**ORBIT & GRAVITY SIMULATIONS**

**Pre-lab**

The arrows represent the amount of pulling force. For example, the picture above right shows a smiley face being pulled or attracted to the strong force of the sun. *A longer arrow represents a big or strong force, and a shorter arrow represent a smaller or weaker force.*

1. Based on the above information choose the picture you think shows the gravity forces on the Earth and the Sun.



2. How would these gravity forces change if the Sun got much bigger?

Increase

Decrease

Stay the same

3. How would these gravity forces change if the Earth was much closer to the Sun?

Increase

Decrease

Stay the same

4. How would these gravity forces change if the Earth got much smaller?

Increase

Decrease

Stay the same

**Use the diagram below for questions 5-7.**

\_\_\_\_\_5. Choose the picture of how the Earth would move if you suddenly “turned off” the gravity forces.

\_\_\_\_\_6. Choose the letter that would demonstrate the movement if only the sun’s gravity was turned off.

\_\_\_\_\_7. Choose the letter that would demonstrate the movement if only the earth’s gravity was turned off.



**Part 1: Understanding motion**

1. Search PhEt [***Gravity and Orbits***](https://phet.colorado.edu/en/simulation/gravity-and-orbits) simulation.
2. Download the simulation.
3. Take 5 minutes to **explore** how the Earth, Moon, and the Space Station move. Talk about what you find with your partner.
4. Compare the motion of the **Earth moving around the Sun** with the **Moon moving around the Earth**. (Be sure to turn on the path!)

|  |  |
| --- | --- |
| **Earth moves around the Sun**Your Picture | **Moon moves around the Earth**Your Picture |
| What similarities can you find between the Earth’s movement around the sun and the moon’s movement around Earth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_What differences can you find between the Earth’s movement around the sun and the moon’s movement around Earth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_What vocabulary word would you use to describe the shape of the orbits? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Why would we not describe the orbits as circular? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**Part 2: Understanding Gravity**

1. For the Sun and Earth system:

D**raw** the path of the Earth with **Gravity ON** and **Gravity OFF**

 **GRAVITY ON GRAVITY OFF**



1. **What role does gravity play in the alignment of the sun and Earth**? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Draw** the Sun’s gravitational pull on the Earth **Draw** the Earth’s gravitational pull on the Sun



Remember: *A longer arrow represents a big or strong force, and a shorter arrow represent a smaller or weaker force.*

1. Return to your pictures in Questions 4 and add arrows to **show the force of gravity**. Label them with “Gravity Force”.
2. **Play** with the sim to find ways to change the length of the blue gravity force arrows. Collect your results in the table below.

a) Fill in an **ACTION** below and **write** whether or not the gravitational force increases or decreases.

|  |  |  |
| --- | --- | --- |
| **ACTION** | **Gravity Force Increases** | **Gravity Force Decreases** |
| Increase the mass of the star |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

b) What has the greatest impact on gravitational forces?

1. Comparisons:

a) **Compare** these two cases:

 **CASE 1** **CASE 2**

  

What was changed between Case 1 and Case 2?

**Draw** the force of gravity on the Earth in each case.

Extension:

[Gravity Simulator](http://www.nowykurier.com/toys/gravity/gravity.html): You can simulate the creation of our solar system, galaxy, universe, or black hole.

For mass input 1,000,000.

Click in the middle of the screen (there should be a red dot).

Click on different sizes (tiny to huge) and add them to the screen as well.

What happens? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Clear the screen and create another red dot.

Try to get another celestial body to orbit the large one-- click, drag and release.

Watch the simulator for a few minutes. Does the orbit stay the same? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What does this tell us about the orbits of the planets around the sun? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Clear the screen and add 4 red dots.

What does this tell you about the creation of planets? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Clear the screen. Add one red dot.

Try to get as many smaller dots orbiting the large dot as possible?

How many could you get? \_\_\_\_\_\_\_\_\_\_\_\_

Can orbits cross without the objects smashing into one another? \_\_\_\_\_\_\_\_

Why do you think this happens? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Clear the screen. Add one red dot.

Try to get as many smaller dots orbiting the large dot as possible but remain on the same (as close as possible) orbit?

What eventually happens? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

[Gravity Simulator](http://sciencenetlinks.com/interactives/gravity.html): Try to successes fully launch and land your rocket ship. What did you learn from this?