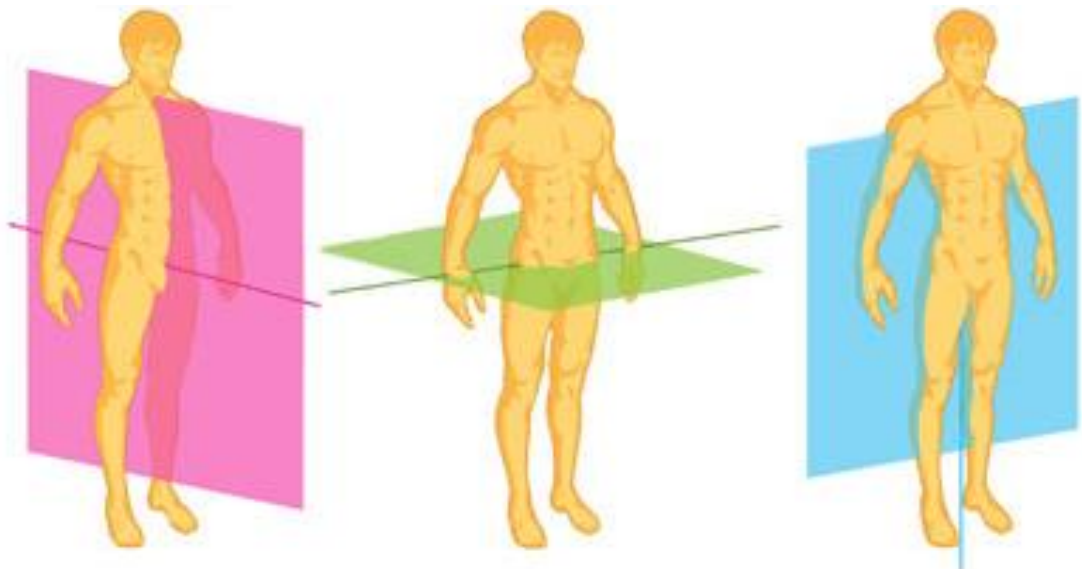


Movement Analysis

Revision Guide

St Mary's Catholic Academy

GCSE Physical Education



Levers

Levers in our body are formed from Bones, Joints and Muscles.

A lever consists of

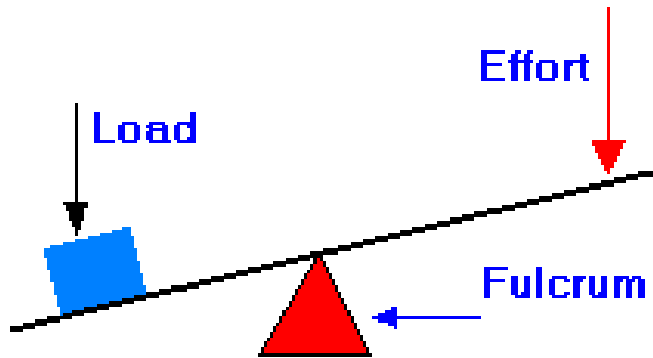
- 1) A rigid structure (**BONE**)
- 2) A force acting upon it (**MUSCLE**) to produce a turning movement (**ANGULAR MOTION**)
- 3) A fulcrum which is a fixed point (**JOINT**)
- 4) A load or resistance that is placed on the rigid structure (**WEIGHT OF BODY PART BEING MOVED AND ANYTHING THAT IT IS CARRYING**)

Remember there are three types of levers!



