices occur in everyday life.
The materials are sturdy and of simple design so that the operating principles are clearly seen and students do not need to spend much time becoming acquainted with the equipment.
The activities are quantitatively based and require only basic arithmetic skills to complete.
The same items of equipment are used in multiple experiments, and the general nature of the designs allows teachers to devise further experiments that require only the equipment contained in the set. Each Activity description consists of a Teacher's Manual and a Student Procedure. These are also provided in electronic form (*Microsoft Word 2003* and *Microsoft Publisher 2003*), to allow modification as required and reproduction for class use.

SETUP

The use of the individual components of the set is described in detail in the Activities where they occur. Basic setups for the lever and pulleys require some explanation and are described here.

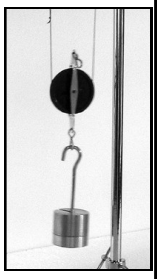
SETTING UP THE LEVER



Although the lever (#3 in the parts list) is only described here in its lever function, it can also be used as a crane boom, a ladder model, and an arm model.
To use the lever as any of the three classes of lever, the pivot rod (#8 in the parts list) is attached to the support rod (#6 in the parts list) at a suitable height— about 20cm above the bench is good— and the lever is attached to the pivot rod (the fulcrum) through any of the 11 pivot holes appropriate to the class of lever being shown.

SETTING UP PULLEYS

Fixed



Moveable

When setting up pulleys, it is important to follow the steps in the order given in the relevant Activity to avoid the cord slipping off the pulley groove or the weights falling onto the bench and releasing the cord to slide off the pulley.

FIXED PULLEYS

Always hang the pulley from the support before threading the cord through the upper slot in the pulley bracket. Adding a small weight to one end of the cord before threading onto the pulley helps maintain tension in the cord and makes threading easier—don't let go of the free end of the cord!

MOVEABLE PULLEYS

First hang a small weight from the lower pulley hook, then attach one end of the cord to the support before threading the cord through the lower slot in the pulley bracket. Maintaining tension in the cord and makes threading easier—don't let go of the free end of the cord!

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ACTIVITY 1

Teacher Manual

Three Kinds of Lever

BACKGROUND

Levers have been used since ancient times to help people make work easier to do, and they are still very useful in our modern society. Levers are mechanical devices for changing the size and the direction of a force.

A lever has five parts:

- Two straight stiff rods called *LEVER ARMS*. These are often two parts of the same rod;
- A pivot point called a *FULCRUM*. This can simply be the edge of a block, or a hole in the rod with a bearing;
- A force that is applied to move or support an object. This is called the *EFFORT*;
- An object to be moved that touches the lever. This is called the LOAD.

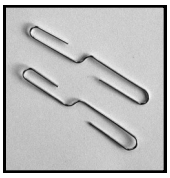
These five parts can be arranged in different ways, depending on the purpose of the lever. In this activity, we will investigate the different arrangements and find what effects they produce. We shall use a straight rod to form the two lever arms, and arrange the fulcrum, the load, and the effort in three different ways on the rod.

LAB ACTIVITY

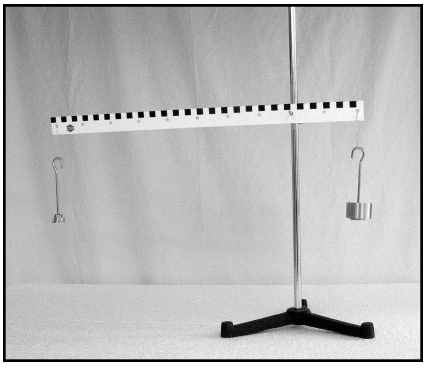
MATERIALS NEEDED:

1	Rod and base
1	Lever (rod)
1	Pivot with clamp
2	Weight hangers
1	Set of slotted weights
1	Spring scale
1	Support rod with clamp
2	Paper clips

ACTIVITY:

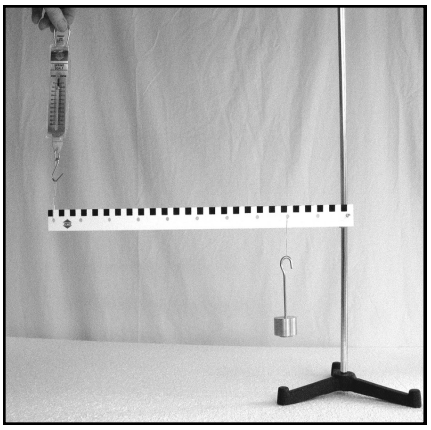


- Straighten out the two paper clips to make two "S" hooks as shown in the picture. You will use these to attach the weight hangers to the lever.
- Assemble the threaded end of the stand rod to the stand base, and attach the pivot with clamp to the rod about 20 cm above the base.
- To make the FIRST KIND OF LEVER, attach an "S" hook to each of the end holes on the lever, hang the lever on the pivot using the third hole from the right side, and attach an empty weight hanger to each of the "S" hooks.
- Now hold the lever steady and add two 100g weights to the right side weight hanger.
- Still holding the lever, add weights to the left side weight hanger until the lever balances as shown (start with small weights.)

