# Newton's Law of Gravitation

In this activity students will be deducing Newton's Law of Gravitation equation using simulation data with the "Gravity Force Lab" PhET simulation.

Open the simulation by clicking on the link:

https://phet.colorado.edu/sims/html/gravity-force-lab/latest/gravity-force-lab_en.html

Take a look at the explanatory video via YouTube:
https://youtu.be/C8ovRVtYfKU
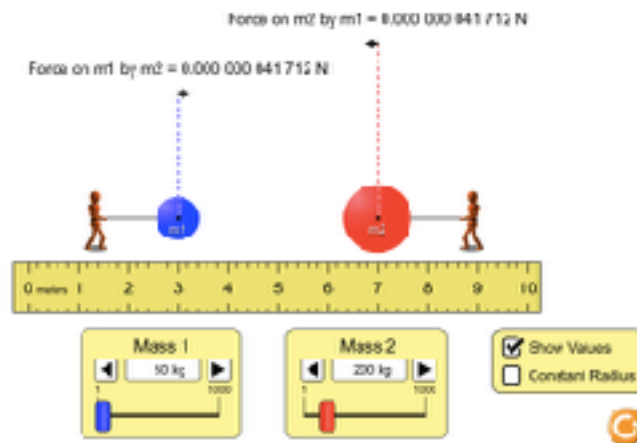

Learning Objectives
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By the end of these activities it is hoped that students will have an acquired the following skills:

• Following explicit instructions to gain acquired knowledge

• Investigate how how the various variables affect the gravitational force.

• Converting data into graphs to determine relationships.

• Finding the gravitational constant.

• Determining the overall Gravitational Law equation.

Deducing the formula

1. What is the relationship between gravitational force and mass.

- Increase one mass (blue circle) incrementally while keeping the other mass constant (red mass) and find the force by turning on the values (green circle).

- Complete the table below using this animation.
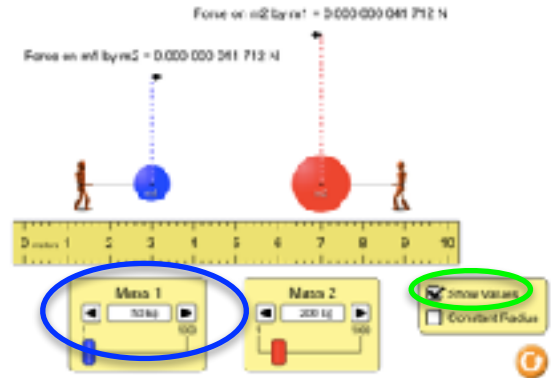
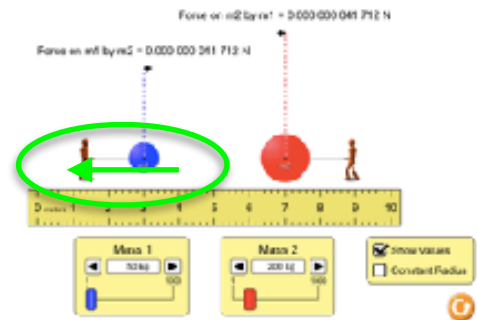| Mass (kg)	Force (N)
50	
100	
200	
300	
400	
500	
600	
700	
800	
900	
1000	
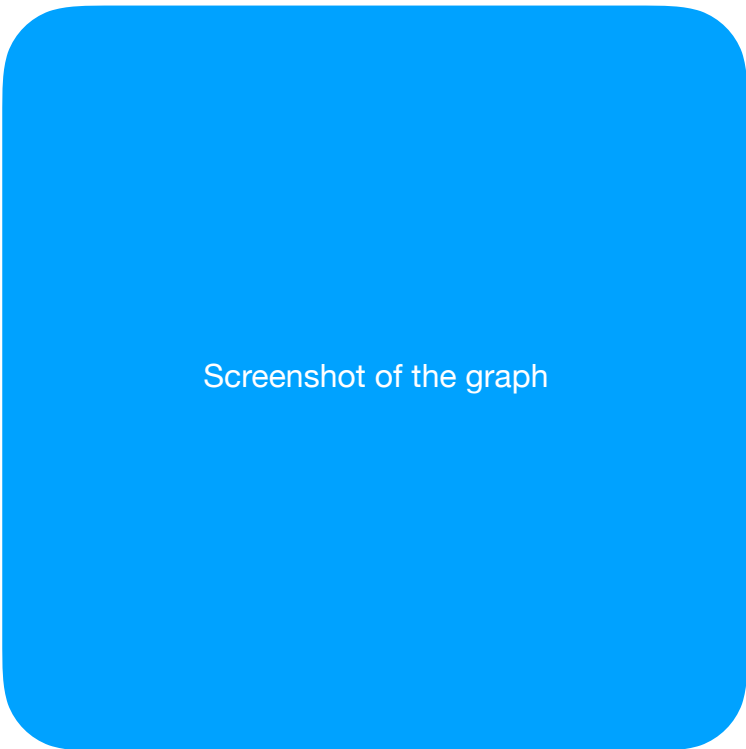
Screenshot of the graph

