MAKING WORK EASIER

SIMPLE TOOLS

Tools used to make work easier are called simple machines.

Examples of simple tools and their functions

<table>
<thead>
<tr>
<th>PICTURE</th>
<th>NAME</th>
<th>FUNCTION / USE</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Hammer" /></td>
<td>Hammer</td>
<td>For driving in and removing nails on wood</td>
</tr>
<tr>
<td><img src="image" alt="A Saw" /></td>
<td>A Saw</td>
<td>For cutting timber and pieces of wood</td>
</tr>
<tr>
<td><img src="image" alt="A Jembe" /></td>
<td>A Jembe</td>
<td>Used for digging and removing weeds. Digging hard places. Used where the soil is soft and for removing weeds</td>
</tr>
<tr>
<td><img src="image" alt="A Panga" /></td>
<td>A Panga</td>
<td>Used for cutting things e.g. woods sugarcane etc</td>
</tr>
<tr>
<td><img src="image" alt="A Knife" /></td>
<td>A Knife</td>
<td>For chopping, cutting, peeling or carrying wood.</td>
</tr>
<tr>
<td><img src="image" alt="A bottle opener" /></td>
<td>A bottle opener</td>
<td>For removing bottle tops from soda bottles.</td>
</tr>
</tbody>
</table>

CARE AND MAINTENANCE OF SIMPLE TOOLS

a) Using for the right purpose (proper use)
b) Cleaning tools after use
c) Sharpening cutting tools
d) Oiling and greasing tools made of metals and moving parts to avoid rusting.
e) Storing tools properly in order:
   - to sell them
   - to keep them
   - to keep people safe
   - for tools to last longer
f) Repairing tools when they break down e.g. loose handles
MACHINES
BALANCING AND WEIGHING
1. To balance – is to cause stability or steadiness.
2. To weigh – is to find the heaviness of something or quantity of something.
3. A weighing balance or scales are used to compare mass of objects which are usually used in retail shops.

4. Mass is the quantity of matter in a substance or object.
5. Mass is measured in grams, kilograms or tonnes.
6. Balances for measuring mass include:
   - Beam balance
   - Lever balance
7. Standard weights – These are pieces of metals with known weights used to balance unknown mass.

**Beam Balance**
- Used to compare masses of different objects

*Making a beam balance*

Materials
- Two tins of the same size
- Strings or wire for suspending the tins from the arm.
- Pieces of board – for making the arm.
- Nail – for support

- Objects of the same mass balance when placed at equal distance from the fulcrum.
- Heavy objects make the arm move downwards and lift the lighter objects upwards.

**A SEE-SAW**
A see-saw is a plank of wood which moves about a point in the middle called a fulcrum or pivot.

*Balancing on a see-saw*
- For people of the same mass to balance, they should sit at equal distance from the fulcrum.
- Heavy and lighter people-the heavy one should sit near the fulcrum and the lighter one should sit far away from the fulcrum for them to balance.

**FORCE AND MOVEMENT**

- Force is a push or a pull.
- When something is moving, it is said to be in motion i.e. it is in movement.
- Force can cause the following:
  a) Start motion i.e. make objects move
  b) Speed up motion
  c) Slow down motion
  d) Stop motion

**START MOTION**

- Force can move objects.
- Force can be applied to move objects by:
  a) pushing objects
  b) pulling objects
  c) lifting objects

**Examples of objects in motion:**

- Pushing a wheelbarrow full of sand
- Kicking a ball – you push the ball using your leg
- In a boat, the sail is pushed by the wind for the boat to move
- Riding a bicycle, the cyclist pushes the pedals in order to make it move
- Using a catapult to pull a stone and then release it
- Wind pushing propellers of a windmill to start motion

**Activity:** Draw the above objects in motion.

**TYPES OF FORCE**

- Force of gravity
- Magnetic force

**Force of Gravity**

- The force of gravity is a pull on all the objects towards the ground (earth).
- The force of gravity can stop the upward movement of an object.
- Objects fall from a height due to force of gravity.

