Introduction to Forces

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What are forces?

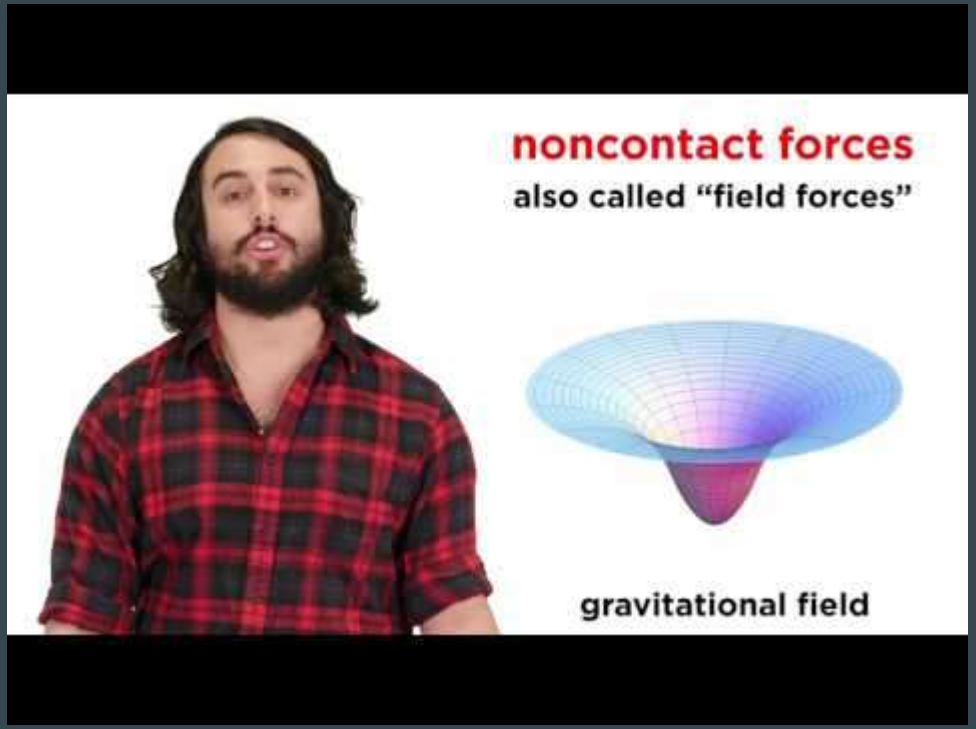
Brainstorm what forces are. Where have you heard this term in everyday life? What does it refer to?

What are forces?

On the following slide, you will watch a short video about forces. As you watch, think about the following questions:

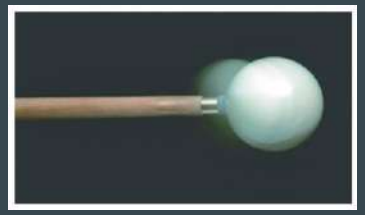
- What is a force?
- What are some types of forces?
- How do we measure forces?

What are forces?



What are forces?

- A **force** is a *push* or a *pull* exerted by one object on another object



- Forces are vectors. They have magnitude and direction.

- **Contact forces** are forces that act on an object by touching it at a point of contact

- **Field forces** are forces that act on an object without physical contact.

Contact and Field Forces

What forces are you familiar with?

Write down two examples of contact forces and two examples of field forces.

Types of Forces

While there are many types of forces, we will focus on a few common ones:

- Weight
- Normal force
- Tension
- Friction

WEIGHT

- The gravitational pull of the earth on an object on or near the surface of the earth is called the **force of gravity** or **weight**.

- An object's weight vector always points vertically downward, no matter how the object is moving.

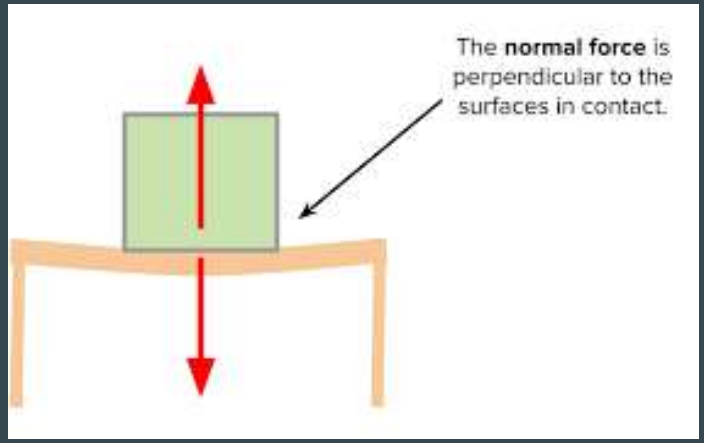
- While we commonly measure weight in pounds, the SI unit is a Newton. 1 pound is around 4 Newtons.

