

Gravitational Force between Objects Lab Practicum

Gravity and orbits PhET Lab

Mary Webster

NASA Physical Science in Motion

Lab Objective: Students use a simulator to explore gravitational forces in space and gather evidence that gravitational attraction is dependent on mass.

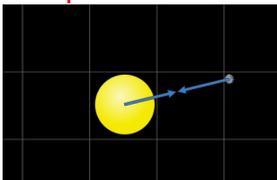
Guiding Question: What factors impact gravitational interactions in a large system, such as our solar system?

Directions:

1. Access the University of Colorado Boulder PhET simulation called "Gravity and Orbits."
2. Click on the "Model" option for the purposes of this activity.
3. Work through the instructions for each simulation below.

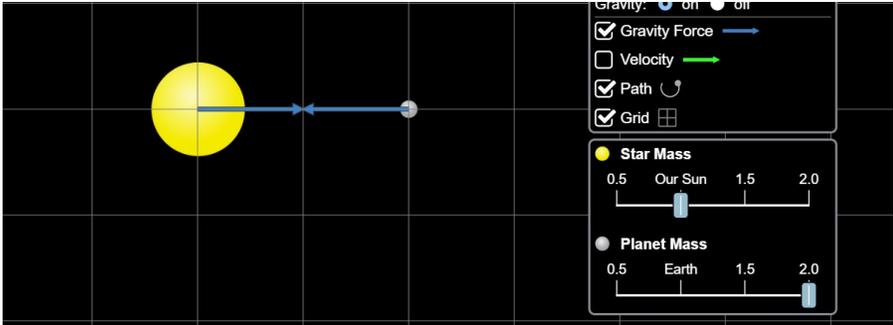
Simulation 1

1. Choose the simulation of the Sun and Earth from the option box at the top right.
2. Turn on "Gravity Force," "Path," and "Grid."
3. What do the blue arrows indicate?
The blue lines indicate the path the moon and Earth orbit in.
The gravitational force
4. Using just the images, compare the size (mass) of Earth and the Sun.
The Sun takes up most of the space of one grid block, the Earth takes up only one corner of the same size grid box. This tells me that the Sun is very big in comparison to Earth.

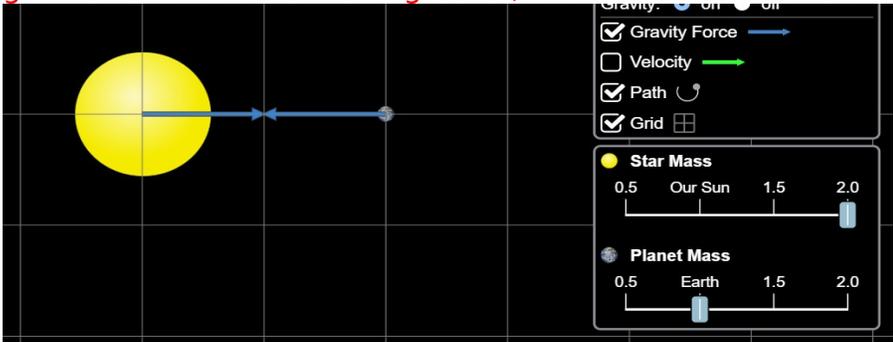


The Sun has more mass than Earth.

5. Use the sliders to increase the masses of Earth and the Sun.
6. What happens to the blue arrows when you make this adjustment?

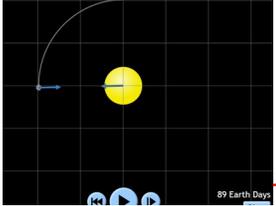


Here I have increased the size of the Sun by two times. I notice the gravitational force is much greater, and the blue lines have met.



In this picture I put the size of the sun back to normal and increased the size of the moon by two times. The blue lines have met, this tells me that the gravitational pull has become greater.

7. Reset the size of Earth and the Sun.
8. Click the blue play button at the bottom of the screen.
9. What does the gray line represent?

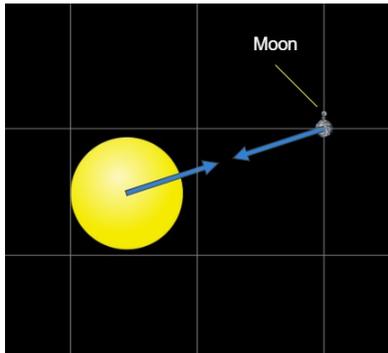


The gray line represents the Earth's orbital path. There have been 89 days past since the orbit began. This is one quarter the amount of days in the year.

10. Which object orbits the other? **The Earth orbits the Sun.**

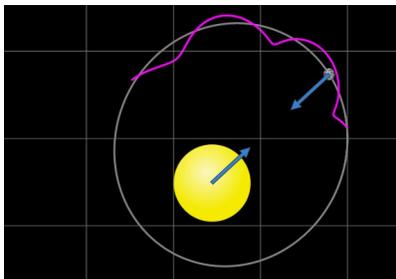
Simulation 2

1. Choose the simulation of the Sun, Earth, and Moon from the option box at the top right.
2. Using just the images, compare the size (mass) of the Sun, Earth, and Moon.



