PURDUE UNIVERSITY

M-STEM HIGH SCHOOL CURRICULUM

BHARATHIDASAN UNIVERSITY

Tiruchirappalli-620024, Tamil Nadu, India

Department of Physical Education and Yoga

Course Title : SPORTS BIOMECHANICS AND KINESIOLOGY

Course Code : 21MPE22

Unit- (IV)

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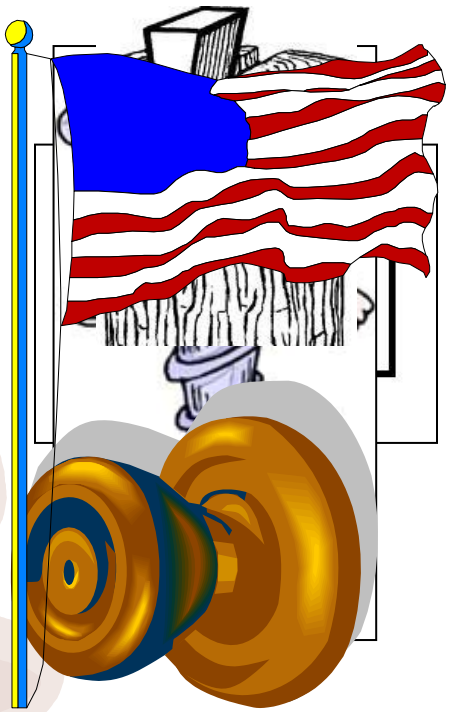
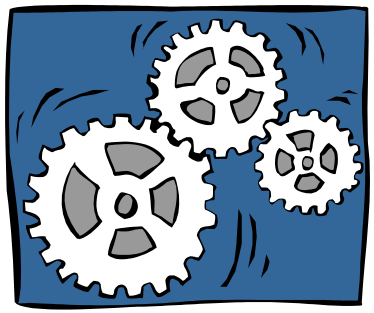
Simple Machines

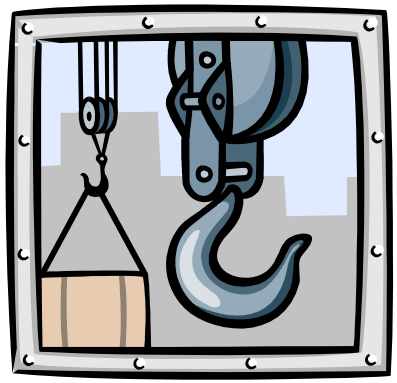
1. Lever: A bar that is free to pivot, or move about a fixed point when an input force is applied.
2. Wheel and Axle: Consists of 2 discs or cylinders, each one with a different radius.
3. Inclined plane: a slanted surface along wh… a force moves an object t… ifferent el…
4. Wedge: a V-shape… e sid… inclined planes slo…
5. Screw: an incline… cylinder.
6. Pulley: A chain, belt , or rope wrapped around a wheel.



