3 FORCE – GRAVITY – SIMPLE MACHINES

OBJECTIVE

Students will:

- Learn about force and simple machines;
- Be able to explore and explain some common phenomena such as falling or how they can move a heavy object more easily by using simple machines.

CONTENT

1. Force
   Activity 1: Our power
2. Gravity
   Activity 2: All fall down?
3. Simple machines
   Activity 3: Lever – Can you lift the Earth?
   Activity 4: Inclined plane

ENGAGE

This part is for coaches to trigger curiosity in students about the topic of this lesson.

Coaches ask students if they have ever seen a mango falls up? If not, what really happen in real life? Why? What makes the mangoes fall down to the ground?

EXPLORE

1 FORCE

Force is a new concept to students of grade 6, therefore, this section will only aim to introduce to them the intuition in the concept of force and the two distinct characteristics of a force (direction and magnitude)

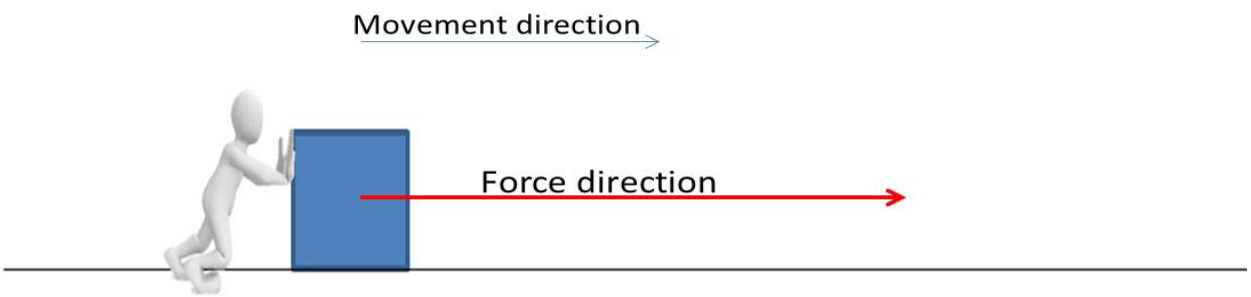
❖ **Activity 1: Our power**

Preparation
Coaches prepare an object (a bag, a ball, shoes, etc.).

Implementation
Coaches leave an object in the middle of class, then a coach will use his/her hand to push the object forward and ask students what happen to the object? Has the object moved? In what direction has it moved? Why did it move?

Coaches ask students to draw an arrow representing the force that the coach has applied to the object (this picture is in their books).

Explanation
This part is for coaches to explain what happened in the demonstration and give answers to the questions above.



– When a coach pushes the object, it moves forward. The object moves because the coach has applied a **force** to the object.

- A force has specific **direction**, in this case, the direction of the force is horizontal and from left to right.
- A force can be represented by an arrow, as illustrated in the picture. The arrow shows the direction of the force.
- In addition to direction, a force also has specific **magnitude**, which tells us how strong or light a force is.

Coaches can further ask kids questions below to expand their learning:

- If the coach does not push the object but pulls the object in the opposite direction (as compared to the first case), how will the object move?

  Answer: The object moves in the opposite direction.

- If the coach pulls the object with a stronger force, what aspect of force changes?

  Answer: Magnitude.

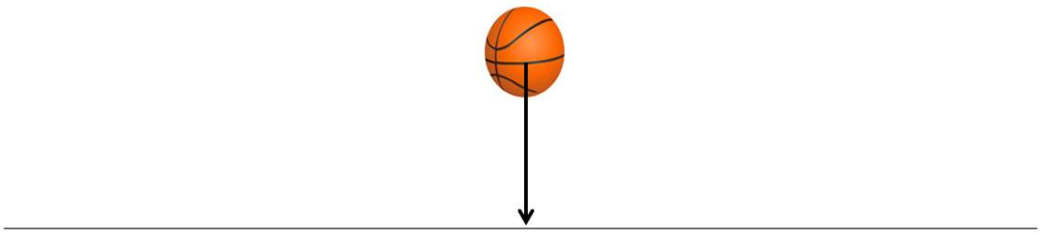
2 GRAVITY

❖ **Activity 2: All fall down?**

Preparation
Coaches prepare a ball (volleyball, soccer ball, etc.)

