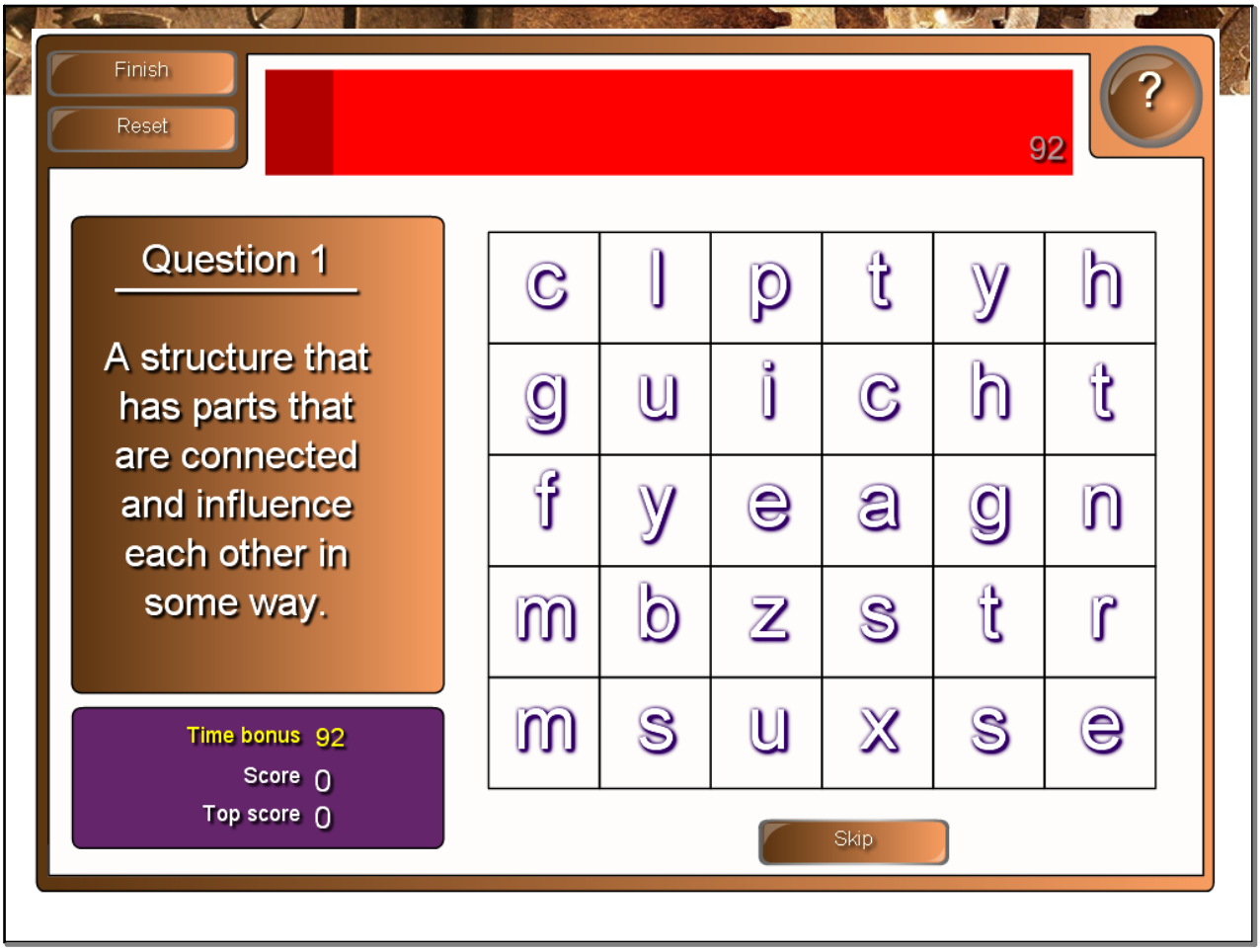
Grade 8 Science

Unit 4: Systems in Action



Does Size Matter?

When people talk about strength, they often look at the ability to lift something as a measure of how strong someone is. Let's take a look at this ourselves.

We need to use three volunteers to discuss this example:

Person A	Person B	Person C
Small	medium	large

So, we need to look at strength based on the ability to lift.

Do you think Person A could lift Person B and hold them up?

What about Person C, do you feel they could hold up Person B?

Is there something Person A could do to accomplish this task?

Could they lift Person C?

Levers

In grade 2 you studied "Simple Machines," one of which was a lever. What is a lever?

Lever	A bar that is free to rotate about a fixed point.

