

2.1. Lever Systems

2.2 Planes and Axes of Movement

Name _____

Class _____



Topic	Description from Specification	Pupil comments – How confident do you feel on this topic?
First, second and third class lever systems within sporting examples	Identification of first, second and third class lever systems. Basic drawings of the three classes of lever to illustrate the positioning of the fulcrum, load (resistance), effort. Draw linear versions of a lever, showing the positioning of the fulcrum, load/resistance and effort. Students do not need to be taught to draw anatomical body parts but must be able to link the correct lever to a sporting movement or action. Interpretation of sporting movements or actions which involve flexion or extension of the elbow and/or knee, and plantar or dorsi-flexion at the ankle.	
Mechanical advantage – an understanding of mechanical advantage in relation to the three lever systems	Label the effort arm and load/resistance arm on the three classes of lever. Mechanical advantage = effort arm ÷ weight (resistance) arm. Labelling of the effort arm and resistance arm on lever drawings, and interpretation of the mechanical advantage of that lever.	
Analysis of basic movements in sporting examples	Types of movement: Flexion/extension at the shoulder, elbow, hip and knee. Abduction/adduction at the shoulder. Rotation of the shoulder. Plantar flexion/dorsiflexion at the ankle. This section links specific sporting actions to the types of movement. Applied anatomy and physiology links the joint type to the type of movement only. This should include but not be limited to the following sporting actions: Elbow action in push-ups/football throw in, hip, knee and ankle action in running, kicking, standing vertical jump, basic squats. Shoulder action during cricket bowling (overarm rotation). Much of this topic was covered in component one.	
Identification of the relevant planes (frontal, transverse, sagittal) and axes (longitudinal, transverse, sagittal) of movement used whilst performing sporting actions.	Planes (frontal, transverse, sagittal) and axes (longitudinal, transverse, sagittal) should be related to sporting actions. Teaching of these planes/axes should include but not be limited to the following sporting actions: Front somersault/forward roll/running action. 360° twist (ice skating spin)/discus thrower rotating in circle effort. Cartwheel.	

What do you think of when you hear the word 'lever'?

How do you think parts of your body can be referred to as levers?

Every lever has 3 components. Use the words below to fill in the gaps.

Fulcrum – The _____ around which the lever _____

Load – The _____ of the thing that you want to _____

Effort – The _____ that is applied by the user of the _____ system

force axis move force lever rotates

Think about a darts player throwing a dart. What would be the....