Implementation
- A coach holds the ball on his/her hands.
- Now that kids have been aware of the concept of force, magnitude, and direction, as introduced in the first part, ask them to observe closely to the movement of the ball once the coach lets it fall.
- After observing the coach, students are to repeat the coach's action with any (non-fragile) object they have at their seats.
- Ask kids what is the common characteristic in all the movements that coaches and they have just performed? (*They should be able to recognize that the direction of all those movements is downward.*)
- Based on the first part, ask them if they think there is some kind of force that drags the ball downward?
- After discussing that, coaches let students draw an arrow representing the invisible force that drags the ball down to the ground.

Explanation



Coaches gives the correct answer as shown in the picture and explain to kids about gravity.

- The ball falls down in a vertical and downward direction.
- The "invisible" force that acts on the ball and makes it fall down is from the ground. It is called **gravity**.
- Gravity applies on **all objects on the Earth**. The **direction** of the force of gravity is **vertically downward**.
- In layman's term, gravity is the attraction that the ground has to all objects.

So, does a mango ever fall up to the sky? No, it doesn't. Under the force of gravity, a mango is pulled down to the ground once it falls.

3 SIMPLE MACHINES

❖ **Activity 3: Can you lift the Earth?**

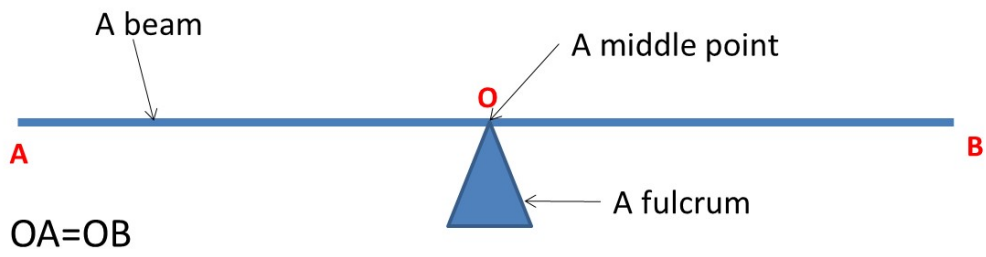
Preparation

Coaches prepare 4 rulers, 4 pens, 4 lemons and 4 kumquats.

Implementation

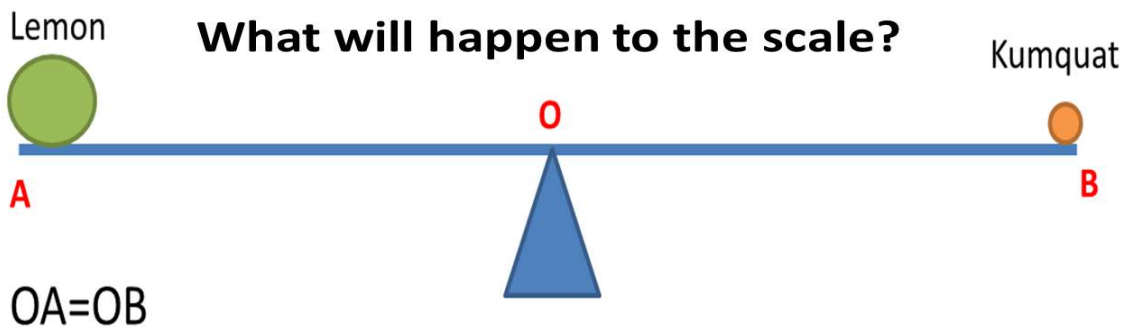
Coaches divide students into 4 groups. Each group will receive: a ruler, a pen, a lemon, and a kumquat. Coaches are to instruct students to do this activity following these steps:

- Step 1: A ruler is used as a beam and a pen is used as a fulcrum. Coaches ask each group to set up the experiment as the picture below and make sure the beam is balanced. When this system is balanced, it works as a scale.