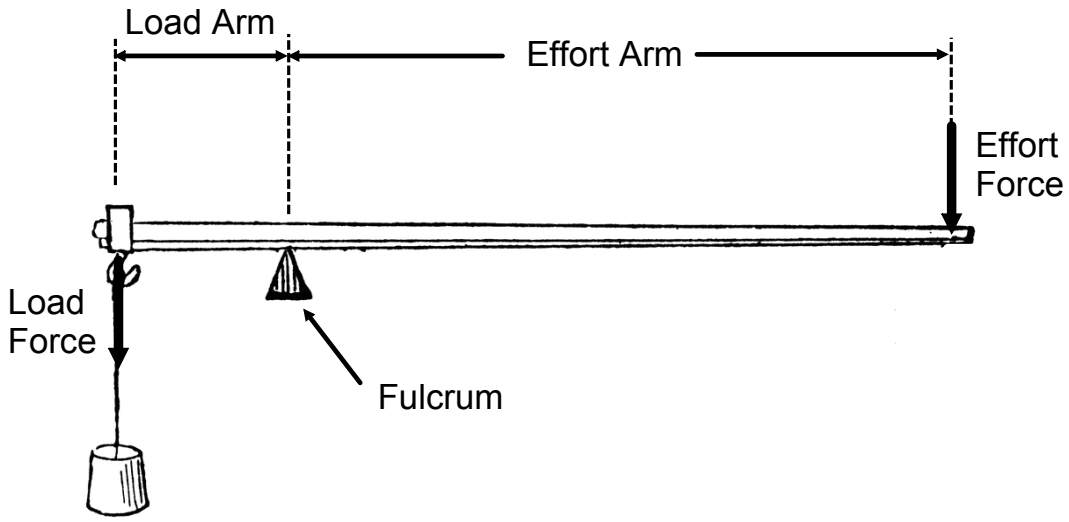
Let's look at how a lever may be used to help our volunteers.

Here is the terminology we used to label our lever:

Load	The output force exerted by the lever.
Effort	The input force exerted on the lever.
Fulcrum	The lever's point of rotation.
Load Arm	The distance between the load and the fulcrum.
Effort Arm	The distance between the effort and the fulcrum.

Levers

Here is a labelled image of a lever:



Levers

We have seen how levers can work to assist in moving an object, now we need to look at the math associated with it. The abilities of a lever may be determined by using ratios. Let's use the example of a parent and child playing on a see-saw:

When two people, with significantly different mass are on a see saw, one person inevitably gets stuck up in the air.

If the parent and child want to play properly on the toy, what must they do?

By moving the parent closer to the fulcrum, you reduce the size of the load arm. The exact distance, to make the see-saw perfectly balanced, can be determined by the following:

Levers

This ratio tells us that if the parent is 3 times the mass of the child, then the child needs to be three times further from the fulcrum.

$$\frac{Load\ Arm}{Effort\ Arm} = \frac{Effort\ Force}{Load\ Force}$$

What is wrong with this picture?

Levers

Here is an example of how we can use this:

A farmer needs to move a boulder to clear some new land. To get it rolling he needs to apply a force of 3000 N. The farmer is only capable of applying 750 N force. If he has a 4 m long pole to use as a lever, where should he place his fulcrum?

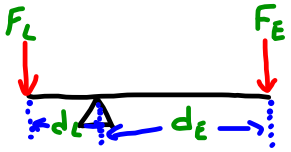
$F_L = 3000\,N$

$F_E = 750\,N$

$d_L = ?$

$d_E = ?$

$*\ d_L + d_E = 4\,m = 400\,cm$

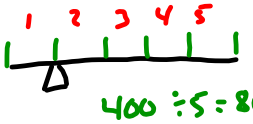


$$\frac{d_L}{d_E} = \frac{F_E}{F_L}$$

$$\frac{d_L}{d_E} = \frac{750}{3000} \quad \div 750 \quad \div 750$$

$$\frac{d_L}{d_E} = \frac{1}{4}$$

∴ The lever can be divided into 5 sections, 1 on the load side and 4 on the effort side



$400 \div 5 = 80$

∴ The fulcrum needs to be within 80 cm of the load.

Levers

Although we often think of a lever as being similar to the examples we have looked at, applying a force on the end on a bar to make a resulting force on the opposite end of the bar, there are actually three different "classes" of lever.

Class 1: A lever in which the **fulcrum** is between the load force and the effort force. A pair of scissors is an example of a class 1 lever.

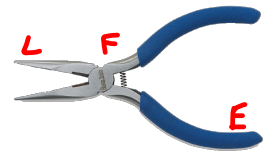
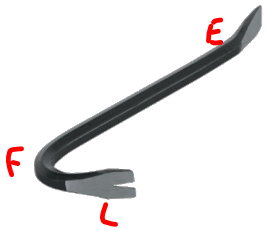
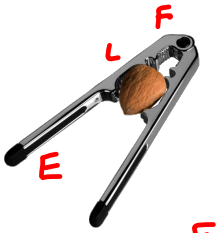
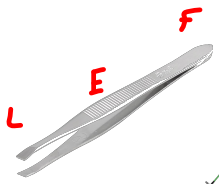
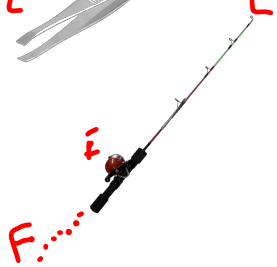
Class 2: A lever in which the **load** is between the effort and the fulcrum. A wheelbarrow is an example of a class 2 lever.