Fulcrum: _____

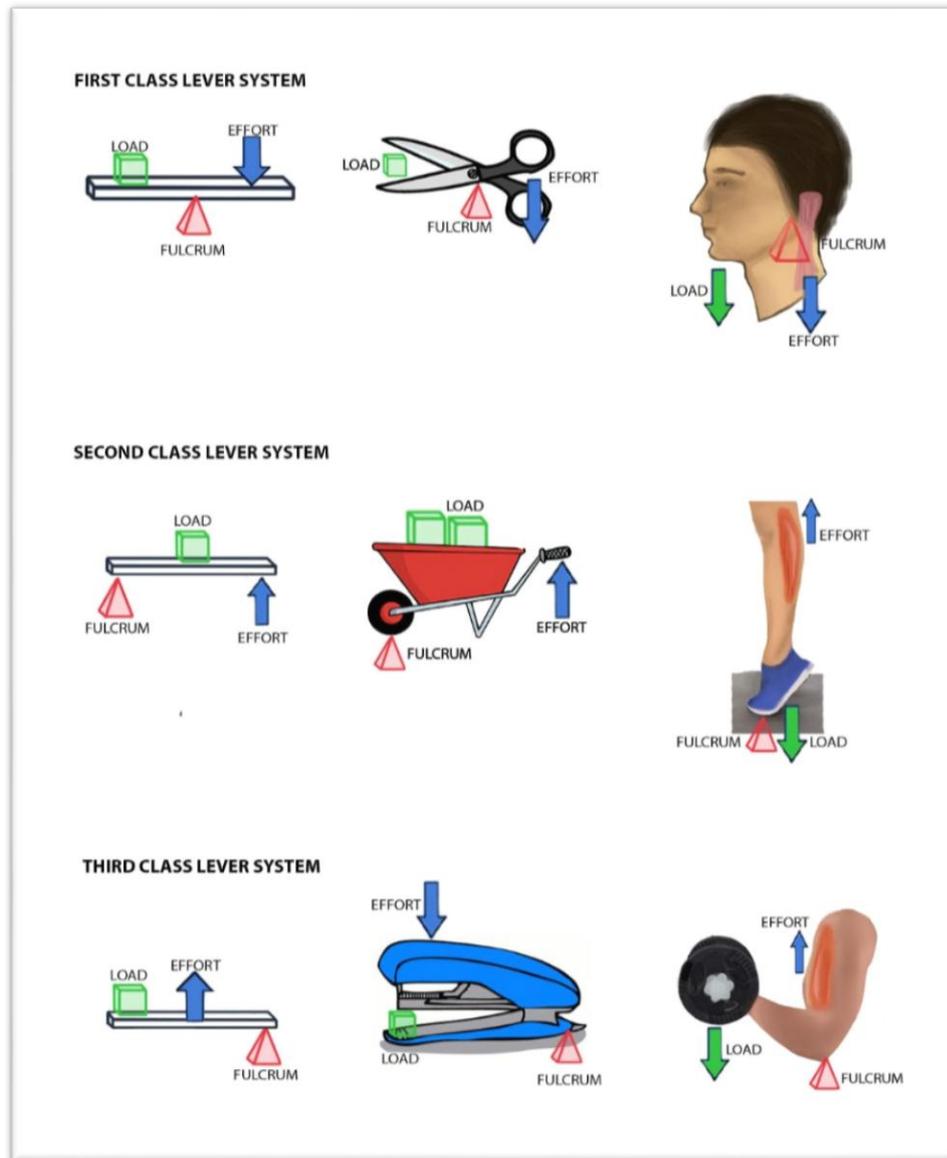
Load: _____

Effort: _____



Different Classes of Lever:

Levers are classified as either **First Class**, **Second Class** or **Third Class** according to the placement of the fulcrum, load and effort.



1st Class = **Fulcrum** in the middle

2nd Class = **Load** in the middle

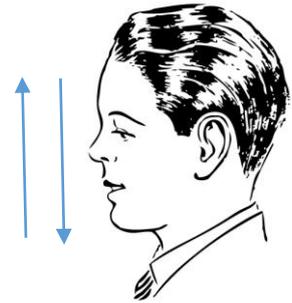
3rd Class = **Effort** in the middle

To remember what is in the middle you simply need to think FLE. Think 'FLY LITTLE ELF' to remember this.

First Class Levers: Load – Fulcrum - Effort

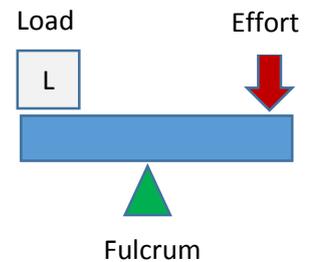
In this lever system the fulcrum sits in the middle, between the load and the effort.

For the pictures shown, fill in the table below.



Exercise/Activity	Load	Fulcrum	Effort

Can you think of any other first class lever systems?



This diagram is **very important**. If asked to draw a lever system in an exam – this is what you will need to present.

Second Class Levers: Fulcrum – Load - Effort

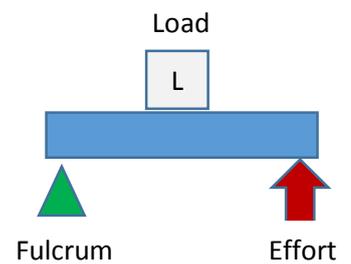
In this lever system, the load sits between the fulcrum and the effort

For the pictures shown, fill in the table below.



Exercise/Activity	Fulcrum	Load	Effort

Can you think of any other second class lever systems?