– <u>Step 2:</u> Ask students:
  - A lemon and a kumquat, which one is heavier?
  - If you put a lemon at A and a kumquat at B what will happen to the scale?

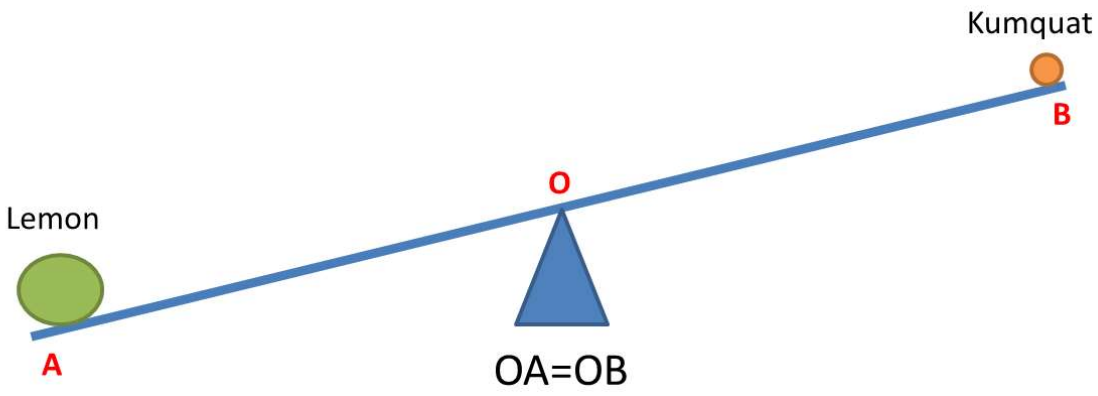
  Coaches let students guess the result and then let them keep doing the experiment.



– <u>Step 3:</u> Give students 2 minutes to solve this problem: Without adding anything **how can a kumquat 'lift' a lemon or how to make ruler inclined to a kumquat?**

Explanation

Firstly, coaches give the answer of step 2: The balance system set up in step 1 works as a scale. The lemon is heavier than the kumquat, so the ruler inclines to the lemon.

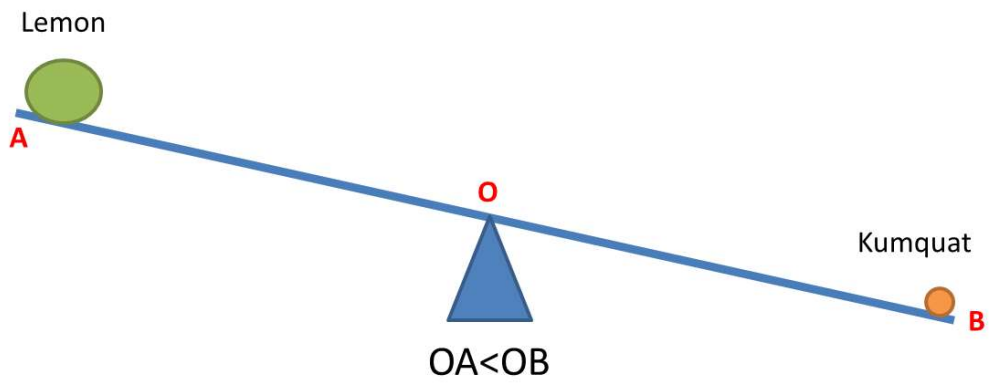


Next, coaches introduce what is a lever to students: A system including a **load**, a **fulcrum**, and an **effort** is called a **lever.**

- Load: the object they are lifting.
  Example: In activity 3, if we want to lift up the lemon, the lemon is a load.
- Fulcrum: point at which the lever pivots.
  Example: In activity 3, a pen at the middle point of the ruler is a fulcrum.
- Effort: the force applied to make the object move.
  Example: In activity 3, a kumquat is an effort.

