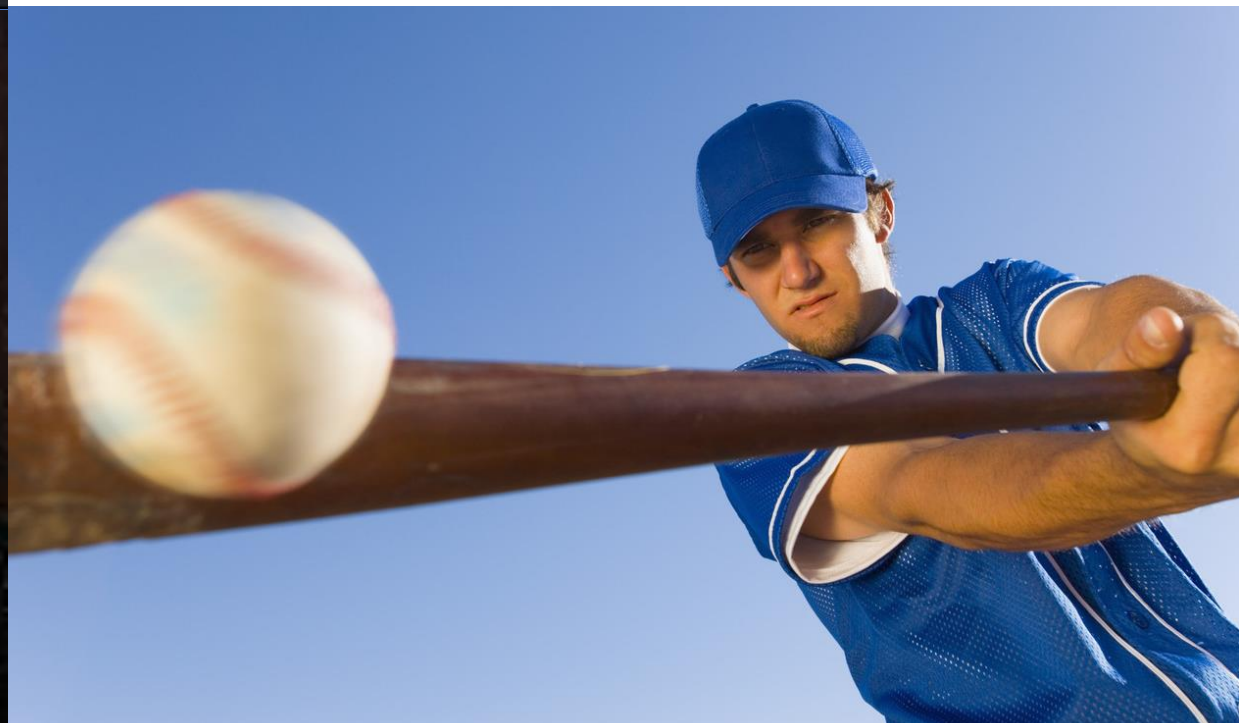
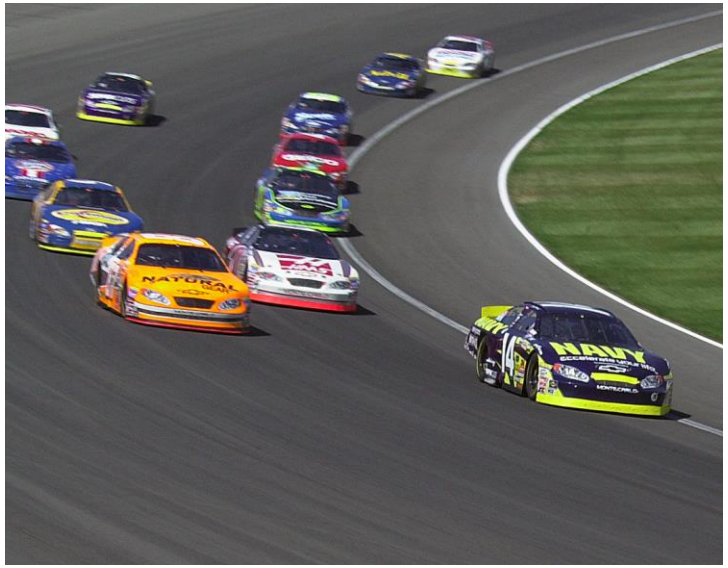
Forces and Newton's Second Law