Third Class Levers: Fulcrum – Effort - Load

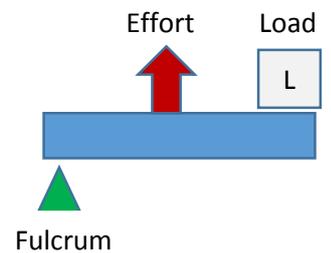
In this lever system, the effort is applied between the fulcrum and the load.

For the pictures shown, fill in the table below.



Exercise/Activity	Fulcrum	Effort	Load

Can you think of any other third class lever systems?



Hint - you must know the difference between each lever system and the location of the fulcrum, effort and load

Advantages/Disadvantages of lever systems:

Lever Systems can be seen to have a **mechanical advantage** or a **mechanical disadvantage**.

Mechanical Advantage = Effort Arm ÷ Resistance Arm.

This is when a large load can be lifted with relatively little effort. It is usually due to effort and the load being a relatively long distance away from one another.

Mechanical Disadvantage:

This is when it takes a lot of effort to lift a relatively small load.

Class of lever	Advantage	Disadvantage
First Class e.g. tricep dip	Mechanical Advantage – A large load can be lifted with relatively little effort	Slower Movement
Second Class e.g. calf raise	Mechanical Advantage – A large load can be lifted with relatively little effort	Slower Movement
Third Class e.g. bicep curl	Fast Movement	Mechanical Disadvantage – A large effort is needed to lift a relatively small load

What **movement action** is shown through a tricep dip?

How do you know that a tricep dip is a first class lever system?

What is the fulcrum when a tricep dip is performed?

Draw the lever system that operates at the ankle joint, labelling the fulcrum, effort and load.



Analyse the lever system being used at the ankle.

A bicep curl is an example of which type of lever system? (1)



Give one advantage and one disadvantage of the lever system used when performing a bicep curl (2)

Planes & Axes of Movements:

Different sports often require different types of movement and positioning. For the following sports, in your own words describe the positioning of the body.

Tennis _____

Swimming _____

Trampolining _____

Planes:

Planes are theoretical divisions that divide the body into sections. There are three planes of motion in the body.

1. The Sagittal Plane:

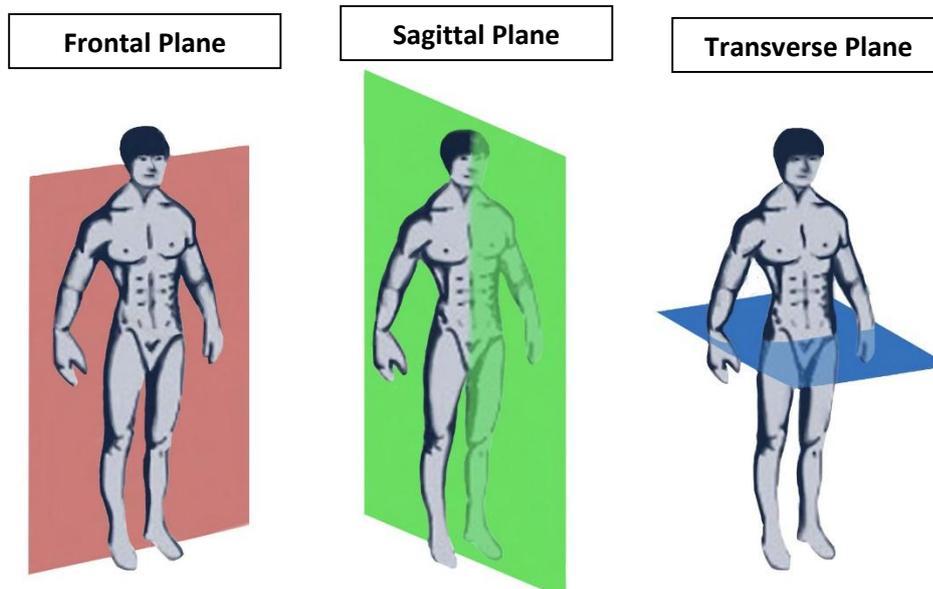
Splits the body down the middle resulting in a _____ side and a _____ side.