The size of the moon is but a speck, the Earth looks like it is at least 50 times bigger and can fill the cross of the grid, The Sun is so big in comparison that it fills almost an entire grid square.

3. Click the blue play button at the bottom of the screen.
4. What does the purple line represent?

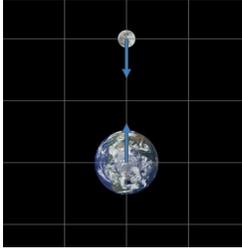


The purple line shows the gravitational path of the moon.

5. Why does Earth have a circular path while the Moon has a “flower-shaped” path?
The moon is orbiting the Earth, Earth is orbiting the Sun.

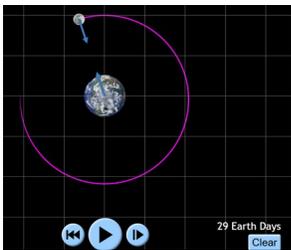
Simulation 3

1. Choose the simulation of Earth and the Moon.
2. Using just the images, compare the size (mass) of Earth and the Moon.



The Earth is much bigger than the moon, the Earth has more mass than the moon.

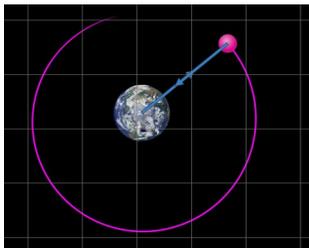
3. Click the blue play button at the bottom of the screen.
4. Which object orbits around the other?



The moon orbits Earth. I also notice that one moon orbit around the Earth is approximately 30 days.

5. Look closely at Earth. What do you observe about its motion? I notice that the Earth is moving up, left, down, right, but not in a steady pattern, a sort of wobble motion.

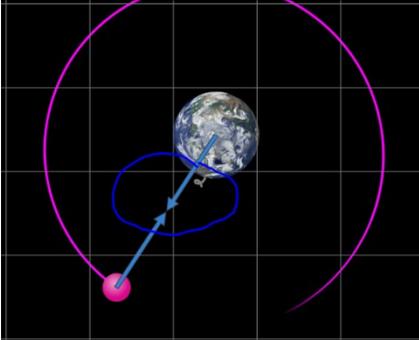
6. Increase the mass of the Moon to its maximum. What do you observe about the motion of Earth now?



The movement of the Earth is still wobbling, but there is more.

7. Use the Sim Speed buttons at the bottom of the screen to speed up the simulation.

8. What do you observe about the motion of the Earth-Moon system?



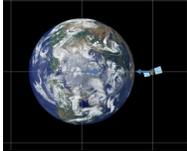
The Earth is now moving with a tail to show how much movement/wobbling there is. Also the entire system is moving.

9. Why do you think this movement is happening?

The moon has a larger pull on the Earth making the Earth and moon have a greater gravitational pull.

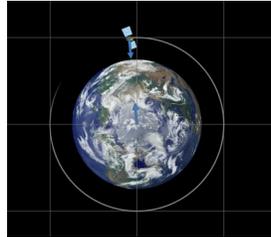
Simulation 4

1. Choose the simulation of Earth and the satellite.
2. Using just the images, compare the size (mass) of Earth and the satellite.



Earth has more mass than the satellite.

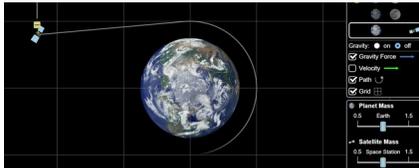
3. Click the blue play button at the bottom of the screen.



4. Which object orbits around the other?

The satellite orbits around Earth.

5. Turn off Gravity. What do you observe?



The satellite moves away from Earth.

Conclusion Questions

1. How do you think astronomers can determine the gravitational force between two celestial objects without measuring it directly? **They can estimate the mass of the objects and the size of the orbit.**

2. Scientists are beginning to develop technology to observe other Sunlike stars distant from our solar system. They can even detect large Jupiter-like planets orbiting some of these stars. Other stars appear to have no planets, but astronomers can see the star wobble a bit in space. What do you think this means?

Astronomers currently believe the wobble indicates the gravitational pull of one or more planets orbiting the Earth that are too small to be seen directly

This PhET simulation is age appropriate for the 8th grade and the concepts/standards taught. It clearly shows how the Sun, Earth and its moon and human satellites interact with each other. This is the first time I have seen the moon's rotation around the Earth is why there is approximately 30 days in the calendar year. At this age group, students ask questions around what they observe in their daily life and I wonder if this would be one of their notices also. This lab wraps up the Unit on gravity and clears up many misconceptions students may have about the relationship of the Sun, Earth and Moon.