The Muscular System 10

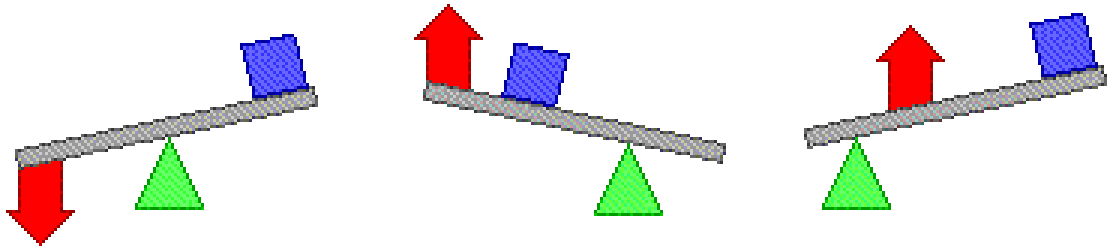
Muscle Mechanics: Importance of Fascicle Arrangement

Lever Systems: Bone-Muscle Relationships

- The operation of most skeletal muscles involves the use of leverage and **lever systems**.
  - Partnership between the muscular and skeletal system.

Lever Systems: Bone-Muscle Relationships

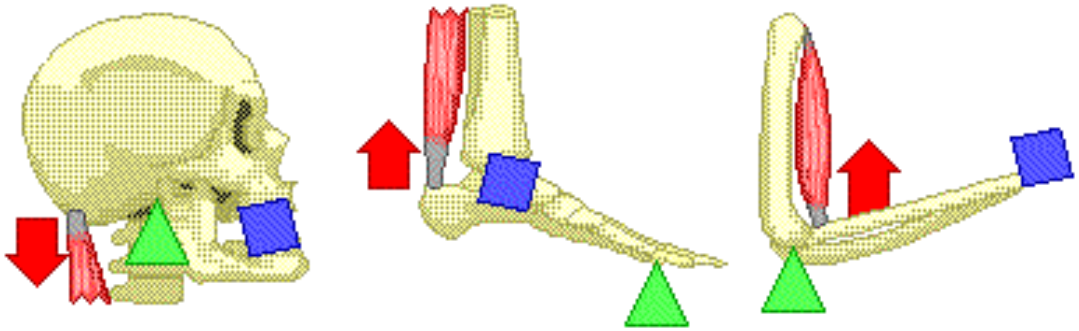
- **Lever**
  - Rigid bar that moves on a fixed point
- **Fulcrum**
  - A fixed point



- **Effort**
  - The applied force
- **Load**
  - What is being moved (the resistance)

Lever Systems: Bone-Muscle Relationships

- In our body:
  - Bones are **levers**.
  - Joints are the **fulcrums**.
  - Muscle contraction provides **effort** at the insertion on the bone.
  - Anything that is being lifted (bone, tissue, anything else) is the **load**.