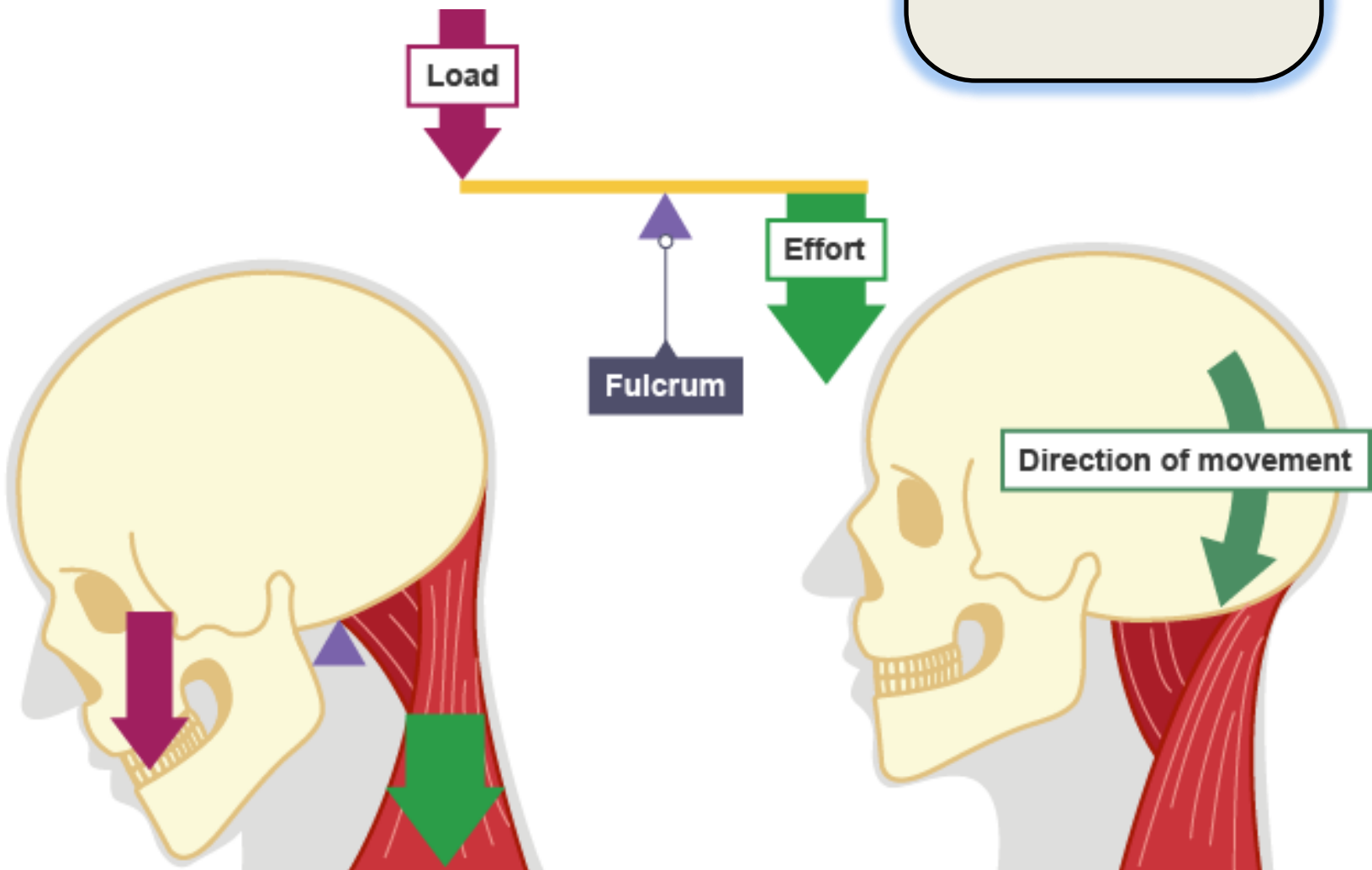
First Class Lever

The **FULCRUM** is in the middle of the effort and the load.



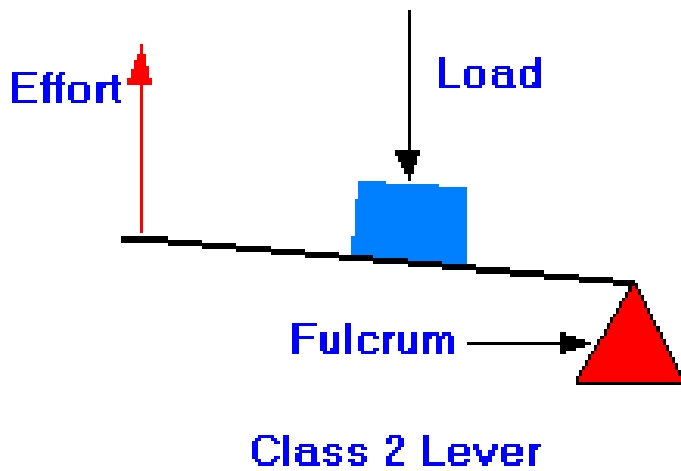
Class 1 Lever

This type of lever is found in the neck when raising your head to head a football. The neck muscles provide the effort, the neck is the fulcrum, and the weight of the head is the load.

