

Gravity & Orbits PhET Simulations

To be completed in your notebook

Link: https://phet.colorado.edu/sims/html/gravity-and-orbits/latest/gravity-and-orbits_en.html

Or search for “PhET Gravity Orbits” to find the simulation page

Pre-lab:

1. Define Revolution in terms of orbiting objects.
2. Define Rotation in terms of orbiting objects.

Procedure:

1. Copy this table into your notebook:

Mass of Sun→ ↓Mass of Earth	0.5	Our Sun	1.5	2.0
0.5				
Our Earth				
1.5				
2.0				

2. Go to the link above or search for “PhET Gravity and Orbits” and then open the simulation. Choose the “Model” simulation from the main menu.
3. Check the “Grid” box so that you can get a better sense of any orbital radius (distance from center of sun to center of Earth) changes.
4. Press play and pause the simulation once the Earth has made one complete revolution. This is the time it takes our Earth to go around our sun. Fill in this number in your table.
5. Notice that there is a slider for the mass of the Earth and the mass of the Sun on the right side. You will change the sliders for each to fill in the table in your notebook. Be sure to reset the position of the Earth as necessary by hitting the orange reset button or waiting until the Earth has returned to its original position and hit “clear” on the day counter.
6. Copy this table into your notebook:

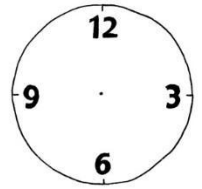
Mass of Earth→ ↓Mass of Moon	0.5	Our Earth	1.5	2.0
0.5				
Our Moon				
1.5				
2.0				

7. In the upper right notice that there are different options for the systems of orbiting bodies. Select the “Moon and Earth” option (third from bottom).
8. Following the same procedural steps as above fill in this table for the different combinations of the Earth and moon system. Answer Analyzing question #3.
9. Check the “Gravity Force,” “Velocity” and “Path” boxes. Zoom in as much as possible and press play. Answer Analyzing question #4.
10. Increase the mass of the planet (Earth) to 1.5 times that of Earth while leaving the moon mass the same. Answer Analyzing question #5.
11. Click on the “Sun, Earth & Moon” system (second from the top) in the upper right and also check the “Path” box.
12. Press play and observe the simulation. Answer Analyzing question #6.

13. Check the “Gravity Force” and “Velocity” boxes as well and observe the simulation. Answer Analyzing questions #7 and 8.

14. Copy this table into your notebook:

Position→	12 o'clock	3 o'clock	6 o'clock	9 o'clock
Our Sun				
1.5 x our sun				



15. Click on the “To Scale” simulation and again start with the default Sun and moon system. Check the Grid, Path and Measuring Tape boxes.
16. Before pressing play arrange the measuring tape to measure the distance between the planet (Earth) and star (sun). Record this in your notebook under the “3 o'clock” position for a planet of the size of our Earth and a sun the size of our sun.
17. Press play and pause the simulation as the Earth moves to the “12 o'clock” position. Repeat for the remaining two positions. Answer Analyzing question #9.
18. Increase the size of the sun to 1.5 times (leaving the size of the Earth the same) and repeat steps #16 and 17 to fill in the next row of your table.
19. Further experiment with the simulation in order to answer the Applying question #10 with a Claim, citing your Evidence and explaining your Reasoning. You should have actual data from the simulation not just “I saw it move when I did this...”

Analyzing:

Underneath your data tables, write “Analyzing” and you will answer the questions below in complete sentences. Don't forget to number your answers!

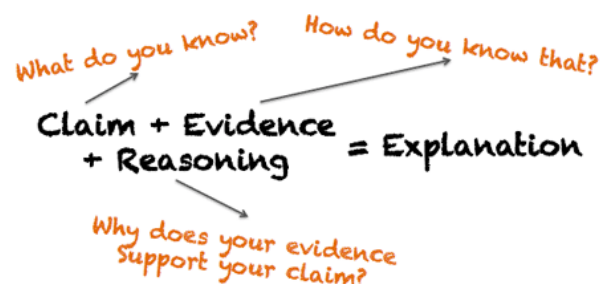
3. Does the mass of the moon or the mass of the Earth play a role in the length of the period? Support your answer.
4. Look carefully at the Earth and notices that it wiggles just a little bit. Why does this happen?
5.
 - a. What changes about the shape of the moon's orbit? Explain why this happens.
 - b. What changes about the moon's velocity during its orbit? Explain why this happens.
 - c. What changes about the Force of Gravity during its orbit? Explain why this happens.
6. Why is the moon's orbit shown this way instead of just circles around the Earth? Support your answer.
7. What happens to the Earth's velocity vector during its revolution? Why does this happen?
8. What happens to the moon's velocity vector during its revolution? Why does this happen?
9. What do you notice about the orbital radius of the Earth in its orbit?

Applying:

Underneath your Analyzing questions, write “Applying” and you will answer the questions below in complete sentences. Don't forget to number your answers!

10. Do planets orbit stars (or do moons orbit planets) in perfect circles?

- Make a **Claim** that answers the question at the beginning of the lab and can be supported using your results. The Claim should answer the question, “What do you know?”
- Cite **Evidence** that supports your claim based on the data you took during the lab. Your evidence should be specific but *do not yet explain* the next step. The Evidence should answer the question, “How do you know that?”
- Now, explain your **Reasoning**, which means explain why the evidence you cited supports your claim (that answers



the question). The Reasoning should answer the question, “*Why* does your Evidence support your Claim?”