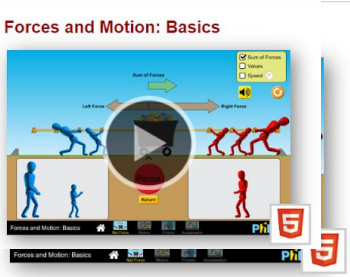


Name____Aaron Minard_____ Date 10/16/20

PhET: Forces and Motion Basics

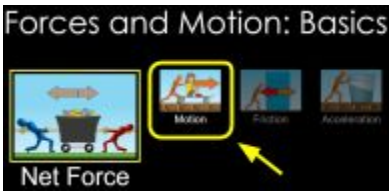
Link to sim: https://phet.colorado.edu/en/simulation/forces-and-motion-basics

Open the simulation and press the arrow to start.

Newton's 1st Law is also known as the Law of Inertia. It says that objects will stay still or keep moving in the same direction and same speed until they're acted upon by an unbalanced force.

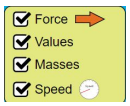
Newton's 2nd Law tells us that the more force is applied to an object the faster it will accelerate. It also tells us that objects with a greater mass need a greater force to be applied in order to accelerate them.

Acceleration is any change in motion. This means speeding up (this includes starting to move), slowing down (including stopping), or changing direction.

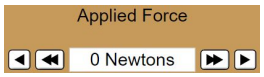


Part 1: The "Motion" tab

- Click on the "Motion" option.

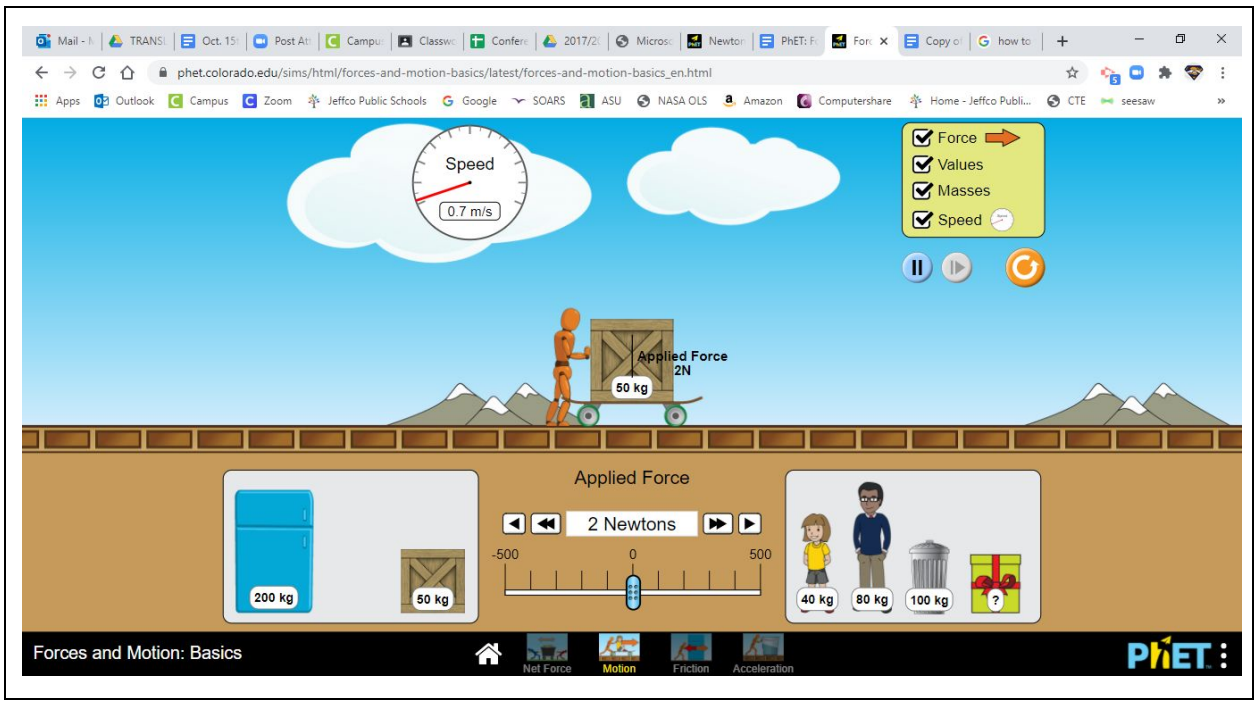


- Check the boxes for "Values", "Masses", and "Speed" ("Force" should already be checked)
- Use the arrows at the bottom to slowly increase the amount of force applied to the box until the box starts moving.