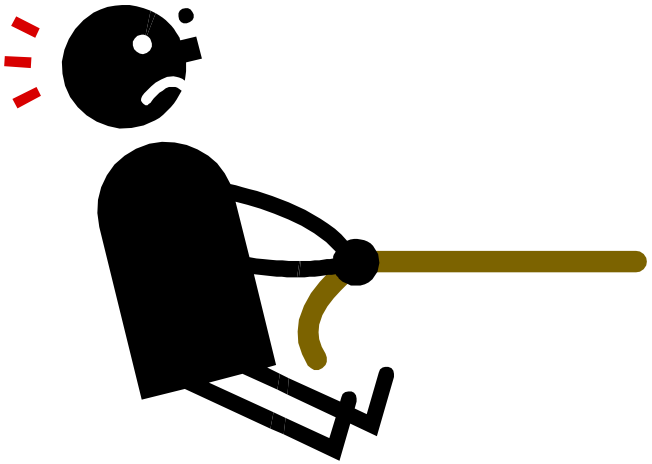


A Review of Forces

What is a force?
What are the 2 categories of forces?
What are 7 kinds of forces we have learned so far?

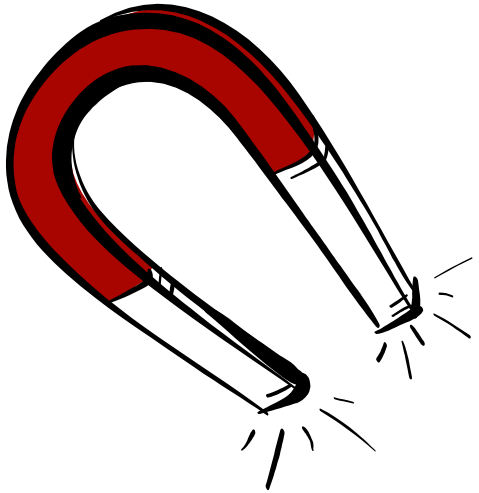


What type(s) of force is shown here?



Contact force: applied force

What type(s) of force is shown here?



Non-contact force: magnetic force

What type(s) of force is shown here?

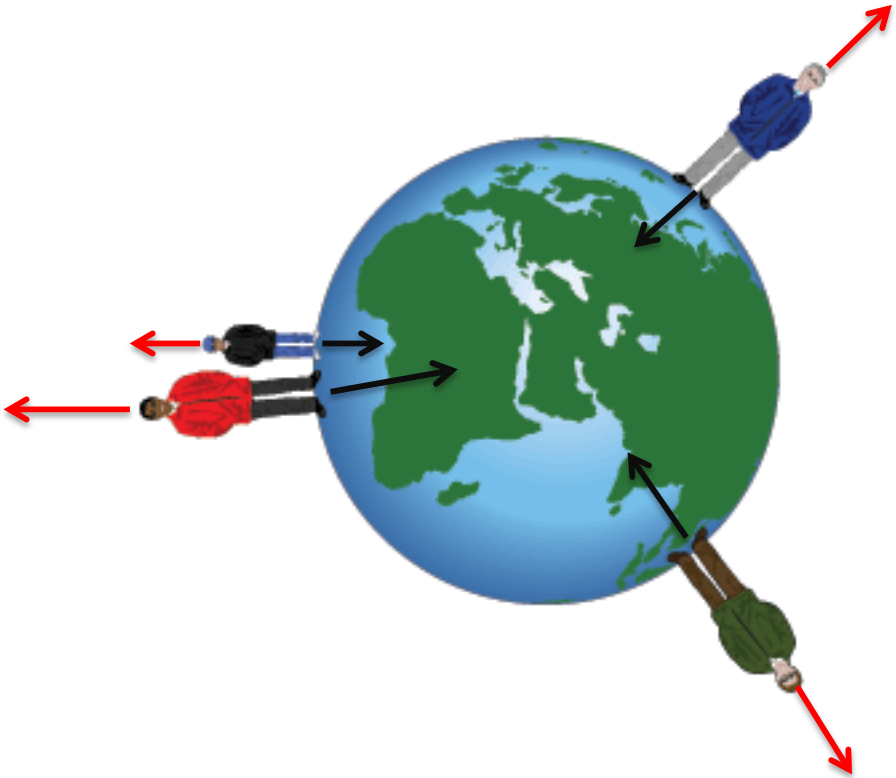
Contact forces: applied force & friction

What type(s) of force is shown here?

