PORt1110

INTD290: Number Systems in pre-Columbian Context

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1 How to Submit this Assignment

Once you answer the questions, take a picture of your work and convert it to a PDF. Submit the PDF to the assignment link on Moodle.

2 Introduction

For this asynchronous assignment, we will be using something called a *Physics Educational Technology* simulation, or PhET simulation. For an introduction to this tool, please follow this link to a tutorial video by one of my colleagues:

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https://youtu.be/m6e2y4fef1I
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3 The Simulation

To find this simulation, which teaches us how gravity and planetary orbits work, follow this link:

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https://phet.colorado.edu/en/simulation/gravity-and-orbits
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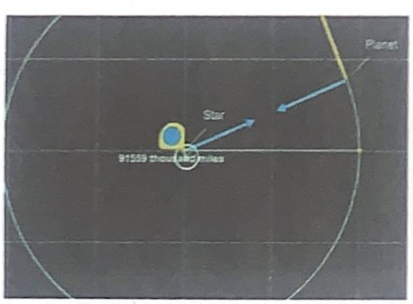
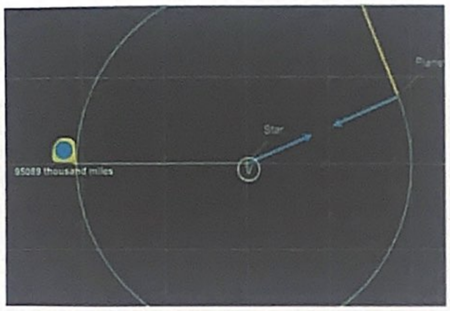
4 The Basics: circular and elliptical orbits

Instructions:

1. Starting with the link above, press the "to scale" option at the bottom of the screen. Choose the option with the star and planet.
2. Activate the path and grid options at right.
3. Click the play button and allow the planet to rotate through 360 degrees, all the way around the star. You can speed up or slow down the motion, which is just governed by gravity, with the controls.
4. Use the yellow measuring tape tool at right to measure two distances: (a) the distance from the star to the path of the planet on the *right*, and (b) the distance from the star to the path of the planet on the *left*. Are they the same number?



a) 91559 thousand miles



b) 95089 thousand miles

No they are not the same distance from the star.

5. What would be true of the numbers if the orbit was perfectly circular?

If the numbers were the same, that would mean the distance from right to left of the star would be the same but the numbers are not nor the distance.

5 Gravity

Instructions:

1. Using the controls at right, display the direction of the force of gravity.
2. What happens to the path of the planet if you deactivate gravity?

If you deactivate gravity then the planet starts to wander away from the star and essentially floats off into space.

3. What happens to the force of gravity if you leave it activated, but click and drag the planet farther from the star?

If you leave it activated but drag it farther from the start, then the number of days it takes to rotate 360 degrees around the star increases.

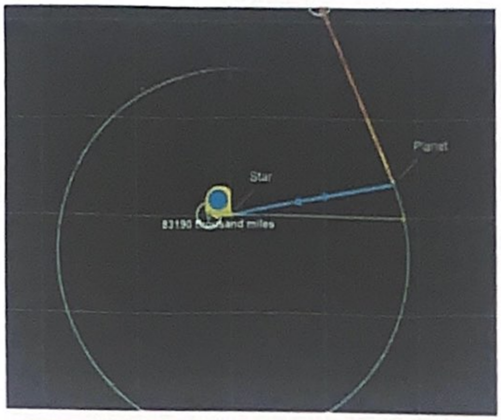
4. Display the velocity with the control at right. Reveal what happens if you let the planet follow one orbit, and then pause, and then change the length of the velocity arrow. This corresponds to changing the speed of the planet. (Changing the direction of the arrow changes the direction of the velocity).

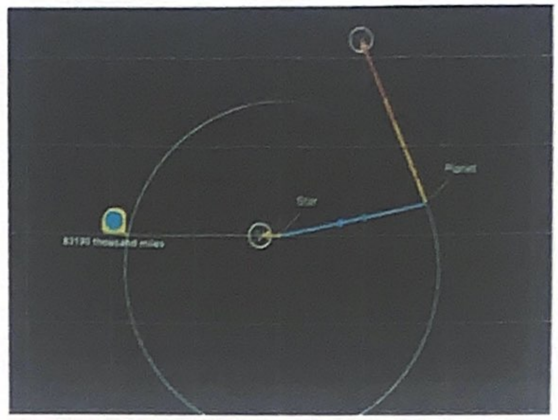
The velocity is constant if not changed in the simulation in regards to the planet going around the star, it is a rate of change of position over time. The shorter the velocity arrow is, the ellipse in which the planet travels around becomes more horizontal, oval and narrow. At certain points it moves quicker around the star than others because this also changes the gravity force between the planet and star to become stronger the closer the two get. If you make the velocity arrow longer, the planet loses its gravity force towards the star and wanders off into space eventually.

6 Kepler's Laws

Instructions:

1. Now that you can see how to control the system using velocity, force, and distance from the star, try to make an orbit that is nearly circular. Show that the radius of the orbit is almost the same when measured at different places (it should be the same number all the way around for a circle, but this might be challenging).



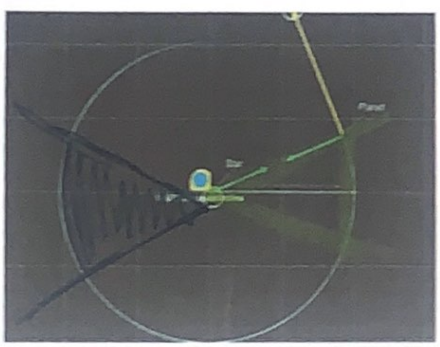


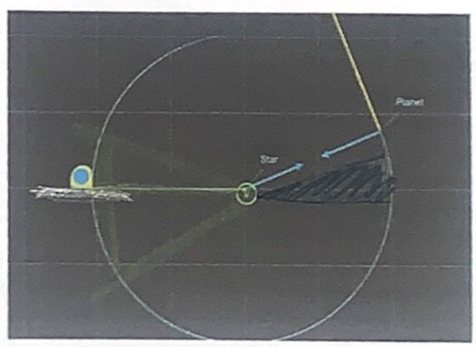
This was the closest I got to a circular orbit but even then the measurements were only even from right to left of the star and not north to south.

2. For your circular orbit, determine what happens if you change the mass of the planet (controls at right). Answer this question: does the rate at which something accelerates downward due to gravity here on Earth depend on its mass? Is it different for planets?

The larger I made the mass, it increased the gravitational force between the sun and planet and instead of staying in place, both the sun and larger planet moved. It also increased the rate in which the planet went around the sun. So yes, the rate at which something accelerates downward due to gravity here on earth is dependent on mass, and yes, gravity varies on planets.

3. Finally, tweak your orbit so that it is elliptical. Using the ruler and grid, find the area of a triangle swept out by the orbit when it is going faster (nearer to the star). The planet needs some number of days to sweep out this area. Find a different triangle on the other side of the orbit that requires the same number of days. Can you show that these triangles have the same area? *This is Kepler's 2nd Law.*





$A = \frac{b \cdot h}{2} = \frac{74710.57262}{2}$

2,139,022,010

$A = \frac{b \cdot h}{2} \Rightarrow \frac{95105.44902}{2}$

2,139,006,555

The areas are not the complete same but, I might have meaured wrong, b/c they are really similar so I think I was close.