Biomechanics

Third Stage/ Biomaterials Engineering and prosthesis Branch

Presented By

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Lecture Three
Movement Analysis
Levers

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- The levers of the body allow you to apply force to create movements of many different kinds. A lever is a very basic machine. It is a bar or a stiff, straight object that can be used to lift weight, increase force, or create speed. The bones of your body are levers that allow you to perform many skills. For example, the bones of your foot act as a lever when you push with your foot while you walk and run. The calf muscles shorten, causing your foot to push down against the ground. To do its work, a lever must have a pivot point at its middle or at its end.

Levers

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- Levers are used to alter the resulting direction of the applied force.
- A lever is a rigid bar (bone) that turns about an axis of rotation or fulcrum (joint). a few examples of these are the shoulder, spine, knee, elbow, and ankle.
- The lever rotates about the axis as a result of a force (from muscle contraction).
- The force acts against a resistance (weight, gravity, opponent, etc.).
- The relationship of the points determines the type of lever.
- The axis (joint), force (muscle insertion point), and the resistance (Load, weight, etc.).

Humans moves through a system of levers

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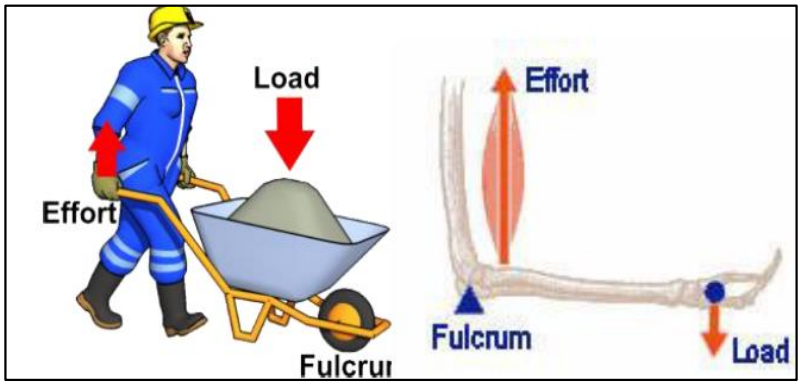
- Every lever is made up of three parts:



Fulcrum
The fixed point or **axis** of the lever. This is where the lever **turns/pivots**.
Joints are fulcrums in the body

Load/Resistance
The **weight** or '**resistance**' that the lever is moving.
E.g. Lifting a **weight** when doing a bicep curl
The fixed point or **axis** of the lever. This is where the lever **turns/pivots**.
Joints are fulcrums in the body

Effort/Force
The **force**applied to move the load.
It can also be referred to as '**force**'.
In the body the effort is provided by the **muscles** contracting.

Levers- The basics

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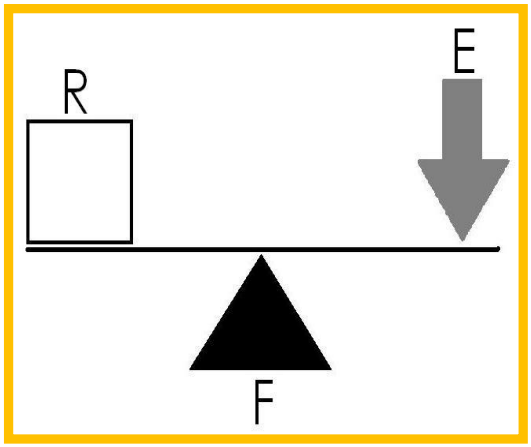
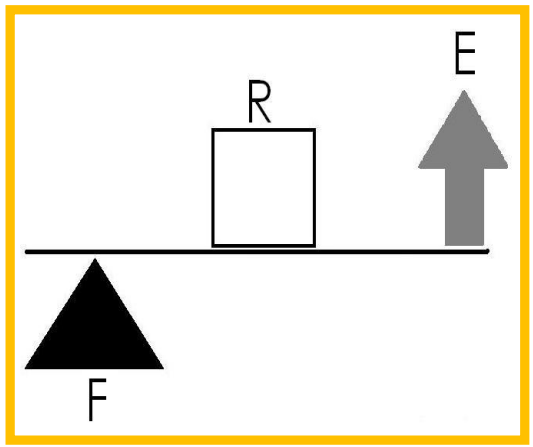
The human body is made up of **levers**, and these work together to create **movement.**