Machines

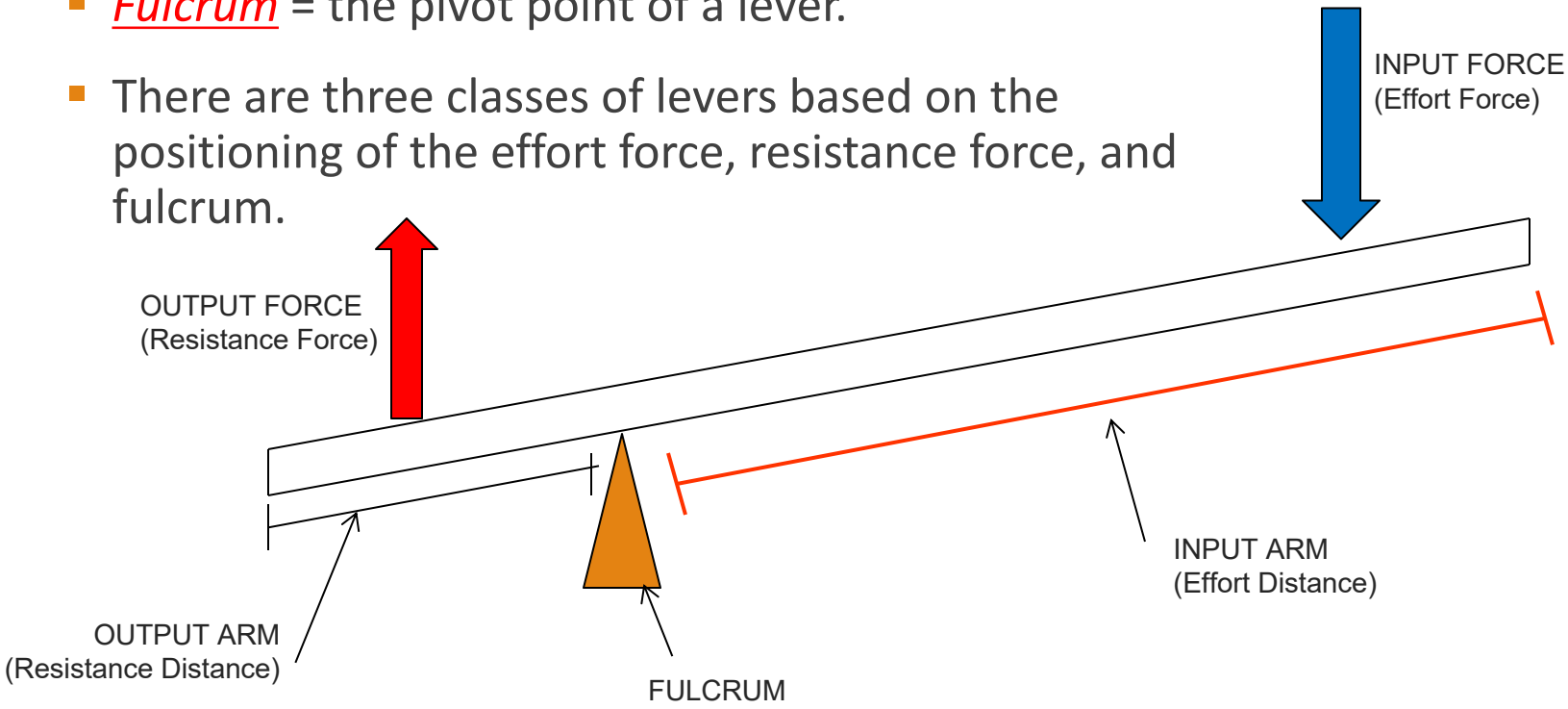
- A device that makes work easier.
- A machine can change the size, the direction, or the distance over which a force acts.