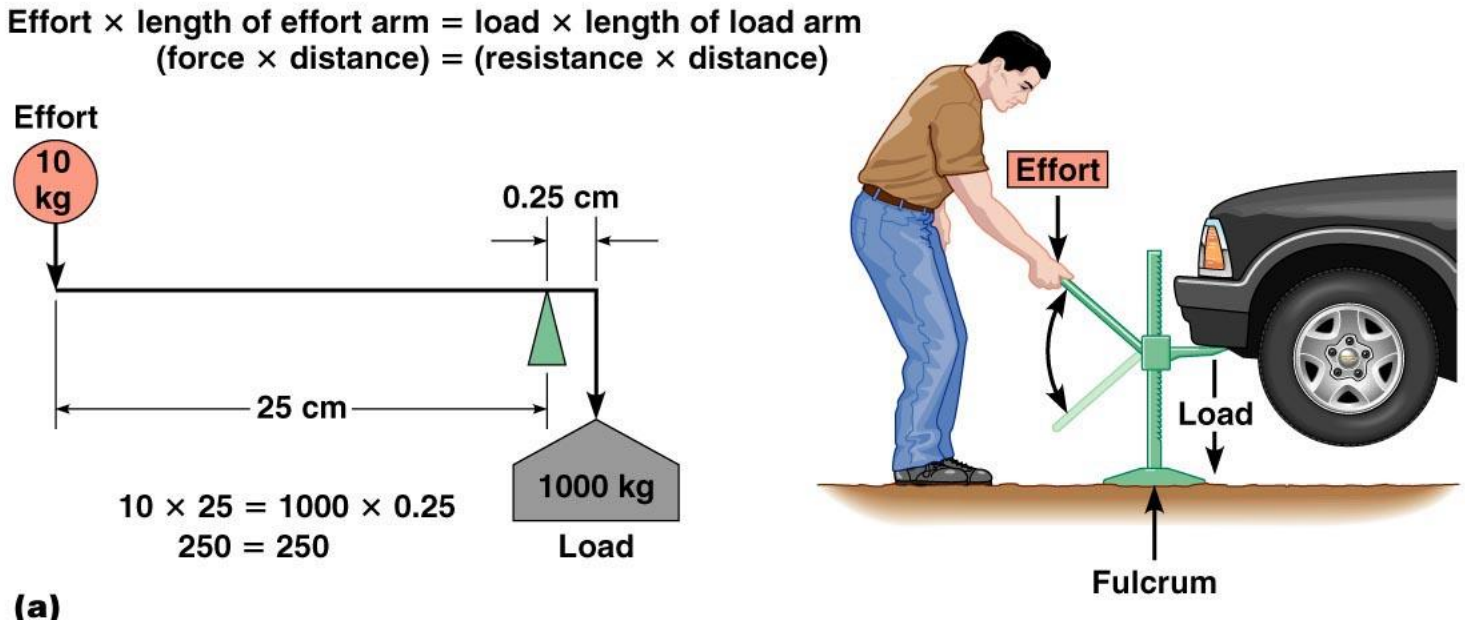


Lever Systems: Bone-Muscle Relationships

- A lever allows a given effort to move a heavier load, or to move a load farther or faster, than it otherwise could.

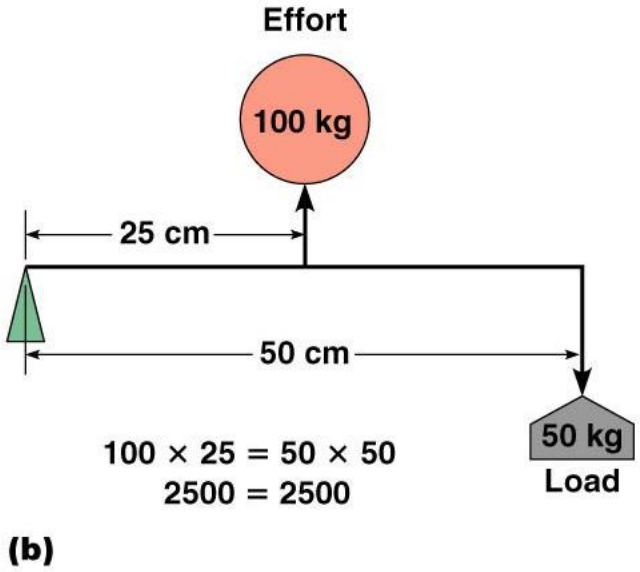
Lever Systems: Bone-Muscle Relationships

- **Mechanical Advantage (power levers)**
  - The load is close the and the effort is applied far from the fulcrum → a small effort exerted over a relatively large distance can be used to move a large load over a small distance



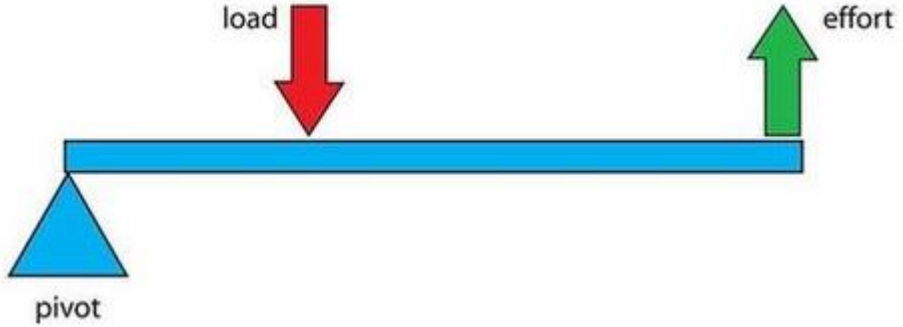
Lever Systems: Bone-Muscle Relationships

- **Mechanical Disadvantage (speed levers)**
  - The load is far from the fulcrum and the effort is applied near the fulcrum.
  - Force exerted by the muscle must be greater than the load moved