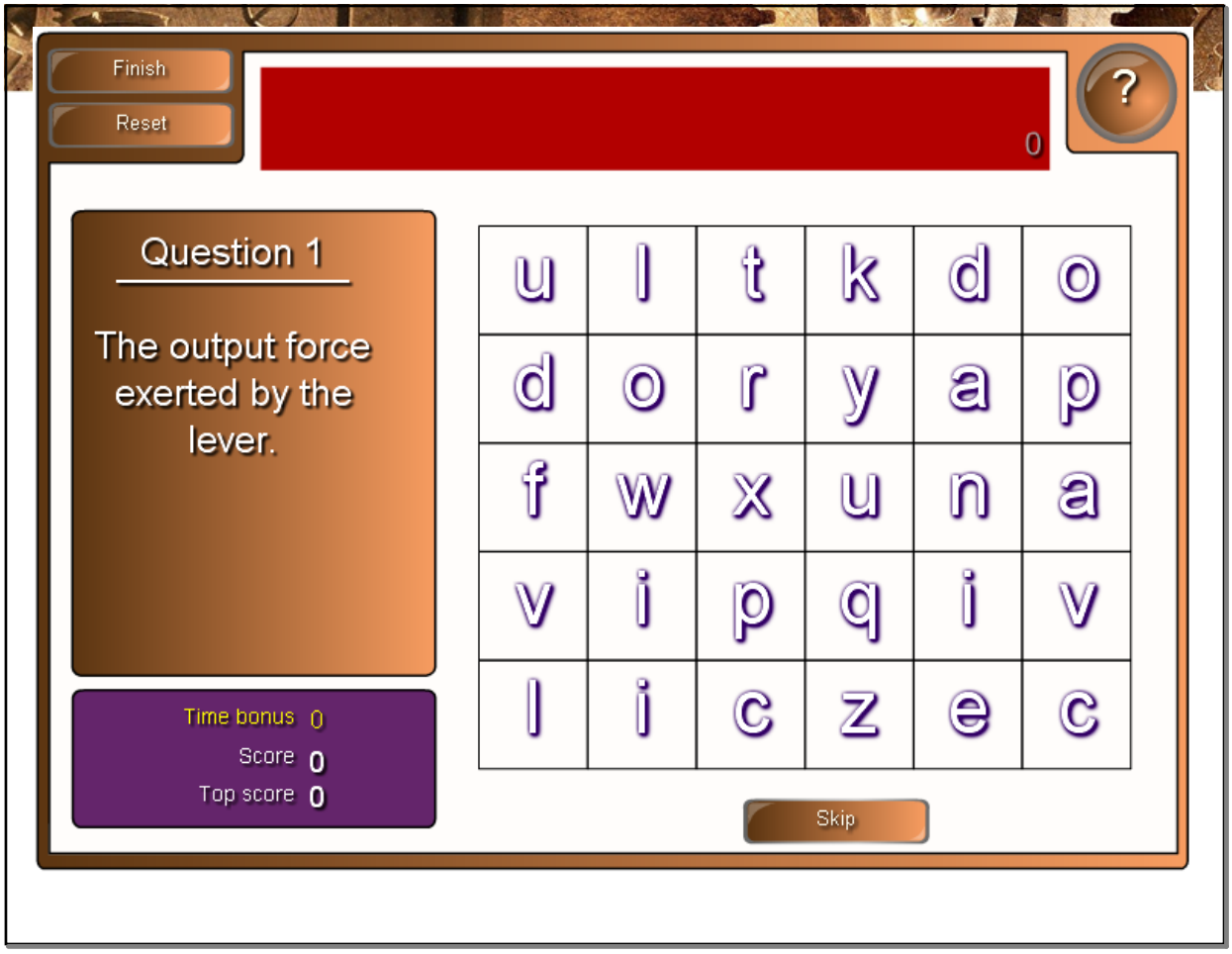
Class 3: A lever in which the **effort** is exerted between the fulcrum and the load. A hockey stick is an example of a class 3 lever.

*The bolded word indicates what is in the middle, it defines that specific class of lever.

Levers

Sort the levers into the proper classes.

Class 1	Class 2	Class 3
 	 	 


Finish
Reset
0
?
Question 1
The output force exerted by the lever.
u l t k d o
d o r y a p
f w x u n a
v i p q i v
l i c z e c
Time bonus 0
Score 0
Top score 0
Skip