$F_g = mg = W$

Weight is another word for the force of gravity

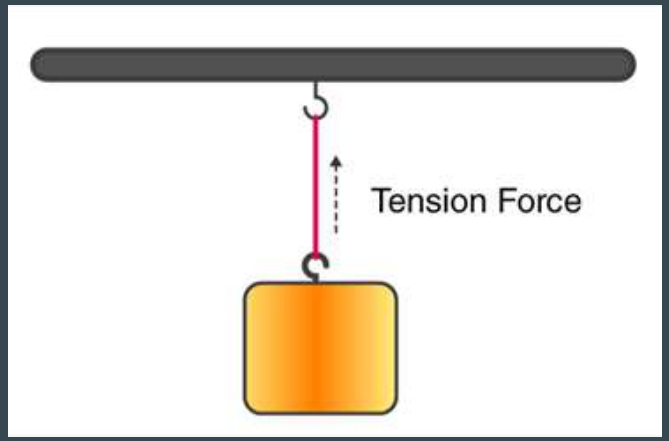
NORMAL FORCE

- Imagine a box sitting on a table. If the force of gravity was the only force on the box, it would fall.
- There must be a force from the table supporting the box. This is called the **normal force**.
- The normal force is the support force from the surface an object is resting on. It is always perpendicular to the surface.



TENSION FORCE

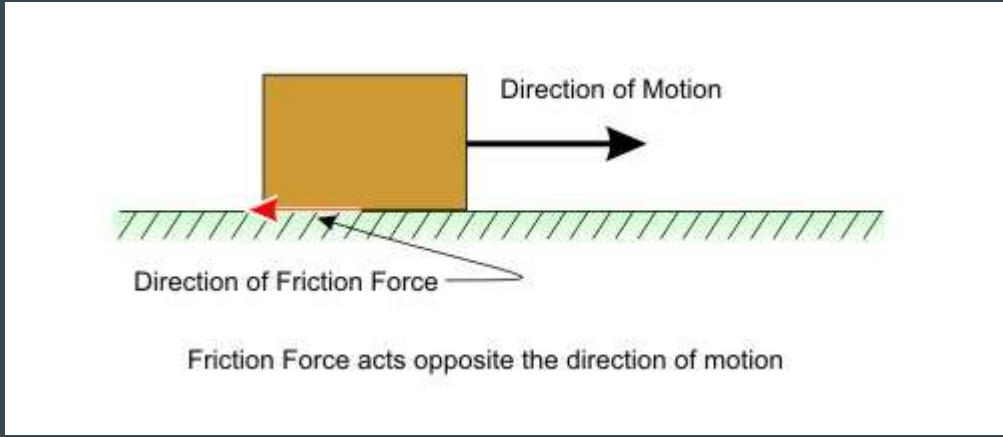
- When a string or rope pulls on an object, it exerts a contact force that we call the **tension force**.
- **The direction of the tension force is always in the direction of the string or rope**.



FRICTION

- Friction, like the normal force, is exerted by a surface. Friction is the force of the surface against the motion.

- Friction is always opposite to the direction an object is moving.



Free Body Diagrams

Free body diagrams, or FBDs, are a way to represent the forces acting on an object. Let's draw a FBD for a book sitting on a table.

The object is drawn as a dot.

The forces on the object are drawn as arrows coming from the dot.

- The direction of the arrow shows the direction of the force.
- The size of the arrow shows the approximate size of the force.
- The forces are given labels.

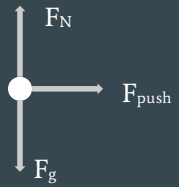
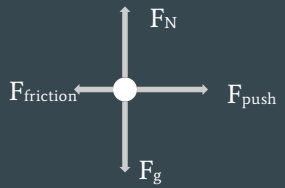
F_N represents the normal force from the table pointing up.

F_g represents the force of gravity (or weight of the book) pointing down

.

The book is at rest, so the arrows are equal in size.

Free Body Diagram Examples

	This object is in free fall. The only force is the force of gravity.
	This object is being pushed to the right. It is accelerating to the right.
	This object is being pushed to the right and there is friction. The friction is smaller than the push, so this object is accelerating to the right.
	This object is hanging from a string and is at rest.

Question to think on

What does it mean if a force is balanced or unbalanced? How does this affect an object's motion? Use your knowledge of forces, motion, and the examples shown on the previous slide. Tomorrow, we will do a lab to investigate this question!