There are 3 classes of levers

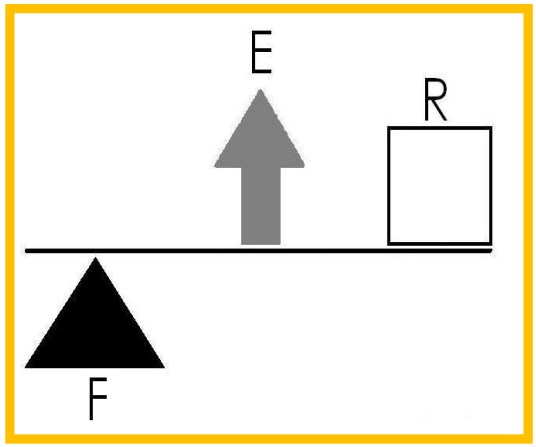
❖ The middle component will determine whether a lever is 1st, 2nd or 3rd class



First class lever:
Fulcrum in the middle



Second class lever:
Load in the middle



Third class lever:
Effort in the middle

Types of Lever

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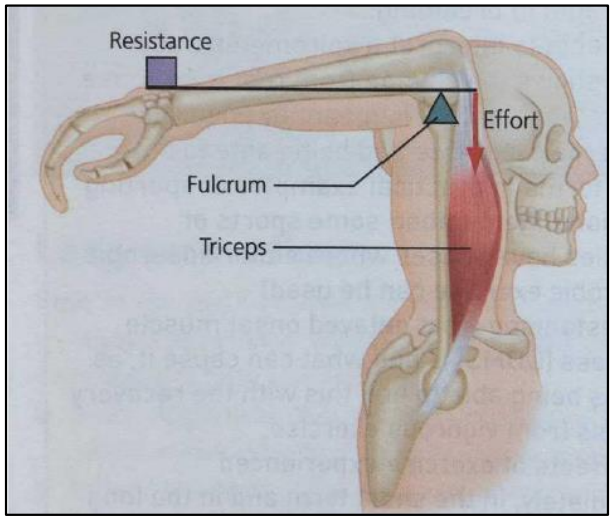
1. First Class Lever

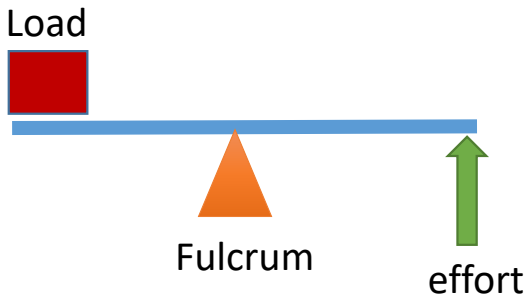
First class levers have the **fulcrum** in the middle.

- ***Example in the body***

➢ **Triceps** causing **Extension** at the **elbow**.



- E.g. When throwing a ball
- **-Fulcrum**= Elbow
- **-Effort**= Tricep
- **-Load**= Arm/ball



