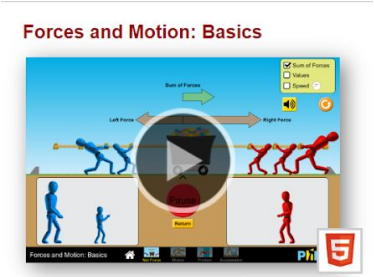


Name_____ Date_____ Per__

PhET: Forces and Motion Basics

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

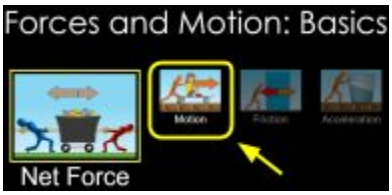
Open the simulation and press the arrow to start.

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.

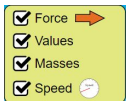
Newton's 2nd Law tells us that the more force is applied to an object the faster it will accelerate. It also tells us that objects with a greater mass need a greater force to be applied in order to accelerate them.

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

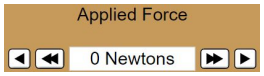
Part 1: The "Motion" tab



- 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?

   1 N (But it's very slow, so the students may answer higher if they don't wait long enough)

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

   Inertia (Objects at rest will stay at rest until acted on by an unbalanced force)

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

   -1 N (Any force in the opposite direction. Again, it's slow, so the students may answer higher)

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

   1st

5. How does it demonstrate that law?

   (See #2)

- 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**	**Answers may vary. 1 N is enough to get any combination up to 5 m/s given enough time, so it again depends on how patient the student is. You may want to give a certain amount of time for them to wait, but there is no timer option in the simulation.**
Box with Girl	**90 kg**	
Box with Man	**130 kg**	
Box with Garbage Can	**150 kg**	
Fridge	**200 kg**	

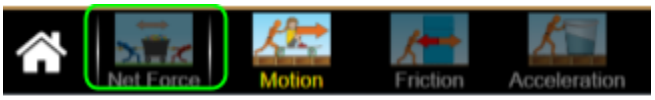
6. What is the pattern you see between the total mass and the force needed to accelerate to 5 m/s? **Here, the students should say one of the following:**
    - **The more mass, the more force is needed**
    - **The more mass, the slower it accelerates**
7. Which of Newton's Laws does this demonstrate?

    2nd

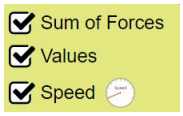
8. How does it demonstrate that law?

(see #6)

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	**(Answers vary)**	**0 N**	**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	**(Answers vary)**	**0 N**	**None**	**0 m/s**
 Different size Same placement	**(Answers vary)**	**(Answers vary depending on chosen sizes)**	**(Answers vary but will favor the larger)**	**(Answers vary but cannot be 0)**
 Different size Different placement	**(Answers vary)**	**(Answers vary depending on chosen sizes)**	**(Answers vary but will favor the larger)**	**(Answers vary but cannot be 0)**
(Answers vary)	**(Answers vary)**	**(Answers vary)**	**(Answers vary)**	**(Answers vary)**

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.

   You would need to know how hard each person could pull and find a way to make the forces the same on each side. This is because, according to Newton's 2nd Law, greater force will cause greater acceleration.