1. How much force does it take to start moving the 50 kg box?

About 2 newtons of force.

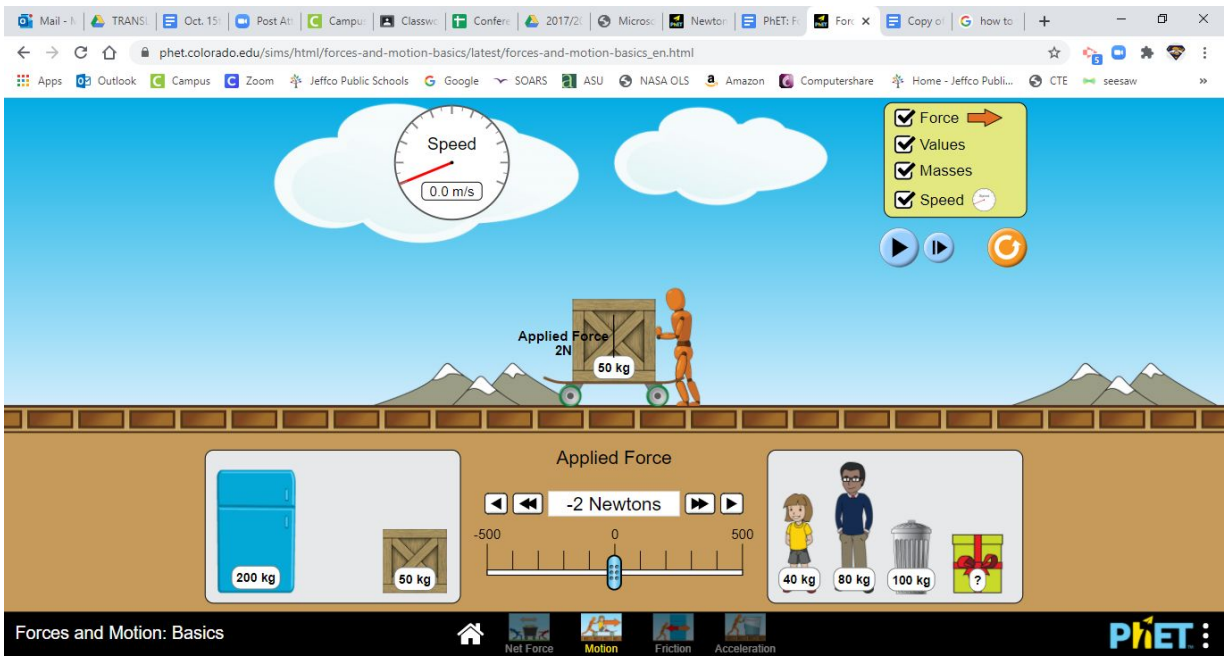


2. Why do you need to apply a force in order to get the box to move?

According to Newton's 1st Law of motion, an object will stay still until it's acted upon by an unbalanced force such as a person pushing it. Also known as the Law of Inertia.

3. How much force do you need to apply in order to stop the box?

About 2 Newtons of force in the opposite direction (-2N)



