Newton's Law of Gravity Remote Lab Gravitational Forces

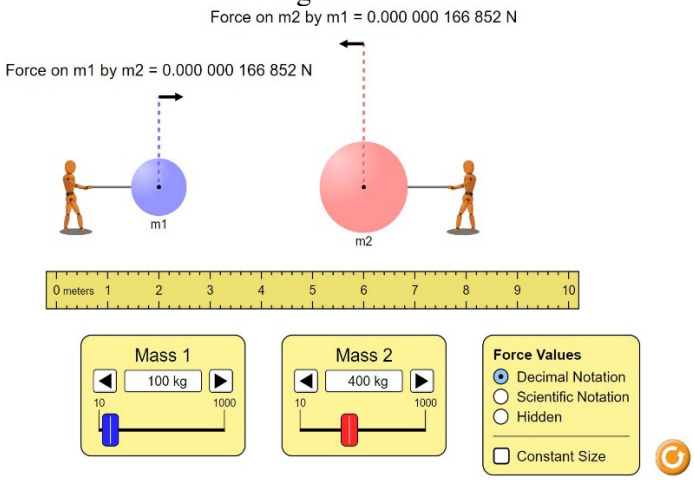
This lab uses the Law of Gravity simulation from PhET Interactive Simulations at University of Colorado Boulder.
https://phet.colorado.edu/sims/html/gravity-force-lab/latest/gravity-force-lab_en.html

Learning Goals: Students will be able to

A. Determine what makes affects the strength of gravity between 2 objects.
B. Explain Newton's third law using gravity.
C. Relate the gravitational for with the masses and the distance between them
D. Use measurements to determine the Universal Gravitational Constant

Develop your understanding:

Open the screen and explore the forces between two charged bodies.



Expand your understanding:

1. By experiment, determine what makes affects the value of the gravitational force. Describe your experiments and observations with some examples. Masses of the objects, either one of the masses, or the distance between the objects.

2. What evidence do you see that Newton's third law applies to gravitational forces?

3. How does the value of the gravitational force vary with the value of the masses?

4. How does the value of the gravitational force vary with the distance between the masses?

Data:

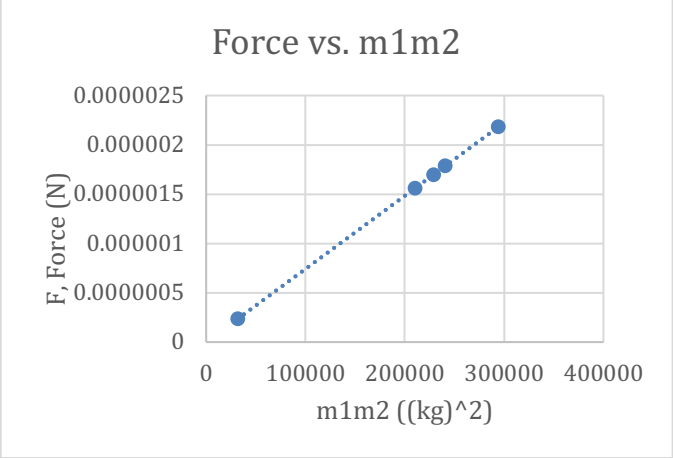
Part 1: Force vs. Mass

1. Begin by picking 2 masses of your choosing and place them a distance from center-to-center of 3 m.
    a. Center-to-center means from the middle of one sphere to the middle of the other, not from surface to surface.
2. Record the values of mass 1 and mass 2 in KILOGRAMS in the first two columns in the table below.
3. Record the corresponding force in NEWTONS from either of the masses in the last column in the table below.
4. Calculate the product of the two masses and record your value in the third column.
5. Repeat these steps with different mass values, while keeping the distance between the two masses constant.

