Name: ______________________ Section: _____ Date: _________

Explore Simulation: Describe Gravity and Orbits

FSAS SC.8.E.5.4, SC.8.N.1.6

Planets in our solar system all circle around the Sun. It contains ____% of the mass in our entire solar system, so its gravitational pull is strong. Objects in orbit have a forward ______________, a measure of how hard it is to stop a moving object. Moving objects also have ____________, the tendency for objects in motion to resist changes to their direction and speed. Because of these two properties, objects in our solar system stay in orbit instead of crashing into the Sun

Despite the Sun's larger mass, all objects with mass exert a gravitational pull on other objects with mass. This means each of the planets pulls on each other, causing orbits to be in an __________ – a stretched out circle. The measure of how far an object's orbit is from being circular is its ____________________, where 0 is perfectly circular and 1 is completely non circular.

Table 1 | Eccentricity of the Planets' Orbits

Planet	Orbital Eccentricity
Mercury	0.206
Venus	0.007
Earth	0.017
Mars	0.055
Jupiter	0.094
Saturn	0.052
Uranus	0.047
Neptune	0.010

Which planet's orbit is most circular? Which planet's orbit is least circular? Explain how you know.

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Procedure

1. Explore the simulation *Describe Gravity and Orbits*.
2. After exploring the simulation on your own, reset the settings.
3. First, you will test the effects of distance on orbital eccentricity. Choose any mass from the *Mass of the Star* section to be held constant for each distance tested. Record this mass in each box in the *Mass of the Star (× Sun's mass)* column in Table 1

Table 1: Effect of Distance on Orbital Eccentricity

Planet's Distance from Star (AU)	Mass of the Star (x Sun's Mass)	Eccentricity Value
10		
20		
30		
40		
50		

4. Set your chosen constant mass on the *Mass of the Star* slider.
5. Then, set the *Planet's Distance From the Star* slider to *10 AU*.
6. Set the *Gravity force arrows* and *Eccentricity value* toggles to *On*.
7. Press *Play*. Observe how the gravity force arrows change throughout the planet's orbit.
8. Record the eccentricity in Table 1. Select *Reset*.
9. Repeat Steps 4–8 for the remaining *Planet's Distance From the Star* values. Remember to use the same *Mass of the Star* for each run.
10. Next, you will test the effects of mass on orbital eccentricity. Choose any distance from the *Planet's Distance From the Star* section to be held constant for each distance tested. Record this distance in each box of the *Planet's Distance from the Star (AU)* column in Table 2.

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Table 2: Effect of Distance on Orbital Eccentricity

Mass of the Star (x Sun's Mass)	Planet's Distance from Star (AU)	Eccentricity Value
1		
2		
3		
4		
5		

11. Set your chosen constant distance on the *Planet's Distance From the Star* slider on the screen.
12. Then, set the *Mass of the Star* slider to *1 × Sun's mass*.
13. Set the *Gravity force arrows* and *Eccentricity value* toggles to *On*.
14. Observe how the gravity force arrows change throughout the planet's orbit.
15. Record the eccentricity in Table 2. Select *Reset*.
16. Repeat Steps 11–15 for the remaining *Mass of the Star* values. Remember to use the same *Planet's Distance From the Star* for each run.

Analyze and Conclude

1. What pattern did you notice in the gravity force arrows as the planet orbited the star? What does the length of these arrows indicate?

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2. How did distance affect the eccentricity of the planet’s orbit?

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3. How did mass affect the eccentricity of the planet’s orbit?

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4. What would happen to the motion of the planet if there were no gravity acting between the star and the planet? Explain your reasoning

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