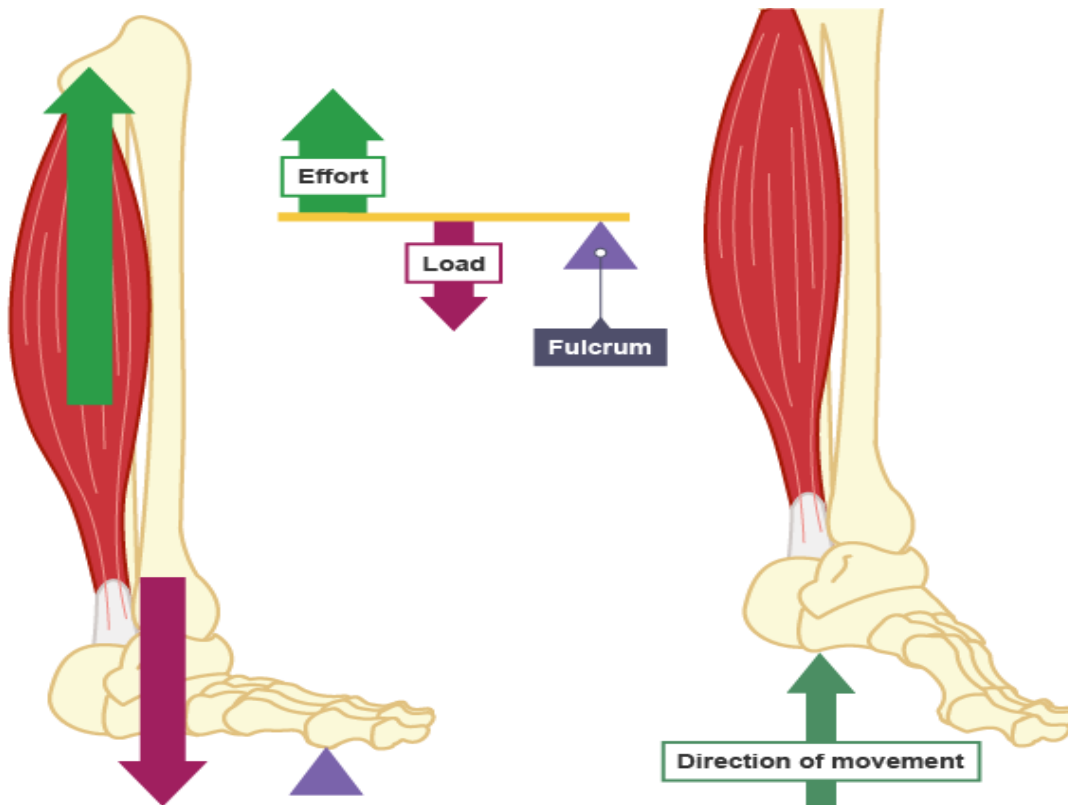


Second Class Lever

The LOAD is in the middle of the fulcrum and the effort

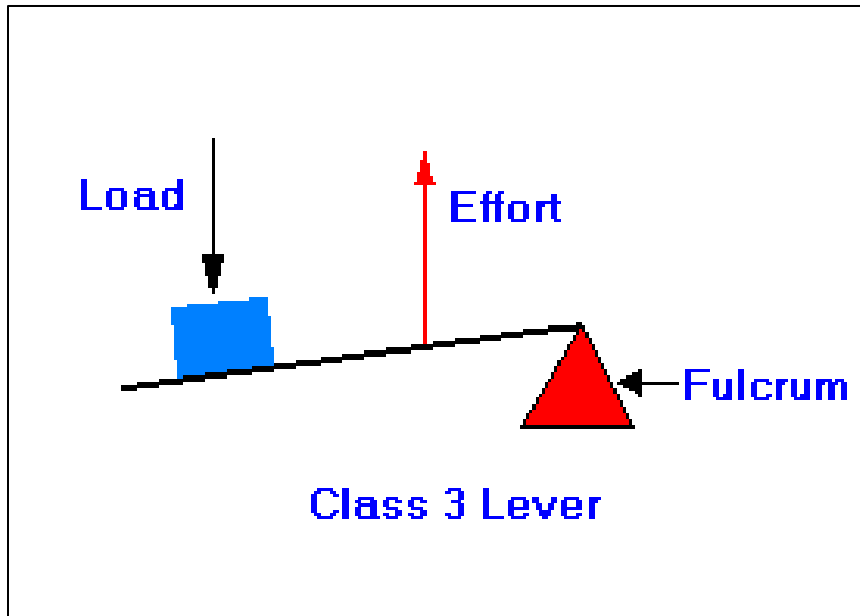


This type of lever is found in the ankle area. When standing on tiptoe, the ball of the foot acts as the fulcrum, the weight of the body acts as the load and the effort comes from the contraction of the gastrocnemius muscle. This second class lever is used when taking off for a jump or pushing against the blocks in a sprint start.