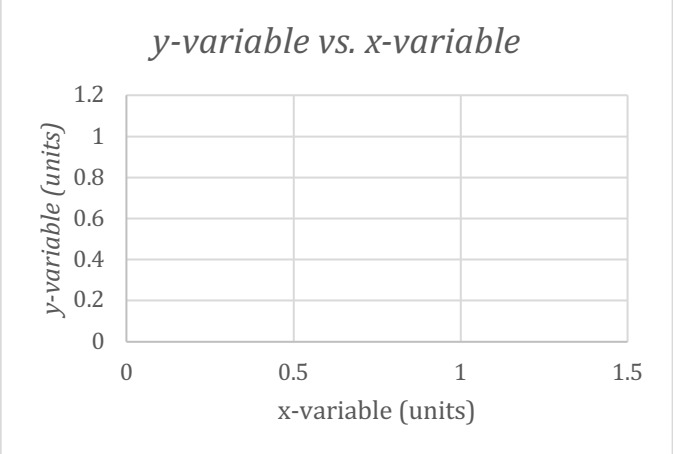
Force vs. Charge Data

m_1, Mass 1 (kg)	m_2, Mass 2 (kg)	m_1m_2, Mass 1 x Mass 2 ($(kg)^2$)	F, Force (N)
730	330	240900	0.000001786429
420	700	294000	0.000002180199
1000	210	210000	0.000001557285
150	210	31500	0.000000233593
260	880	228800	0.000001696699

In the graph below, create the F vs. m_1m_2 graph and place the appropriate regression. Display the equation and R^2 value. You may use your Lab Analysis Practice Assignment to review how to do this.



If the graph needs to be linearized, you may use the graph below to do so. Be sure to place a linear regression on the data afterward.



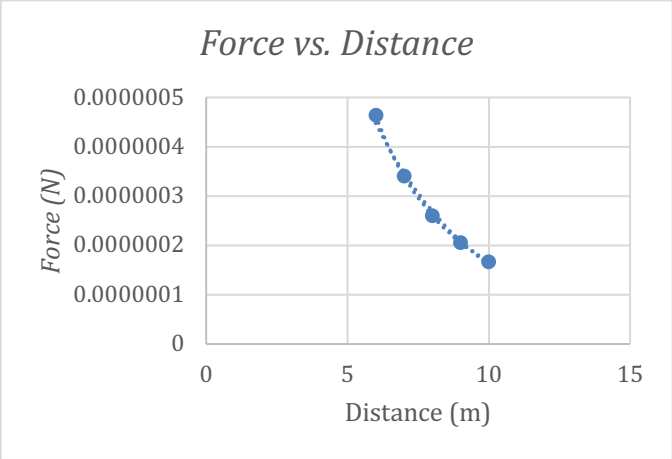
Part 2: Force vs. Distance

1. Begin by picking 2 masses of mass of 500 kg each.
2. Place the two masses at a distance of your choosing and record the distance from center-to-center in METERS in the first column of the table below.
3. Record the force on either charge in NEWTONS in the second column below.
4. Without changing the values of either mass, change the distance between the masses a few times and record the values as appropriate.

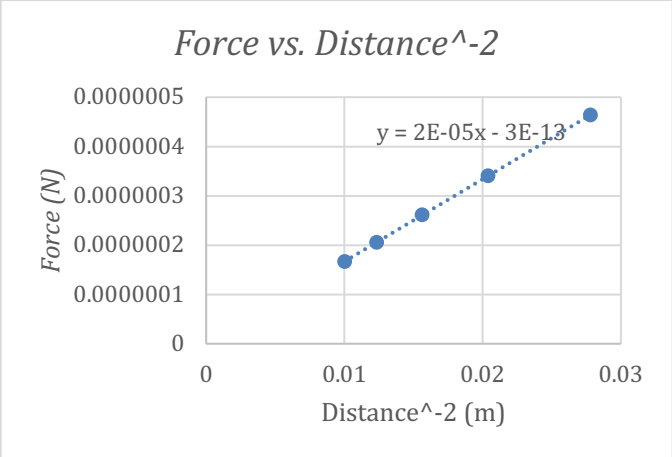
Part 2: Force vs. Distance

r, Distance (m)	*F*, Force (N)
10	0.000000166852
9	0.000000205990
8	0.000000260706
7	0.000000340514
6	0.000000463478

In the graph below, create the *F* vs. *r* graph and place the appropriate regression. Display the equation and R^2 value. You may use your Lab Analysis Practice Assignment to review how to do this.



If the graph needs to be linearized, you may use the graph below to do so. Be sure to place a linear regression on the data afterward.



Questions to consider before taking your lab quiz:

1. What type of proportionalities/relationship existed with the measured variables?
2. What would the slope of any of the linear graphs be equal to?
3. What should each graph visually look like?
4. What sort of equation can be formulated from combining these proportionalities?
5. What type of regressions belonged on each type of graph?
6. Were there any other significant variables?