**To investigate**

- When a ball is thrown upward, the speed of the motion decreases as it goes up until
the ball stops.
- The ball starts moving downwards towards the ground.
- The speed increases as it come down i.e. it accelerates due to the pull of gravitational force.
- The force of gravity is as a result of the earth’s mass.

**N.B** When two objects of the same weight are dropped from the same level above the ground at the same time, they reach the ground at the same time. This is because the force of gravity acts equally in all objects.

**Magnetic Force**
- Magnetic force pulls objects made of magnetic materials together.
- Magnetic materials are pulled together by a magnet (attracted by a magnet).
- Examples of magnetic materials are:
  - Iron
  - Steel
  - Chromium
  - Cobalt
  - Iron-nickel
  - Graphite
  - Tin

N.B. Force of gravity and magnetic force causes motion.

**STATIONARY AND MOVING OBJECTS**
- An object that is NOT in motion is said to be stationary.
- When an object is stationary, it tends to remain in that state unless it is moved by a force.
- The tendency of an object to remain in the same state (moving or stationary) is called Inertia.
STOPPING MOVING OBJECTS

1. The force of gravity stops objects from moving upwards. They stop and start falling downwards.
2. Applying a push or force in the opposite direction stops moving objects.
3. The force that opposes motion in the opposite direction is called friction.

ACTIVITY ONE

• Arrange a coin, glass and a piece of cardboard as shown below:
• Pull the cardboard suddenly.
• The coin does NOT move along with the cardboard.
• This shows inertia

ACTIVITY TWO

i. Arrange coins in a pile as shown below.
ii. Suddenly knock out the coin at the bottom using a ruler.
iii. The coin moves out leaving the pile intact.
iv. The pile remains intact because of inertia.

Think of.....
Emergency brakes applied on a moving vehicle carrying passengers.
What happens to the passengers?
UNITS OF FORCE

• Units for measuring force are called Newtons (N)
• A spring balance is used to measure force.

When force of gravity on an object is measured using a spring balance, we say we are measuring weight.
• Weight of an object is the amount of the force of gravity acting on it.
• Weight is a force.
• Weight is measured in Newtons.

FRICTION

• Friction is the force that opposes motion (movement) between two surfaces over each other.
• It is a force that resists the sliding of an object.
• Friction is measured in Newtons.
• Friction is more on rough surfaces and less on smooth surfaces.
• Friction can stop or slow down a moving object.
**Advantages of friction**
This is the usefulness of frictional force on daily activities. These include:

a) Walking – Force between the ground and feet enables you to walk.
b) Lighting matches
c) Writing on the board
d) Rubbing / Erasing – Use of a rubber and paper
e) Skating – The force of friction between the roller skates and tarmac enables one to skate.

f) Stopping – The use of brakes for vehicles or bicycles to stop depends on the frictional force.
g) Driving – The wheels or tyres of vehicles and bicycles have treads that enhance the grip on the ground for the vehicle to move.
    This is as a result of friction.

**Disadvantages of friction**
a) Friction causes wearing out of objects e.g. car/bicycle tyre, soles of shoes, rubbers, pencils, pieces of chalk.
b) Produces unwanted heat.
c) Makes work difficult especially on rough surfaces when pushing or pulling objects.
d) Clothes wear out especially during washing due to friction when rubbing.
e) Moving parts of machines/vehicles wear out due to friction.

**Ways of increasing friction**
a) Use of treads especially on the soles of shoes and car tyres that increase grip on the ground.
Ways of reducing friction

- Smoothing surfaces/polishing them.
- Streamlining surfaces – This is giving an object a smooth special shape so that it can move quickly, smoothly and easily through air, water or any gas or liquid media e.g. airplanes, vehicles, ships, etc.
  Some animals are also streamlined to reduce friction when they are moving e.g. fish and birds.
• Using sets of roller or ball bearings – placed between the rubbing surfaces to reduce friction

• Oiling and greasing – done on the movable parts so that they can slide easily.

N.B Oiling and greasing is also known as lubricating.

SIMPLE MACHINES
Simple machines are used to make work easier.
• Examples of the simple machines include levers, inclined planes, wedges and pulleys.
N.B. Simple machines do not reduce the amount of work to be done.
They make the work easier by:

a) increasing the effort or force that is applied;
b) increasing the speed with which a task is performed;
c) transferring a force from one point to another;
d) changing the direction of force.