1. First Class Lever

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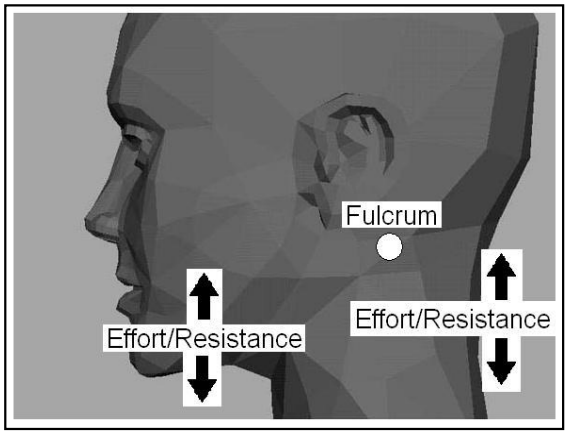
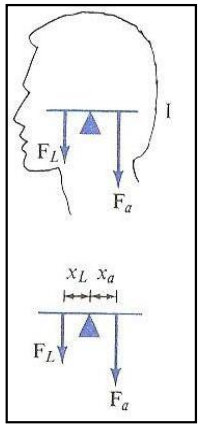
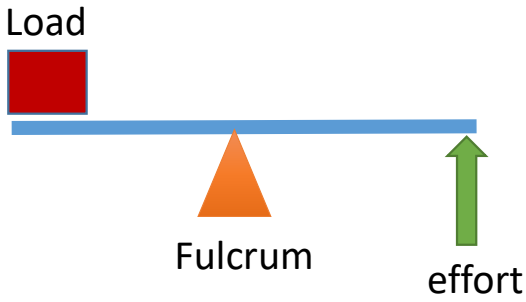
- **Up and down movement of the head about the atlas joint.**

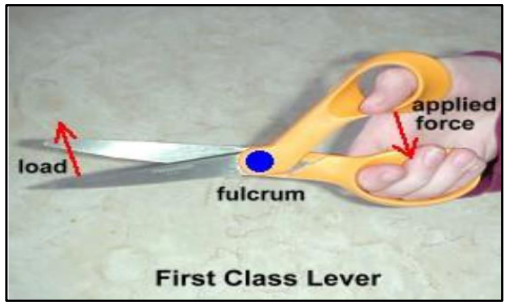


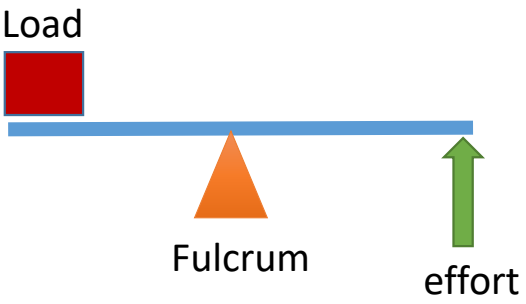




- **Fulcrum**= neck joint
- **-Effort**= jaw
- **-Load**= neck extension

- **Using scissors or cutter machine.**





- **Fulcrum**= center machine
- **-Effort**= hand
- **-Load**= start machine

1. First Class Lever

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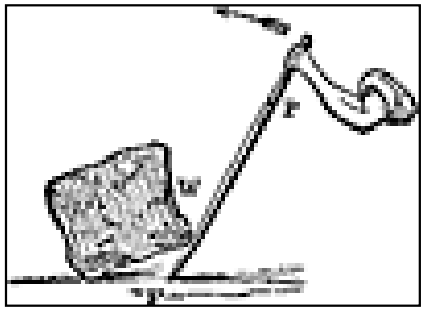
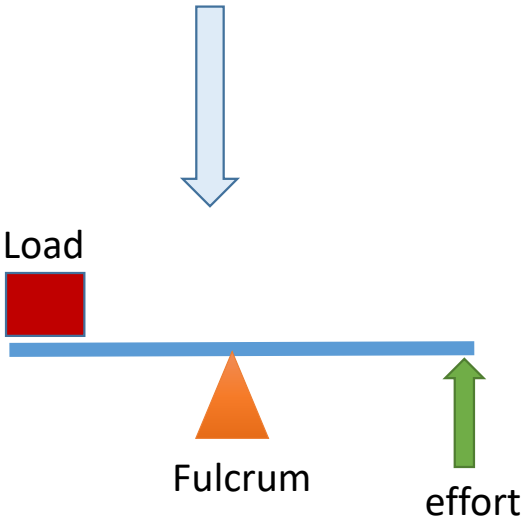
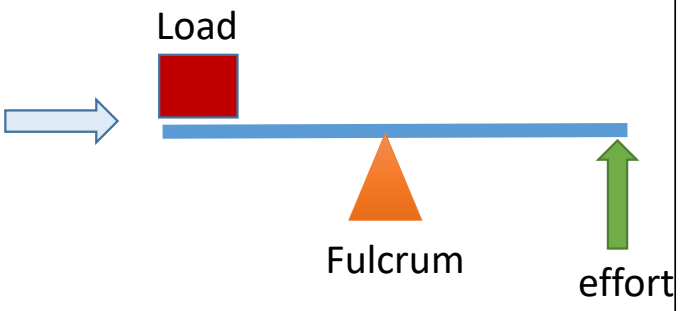
➢ Using a crowbar to move a rock.





