Guiding Question: What is the relationship between force, mass, and acceleration?

Learning Goal

1) Calculate force using Newton's 2nd Law.

Agenda
1) DSR-Friction
2) Free-Body Diagrams Part II
3) Newton's 2nd Law Notes
4) Finish friction lab and turn in lab
5) Exit Ticket

Words of the day
None

Newton's 2nd Law Equation

# Newton's 2nd Law Lab

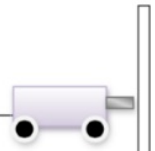
**Guiding Question**: What us the relationship between Force, Mass, and Acceleration.

**Materials:** books, dynamics cart, meter stick

## Part I: Mass and Acceleration

**Testable Question:** How does changing mass of the cart affect the acceleration of the cart?

**Variables:** Dependent variable: _____ Independent variable: _____



**Hypothesis**: _____

---

**Procedure**: Push the spring rod into the cart and lock the rod into place. Place the cart against the wall so that the rod touches the wall. Push the trigger button so that the rod pushes the cart away from the wall. Measure the **distance** that the cart travels before coming to rest. Repeat the process and add one text book each trial for a total of 6 trials.

| # of Books | Trial 1 | Trial 2 | Avg. |
|---|---|---|---|
| 0 | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

Claim:

## Part II: Force and Acceleration

**Testable Question:** How does changing the force affect the acceleration of the cart?

**Variables:** Dependent variable: _____ Independent variable: _____

**Hypothesis:** _____

_____

**Procedure:** Place two books on the cart and push the rod into the cart so that it stops on the first. Place the cart against the wall and hit the trigger button. Measure the **distance** that the cart travels before coming to rest. Repeat the procedure by changing the setting of the rod by pushing it in farther.

| Force | Trial 1 | Trial 2 | Avg. |
|---|---|---|---|
| Setting 1 | | | |
| Setting 2 | | | |
| Fully compressed | | | |

Claim:

## Add these new variables and equations to your notebook!

| Variables | Abbreviations | Common Units | Equation |
|---|---|---|---|
| Distance | d | meters, kilometers, centimeters | |
| Time | t | seconds, minutes, hours | |
| Speed/Velocity | s or v | m/s, km/hr, Miles per hour | s = d/t |
| acceleration | a | m/s^2 | a = change in v/ change in t |
| Force | F | Newtons | F = ma |
| Mass | M | kilograms, grams | |

## Flag in the back of your notebook!

# *Get Ready for Daily Science Review*

socrative
by MasteryConnect

STUDENT

Enter Teacher Room Code **47876**

JOIN ROOM

**Daily Science Review**

**Name**_____ **Period**_____
**Unit Name**_____**DSR #**_____

| 1) | 2) | 3) |
|---|---|---|
| Key Idea | Key Idea | Key Idea |
| Reflection | Reflection | Reflection |

**Day**_____ **Date**_____

| 1) | 2) | 3) |
|---|---|---|
| Key Idea | Key Idea | Key Idea |
| Reflection | Reflection | Reflection |


STOP

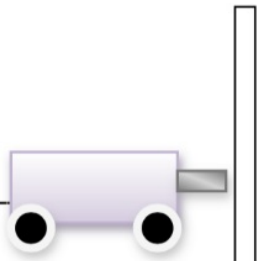
# Newton's 2nd Law Lab

**Guiding Question**: What us the relationship between Force, Mass, and Acceleration.

**Materials:** books, dynamics cart, meter stick

## Part I: Mass and Acceleration

**Testable Question:** How does changing mass of the cart affect the acceleration of the cart?



**Variables:** Dependent variable: _____ Independent variable: _____

**Hypothesis**: _____

---

**Procedure**: Push the spring rod into the cart and lock the rod into place. Place the cart against the wall so that the rod touches the wall. Push the trigger button so that the rod pushes the cart away from the wall. Measure the **distance** that the cart travels before coming to rest. Repeat the process and add one text book each trial for a total of 6 trials.

| # of Books | Trial 1 | Trial 2 | Avg. |
|---|---|---|---|
| 0 | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

Claim:

## Part II: Force and Acceleration

**Testable Question:** How does changing the force affect the acceleration of the cart?

**Variables:** Dependent variable: _____ Independent variable: _____

**Hypothesis:** _____

_____

**Procedure:** Place two books on the cart and push the rod into the cart so that it stops on the first. Place the cart against the wall and hit the trigger button. Measure the **distance** that the cart travels before coming to rest. Repeat the procedure by changing the setting of the rod by pushing it in farther.

| Force | Trial 1 | Trial 2 | Avg. |
|---|---|---|---|
| Setting 1 | | | |
| Setting 2 | | | |
| Fully compressed | | | |

Claim:

## The Equation

**Newton's 2nd Law gives the equation for force**

**F = ma**

- **F = Force**
- **m= mass**
- **a= acceleration**

**Units**

**m = kilograms (kg)**

**a = meters per second squared ($m/s^2$)**

**F = Newtons (N)**

$$\frac{kg \times m}{s^2} = N$$

## Example Problem #1

**What is the force on a box that is 10 kg and has an acceleration of 2.3 $m/s^2$?**

## Example Problem #2

**Jose pulled an object with 5 N and has a mass of 18 kg. What is the object's acceleration?**

## Example Problem #3

**Dulce moved a table with a force of 15 N and a mass of 25 kg, what is the tables acceleration?**

# Force Due To Gravity

**Acceleration from gravity on Earth is ALWAYS = 9.8 $m/s^2$**

$$F_{gravity} = mg$$

**g = acceleration of falling object = 9.8 $m/s^2$**

**Example Problem #4 (gravity)**

**What is the force due to gravity of a falling object with a mass of 23 kg?**

# Exit Ticket

**Solve**

What is the force on a 23 kg box that is accelerating at 12 $m/s^2$? Show your work! (5 steps)