PHYSICS IN MOTION
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Unit 3F
Gravity
Newton's Law of Universal Gravitation Lab

Name:

Date:

Using the Gravity Force Lab simulation at phet.colorado.edu, you will determine the gravitational constant according to Newton's law of universal gravitation.

Part One

1. **Set the mass of person one at 10 kg and the mass of person two at 10 kg. The two people may be any distance apart. Note the force between them.** *This is the* ***initial condition.***

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

2. **Double the mass of person one, keeping the distance constant, and note the force between them.**

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

3. **Is this force greater or less than the initial force?**

_____

4. **By what factor did it change?**

_____

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5. **Double the mass of person one again, keeping the distance constant, and note the force between them.**

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

6. **Is this force greater or less than the initial force?**

_____

7. **By what factor did it change?**

_____

8. **What does this indicate about the proportionality of person one to the force of gravity?**

_____

_____

9. **Set the mass of person one at 10 kg and the mass of person two at 20 kg, keeping the distance constant, and note the force between them.**

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

10. **Is this force greater or less than the initial force?**

_____

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11. By what factor did it change?

12. Double the mass of person one again, keeping the distance constant, and note the force between them.

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

13. Is this force greater or less than the initial force?

14. By what factor did it change?

15. What does this indicate about the proportionality of person one to the force of gravity?

16. Set the mass of person one at 10 kg and the mass of person two at 20 kg, keeping the distance constant, and note the force between them.

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

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17. Is this force greater or less than the initial force?

18. By what factor did it change?

19. What does this indicate about the proportionality of person one and person two together to the force of gravity?

Part Two

1. Set the mass of person one at 10 kg and the mass of person two at 10 kg. Put their centers of mass (the black dots) 1 m apart. Note the force between them. *This is the **initial condition** for part two.*

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

2. Move one of the two masses so that they are now 2 m apart, and note the force between them.

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

3. Is this force greater or less than the initial force?

questions continued on next page

4. By what factor did it change?

5. Move the other mass so that they are now 3 m apart. Note the force between them.

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

6. Is this force greater or less than the initial force?

7. By what factor did it change?

8. Move one of the masses another meter so that they are now 4 m apart. Note the force between them.

Mass 1 (kg)	
Mass 2 (kg)	
Distance (m)	
Force of Gravity (N)	

9. Is this force greater or less than the initial force?

10. By what factor did it change?

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11. What does this indicate about the proportionality of the distance to the force of gravity?

Part Three

1. Based on your results from parts one and two, you have determined relationships between the force of gravity, the masses involved, and the distance between the masses. Put all of these together in one proportionality. (If you get stuck, find the force value for 20 kg masses with 2 m between the masses — what does this value tell you about how they all relate?)

2. Plug in values for the force of gravity, mass 1, mass 2, and the distance into the proportion. You should now be finding the proportionality constant, which makes your proportion an equality.

3. Write Newton's law of universal gravitation.

Courtesy of:
PhET Interactive Simulations
University of Colorado Boulder
https://phet.colorado.edu