Contact force: drag

Non-contact force:
force of gravity

What type(s) of force is shown here?



Contact force:

the normal force

Non-contact force:

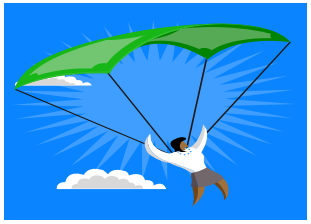
force of gravity

Types of Forces

Contact forces: interactions between objects that touch

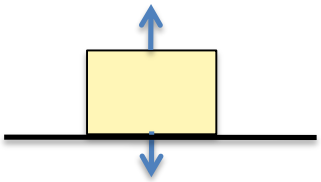
applied force

spring force



drag force

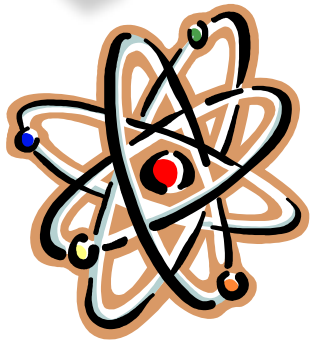
frictional force



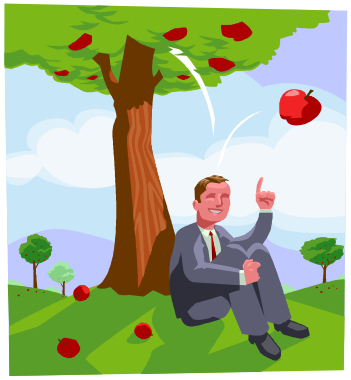
normal force

Non-contact forces: attract or repel, even from a distance

magnetic force



electric force



gravitational force

A force is a push, pull or twist

Applying a force can change an object's velocity.

What is the scientific unit of forces?

Newtons!

What is Newton's first law?

Give some examples of Newton's first law.

What is acceleration?

Acceleration is a change in velocity.

Applying a force can change an object's velocity.

Newton's Second Law of Motion

An object's acceleration depends on:

- **the strength of the *unbalanced force* acting on it**
- **the mass of the object**