2. The Frontal Plane:

Divides the body so that there are _____ and _____ sections.

3. The Transverse Plane (AKA Horizontal Plane):

Divides the body across the middle (horizontally), giving a _____ section and a _____ section.



Underneath each of the pictures shown above, write down one of the following phrases to describe the movement possible within the plane. Think about how the person could move and **still keep the plane intact**:

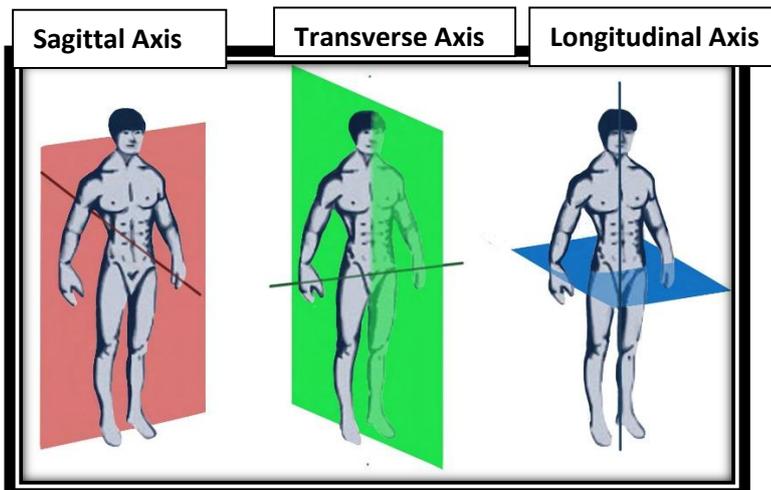
- Forward or backward
- Side to side
- Rotational

Use the table below to select the plane of movement for each exercise/sporting action:

Exercise/Action	Plane
Walking	
Side Bends	
Side Stepping	
Jogging	
360 degree twist	

Axes:

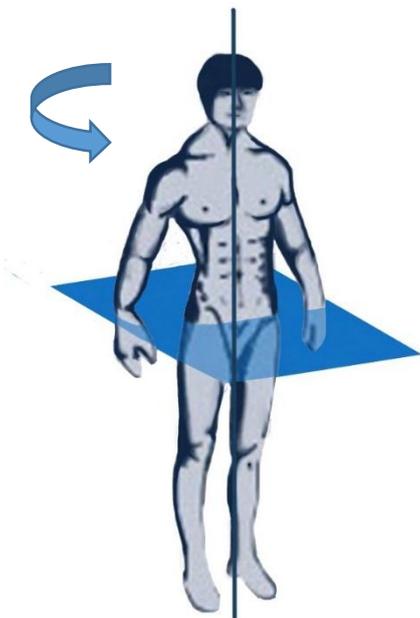
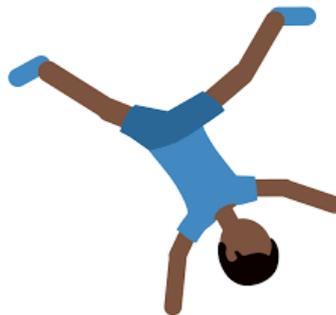
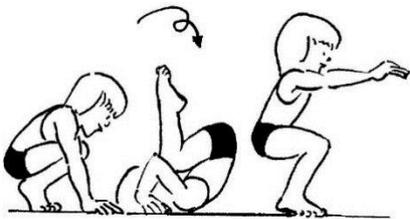
The joints in our bodies rotate around one of three different axes. These axes allow rotation to take place in one of the planes. There are three different axes:



1. **The Transverse Axis:**
Hip to hip
2. **The Longitudinal Axis:**
Vertical **line** - top to bottom
2. **The Sagittal Axis:**
Stabs through the body

Use the table below to state the plane and axes present during each movement/action.