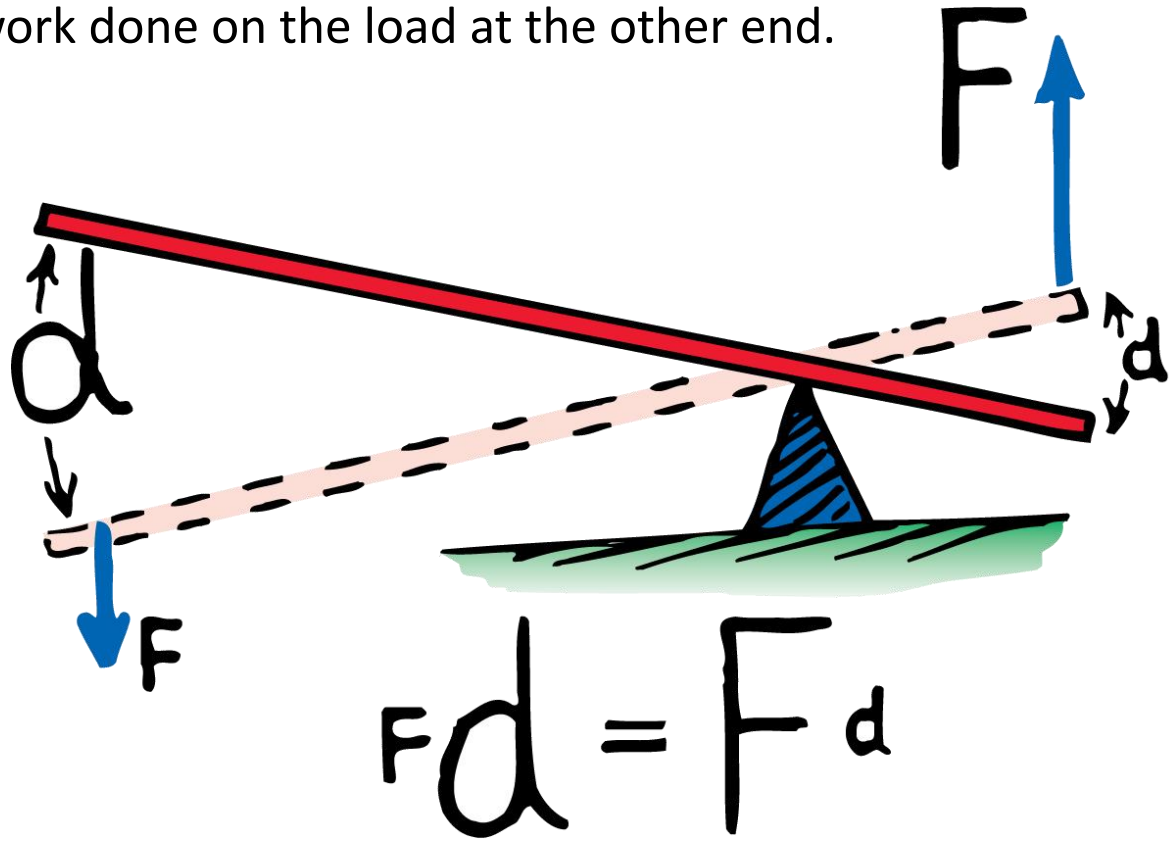
Levers

- A bar that is free to pivot, or move about a fixed point when an input force is applied.
- *Fulcrum* = the pivot point of a lever.
- There are three classes of levers based on the positioning of the effort force, resistance force, and fulcrum.



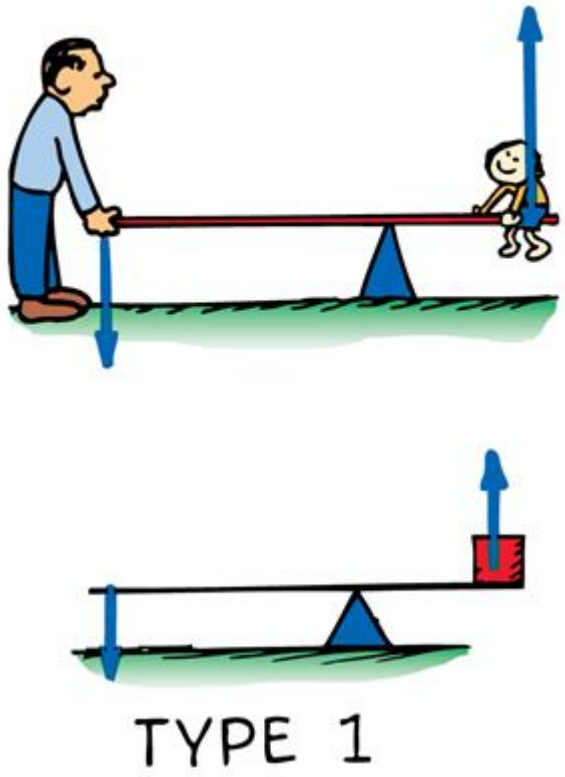
Levers

In the lever, the work (Force × displacement) done at one end is equal to the work done on the load at the other end.



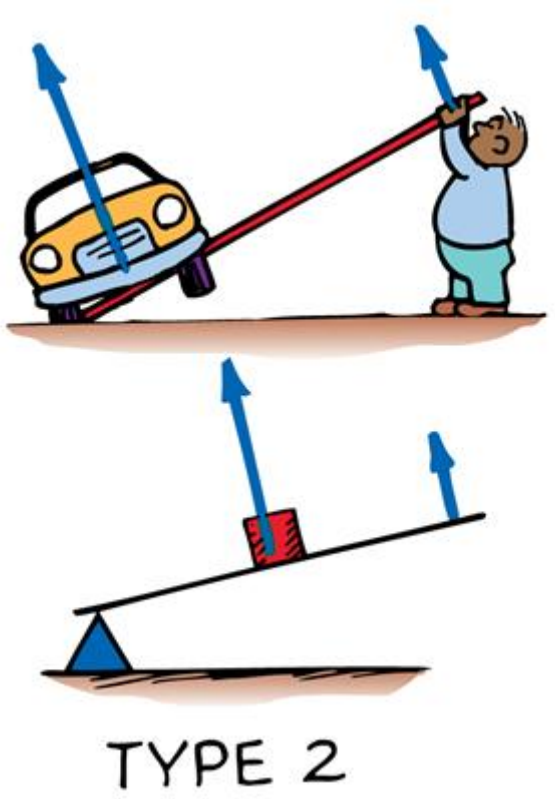
Three Classes of Levers

For a type 1 lever, push down on one end and you lift a load at the other. The directions of input and output are opposite.