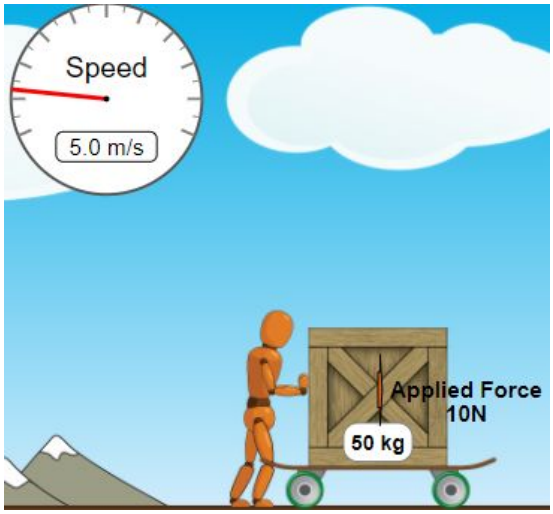
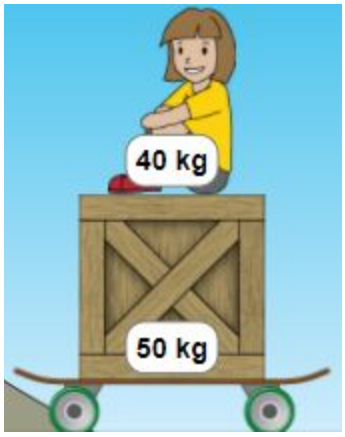
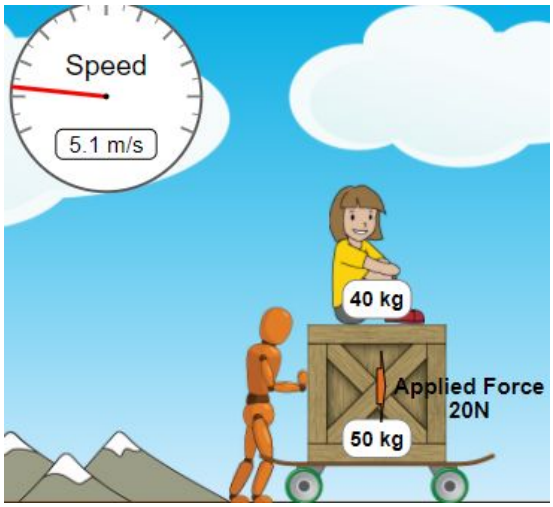
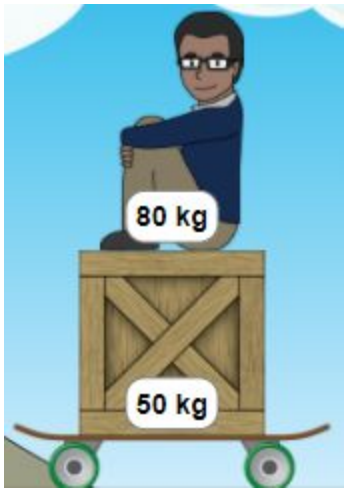
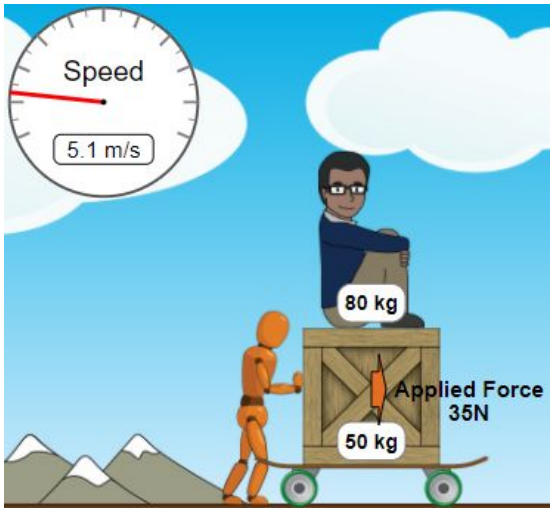
4. Which of Newton's Laws does this demonstrate?