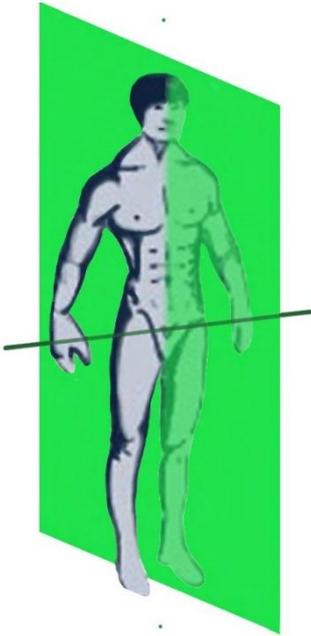
Movement/Action	Plane	Axes
Forward Roll		
Cartwheel		
Somersault		
Twist Jump		



Sample exam questions:

Identify the plane and axis shown in the figure on the left (1)

Give an example of a sporting action used at this plane and axis?



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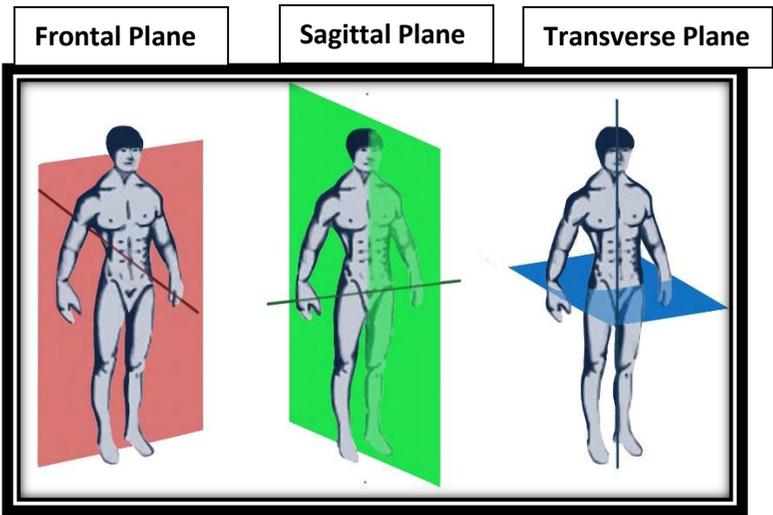


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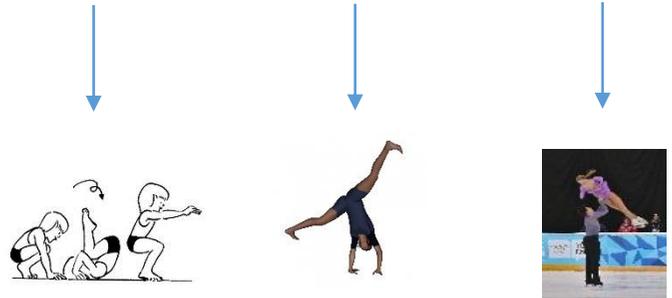
Identify the plane and axis shown in the figure on the left (1)

Give an example of a sporting action used at this plane and axis?

Revision



Sagittal Axis Transverse Axis Longitudinal Axis



Planes:

- Frontal = **Front** and back
- Sagittal = **Split** down the middle
- Transverse = **Top** and bottom

Axes:

- Transverse = Hip **to** hip
- Longitudinal = Vertical **Line**
- Sagittal = **Stabs** through the body

- Sagittal Plane and Transverse Axis = **Forward Roll**
- Transverse Plane and Longitudinal Axis = **Twist Jump**
- Frontal Plane and Sagittal Axis = **Cartwheel**

Key Terms:

Fulcrum – The point around which the lever rotates

Load – The force of the thing that you want to move

Effort – The force that is applied by the user of the lever system

Mechanical Advantage – A large load can be lifted with relatively little effort

Mechanical Disadvantage – Cannot lift as heavy a load with the same amount of effort

Plane – An imaginary line through which movement takes place. All movement actions take place within a plane

Axis – A straight line around which an object rotates