- **Fulcrum**= joint crowbar
- **-Effort**= hand
- **-Load**= rock

➢ Using a hammer to pull out a nail.



- **Fulcrum**= joint hammer
- **-Effort**= hand
- **-Load**= nail

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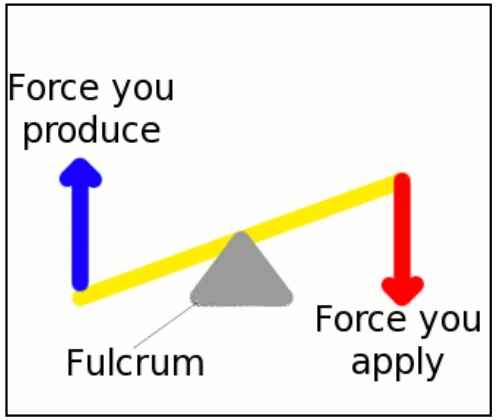
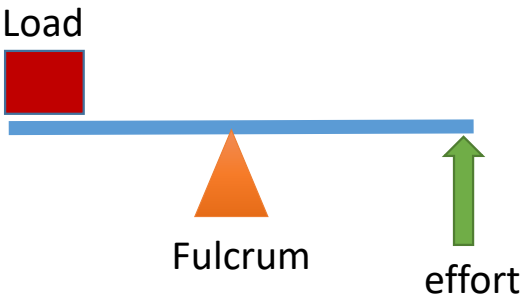
1. First Class Lever

- **A see-saw.**





- **Fulcrum**= joint see -saw
- **-Effort**= boy
- **-Load**= girl

2. Second Class Lever

Second class levers have the **load** in the middle.

-This means a **large load** can be moved with relatively low effort.

Example in the body

- **Gastrocnemius** causing **plantar flexion** at the **ankle**.

E.g. When taking off in high jump/jumping to shoot in basketball.