**Levers**

A lever is a simple machine or device that is used to make work easier.

**Parts of a lever**

a) **Fulcrum** – It is the turning point in a lever.
   - Also called pivot
b) **Effort** – This is the force applied to the lever to overcome the load force.
c) **Load** – This is the force to be lifted or overcome in a lever so that work is done.

**Types of Levers**

• Levers are divided into three classes depending on the position of the fulcrum, load and effort.
  
a) **First class levers**
  
  - Fulcrum is in the middle i.e. between the load and the effort.
  
  - Example of levers in first class:
  
  • claw hammer
  • beam balance
  • crow bar
  • pair of scissors
  • lid opener
  • pliers
b) Second class levers

The load is in the middle i.e. between the effort and fulcrum.

Examples of levers in the second class are:- Wheelbarrow
- Human foot
- Nut cracker
- Bottle opener
- Door hinges
c) **Third Class Levers**

Effort is in between the load and fulcrum.

Examples of third class levers are:
- fishing rod
- Pair of tongs
- jembe
- broom
- human arm

**N.B**
- For levers to be more efficient and effective, the effort distance must be longer than the load distance,
- Second class levers are very efficient because load distance is shorter than the effort distance.
Inclined Planes
- Inclined planes are slopes (sloping surfaces)
- A slope can also be referred to as a ramp.

Examples of inclined planes
- A ladder
- A staircase
- A road winding up a hill
- A ramp
- Screw nail
- Screw-type car jack

- Slope 1 is the best to use since least effort is used.
- Slope 3 is the most difficult to use since most effort is used.
If three pupils, Ali, Ahmed and Juma used slope 1, 2 and 3 respectively, the amount of work each will do will be the same but the effort will vary.
NOTE: The amount of work done does not change because no machine can increase or reduce the work. The above slopes are machines.

Inclined planes are put into two groups.
1. **Ramp**
   - Requires less effort to raise and move a heavy load from the ground to the back of a lorry using a ramp than trying to lift the load vertically from the ground.

2. **Ladder**
   - Less effort is used to climb using a ladder.
   - Ladder makes the slope gentle increasing the effort distance. Hence, it is easier to climb since less effort is used.

3. **Staircase**
   - Found in maisonettes, flats and skyscrapers.
   - Stairs are a set of steps from one level of ground to another.
   - A staircase allows a person to climb by lifting his or her mass only a short height at a time, hence less effort is used.
   - A staircase makes steep slopes gentle.

4. **A road winding up a hill.**
   - Also known as contour road.
   - It is similar to a spiral staircase
• It forms a gentle slope. Therefore it is easier to climb up a hill using a winding road than a straight road up the hill because less effort is used.

5. Screws
- Used for joining pieces of wood.
- The threads move in a spiral way just like a winding road hence less effort is used.
6. The screw-type car jack

Used for lifting up cars when changing a wheel.
**Wedge**

- It’s a tool with a sharp edge.
- Opposite side of a wedge slopes to a sharp edge.
- Wedges concentrate the force to the sharp edge, hence less effort is used.

Examples of wedges:
- an axe
- a knife
- a panga
- a jembe
- an ox-drawn plough
- any other sharp tool.

**Points to note:**
- In all inclined planes, the effort used is very little but the distance moved is longer i.e. they increase the effort distance reducing the effort used.
- They have a mechanical advantage.

**Pulleys**

- A pulley is a wheel over which a rope or a chain is stretched.

- **Single fixed pulleys** can be used for:
  1. Raising flags
  2. Raising heavy loads up vertical heights such as buildings or deep holes

*A Single Fixed Pulley in Use*
• The effort distance is always equal to the load distance.
• The load is always equal to the effort i.e. the effort used to lift a load without the pulley is almost equal to the effort used when using a single fixed pulley.
• Makes work easier by changing the direction of the force. This is more convenient and easier than pulling the rope upward.
• An example of a single fixed pulley is a flagpost used to raise the flag.