

Lab 15-1: Universal Gravitation

- Purpose:**
1. To gain a conceptual feel for how mass and distance affect gravitation.
 2. To make and interpret graphs of Force vs Mass and Force vs Distance.

Procedure:

Part 1: Getting familiar with the software.

1. Start the simulation software "Gravity Force" by doing what your teacher told you to do. If you wish to avoid sarcastic comments, check the board before asking your teacher for help.
2. The simulation allows one to measure the gravitational force between two masses. Experiment with the program to see what you can control. What three things are you able to change?
3. Why are there so many zeros in the forces?
4. How can you measure the distance between the masses?
5. How can you reset everything to the original settings?

Part 2: Quantitative investigations.

6. Reset everything to the original settings. Then change m_2 to 10 kg and record the force.
7. Fill out the rest of the data table by continuously adding 10 kg to the red mass and measuring the force. Make sure you don't change anything other than the red mass.
8. Reset everything and then repeat step 11, but this time change m_1 .
9. Make both masses 10 kg. Slide the blue mass to the left of the screen. Place the red mass 2 meters away from the blue one and record the force.
10. Fill out the rest of the data table by increasing the distance between the masses by 1 meter and recording the resulting force.

Data:

Mass 1 = _____

Mass 2 = _____

Mass 1 = _____

Distance = _____

Distance = _____

Mass 2 = _____

Mass 2 (kg)	Force (N)
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

Mass 1 (kg)	Force (N)
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

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

Graphs: Make the following three graphs from your three sets of data: Force vs Mass 2, Force vs. Mass 1, and Force vs. Distance. Linearize any graphs that are not lines, and then put regression lines through the three linear graphs.

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Questions:

1. When you measure the distance between the masses, where exactly are you measuring to on the masses?
2. Why are the two forces on the screen always equal and opposite?
3. How does the force of gravity depend on each of the three variables you had changed. (This is just three interpretations of your three different graphs.)
4. Try and combine all three ideas into one relationship: how does the force of gravity between two objects depend on the two masses and the distance between the two masses?
5. Obviously, Newton came up with his theory of gravity without the aid of computer simulations, but hopefully, you came to the same conclusions he did. Why do you think he called his theory "universal gravitation?"
6. What is the value of the constant of proportionality from number 4?