-Fulcrum= Ankle joint

-Effort= Gastrocnemius

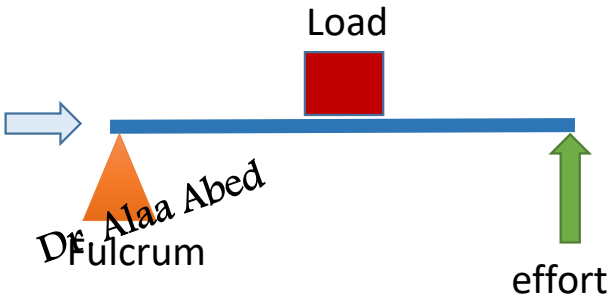
-Load= Body

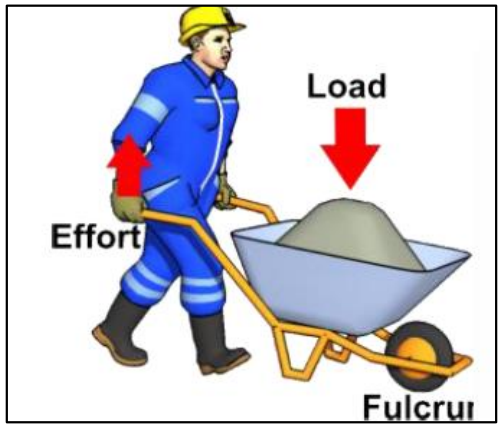
- **man push vechile**

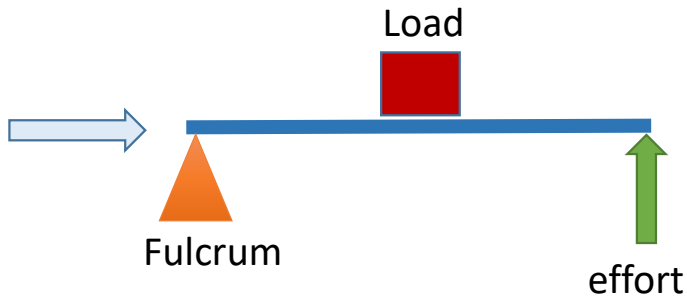
- **Fulcrum**= wheel

-Effort = Body

-Load = vechile contains



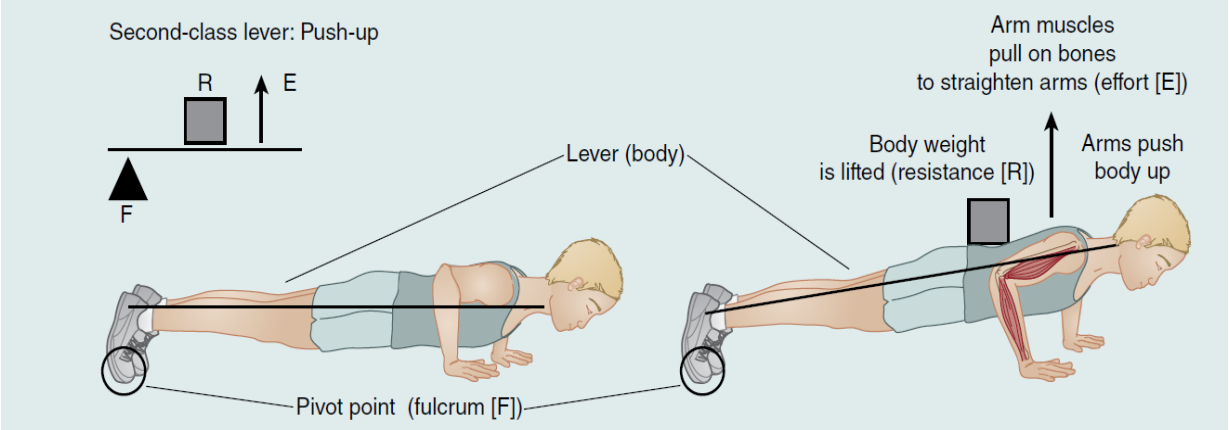




2. Second Class Levers

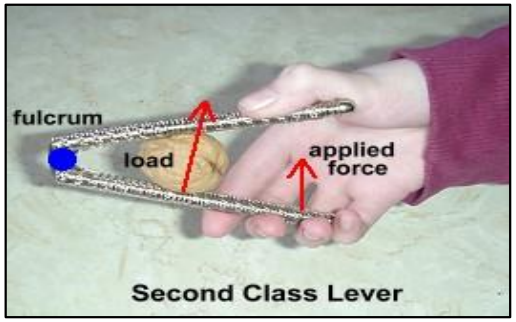
- a person doing **a push-up**

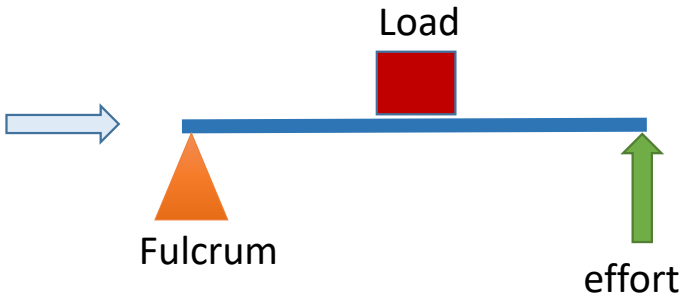
- Fulcrum = Ankle joint
-Effort = muscles pull on bones
-Load= Body weight