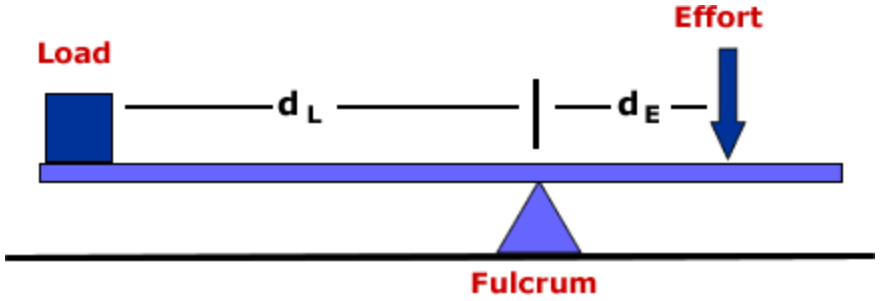


Lever Systems: Bone-Muscle Relationships

- Effort farther than the load from the fulcrum = mechanical advantage

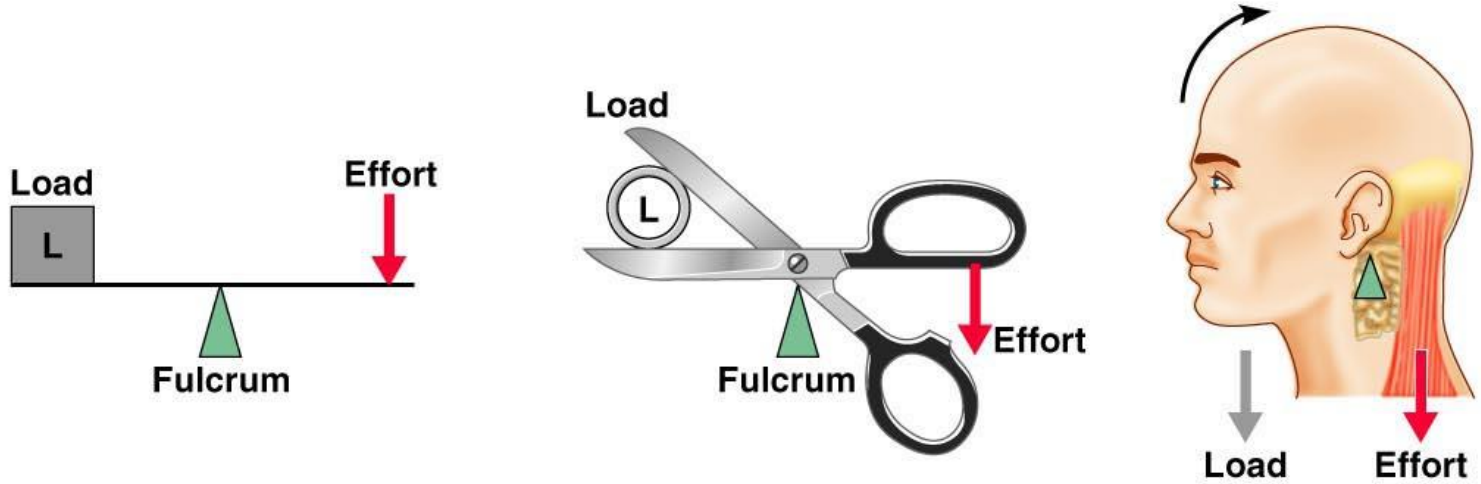


- Effort nearer than the load to the fulcrum = mechanical disadvantage



Lever Systems: Bone-Muscle Relationships

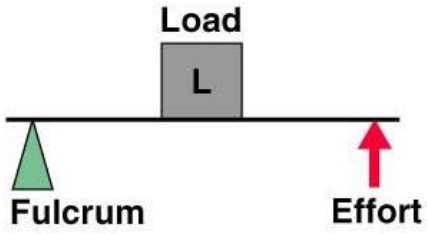
- **First-Class Levers**
  - Fulcrum in the middle of load and effort
  - Ex. Seesaws and scissors
  - Mechanical advantage or disadvantage

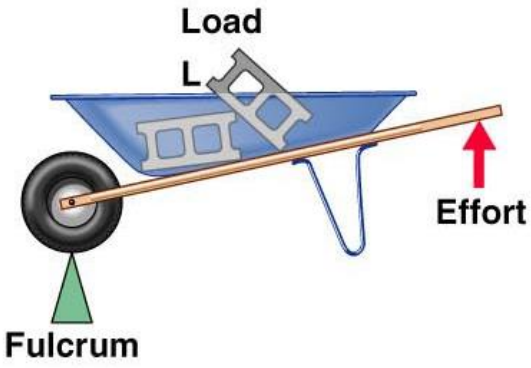


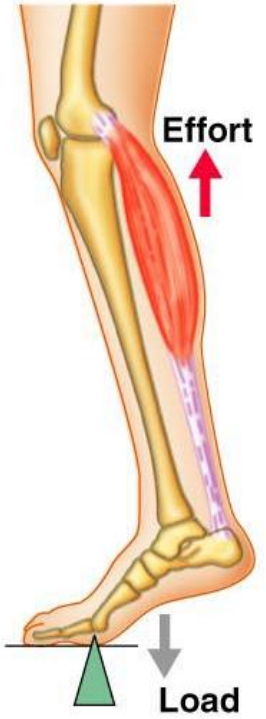
(a) First-class lever

Lever Systems: Bone-Muscle Relationships

- **Second-Class Levers**
  - Load in middle of effort and fulcrum
  - Ex. Wheelbarrow
  - ʅ