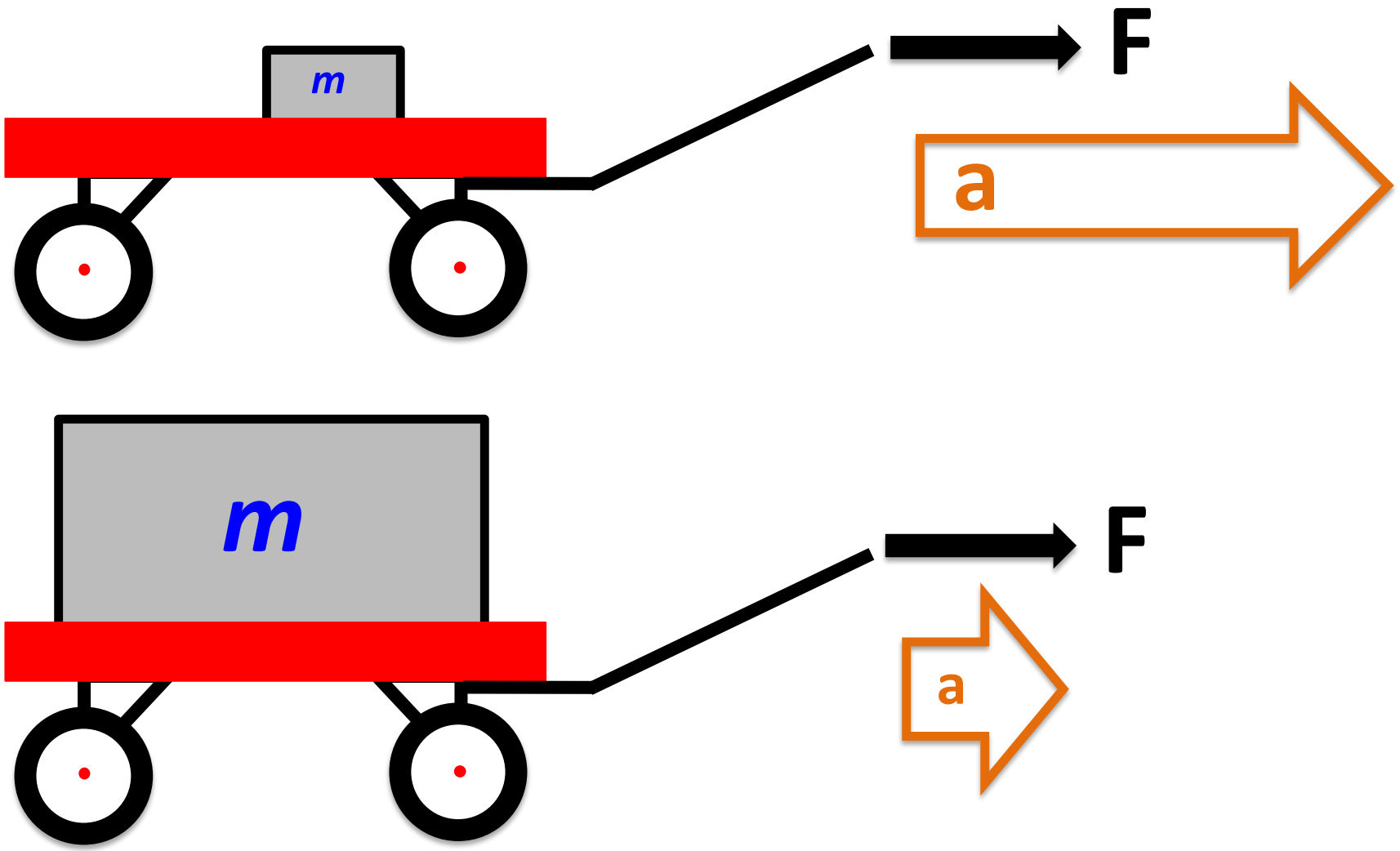
acceleration → $a = \frac{F}{m}$ ← **force**, ← ***mass***

More commonly written as: $F = ma$

Newton's Second Law

$F=ma$

Pull on each wagon as hard as you can, applying the same force…



Mass vs. Weight—A Goldilocks Story

Mass **is the amount of matter an object contains**

Weight **is a gravitational force; a measure of how strongly gravity pulls on an object**

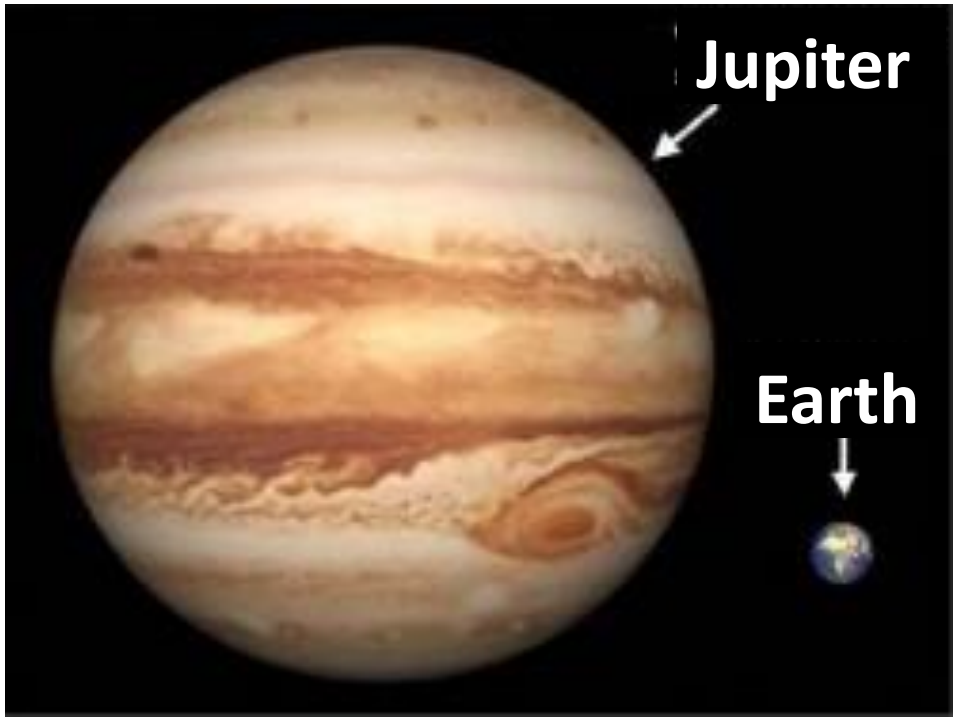
Your weight **depends on the strength of gravity:**