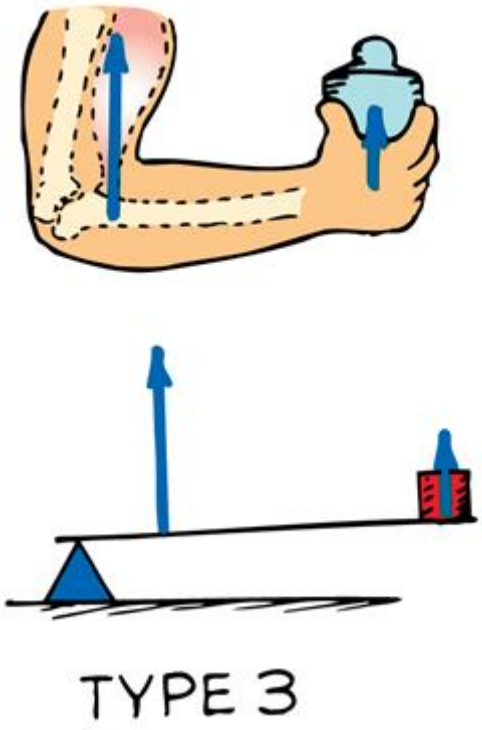
Three Classes of Levers

For a type 2 lever, you *lift* the end of the lever. Since the input and output forces are on the same side of the fulcrum, the forces have the same direction.



Three Classes Levers

For a type 3 lever, the input force is applied between the fulcrum and the load. The input and output forces are on the same side of the fulcrum and have the same direction.



Mechanical Advantage

Mechanical Advantage is the number of times a machine multiplies the input force.

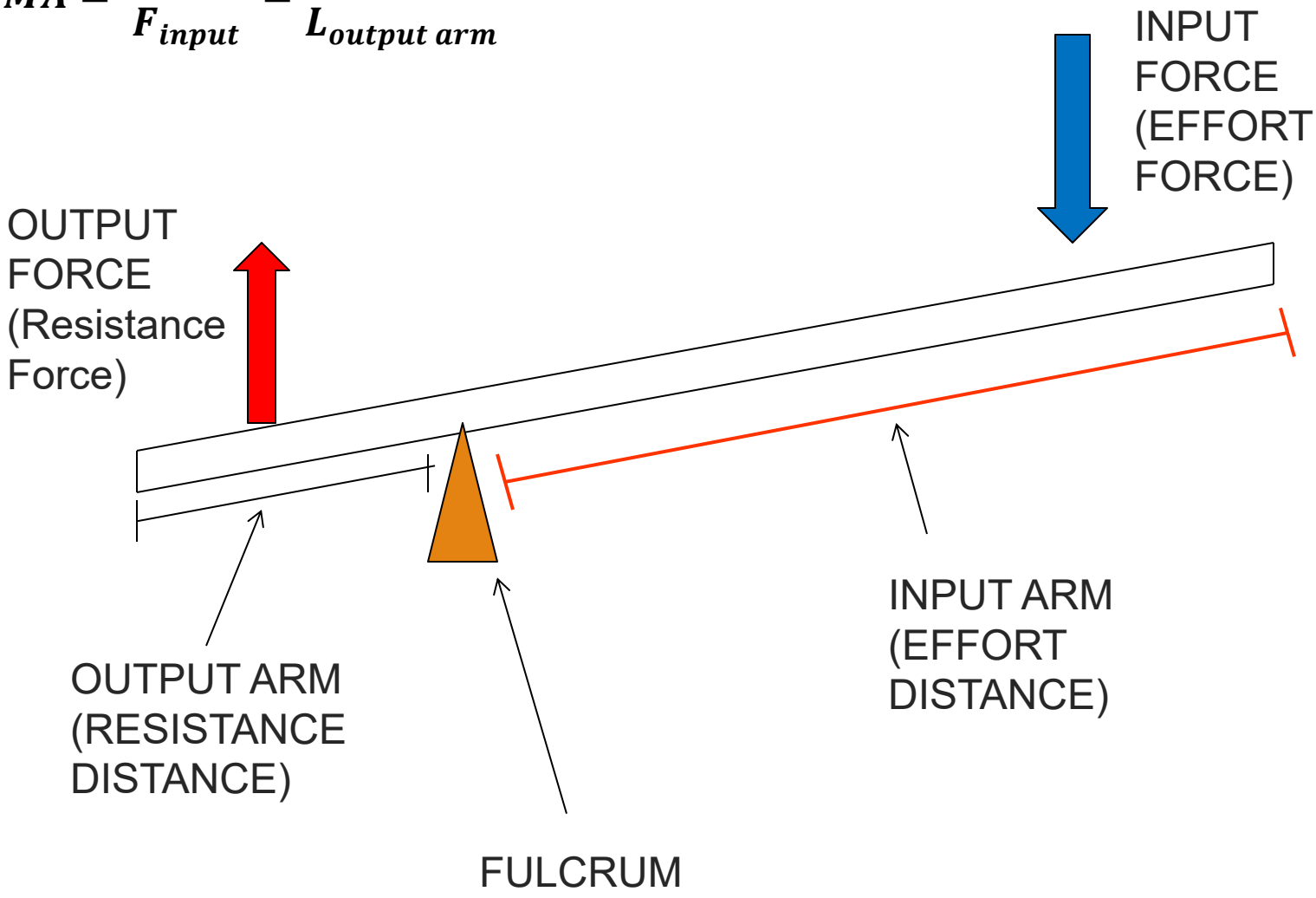
Ratio of the output force compared to the input force.