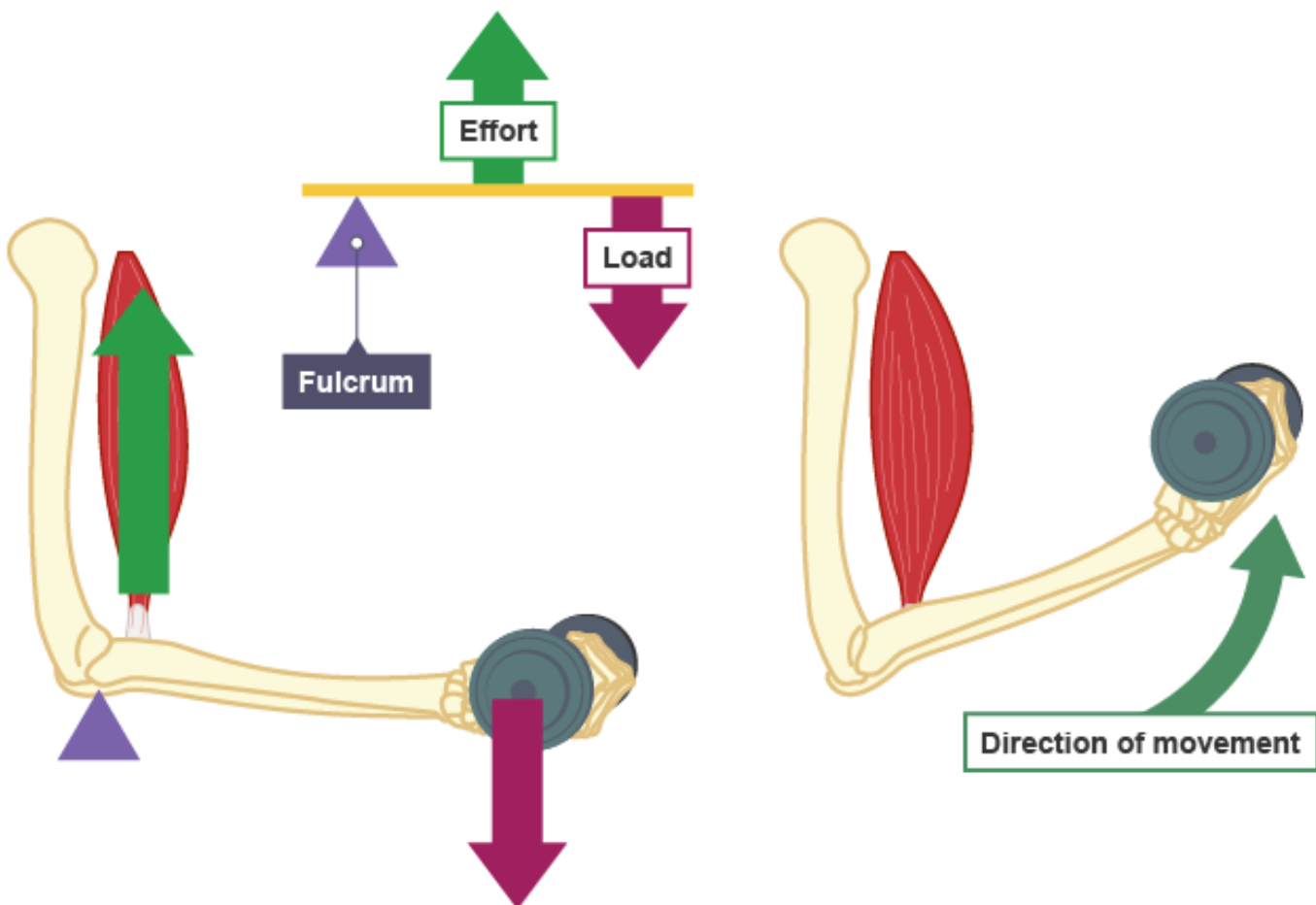


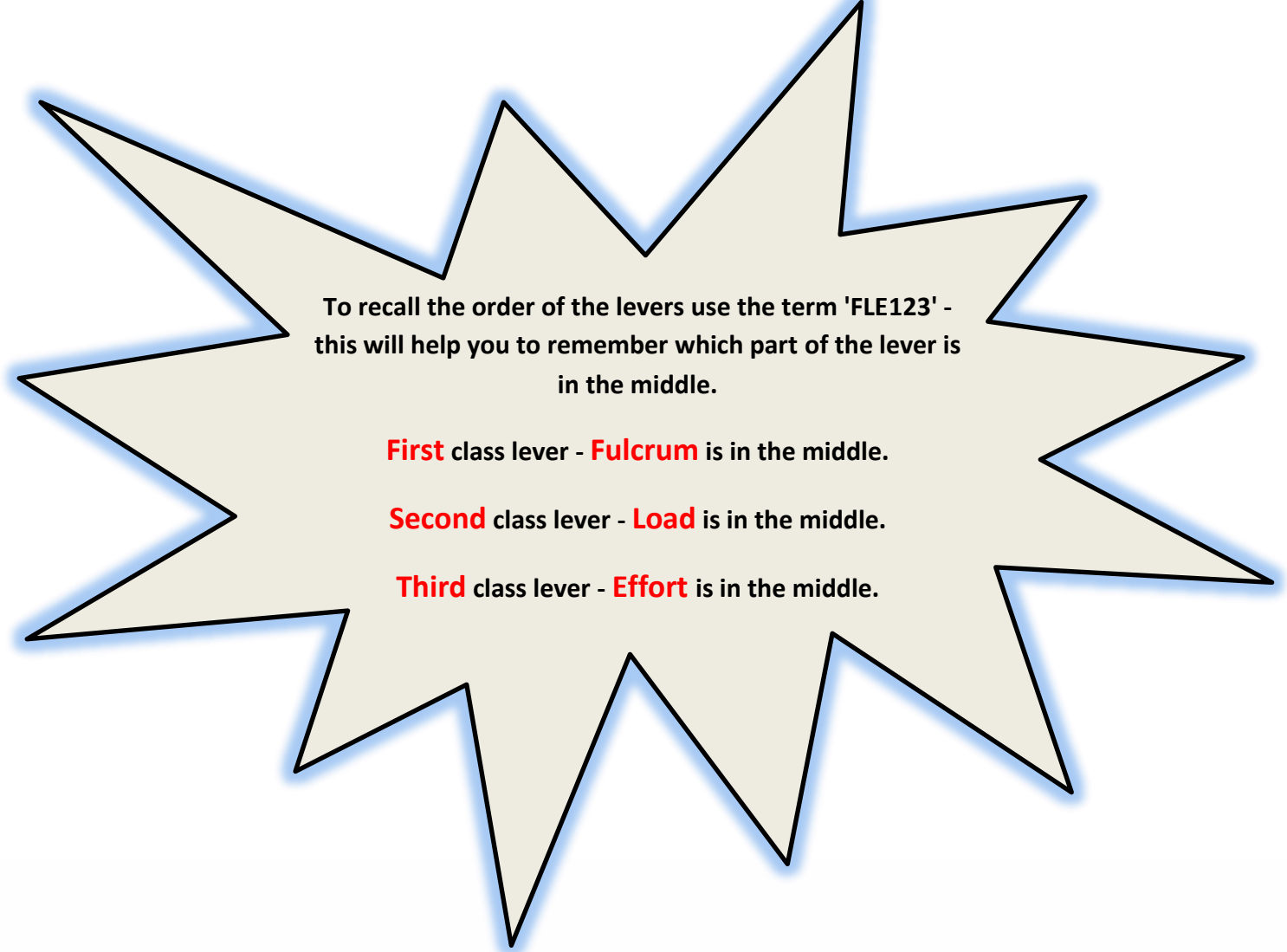
Third Class Lever

The **EFFORT** is in the middle between the fulcrum and the load



During a biceps curl, the fulcrum is the elbow joint, the effort comes from the biceps contracting and the resistance is the weight of the forearm and any weight that it may be holding.





To recall the order of the levers use the term 'FLE123' -
this will help you to remember which part of the lever is
in the middle.

First class lever - **Fulcrum** is in the middle.

Second class lever - **Load** is in the middle.

Third class lever - **Effort** is in the middle.

F L E

3rd Class has
the effort or
applied force
in the middle

1

1st Class has
Fulcrum in the
middle

2

2nd Class has
Load in the
middle

3

Mechanical Advantage of Levers

Some levers operate with **MECHANICAL ADVANTAGE**. This means that the lever can overcome a large load with relatively little effort. **MECHANICAL ADVANTAGE** is very useful for joint which are weight bearing as they have to overcome the weight of the whole body.

$$\text{MECHANICAL ADVANTAGE} = \text{EFFORT ARM} \div \text{RESISTANCE ARM}$$

Therefore, the greater the **EFFORT ARM** in comparison to the **RESISTANCE ARM**, the greater the **MECHANICAL ADVANTAGE**.

