[Kepler’s Laws and Orbits PhET](https://phet.colorado.edu/sims/html/gravity-and-orbits/latest/gravity-and-orbits_en.html) Name: Per:
Objective 4: Explain each of Kepler’s Laws and apply them quantitatively.

**Define Key Terms:**

1. Eccentricity: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Semi-major axis: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Is the orbit of a planet circular?

* Press the TO SCALE option at the bottom of the screen with only the star and planet chosen
* Turn on the path/grid option ON
* Allow the planet to move through one full orbit
* Turn on the measuring tape from the tool bar
* 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 path to star |  |

a. What do you notice about these distances? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Which of Kepler’s Laws does this relate to? State the law.

2. Linking planetary orbits to Kepler’s Laws

* Leave the TO SCALE and open MODEL
* Click on sun and planet
* Turn path, gravity, and velocity ON
* Press play and immediately pause after one full orbit

a. What holds the planet in the orbit? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Turn ON the gravity force button

b. What direction do the forces face? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Turn the gravity (not gravity force) OFF

c. What happened to the planets and why?

* Turn the gravity (not gravity force) back ON
* Increase the red velocity arrow very slightly in length
* Run simulation and observe

d. Did the planets orbit change in any way? If so, how?

* Increase the red velocity arrow substantially
* Run simulation and observe

e. What happened to the planet in orbit?

* Decrease the red velocity arrow substantially
* Run simulation and observe

f. How did the orbit of the planet change?

g. Can this be explained in terms of velocity and gravity?

* Make sure the only thing selected is the path and grid
* Hold the graph paper to the screen and draw the sun in the center of the paper
* Run in slow motion, pausing every 30 days and indicating the placement of the planet
* Once each month has been marked, mark the orbit path and draw a straight line from each planet to the sun
* Count the grid boxes within each month period

h. How do the areas covered during each month compare?

i. Which of Kepler’s Laws does this pertain to? State the law.

3. It is possible to see Kepler’s 3rd Law using this PhET. Explain.