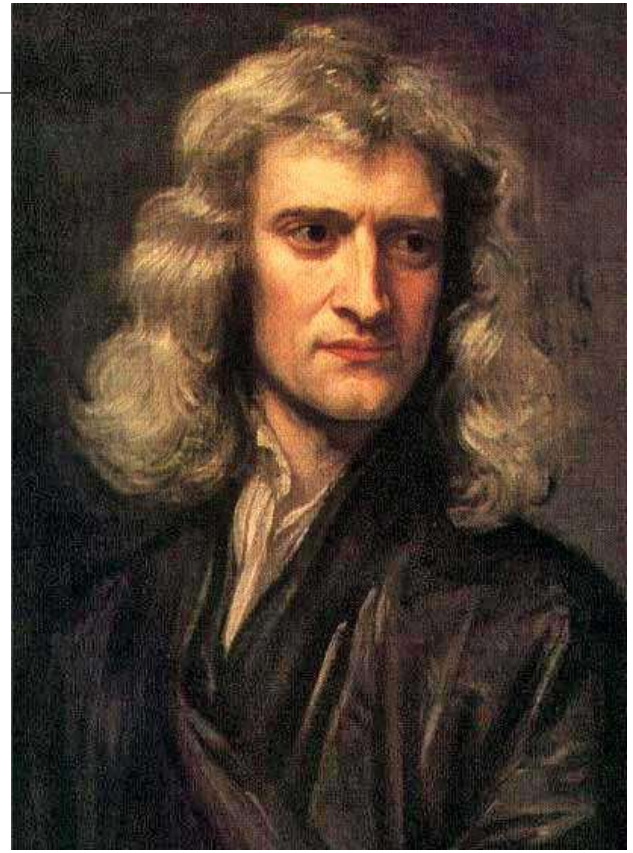
FORCES

Newton's Three Laws of Motion

1. An object at rest tends to stay at rest and an object in motion tends to stay in motion unless acted on by an outside force. This is due to an object's *inertia*.

2. The relationship between an object's mass *m*, its acceleration *a*, and the forces *F* acting on it is $\Sigma F=ma$, where F is measured in a unit called "Newtons."

3. For every action there is an equal and opposite reaction.



Contact vs. Non-Contact Forces

Contact forces have to be in contact with an object to cause an acceleration.

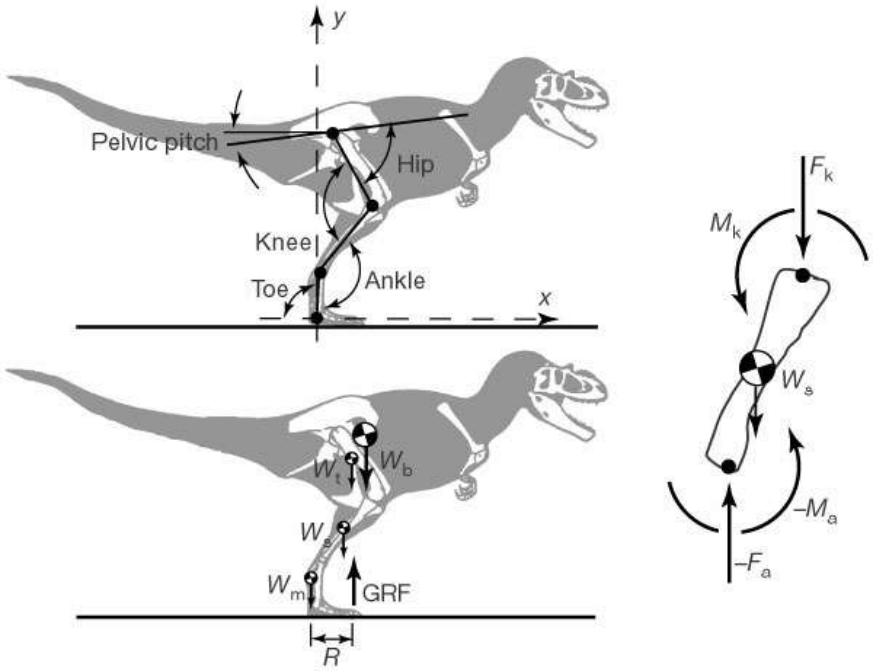
Non-contact forces create a “field” and can cause acceleration even when not in contact.

Contact Forces	Non-contact forces
Applied force Friction force Normal force Tension Spring force Centripetal force	Gravitational force (weight) Electrostatic force

Free Body Diagram

A force is a vector, so it has magnitude and direction.

A freebody diagram is a diagram of force vectors acting on an object. NOTHING ELSE.

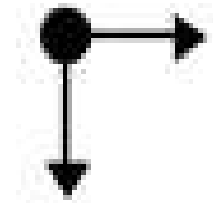


An egg is free-falling from a nest in a tree. Neglect air resistance.

A softball is tossed upwards into the air. Neglect air resistance. The ball has already left the hand

A softball is tossed from the pitcher's mound to home plate. Neglect air resistance. The ball has already left the hand.

A



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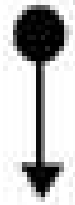

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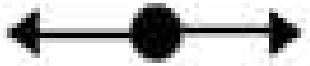

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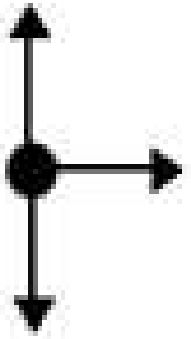

Newton's Second Law: Equilibrium vs. Not in Equilibrium

Not in equilibrium: $\Sigma F = ma$

An object is not in equilibrium when the net forces on the object create an acceleration. The forces are not balanced.

Equilibrium: $\Sigma F = 0$

An object is in equilibrium when there are no net forces acting on the object. The object is not accelerating (a=0)

Does this necessarily mean there are no forces acting on it?

Does this necessarily mean that it is not moving?

Steps to take to solve a problem dealing with forces:

1. Draw a freebody diagram (FBD). Include all forces acting on an object.

2. Write your net force equation ($\Sigma F = ma$) in the x- and in the y-directions.

3. Determine if your object is in equilibrium or not. Adjust your net force equation accordingly.

4. Solve!

Scenario #1: An apple falling from a tree

- Equation: $F_g = mg$, where $g = 9.8\ m/s^2$
- Why is g not negative?
- What is the force of the apple pulling on the earth?
- Net force equation:

Scenario #2: An apple sitting on a desk

- An effect of Newton's 3rd law
- Net force equation:

Scenario #3: An apple hanging on a rope

Net force equation:

Scenario #4: I push an apple resting on a table

Net force equation:

Scenario #5: I push an apple at an angle of 45°

Net force equations:

Problem

Two forces act on a 55 kg block. The magnitudes are F1=79 N and F2= -41 N. What is the horizontal acceleration of the block?

Problem

In a grocery store, you push a 14.5-kg cart with a force of 12.0 N. If the cart starts at rest, how far does it move in 3.00 seconds?

Follow Up Questions

1) A book is sitting on a table. Create a Free Body Diagram to show this situation. Make sure to include all forces.
2) A book is being pushed to the right with a force of 60 N. Create a Free Body Diagram to show this situation.
3) A cart is being pushed with 100 N to the right and 40 N to the left. What the net force on this object and in which direction?
4) A 50 kg cart is being pushed -10 N and 40 N. What is the acceleration of the cart?

Complete your follow up questions to the best of your ability! They are NOT graded. Take a picture and upload to Google Classroom. If you need help completing your Flipped Lesson, reach out to Ms. Logan.