The **SECOND CLASS LEVER** provides the most **MECHANICAL ADVANTAGE** and this explains why it is so crucial that it operates at the weight bearing foot

At take-off, the high jumper applies large forces to the ground through their ankle. The ankle operates with **MECHANICAL ADVANTAGE** in order to resist these forces and enable the jumper to achieve

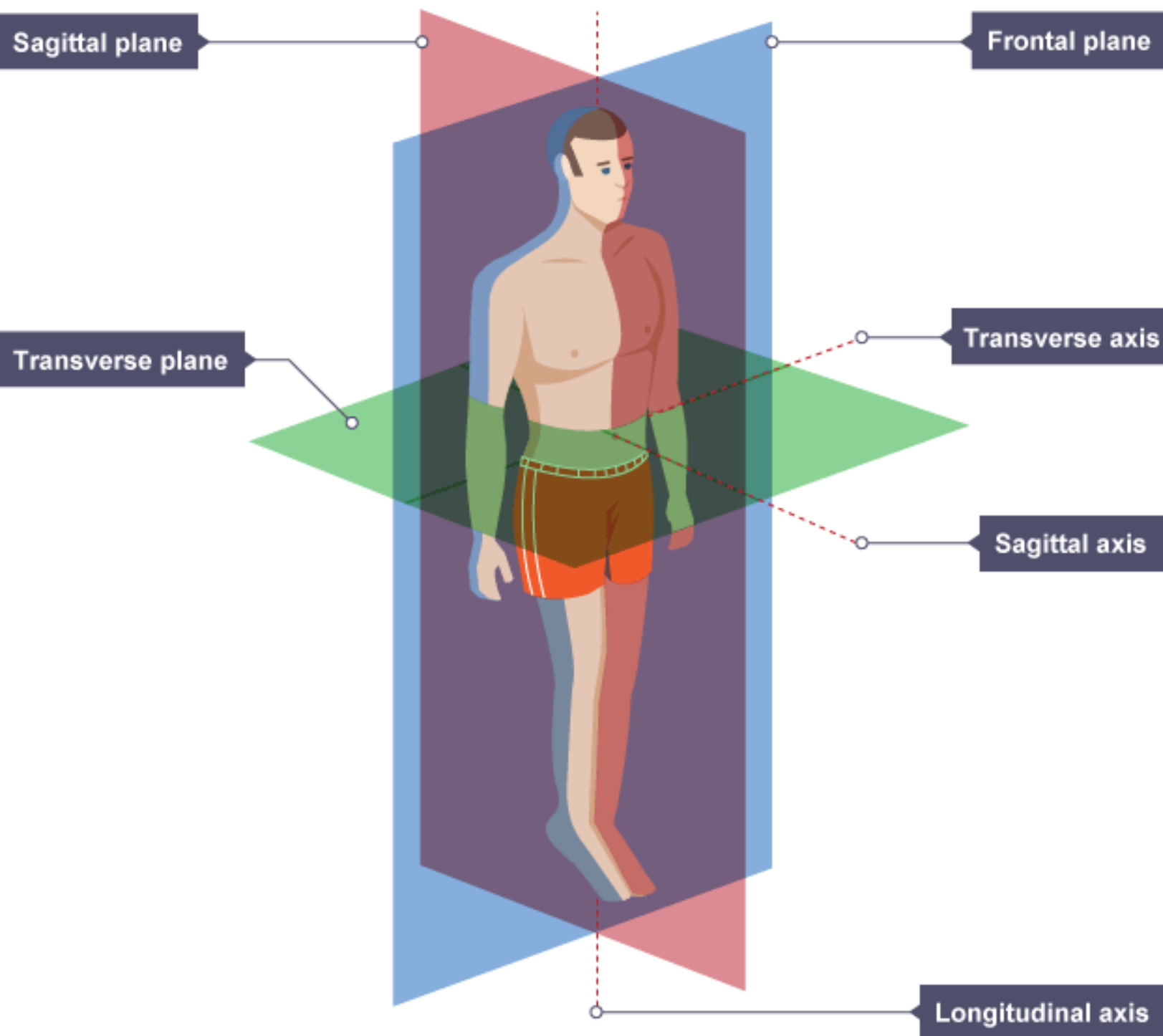


Planes and Axes

All body movements occur in different planes and around different axes.

