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

**Purple Round and Round (Gravity Simulation)**

***Day 1***

**Part 1 Directions:** As a class watch the gravity simulation video. Answer the questions below as you watch the video using complete sentences and a restate. https://kottke.org/13/12/cool-gravity-visualization

1. Write down any evidence that will help you answer “How does mass affect orbits?”

2. What do you think he means when he says the matter warped space time?

3. What happens when he adds objects with more mass?

4. What happens in the model that doesn’t happen in the solar system?

5. How does he model the moon-earth system?

6. How does he model dark energy? What happens when marbles hit the dark energy?

**Part 2 Directions:** Read the article with your table partner (be sure to summarize after each paragraph)

HIGHLIGHT or underline: Any pieces of textual evidence that will help you answer the question “How does mass affect orbits?”





Gru

**The Moon, the Earth, and gravity**

What would happen if an aspiring villain, a scientist who’s a little too old and deaf, and a group of clumsy and spiteful assistants ventured into the construction of rockets and anti-gravitational weapons? You can find out in Despicable Me, Universal Pictures’ 3D animated feature coming out in cinemas on 15 October. In the film, our odd heroes struggle with the Moon, its mass, and the force of gravity.

So let’s just have a little talk about these key concepts in order to understand better what happens in the film. Have you ever seen a fruit or object falling from a tree? And have you ever tried to throw a stone and watch it fall? This force that ‘brings down’ things is called the force of gravity.



Gru

We are constantly attracted to the Earth by its gravitational force , That is the reason why we always keep our feet on the ground. We don’t need to be in direct contact with Earth to be attracted by it however; not being too far away is just enough for the same forces to act. This is why our own planet orbits around the Sun, and the Moon orbits around the Earth.

The gravitational force is determined by the mass of an object. The gravitational force among two objects is proportional to the mass of the objects, and it decreases very fast the moment we separate them. In fact we also attract objects with ‘our’ force of gravity, but we’re too lightweight to see the effects! The Sun, however, is so big that it’s able to hold us close even when it’s so far away. The Moon also exerts its force of gravity; since it’s smaller and lighter than Earth, if we could weigh ourselves on it we would discover we weigh around a sixth of our weight on Earth.



One could ask why the Moon doesn’t fall on Earth as an apple from the tree. The reason is that the Moon is never still. It constantly moves around us. Without the force of gravity from the Earth, it would just float away into space. This mix of velocity and distance from the Earth allows the Moon to always be in balance between fall and escape. If it was faster, it would escape; any slower and it would fall!

We said the force of gravity depends on distance too. If we were to distance ourselves enough, we could escape its hold. That’s what we try to do with spacecraft. We need to reach and exceed the so-called ‘escape velocity’, that is about 11.2 km/s (at such velocity, we would be able to move from London to New York in just ten minutes!). Once a shuttle reaches this velocity, it is free to travel in the Solar System.



Minions

Inside an orbiting shuttle we do not feel the gravitational force of the Earth. Objects don’t fall, they float; if you jump up, you don’t come back down. A similar thing also happens to astronauts when they are in space stations orbiting the Earth.

In Despicable Me you will see rockets flying and the effects of gravity on the Moon. Gru has a group of assistants called Minions who will help him in his quest to steal the Moon and become the most famous villain in the world.

**Forces of Attraction**

Gravity or **gravitational forces** are forces of attraction. We're not talking about finding someone really cute and adorable. It's like the Earth pulling on you and keeping you on the ground. That pull is gravity at work.

Every object in the universe that has **mass** exerts a gravitational pull, or [**force**](http://www.physics4kids.com/files/motion_force.html), on every other mass. The size of the pull depends on the masses of the objects. You exert a gravitational force on the people around you, but that force isn't very strong, since people aren't very massive. When you look at really large masses, like the Earth and Moon, the gravitational pull becomes very impressive. The gravitational force between the Earth and the molecules of gas in the atmosphere is strong enough to hold the atmosphere close to our surface. Smaller planets, that have less mass, may not be able to hold an atmosphere.

