Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_ Hour \_\_\_\_\_\_\_

 **Gravity and Orbits Station: String Thing**

**Content Objective:** Explain and demonstrate how mass, gravity and orbits are related.

**Writing language objective**: Develop a model showing the relationship between mass, gravity and orbits.

Essential Question \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part 1:** Read the following background information with your table partner.

Background information: Gravity attracts all objects towards each other. Gravity has been around since the very beginning of the universe, and it works the same way everywhere in the universe, on all kinds of different objects, of all different sizes (larger than atoms- those are held together by atomic forces instead). The bigger the object is, and the closer you are to it, the stronger its gravitational pull is.

In the very beginning of the universe, after the Big Bang, gravity pulled atoms together to make stars and planets (this is the most supported theory as of date). Once the stars and planets had formed, gravity kept the planets in orbit around the stars, and moons orbiting around the planets. And on each planet that is large enough, gravity keeps an atmosphere around the planet.

On Earth, gravity keeps the air around us (and everything else) from drifting off into space. Gravity also causes things to fall to the ground, and causes the ocean’s tides, and causes hot air to rise while colder air falls (Which in turn causes wind).

Nobody fully understands how gravity works, or even why gravity exists. One way of looking at gravity is to think of it not as a force like magnetism, but instead as a natural result of the way mass bends space. Any object with mass (like a star) pushes on space and bends it, so that other objects (like planets) that are moving in a straight line are also going around the star. It looks to us like the star is pulling on the planet, but really the star is bending in space.

A law of physics states that “an object at rest tends to remain at rest, and an object in motion tends to remain in motion”. Newton called these tendencies inertia. Inertia is a way of measuring how hard it is to change the momentum of an object, whether that is getting it to speed up or getting it to slow down. That depends on how much mass the object has. Things with a larger mass more inertia than things with a smaller mass. You have to push a bus harder than a scooter to get it to move.

If something has a lot of mass, it is also hard to get it to stop moving. If the bus was moving fast, you’d need good brakes to get it to stop. Because the bus has more mass than the scooter, it would be a lot harder to stop the bus. That’s also inertia- inertia’s a way of measuring how hard it is to get something to stop moving, too.

According to Newton, the planets are constantly traveling in straight lines away from the Sun. However while they are traveling away from the Sun, the Sun is constantly pulling them back inward. This causes them to appear to circle or “orbit” the Sun. If the Sun suddenly disappeared or lost all of its gravity one day, the planets would go flying outward into space in straight lines.

When on object circles another object it is said to “revolve” around it. The Earth revolves around the Sun. The moon revolves around the Earth. You revolve around the center of a Ferris wheel. On the other hand, when an object turns itself around (spinning) it is said to “rotate” on its axis. The Earth spinning on its axis is considered to be “rotating”. The Earth both rotates and revolves around the Sun at the same time.

**Part 1.B: Answer the following questions related to the background information. Use complete sentences and a restate.**

1. Explain why the Earth orbits the Sun (you must include both terms gravity and inertia)

2. If the Earth slowed down suddenly and its inertia dropped (so it stopped trying to fly away as fast) what would happen?

3. How long does it take the Earth to “revolve”?

4. How long does it take the Earth to “rotate”?

5. Does the Earth’s rotation cause the Seasons or does it cause Day/Night?

**Part 2:** Hoop and Marble Lab; you will be working with your table partner

1. When you reach this part in the assignment, raise your hand and wait patiently for Ms. Murphy to address you.

2. Ask Ms. Murphy for the Hoop Lab Materials (hoop, marble, and paper)

3. Take the hoop and use it to trace a circle on your paper. Number all four sides Picture

4. Rest the hoop on your traced circle. Put a marble inside the hoop. Slowly rotate the hoop to make the marble spin inside and along the edges. Don’t spin the marble too fast or it will go flying. Picture

5. Once the marble is rolling around at a steady pace, tilt the hoop up at point one keeping the other side of the hoop flat on the paper. Watch what happens to the marble (watch which way it goes). Draw a line on your paper next to your circle to show which way your marble went.

6. Repeat for sides 2, 3, and 4. For each one, draw an arrow showing which way your marble went flying.

**Part 2.** B: Answer the following questions using complete sentences with a restate.

1. How would you describe the path the marble took when it exited the hoop? (draw or describe)

2. Is the path the marble took, the same for all 4 exit points?

3. As the marble traveled within the hoop, what directions does the hoop “push” the marble (Hint: how does it stop the marble from flying outward?)

4. If we compare this model to an orbiting planet, what force does the hoop represent?

5. How would you compare the marble within the hoop to the forces that are on a satellites (moon/spaceship) orbiting the Earth?

6. Raise your hand and check your lab materials in with Ms. Murphy

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ms. Murphy approval

**Part 4:** Ball on a String Raise your hand and ask Ms. Murphy to demonstrate “the ball and the string”. Or watch the demonstration <https://www.youtube.com/watch?v=ofywdGdsNV8> (link can be found on the blog)

Draw a labeled picture or what you saw.

|  |
| --- |
|  |

 Think of the different variables that can affect an orbit, which of those variables could you test in class? Discuss this with your table partner, decide which variable you will test and complete your lab design. Before you can gather your materials

Variable- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Complete your lab design below before getting Ms. Murphy’s approval.

|  |  |
| --- | --- |
| Question:  |  |
| Hypothesis: |  |
| Variables: | Independent:Dependent:Constant: |
| Materials: |  |
| Procedure: |  |
| Data Table: |  |
| Analysis: How will you communicate your results |  |

**Directions:** Complete your testing and analysis then Follow the directions and answer the questions using complete sentences with a restate on a separate piece of paper

1. Before moving onto your comprehension questions. Be sure that you completed your analysis; attach it to this assignment when complete

2. What is causing the ball to move in a circle?

3. What does the ball WANT to do or go?

4. How does inertia play a role in the model?

5. What kind of things orbit?

6. What does it mean for an object to orbit?

7. What do you think we could be trying to model with this demonstration?

8. What is the main force in action during this model?