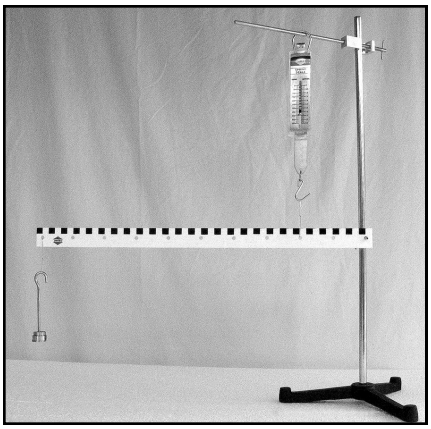


Record the total weights on each side of the lever in the table, and fill in the positions of the load, effort,

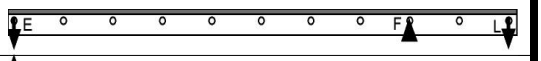
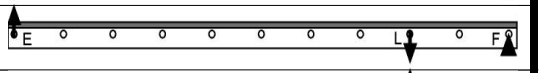
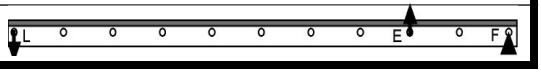
- and fulcrum on the sketch of the lever. Show the fulcrum as a triangle (Δ) and the load and effort as vector arrows.
- To make the SECOND KIND OF LEVER, move the "S" hook on the right side of the lever to the third hole from the right, hang the lever on the pivot at the right hand end hole, attach an empty weight hanger to the right "S" hook, and attach a spring scale to the left "S" hook.
- Now hang a 100g weight from the weight hanger and lift the spring scale until the lever is level, as shown.
- Record the total weight of the hanger and weight and the reading of the spring scale in the table (use the gram scale for easy comparison with the weight.) Mark the positions of the load, effort, and fulcrum on the diagram as before.



- To make the THIRD KIND OF LEVER, attach the support rod with clamp to the top of the stand rod as shown, move the weight hanger to the left "S" hook, attach the spring scale to the right "S" hook, and place the loop of the spring scale over the support rod.
- Now add 30g of weights to the weight hanger and carefully adjust the height of the support rod and clamp until the lever is level as shown.
- Record the total weight of the hanger and weight and the reading of the spring scale in the table (use the gram scale for easy comparison with the weight.) Mark the positions of the load, effort, and fulcrum on the diagram as before.



EVALUATION

Kind of lever	Load (g)	Effort (g)	Lever arrangement
1	*220*	*35*	
2	*120*	*55*	
3	*50*	*400*	

- Look at your diagrams of the levers. Where is the fulcrum located with respect to the load and effort for each type?

  1: *Between E and L* 2: *At end, beyond L* 3: *At end, beyond E*

- How did each of the levers affect the effort needed to move the load? Larger or smaller?

  1: *Much smaller* 2: *Smaller* 3: *Much larger*

- Levers are common in everyday life. Give some examples of each type:

  1: *Weighing balance, pry bar* 2: *Wheelbarrow, crane* 3: *Human arm, crane*

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ACTIVITY 1 *Student Procedure*

Three Kinds of Lever

BACKGROUND

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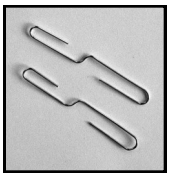

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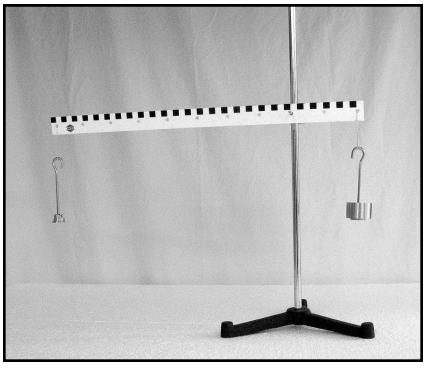

and fulcrum on the sketch of the lever. Show the fulcrum as a triangle (Δ) and the load and effort as vector arrows.

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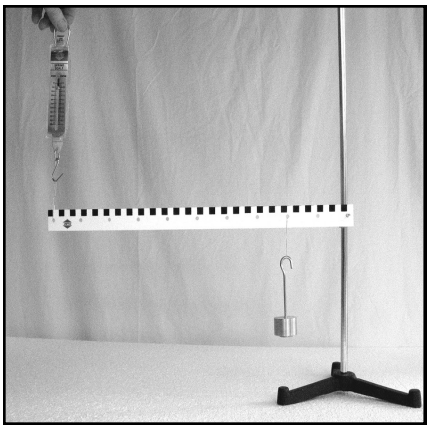

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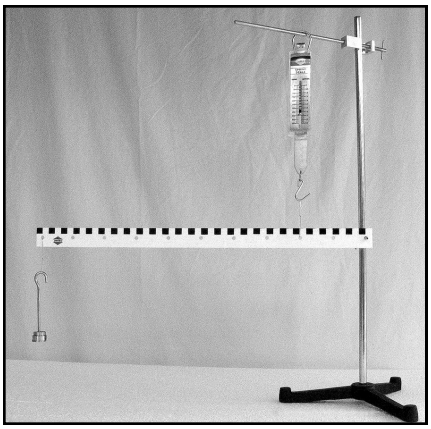

EVALUATION

Kind of lever	Load (g)	Effort (g)	Lever arrangement
1			
2			
3			

- Look at your diagrams of the levers. Where is the fulcrum located with respect to the load and effort for each type?

  1: _____ 2: _____ 3: _____

- How did each of the levers affect the effort needed to move the load? Larger or smaller?

  1: _____ 2: _____ 3: _____

- Levers are common in everyday life. Give some examples of each type:

  1: _____ 2: _____ 3: _____

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