- Convert this data onto a graph. Screen shot this and place it in the space provided above.

• What is the relationship between the two masses and force? ANS:

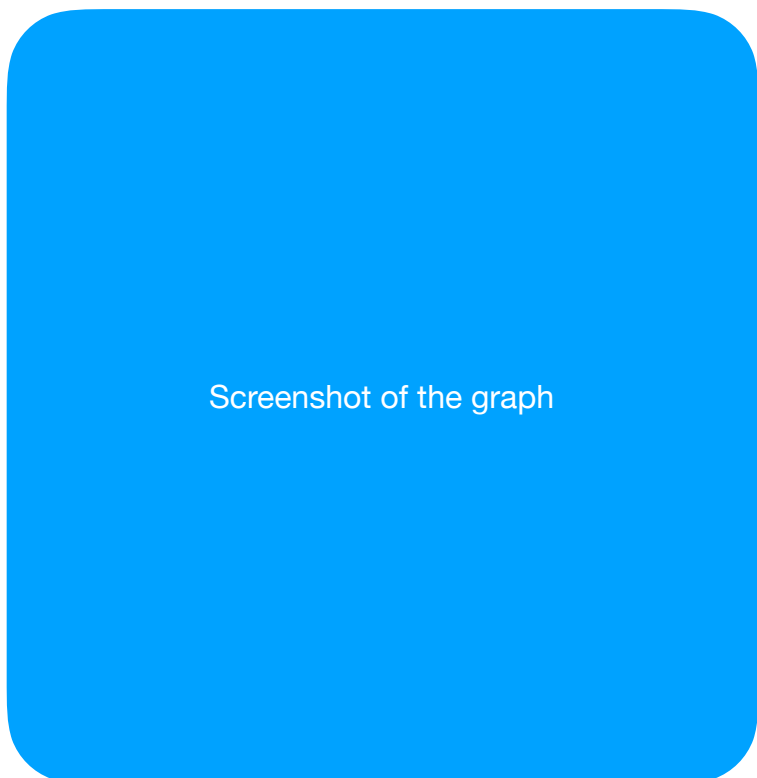## 2. What is the relationship between force and distance?

- Keep both masses the **same**

- Pull apart the masses so the ruler measures 10m from centre of the red to the centre of the blue (green arrow, circle).

 Remember the ruler moves

- Measure the force for each distance as you bring a mass 1m closer.

- Complete the table below with the data for force at each distance.

Distance (m)	Force (N)
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	

Screenshot of the graph

- Convert this data onto a graph. Screen shot this and place it in the space provided above.

• What is the relationship between distance and force? ANS:

3. Determining the constant and equation.

- Combine the relationships between force and the two masses and distance.

  - Write the combined relationship between these variables? ANS:

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- Now choose a value for the two masses; distance and find the force. Use these values to determine the gravitational constant. Place this value in the table below.

Test	Gravitational Constant, G
1	
2	
3	
Average	

- Do this three times and calculate the average gravitational constant.

- The actual value for Newton's Gravitational Constant is

  6.67408×10^{-11} m^{3}kg^{-1}s^{-2}

  - How does your average Constant compare with the accepted value, discuss? ANS:

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  - Write your overall formula for Newton's Gravitational Law? ANS:

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