$$F = m \times a$$

$$\text{Force} = m \times g$$

$$_{\text{Force}} = m \times _{g}$$

$$\text{Force} = m \times g$$



Mass vs. Weight—A Goldilocks Story

So weight changes depending on where you are:

On Earth, acceleration due to gravity is 9.8 m/s²

$$F = m \times a$$

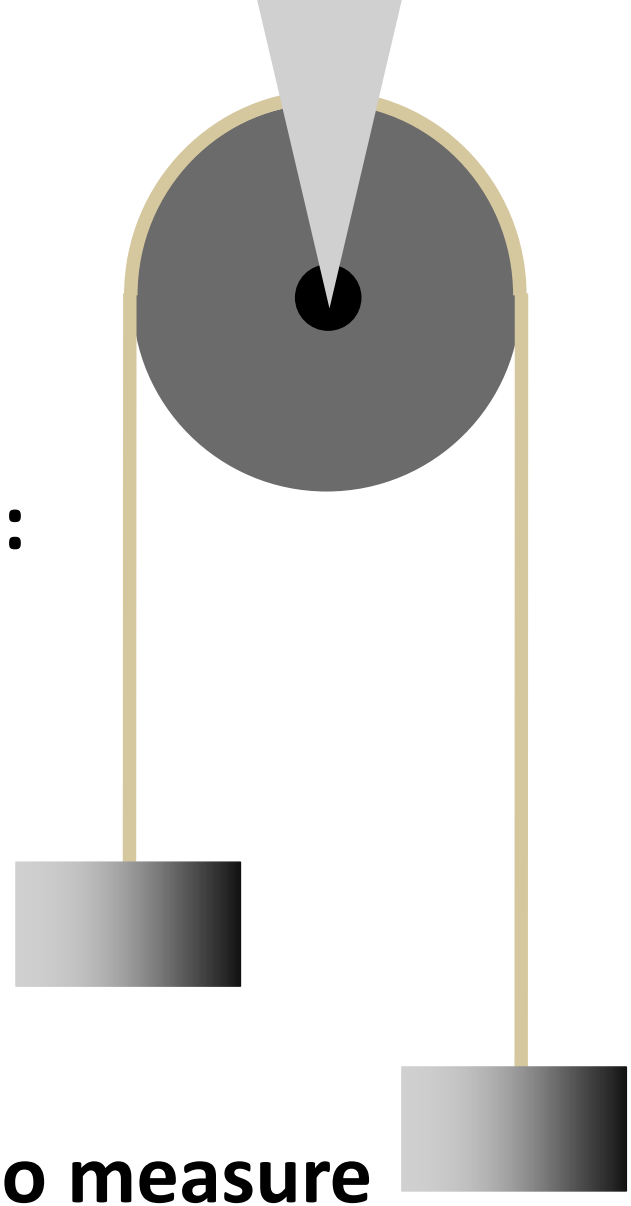
It's only 1.6 m/s² on the Moon

$$F = m \times a$$

On Jupiter, acceleration due to gravity is 26 m/s²

$$F = m \times a$$

Atwood Machine



Equal masses, at different heights:

What happens when I let go?

Use what you know about forces and Newton's first and second laws of motion!

You can use an Atwood machine to measure frictional forces and the force of gravity

Concept Review

1. Newton's second law can be written mathematically as:

   force = mass x acceleration.

2. From Newton's second law, an object's acceleration depends on the object's mass and the strength of the unbalanced force acting on it.

3. Your weight will be different on other planets because the acceleration due to gravity is different.

4. BONUS: What are some examples of engineering designs that must consider Newton's second law of motion? The design of vehicles, structures, products…