**Planetary Gravity**

Obviously, gravity is very important on Earth. The Sun's gravitational pull keeps our planet **orbiting** the Sun. The motion of the Moon is affected by the gravity of the Sun AND the Earth. The Moon's gravity pulls on the Earth and makes the tides rise and fall every day. As the Moon passes over the ocean, there is a **swell** in the sea level. As the Earth rotates, the Moon passes over new parts of the Earth, causing the swell to move also. The tides are independent of the phase of the moon. The moon has the same amount of pull whether there is a full or new moon. It would still be in the same basic place.

We have to bring up an important idea now. The Earth always produces the same **acceleration** on every object. If you drop an acorn or a piano, they will gain velocity at the same rate. Although the gravitational force the Earth exerts on the objects is different, their masses are just as different, so the effect we observe (acceleration) is the same for each. The Earth's gravitational force [**accelerates**](http://www.physics4kids.com/files/motion_velocity.html) objects when they fall. It constantly pulls, and the objects constantly speed up.

**They Always ask About Feathers**

People always say, "What about feathers? They fall so slowly." Obviously, there is air all around us. When a feather falls, it falls slowly because the air is in its way. There is a lot of resistance and that resistance makes the feather move slower. The forces at work are the same. If you dropped a feather in a container with no air (a **vacuum**), it would drop as fast as a baseball.

**What About the Moon?**

But what keeps the Moon from falling down, if all of this gravity is so strong? Well, the answer is that the moon IS falling; all the time, but doesn't get any closer to us! Remember that if there wasn't force acting, the Moon would be traveling in a straight line. Because there IS a force of attraction toward the Earth, the moon "falls" from a straight line into a curve (orbit) around the Earth and ends up **revolving** around us. The Earth's gravity holds it in orbit, so it can't just go off in a straight line. Think about holding a ball on a string and spinning it in a circle. If you were to cut that string (no more gravity), the ball would fly off in a straight line in the direction it was going when you cut the string. That direction, by the way, is not directly away from your hand, but **tangent** to the circle. Tangent is a geometry term used to describe a direction that are related to the slope of a curve. Math stuff. The pull of the string inward (toward your **hand) is like the Earth's gravitational pull (inward toward the center of the Earth).**

**Part 3 Directions: Answer the following questions using complete sentences and a restate.**

1. Define gravitational forces and mass.

2. How are ocean tides and the moon related?

3. Is the moon falling? Explain

***Day 2***

 **Round and Round**

**Unit Essential Question:** How do things move in space?

**Lab Question:** How does the mass of an object affect the gravitational pull and orbit of that object?

**Task:** Develop an argument using observed evidence to show that gravitational forces are dependent on the mass of an object.

**Materials**

* Hula hoops - Tablecloth/sheet -round objects of different masses
* Binder clips -marbles -beads

**Hypothesis:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Part 1 Directions :Procedure (Check mark your steps as you complete them)**

1. Construct your model. Place a sheet or tablecloth around the hula hoop and clasp it in place. (Similar to yesterday’s video) \_\_\_\_

2. Decide which variables you will test record your variables on the chart provided. \_\_\_\_

3. Choose three different set-ups to test your variables, record your set ups on the chart.\_\_\_\_

4. Collect your materials from Ms. Murphy (you will need to show her your set-ups)\_\_\_\_\_\_

5. Start testing by placing one object in the center of the hoop; push another object so it begins to move around the rim of the hoop. Be sure to test at least three times to ensure valid and reliable results.\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Variable tested | Labeled diagram of setup | Observations(Quantitative and visual) |
|  |  | Trial1:Trial 2 :Trial 3: |
|  |  | Trial 1:Trial 2 :Trial 3: |
|  |  | Trial 1:Trial 2 :Trial 3: |

**Part 2 Directions:** Write a claim about how mass affects the attractive force of gravity on objects moving in space. Include 3 statements of evidence supporting your claim. You may elaborate your evidence with a diagram. All statements should be in complete sentences.

|  |
| --- |
| Claim (answer your lab question):  |

|  |
| --- |
| Observed Evidence #1:Source: |
| Observed Evidence #2:Source: |
| Textual/video Evidence:Source: |
| Textual/video EvidenceSource: |

|  |
| --- |
| Reasoning (Explain how your evidence supports your claim)  |