A **PLANE** is an imaginary flat surface running through the body.

An **AXIS** is an imaginary line at right angles to the plane, about which the body rotates or spins.



Planes of Movement

There are three planes of movement:

Sagittal plane - a vertical plane that divides the body into **left and right sides**. **Flexion** and **extension** types of movement occur in this plane, eg kicking a football, chest pass in netball, walking, jumping, squatting.

Frontal plane - passes from side to side and divides the body into the **front and back**. **Abduction** and **adduction** movements occur in this plane, eg jumping jack exercises, raising and lowering arms and legs sideways, cartwheel.

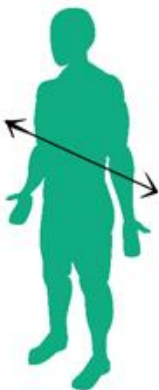
Transverse plane - passes through the middle of the body and divides the body horizontally in an **upper and lower half**. **Rotation** types of movement occur in this plane, eg hip rotation in a golf swing, twisting in a discus throw, pivoting in netball, spinning in skating.

Movements are **parallel** to the plane in which they take place.

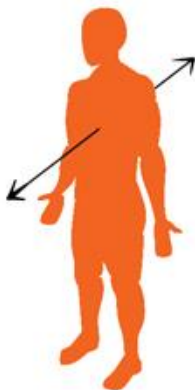
TRANSVERSE



FRONTAL



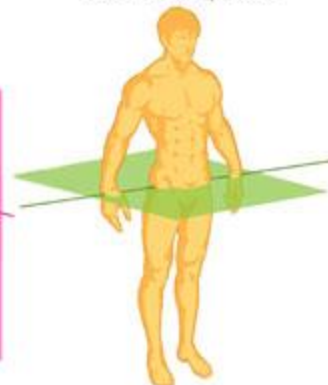
SAGITTAL



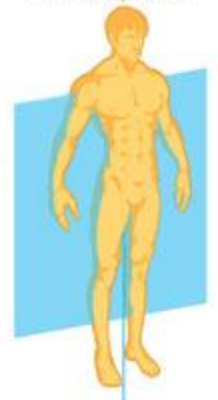
Sagittal plane



Horizontal plane



Frontal plane



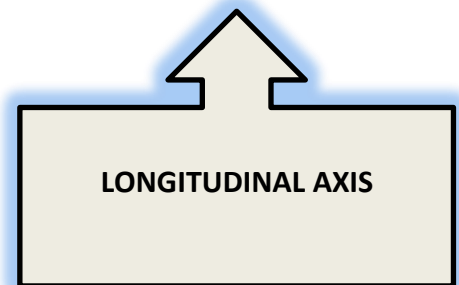
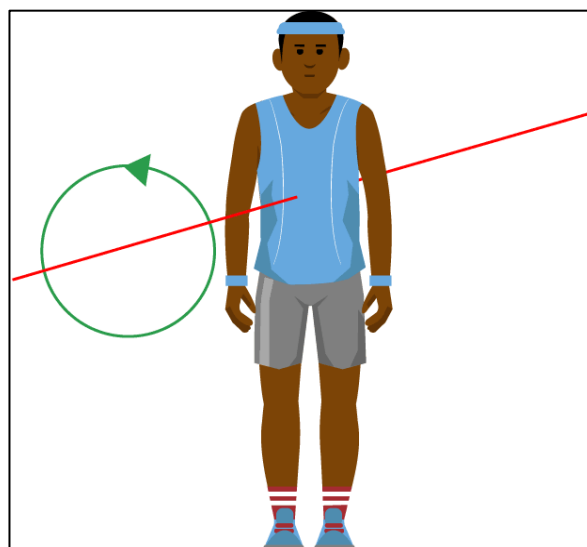
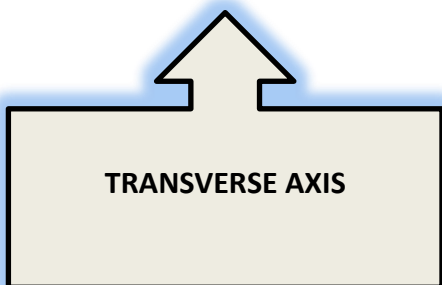
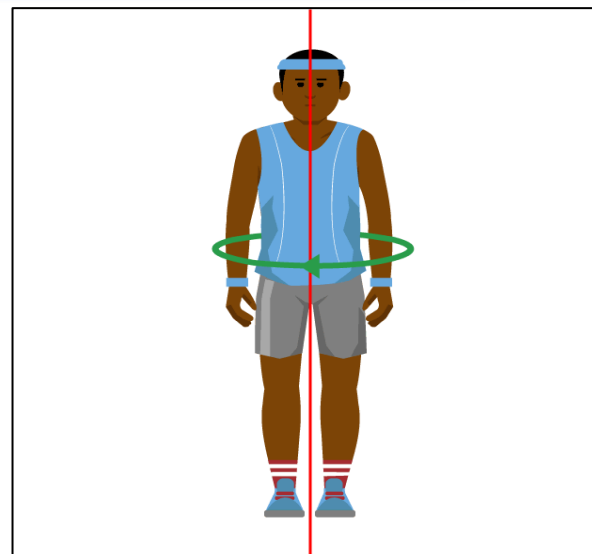
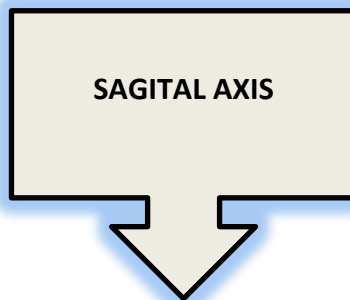
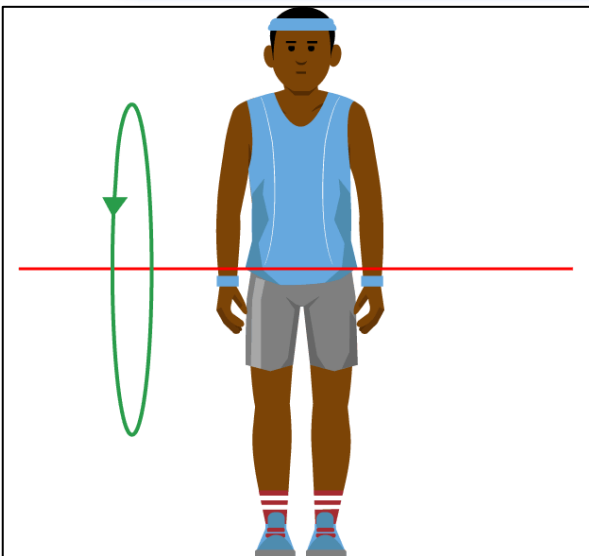
Axes of Movement

There are three axes of movement around which the body or body parts rotate:

Transverse axis - this line runs **from left to right through the centre of the body**. For example, when a person performs a somersault they rotate around this axis.

Sagittal axis - this line runs **from front to back through the centre of the body**. For example, when a person performs a cartwheel they are rotating about the sagittal axis.