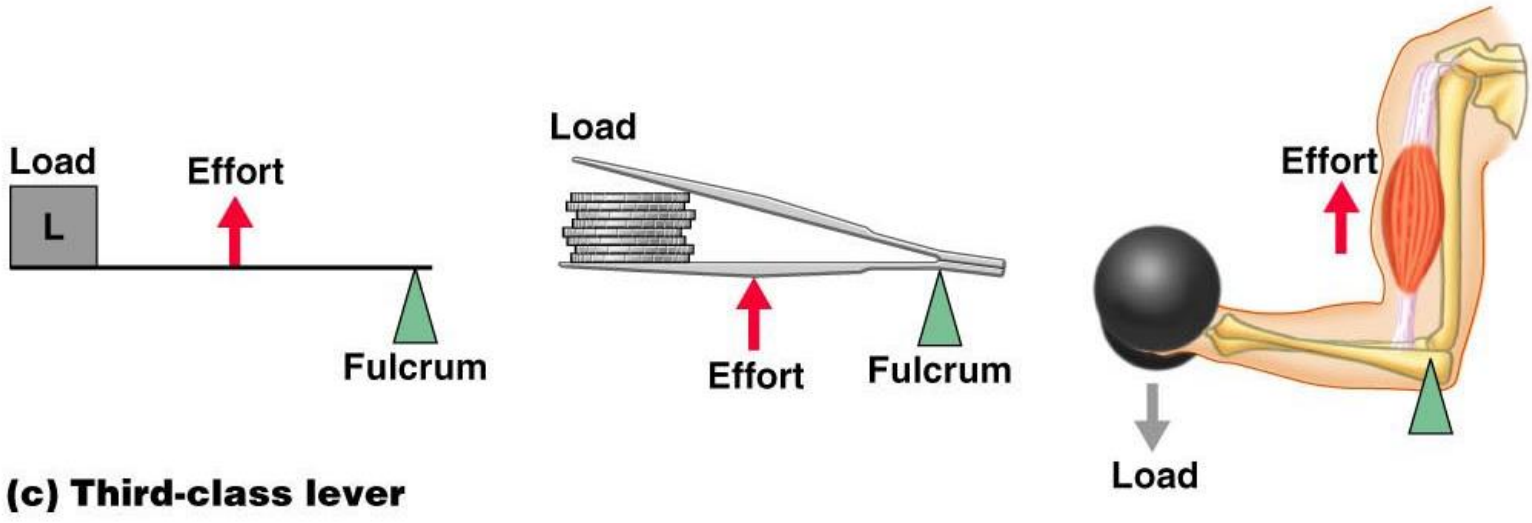




(b) Second-class lever

Lever Systems: Bone-Muscle Relationships

- **Third-class levers**
  - Effort is in the middle of the load and fulcrum
  - Ex. Tweezers
  - Always mechanical disadvantage
  -]



(c) Third-class lever

Lever Systems: Bone-Muscle Relationships

- Mneumonic to remember Levers:
  - 123
  - FLE

Muscle Facts!!!

Muscle Facts

- Muscles can shorten themselves but not lengthen themselves. Every time a muscle contracts, it must be pulled back to its original length by another muscle shortening itself in the other direction.

Muscle Facts

- There are over 600 skeletal muscles in the human body!!
- It takes 17 facial muscles to smile
- It takes 42 facial muscles to frown
- 72 muscles are required to speak one word!

Muscle Facts

- It takes 200 muscles to walk. About 40 muscles are used to lift your leg and move it forward
- Nerve signals may travel through nerve or muscle fibers at speeds as high as 200 mph

Muscle Facts

- The strongest muscle in the body is the tongue
- The ability to grip with your hand comes from muscles in the forearm. The muscles pull tendons in the hand, bending the fingers

Muscle Facts

- Muscles in the human body are 75% water
- The brain is not sensitive to pain. Headache pain originates in the nerves, muscles and tissues surrounding the skull, not from the brain

Muscle Facts

- There are 40,000 muscles and tendons in an elephant's trunk. This makes it very strong and flexible, allowing an elephant to pluck a delicate flower or lift a huge log. The trunk is used for touching, grasping, sucking, spraying, smelling, and striking.

Muscle Facts

- There are about 40 different muscles in a bird's wing.
- A cat has 32 muscles in each ear
  - Humans only have 6 muscles in their ear
- A hedgehog has a large muscle running along its stomach so that it can curl its body into a prickly little ball