$$MA = \frac{F_{output}}{F_{input}}$$

There are two types of mechanical advantage

- IDEAL
  - Involves no resistance.
  - Is calculated differently for different machines
  - Usually input distance/output distance
- ACTUAL
  - Involves resistance.
  - Calculated the same for all machines

$$MA = \frac{F_{output}}{F_{input}} = \frac{L_{input\ arm}}{L_{output\ arm}}$$



Different mechanical advantages:

- MA equal to one. ($F_{output} = F_{input}$)
- Change to the direction of the applied force only.

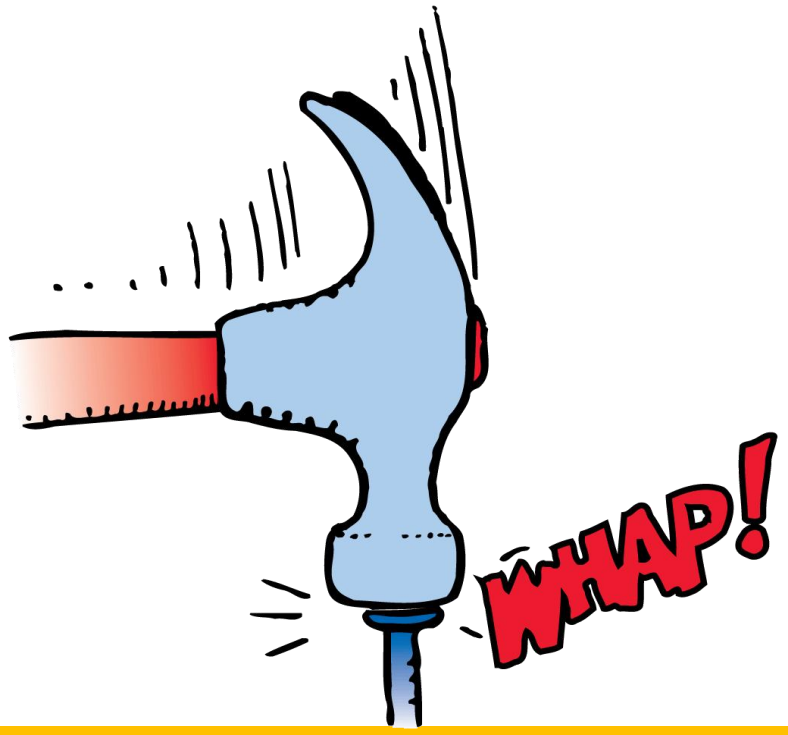
- MA less than one
- An increase in the distance an object is moved (d_{output})

Forces and Interaction

In the simplest sense, a force is a push or a pull.

A mutual action is an **interaction** between one thing and another.