A lever is a simple machine that allows us to gain mechanical advantage. It can be used to **exert a large force over a small distance at one end by exerting only a small force over a greater distance at the other.**

That mechanical advantage is shown in step 3. In that step, to make the ruler inclined to the kumquat without putting anything at B we can move the pen (O or the fulcrum) to the lemon till the ruler inclines to the kumquat or OA<OB.

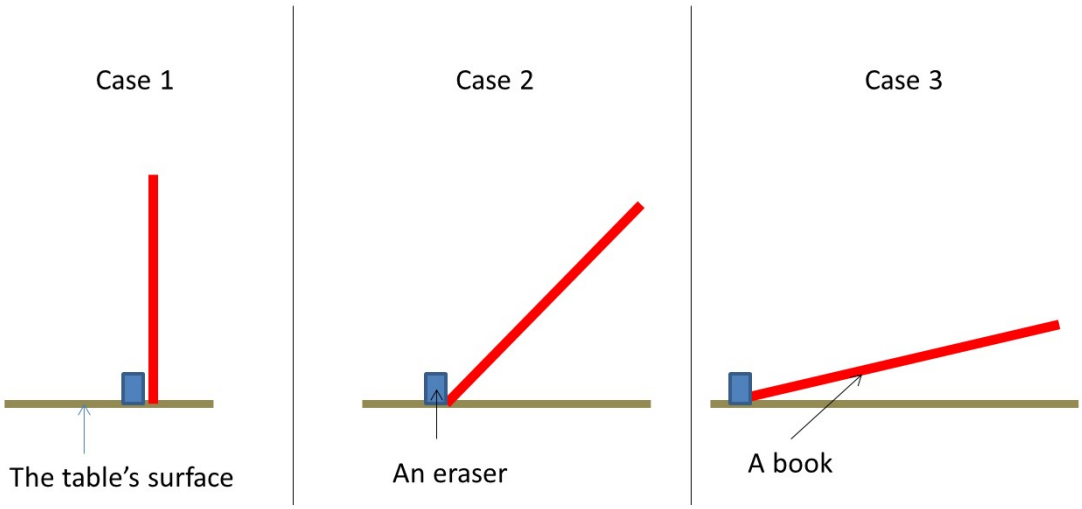


You can be a superman/superwoman: If you have an ideal beam and fulcrum, in theory, you can lift up a building, a mountain, or even the Earth.

❖ **Activity 3: Inclined plane – Strength of length**

Preparation
Coaches prepare 4 books and 4 erases.

Implementation
Coaches divide students in 4 groups (3 students/group). Each group has a book and an eraser. Coaches are to guide students implement this activity following 3 cases below, students have to move the eraser up on the book surface without lifting the eraser.



Explanation

This activity is to demonstrate the mechanical advantage of an inclined plane.

In this activity, an eraser is as a load that we want to move. Given the same force, the steeper the slope is, the harder it is to make the erase move up. With the same force applied, the eraser in case 3 will be moved further among the three cases, because its slope is not as steep. The book was used as an inclined plane in this experiment.

An inclined plane is a flat surface with one end higher than the other. It is used as an aid to raise or lower a load. The inclined plane is one of the classical simple machines defined by the Renaissance scientists. Examples of inclined planes include slides and ramps. Inclined planes are believed to have been used by the Egyptians in building the pyramids.

If the slope is not very steep, a person has to push or pull the object over a **long distance**, but with **little effort**. If the slope is steep, a person has to push or pull the object over a very **short distance**, but with **more effort**.

EVALUATE