- a person using **nut crusher**

- Fulcrum = head crusher
-Effort = hand
-Load= arms crusher





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2. Second Class Levers

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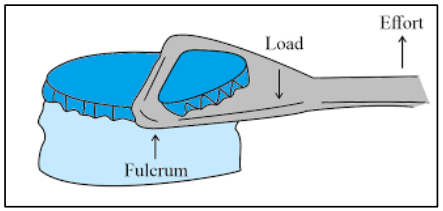
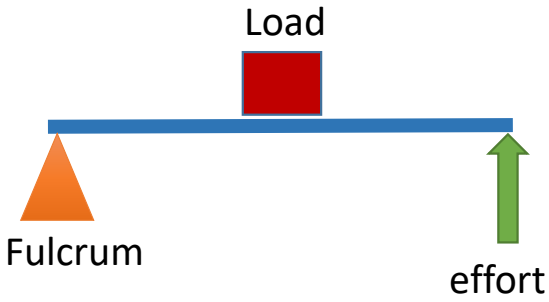
- **Opening a bottle** with a bottle opener





- **Fulcrum** = head bottle
-**Effort** = hand
-**Load**=middle bottle opener

3. Third Class Levers

Third class levers have the **effort** in the middle.
-This means they can produce a large **range of movement** with relatively low effort.
Example in the body
-**Bicep** causing **flexion** at the **elbow**

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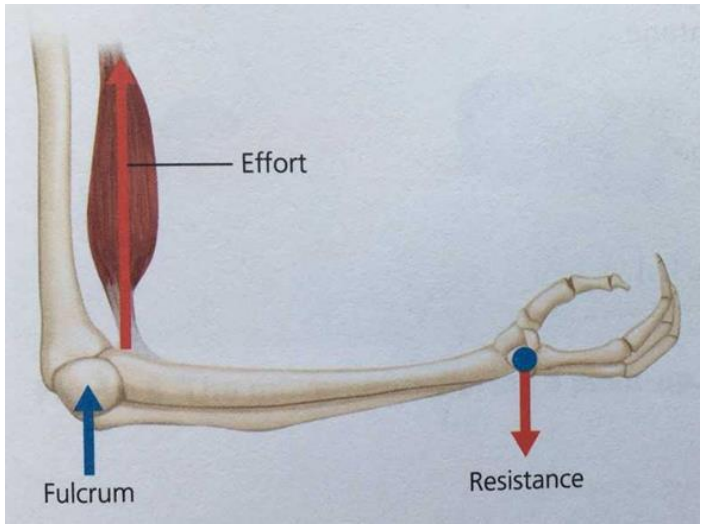
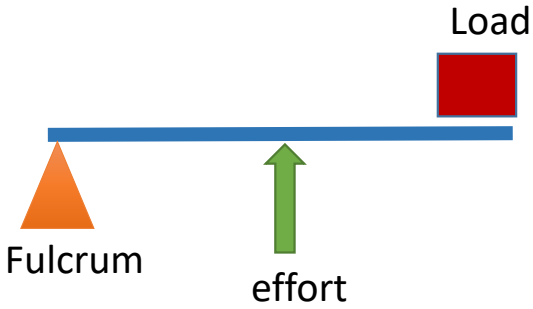
E.g. Performing a bicep curl
-Fulcrum= Elbow joint
-Effort= Biceps
-Load= Arm/weight





The End of Lecture