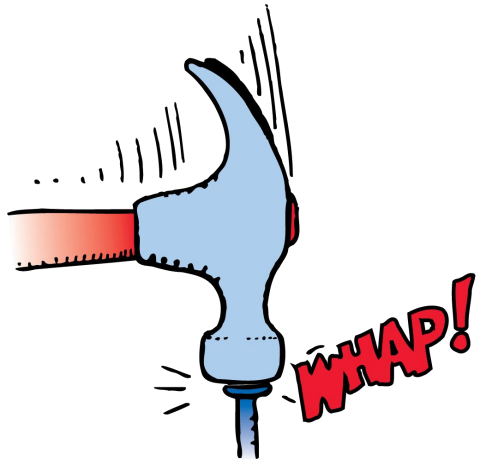
The interaction that drives the nail is the same as the one that halts the hammer.



Forces and Interactions cont.,

A hammer exerts a force on the nail and drives it into a board.

- There must also be a force exerted on the hammer to halt it in the process.
- Newton reasoned that while the hammer exerts a force on the nail, the nail exerts a force on the hammer.
- In the interaction, there are a pair of forces, one acting on the nail and the other acting on the hammer.



Newton's Third Law

Newton's third law is often stated: "To every action there is always an equal opposing reaction."

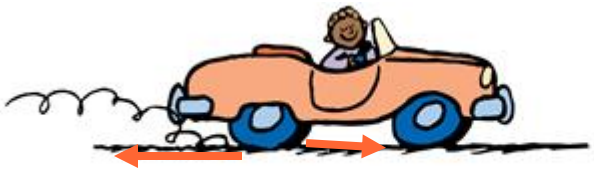
Newton's third law describes the relationship between two forces in an interaction.

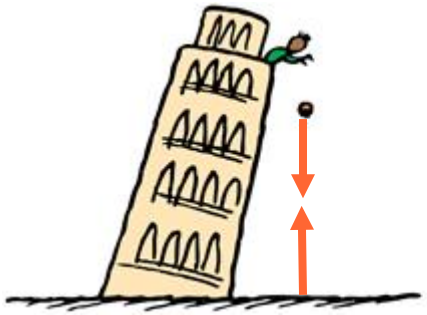
- One force is called the **action force.**
- The other force is called the **reaction force.**
- Neither force exists without the other.
- They are equal in strength and opposite in direction.
- They occur at the same time (simultaneously).

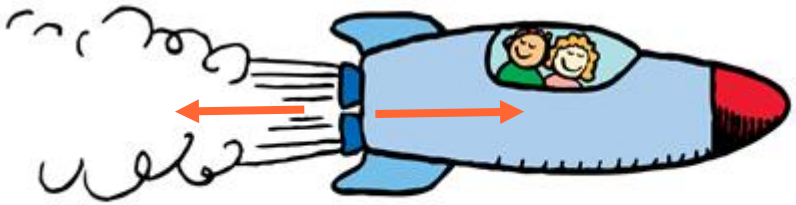
It doesn't matter which force we call *action* and which we call *reaction*.

Identifying Action Reaction Pairs

When action is *A exerts force on B,* the reaction is simply *B exerts force on A.*





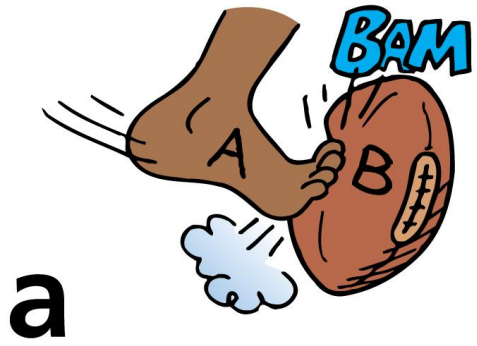


Action Reaction Pairs cont.,

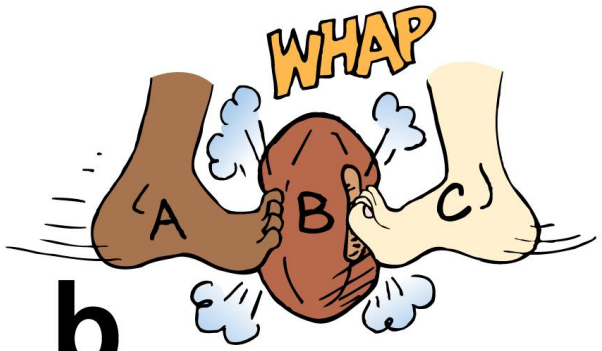
A football is kicked.

a. A acts on B and B accelerates.

b. Both A and C act on B. They can cancel each other so B does not accelerate.



a



b

Action Reaction Pairs cont.,