Title: Force and Motion

Definitions:

Force is a push or a pull
Mass is the measurement of how much matter is in an object

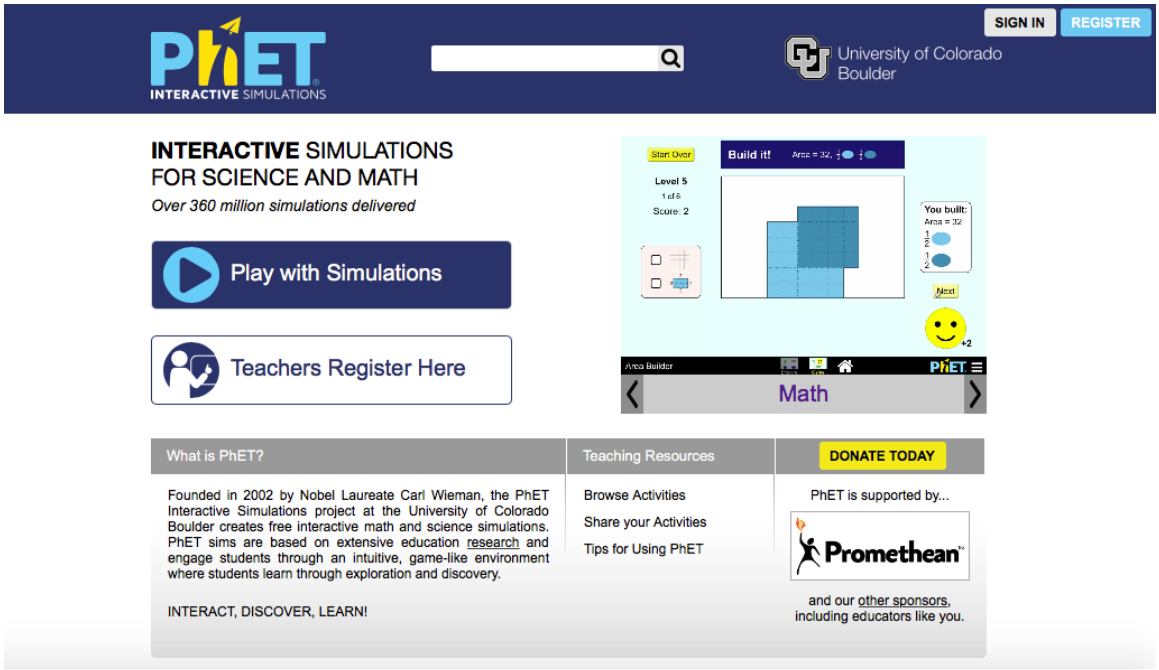
Important Questions:

How do we determine how much force is needed to move an object?
How do we compare the speed of different forces?
How do we determine the mass of an unknown object based on it's speed when pushed or pulled?

Instructions:

In this activity, the above questions are investigated. Complete this document by filling in data tables and writing complete responses. This investigation has three phases: Exploration, Explanation and Application. Work between this document and the simulation (sim).

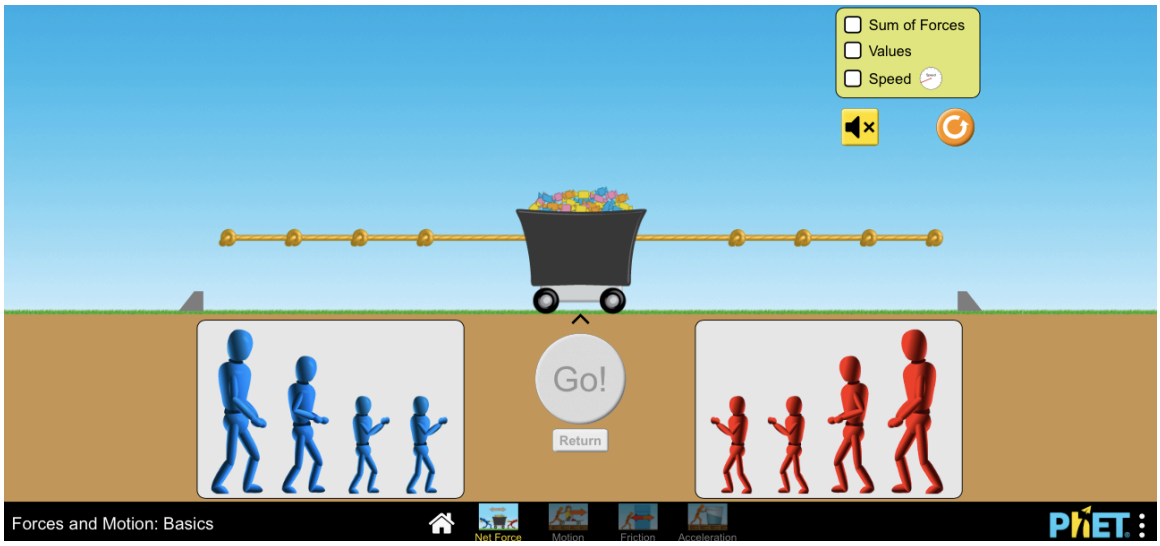
1. Click this link: http://phet.colorado.edu/
This is a screen shot of the website:



2. Enter "Forces and Motion" in the search bar.

3. Find "Forces and Motion: Basics" and click the large start button.

4. This screen appears:



Exploration Phase:
(5-7 minutes)

1. Briefly explore this sim by clicking around and manipulating the players.

2. Place various blue and red players on either side of the rope.

3. Click "Go" to play tug-o-war with the players.

4. Explore different combinations and placements of players.

5. Notice the reset button in the bottom right hand corner.

Questions

1. How do you make the blue team win?

_____

_____

2. How do you make the red team win?

_____

_____

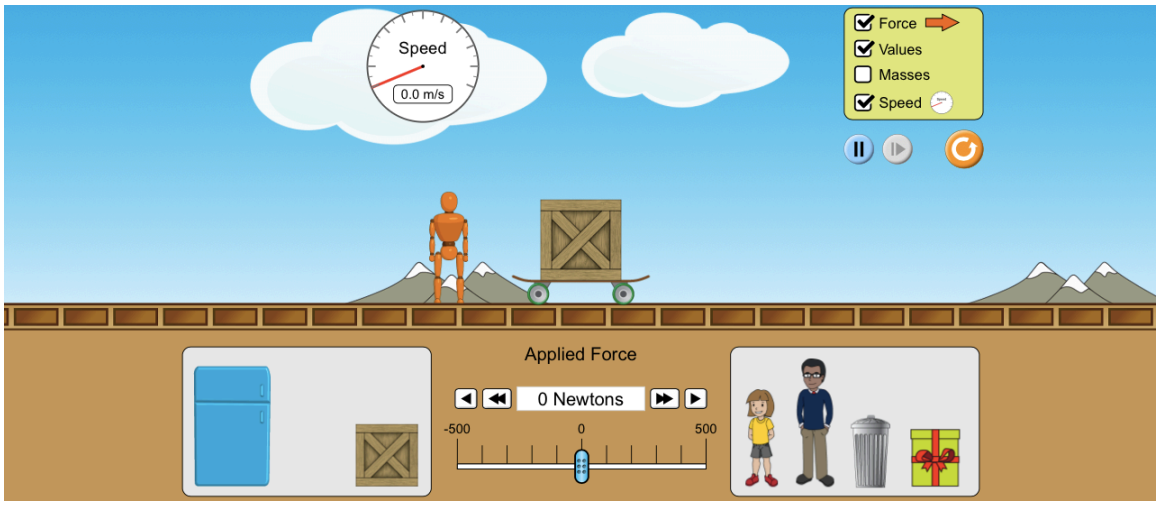
3. How do you make neither team win?

Explanation Phase:
(25-30 minutes)

This Phase has an investigative goal.

Aim: Determine how mass effects the speed of an object when a constant force is applied.

Click on the "Motion" tab. Check "Force" "Values" and "Speed" in the yellow box located at the top right corner. This screen appears:



Use these concepts:

There is no friction being applied during this simulation.
An object in motion will stay in motion with a push or a pull.

1. Using the double-arrow button next to the box, set the force to 100 Newtons.
2. Let the simulation run until the "force", or the player pushing the box, releases.
3. Answer the following question:

    a. What did you notice about the speed on the speedometer as the player continued to push the box?

    _____

    _____

b. What happened when the player released the force on the box?

_____

_____

4. Reset the simulation by clicking the orange "Reset" button, and check the boxes for "Force," "Values," and "Speed" again. Remove the box from the board.

5. Make a prediction:

Which object will take the longest amount of time to increase the speed of the board? Circle your answer below:

Refrigerator Small girl Trash can

6. You will complete the table below by placing different objects on the board and exerting a force on it.
After all three trials, rate the time it takes to reach maximum speed.

Object on Box	Force (N)	Rating (1=fastest, 3=slowest)
Small Girl	100	
Trash can	100	
Refrigerator	100	

7. Click the "Masses" tab in the yellow box. Record the mass of the objects in the table below.

Object on Box	Force (N)	Mass
Small Girl	100	
Trash can	100	
Refrigerator	100	

8. Analyze:

a. What do you notice about the speed of the forced object and the mass?

_____

_____

b. What rule can you determine about mass and force?

The greater the mass, the _____ the force needed to move it.

Application Phase:
(10 minutes)

Aim: You will be determining the mass of the "Mystery Box" in comparison to the other masses you have used during the activity.

1. Reset the simulation, and check off all options in the yellow box. Remove the box from the board.
2. Set the Applied Force to 100 Newtons.
3. Add the "Mystery Box" to the board.
4. Observe the time it takes for the speedometer to reach maximum speed.
5. In the table below, record whether the "Mystery Box" is greater or less than the other masses.

Object on Box	Force (N)	Greater or Less Than Mystery Box
Small Girl	100	
Trash can	100	
Refrigerator	100	

Write a statement about below about the mystery box and it's mass:

_____

_____