**Kepler’s laws & Orbits[[1]](#footnote-1)**

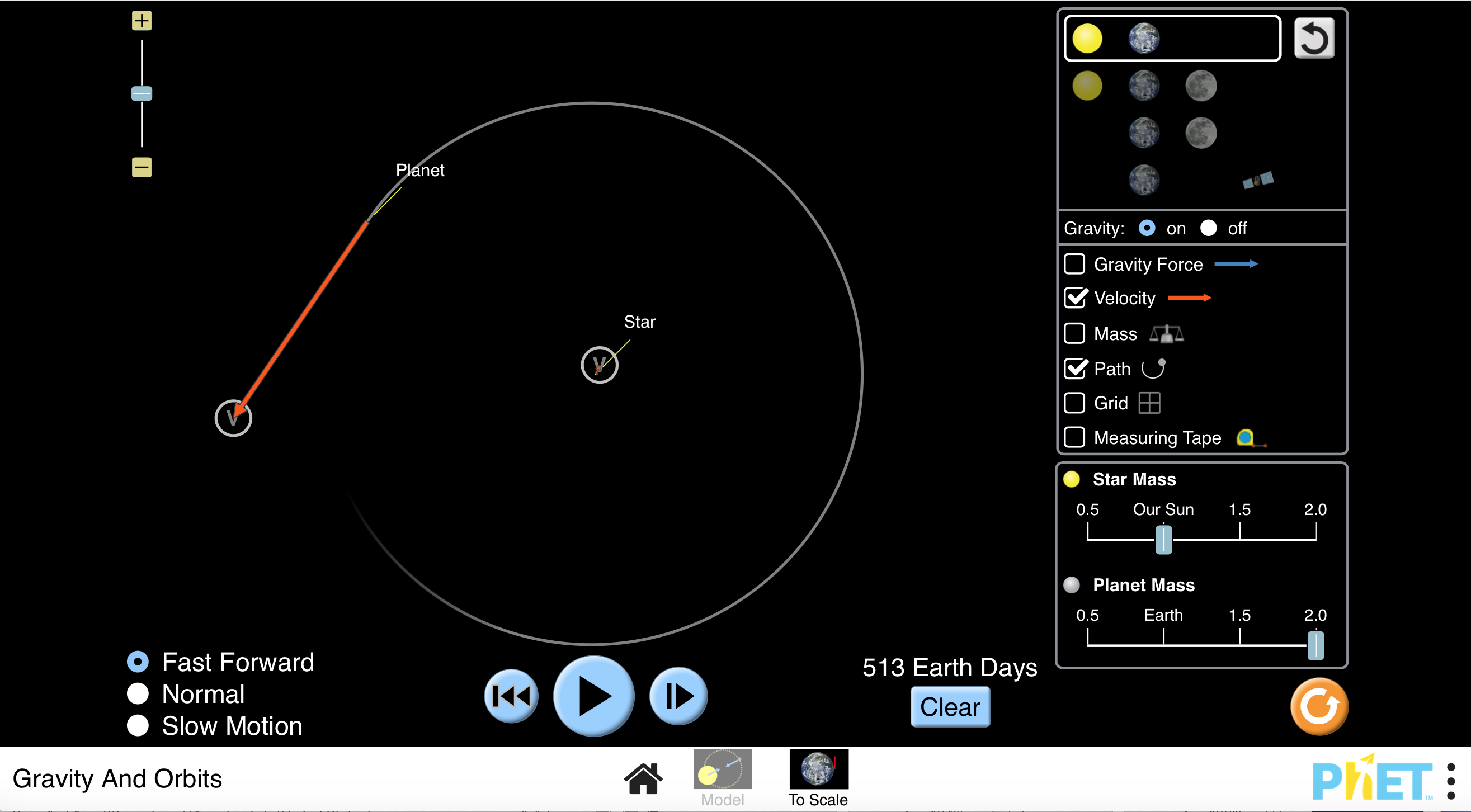
In this activity you will be exploring Kepler’s Laws and Orbital Motion using the “Gravity and Orbits” PhET simulation.

Open the simulation by clicking on the link:

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

Take a look at the explanatory video via YouTube (3m27s):

<https://youtu.be/m6e2y4fef1I>



**Learning Objectives** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_By the end of these activities it is hoped that you will have acquired a better understanding of:

* The shape of planetary orbits and determining factors
* Relate how planetary orbits link to Kepler’s first two laws of planetary motion.

**1. Is the orbit of a planet circular?**

1. Press the **TO SCALE** option at the bottom of the screen with the star and planet chosen, see opposite image.
2. Turn on the path/grid option ON, see green circle.
3. Allow the planet to move through 360o.
4. Turn on the measuring tape from the tool bar, green circle.
5. Measure the horizontal distance from the path line on the left of the star. Write the measurement in the table below.
6. Now do the same from the star to the path line on the right hand side.

|  |  |
| --- | --- |
|  | Distance (miles) |
| Left side from path to star |  |
| Right side from star to path |  |

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**Questions:**

* What do you notice about the distances?
* What does this data say about the orbit of the planet? Discuss.

**2. Linking planetary orbits to Kepler’s Laws?**

1. Go to model
2. Click sun and planet
3. Press **PLAY**, blue circle (with path/gravity/ velocity/grid **ON**, green circle) and leave for one cycle then **PAUSE**.

**! Paste screen shot of trajectory here:**

**Questions:**

* What holds the planet in the orbit?
* What shape is the orbit? Use the screenshot to explain this.

1. Turn **ON** gravity force button, green circle above.

**Question:** What direction do the forces point? Include screenshot as proof.

1. Turn the gravity **OFF**, green circle above.

**Question:** What happens to the planet & why? Include screenshot this as proof.

Screenshot of the trajectory

t of the direction

1. Reset the simulation (Orange button with circular arrow.) Increase *slightly* the velocity of the plant by extending the red ‘v’ arrow of the planet, green circle.

**Questions:**

* What happens to the planet in the orbit?
* What is the shape of the orbit when v is increased?

1. Reset the simulation again. Now increase the velocity of the plant to a large extent by extending the red ‘v’ arrow.

**Question:** What happens to the planet in the orbit?

1. Reset. Now decrease slightly the velocity of the plant by diminishing the red ‘v’ arrow, green circle.

**Questions**:

* What happens to the planet in the orbit?
* What is the shape of the orbit when increased?

1. Reset. Now decrease the velocity of the plant to a large extent by moving the ‘v’ arrow in.

**Questions**:

* What happens to the planet in the orbit?
* What would explain this?
* Is the velocity constant throughout the journey?
* Which one of Kepler’s law does this relate to?

1. Reset. With the star and planet chosen and path/grid on, increase the mass of the **star** by sliding the controller to 1.5/1.75/2.0.

* What do you notice about the orbit?
* What happens to the velocity on the path?

1. Reset. Now do the same but change the **planet’s** mass 1.5/1.75/2.0.

• What do you notice about the orbit?

• Why do you think the observation for your previous answer occurs?

1. Content author: Simon Lees 2017, via https://phet.colorado.edu/en/simulation/gravity-and-orbits [↑](#footnote-ref-1)