Today we will be using JavaLab. Enter the link below to access the webpage.

https://javalab.org/en/force_movement_en/

On your screen, you'll see the title "F = ma (Newton's law of motion)" along with a hand pulling a spring scale. If you scroll down, you can choose between "spring scale", and "shopping cart". Choose whichever one you want!

On the left-most side, you'll see a red dot that you can move. This is how you adjust the Force being applied. This ranges from 1 Newton (N) to 10 Newtons (N).

Next to that is a green dot that you can move. This is how you adjust the Mass of the object that the Force is being applied to. This ranges from 1 kilogram (kg) to 10 kilograms (kg).

- Set both Forces and both Masses to 1N and 1kg respectively for now.

Finally, below these adjustable dots, you'll see time intervals with the options being 0.1 seconds, 0.2 seconds, 0.5 seconds, and 1 second intervals. If we set the time interval at 0.5 seconds, what this will do, is give us the position at time intervals of 0.5 seconds, 1 second, 1.5 seconds, 2 seconds, and so on!

- For this lesson, we're going to set the time interval to 0.5 seconds.

We will have to use our previous knowledge of dot patterns determining motion for these problems!

The first part of our experiment will be to see how a change in Force affects the motion of the object. What we're going to do in this part of the experiment is adjust the Force that's being applied, while keeping the Mass constant, and seeing how motion is affected.

Part 1: Adjusting the Force

Double the Force (×2)

We will be keeping one of the Forces at a constant value of 1N and double the other Force.

Force 1 = 1 Newton
Force 2 = 2 Newtons

Keep mass at 1kg for BOTH!

- When the force is 1 Newton, record what the displacement is at each 0.5 second interval by filling in the table below

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

- When the force is 2 Newtons, record what the displacement is at each 0.5 second interval by filling in the table below.

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

What kind of motion are they both undergoing?

Which one is greater and by how much?

Triple the Force (×3)

We will be keeping one of the Forces at a constant value of 1N and triple the other Force.

Force 1 = 1 Newton
Force 2 = (insert force here)

Keep mass at 1kg for BOTH!

- When the force is 1 Newton, record what the displacement is at each 0.5 second interval by filling in the table below

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

- When the force is (insert magnitude of force 2 here), record what the displacement is at each 0.5 second interval by filling in the table below.

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

What kind of motion are they both undergoing?

Which one is greater and by how much?

Quadruple the Force (×4)

We will be keeping one of the Forces at a constant value of 1N and quadruple the other Force.

Force 1 = 1 Newton
Force 2 = (insert force here)

Keep mass at 1kg for BOTH!

- When the force is 1 Newton, record what the displacement is at each 0.5 second interval by filling in the table below

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

- When the force is (insert magnitude of force 2 here), record what the displacement is at each 0.5 second interval by filling in the table below.

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

What kind of motion are they both undergoing?

Which one is greater and by how much?

Part 2: Adjusting the Mass

Double the Mass (×2)

We will be keeping one of the Masses at a constant value of 1kg and double the other Mass.

Mass 1 = 1 kg
Mass 2 = (insert mass here)

Keep Force at 4 Newtons for BOTH! (Yes, 4 Newton's NOT 1 Newton!)

- When the Mass is 1 kg, record what the displacement is at each 0.5 second interval by filling in the table below

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

- When the mass is (insert magnitude of mass 2 here), record what the displacement is at each 0.5 second interval by filling in the table below.

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

What kind of motion are they both undergoing?

Which one is greater and by how much?

Triple the Mass (×3)

We will be keeping one of the Masses at a constant value of 1kg and triple the other Mass.

Mass 1 = 1 kg
Mass 2 = (insert mass here)

Keep Force at 4 Newtons for BOTH! (Yes, 4 Newton's NOT 1 Newton!)

- When the Mass is 1 kg, record what the displacement is at each 0.5 second interval by filling in the table below

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

- When the mass is (insert magnitude of mass 2 here), record what the displacement is at each 0.5 second interval by filling in the table below.

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

What kind of motion are they both undergoing?

Which one is greater and by how much?

Quadruple the Mass (×4)

We will be keeping one of the Masses at a constant value of 1kg and quadruple the other Mass.

Mass 1 = 1 kg
Mass 2 = (insert mass here)

Keep Force at 4 Newtons for BOTH! (Yes, 4 Newton's NOT 1 Newton!)

- When the Mass is 1 kg, record what the displacement is at each 0.5 second interval by filling in the table below

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

- When the mass is (insert magnitude of mass 2 here), record what the displacement is at each 0.5 second interval by filling in the table below.

Time (seconds)	Displacement (meters)
0.5 seconds	
1.0 seconds	
1.5 seconds	
2.0 seconds	

What kind of motion are they both undergoing?

Which one is greater and by how much?

1.) After your trials, how does the Force that is being applied affect the acceleration of the object?

2.) After your trials, how does the Mass of the object that's experiencing a force, affect the motion of the object?

3.) Using the relationship between Force and acceleration, along with Mass and acceleration, derive an equation that accurately represents what we're seeing.