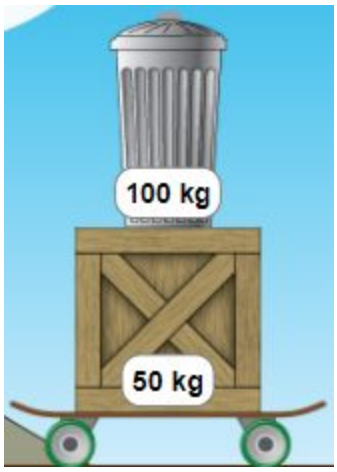
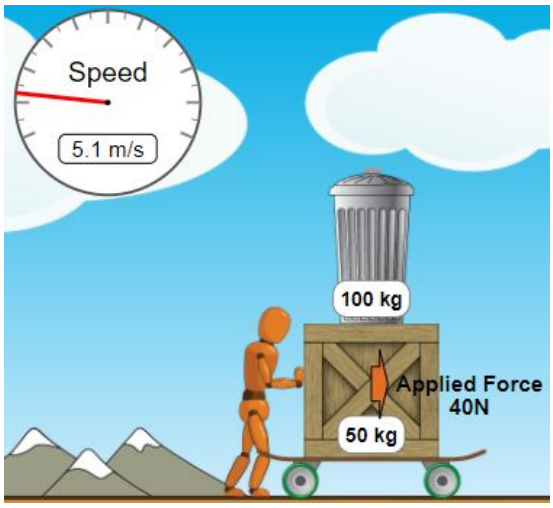
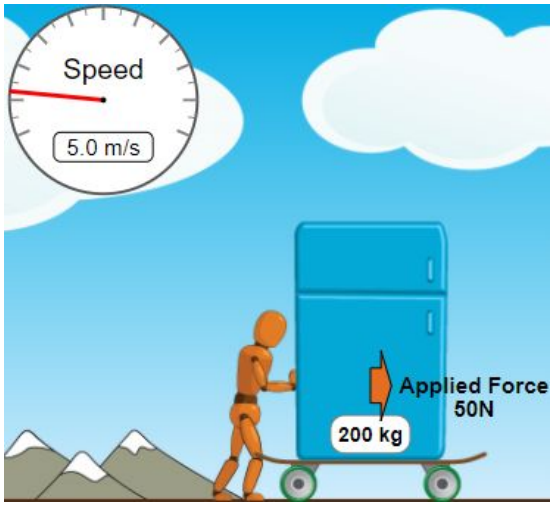
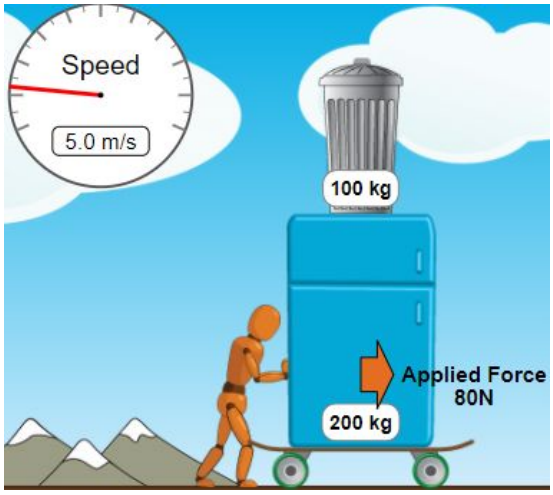
This simulation demonstrates Newton's 1st Law of Motion - The Law of Inertia.

5. How does it demonstrate that law?

When the object (crate on a skateboard) is at rest it stays that way until it's acted upon by an unbalanced force (man pushing object). When the object (crate on a skateboard) is set in motion it stays in motion until it's acted upon by an unbalanced force (man pushing object in opposite direction).

- Fill in the chart below, adding your own mix in the final row.

Object	Total mass	Force needed to get it moving at 5 m/s
Box	 **50 kg**	 **10 Newtons of Force**
Box with Girl	 **50kg + 40kg = 90 kg**	 **20 Newtons of Force**
Box with Man	 **50kg + 80kg = 130kg**	 **35 Newtons of Force**

Box with Garbage Can	 **50kg + 100kg = 150kg**	 **40 Newtons of Force**
Fridge	 **200kg**	 **50 Newtons of Force**
Fridge with Trash Can	 **200kg + 100kg = 300kg**	 **80 Newtons of Force**

6. What is the pattern you see between the total mass and the force needed to accelerate to 5 m/s?

The greater the mass of the object(s) the greater the amount of force is needed to accelerate the object(s) to 5 m/s.

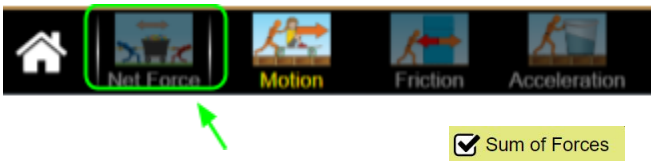
7. Which of Newton's Laws does this demonstrate?