Longitudinal axis - this line runs **from top to bottom through the centre of the body**. For example, when a skater performs a spin they are rotating around the longitudinal axis.



Quick Questions

What feature of a human body acts as the fulcrum in all lever systems?

- 1) Muscle
- 2) Long Bone
- 3) Joint

How many classifications of lever systems are there?

- 1) Four
- 2) Five
- 3) Three

In which position will the fulcrum be in relation to the effort and load in a first class lever system?

- 1) On the left
- 2) In the middle
- 3) On the right

What type of lever, useful for overcoming large loads, can be found at the ankle when a basketball player jumps for a rebound?

- 1) First class lever
- 2) Second class lever
- 3) Third class lever

Which muscle contracts and acts as the effort during elbow flexion?

- 1) Triceps
- 2) Deltoid
- 3) Biceps

What term defines the use of a lever to overcome a large load with relatively little effort?

- 1) Mechanical disadvantage**
- 2) Mechanical advantage**
- 3) Resistance arm**

Which plane of the human body runs from side to side and separates the human body into front and back?

- 1) Frontal**
- 2) Sagittal**
- 3) Transverse**

When a gymnast performs a forward roll, which axis are they rotating around?

- 1) Sagittal**
- 2) Longitudinal**
- 3) Transverse**

Which of these equations accurately describes mechanical advantage?

- 1) Effort arm + resistance arm**
- 2) Resistance arm $\div$ effort arm**
- 3) Effort arm $\div$ resistance arm**

Which axis, passing from the top of the head out of the bottom of the body, is rotated around during a spin in ice skating?

- 1) Longitudinal**
- 2) Transverse**
- 3) Sagittal**

Answers

Joint

Three

In the middle

Second class lever

Biceps

Mechanical Advantage

Frontal

Transverse

Effort arm $\div$ Resistance arm

Longitudinal

