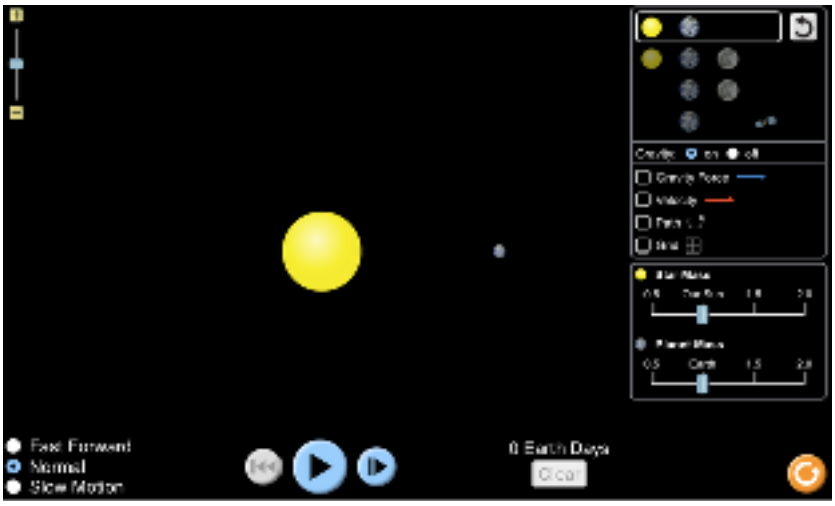
Kepler's Laws & Orbits

In this activity students 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:
https://youtu.be/m6e2y4fef1I



Learning Objectives

By the end of these activities it is hoped that students will have an acquired the following skills:

- Following explicit instructions to gain acquired knowledge
- Investigate the shape of planetary orbits
- Relate how planetary orbits link to Kepler's first two laws of planetary motion.

Author: Simon Lees 2017

1. Is the orbit of a planet circular?

- Press the **TO SCALE** option at the bottom of the screen with the star and planet chosen, see opposite image.
- Turn on the path/grid option ON, see green circle.
- Allow the planet to move through 360º.
- Turn on the measuring tape from the tool bar, green circle.
- Measure the horizontal distance from the path line on the left of the star. Write the measurement in the table below.
- 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	

- What do you notice about the distances?

_____

- What does this data say about the orbit of the planet, discuss?

_____

_____

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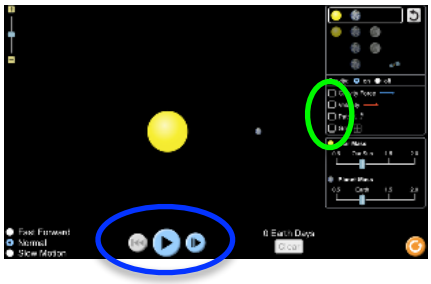
2. Linking planetary orbits to Kepler's Laws?



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

Screenshot of the trajectory

- What holds the planet in the orbit?

What shape is the orbit use the screenshot to explain this?

- Turn **ON** gravity force button, green circle above.
    - What direction do the forces face, screenshot this as proof?

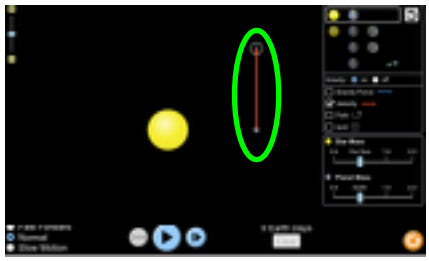
Screenshot of the trajectory

- Turn the gravity **OFF**, green circle above.
    - What happens to the planet & why, screenshot this as proof?

Screenshot of the direction

Author: Simon Lees 2017

- Now increase slightly the velocity of the plant by extending the red ‘v’ arrow of the planet, green circle.



  - What happens to the planet in the orbit?

_____

_____

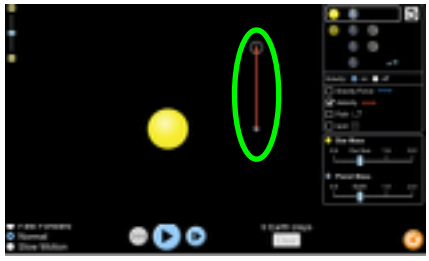
  - What is the shape of the orbit when increased?

_____

- Now increase the velocity of the plant to a large extent by extending the red ‘v’ arrow.
  - What happens to the planet in the orbit?

_____

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



  - What happens to the planet in the orbit?

_____

  - What is the shape of the orbit when increased?

_____

- Now decrease the velocity of the plant to a large extent by moving the ‘v’ arrow in.
  - What happens to the planet in the orbit?

_____

  - Now try to explain this in terms of v and gravity?

_____

  -

- Is the velocity constant throughout the journey?

_____

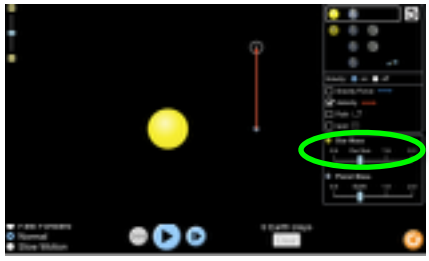
_____

_____

- Which one of Kepler's law does this relate to?

_____

- With the star and planet chosen and path/grid on, increase the size of the star by sliding the controller to 1.5/1.75/2.0, green circle.



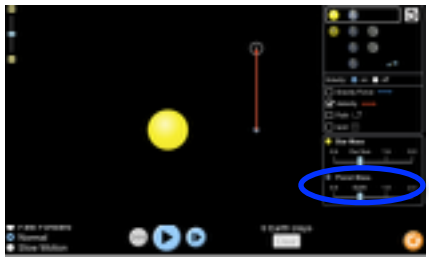
- What do you notice about the orbit?

_____

- What happens to the velocity on the path?

_____

- Now do the same but change the planets mass 1.5/1.75/2.0, blue circle.



- What do you notice about the orbit?

_____

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

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