This simulation demonstrates Newton's 2nd Law of Motion.

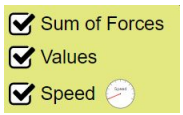
8. How does it demonstrate that law?

Objects with a small mass like the crate box (50kg) took a lot less force (10N) to accelerate to a speed of 5 m/s than objects with a large mass like the refrigerator (200kg) needing a greater force (50N) to acquire the same speed.

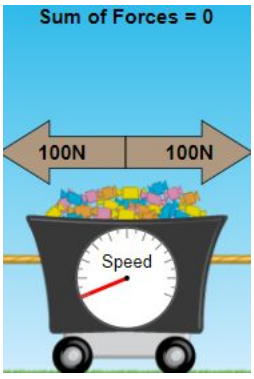
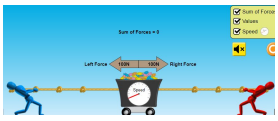
Part 2: The "Net Force" tab

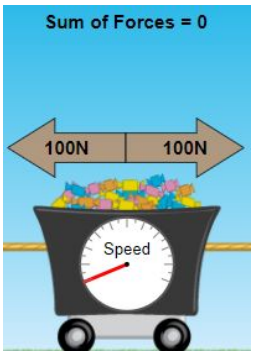
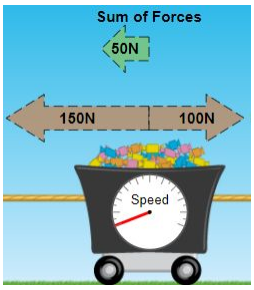
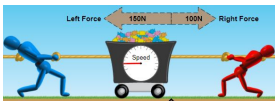
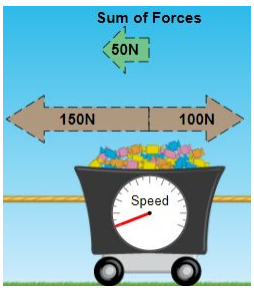
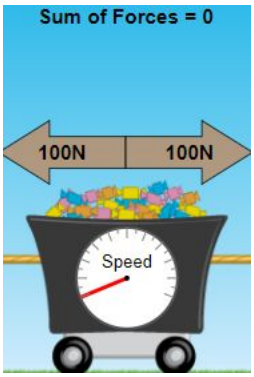
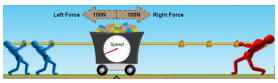


- Click on the "Net Force" option at the bottom of your screen.
- Check the boxes for "Some of Forces", "Values", and "Speed"



- Fill in the chart below, adding your own mix in the final row. **Be sure to fill out your prediction before you press "Go!"**

People & Placement	**Predicted Movement**	**Sum of Forces (0, x-left, x-right)**	**Actual Movement (none, left, right)**	**Speed (m/s)**
 Same size Same placement	**I predict that there will be no movement with the same size & same placement.**	 **0 Newtons**	 **None**	 **0 m/s**

People & Placement	Predicted Movement	Sum of Forces (0, x-left, x-right)	Actual Movement (none, left, right)	Speed (m/s)
 Same size Different placement	I predict that there will be no movement with the same size & different placement.	 0 Newtons	 None	 0 m/s
 Different size Same placement	I predict that the load will move to the side (left) with a greater size and same placement.	 50 Newtons Left	 Left	 >0 m/s No Digital Display
 Different size Different placement	I predict that the load will move to the side (left) with a greater size and different placement.	 50 Newtons Left	 Left	 >0 m/s No Digital Display
 Different size and quantity of people and Different Placement	I predict that there will be no movement since the left & right forces are balanced. (100N = 100N)	 0 Newtons	 None	 0 m/s

9. Your science class is going to play a game of tug-of-war and you need to divide up the teams. There are **11** people participating. If you want equal teams, how would you decide who is on which side and why? Use what you have learned about Newton's Laws of motions to explain.

It would be difficult to make equal teams unless you know how many newtons of force each person could pull. If you knew this information then you could put 6 people with a sum of forces somewhat equal to the remaining 5 people on opposite sides of the rope. The team with the greater force, according to Newton's 2nd Law, will cause the greater acceleration.