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Standard

5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.

Engage

- Phenomena: Gravity
 - To engage the students – As a class they would try to solve the problem of how to have an egg drop into a cup hitting it with a broom. Materials are a cup, pizza pan, and toilet paper roll. Students decide how to place the materials and hit the materials with the broom to have the egg drop right into the cup.

- Background Knowledge: Lesson on what gravity is and why it occurs. Gravity an object is pulled down toward Earth. Explanation of Newtown's law of gravity and Galileo's. Posing the question of what direction is gravity pull down. This will be important because it justifies the students' findings within each center. During the lesson students will be having wonderings about gravity that they will write down and hopefully be able to answer through the lesson or the learning centers.

- Students will have a packet that day with graphic organizers and any other information they might need.

Center 1

- **Challenge:** Compare the difference of dropping a rock and dropping a feather. What direction are they falling?
 - Students will make two videos in slow motion of dropping a feather and a rock. They will be able just to use the slow-motion feature on the camera. Students could also make one video with both objects dropping at the same time. Then they will watch the two videos and compare and contrast the path that the two items took when falling to the ground. How do their observations relate to

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Newton's law of gravity as well as Galileo's. They will document this information on the graphic organizer.

- Students will need to be reminded to use the iPads in a respectful and responsible way. Students should be in groups of 2 to complete the activity. One dropping and one recording.
- Students will work in partners to complete the task.
- **Materials Needed:** Rock, Feather, iPad
- **Learning Documents:** Compare and contrast graphic organizer
- **Special Directions:**
 - By the end of this center students should have compared the dropping of a feather and of a rock. They should notice that they do drop at different rates and the feather may sway while dropping, however they both end up dropping straight down.

Center 2

- **Challenge:** Create an experiment that defies/interrupts the path of gravity.
 - Students will be creating their own experiment that shows what happens when the path of gravity is interrupted.
 - An example of this would be dropping a ball and holding a lid in which the ball would bounce off of it and head in another direction.
 - Students will be provided with many different materials and can use which ever they think would be best for the experiment. After testing their experiment, they will explain how it defies gravity and then why the object still goes back downward.
- **Materials Needed:** Balls, feathers, boxes, lids, cups, plates, toilet paper tubes, paper bowls, and any other random supplies (anything the students might want to use)
- **Learning Documents:** Interrupt Gravity Graphic Organizer
- **Special Directions:**
 - Students will need to be directed on what it means if something defies gravity or interrupts the path. This can be explained by something coming in the path

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of the object that is dropping. So, an example would be water from a bucket or hose being poured down and lid comes in the way of the water which makes it turn directions and then go down. The lid interrupts the path that the gravity was pulling the water.

- Students will create their plan for their experiment, test their experiment, and then explain what happens when the path is interrupted, and then reason how/why gravity directs it down again. They will put all this information on their graphic organizer.
- The point of this assignment is to help students to understand how even when the path of gravity is interrupted, the gravitational force directed by earth is still downward.

Center 3

- **Challenge:** Create a design with the cubes to show gravitational force.
 - In this center have the students work in pairs. They will create a maze with the cubes in which the marble will end up at the bottom. There are many different task cards provided with the maze that states where the ball needs to be dropped and where it is supposed to end up. The cubes that are provided to move the ball are all shapes and have different insides.
 - Students will document their design and why they choose it/why does it work (how do their choices relate to the laws of gravity/why did they put the pieces in the order they did)
 - Once they have completed two task cards they may experiment with a maze creation of their own.
- **Materials Needed:** Three kits of ThinkFun Gravity Maze Marble Run (I would purchase for my classroom or get from the teacher center)
- **Learning Documents:** Graphic organizer of the documentation of the design
- **Special Directions:**
 - Students will be directed on what the task cards in the kit mean, how to read them. Students will also need to be reminded of proper use with materials.

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- Explain to students that with their partner they have to complete at least two task cards before creating their own design. They need to document one of the task cards and then their own design (if they choose to do one).

Wrap-Up Session

- **Challenge:** Create their own straight forward experiment that displays what they have learned about gravity with a group – present to class and give explanations that includes content.
 - In this wrap-up session. With their group that they have been moving through the learning centers with, they will come up with an experiment to display what they have learned about gravity through the centers.
 - The experiment should include that the gravitational force directs an object down, this is all objects. That path may be interrupted but will then still be directed downward. Within their presentation they will explain how the content covered relates to their experiment (Newton, Galileo, gravitational force directed downward, etc.)
 - After this challenge I would give students the summative assessment.
- **Materials Needed:** Students could use any classroom materials that would help them to show gravity. Some examples of more items to have: balls, cardboard and cardboard tubes, lids, etc.
- **Learning Documents:** Explanation of the experiment and how it connects to content.
- **Special Directions:**
 - Explain to students that they will be working as a group to come up with an experiment to show gravity and what they have learned about gravity from the different learning centers. Explain that they should use terminology from the lesson. The key point they want to get across is that the gravitational force exerted by Earth is directed downward.
 - They will have time with their group to come up with an experiment, test it, and then document it. This time will be fairly short, about 20 min. Then they will have 3-4 minutes to present their experiment to the class. During the presentation they will need to make sure that each group member has a role. They will also need to clearly explain how their experiment shows the content.

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- The point of this is to assess the students' knowledge, to see if they would be ready for a summative assessment or if they need more exposure to the content. The students should all show an understanding of gravity and why it is directed downward.
- Students should be made aware that this might be a good time for them to refer back to the learning supports that they have already looked at.

Big Idea

- **Science Content:** Gravity – Newton's law, Galileo's law, explanation of gravity and gravitational force, gravitational force exerted by earth is directed downward.
- **Learning Supports:** I would provide the students with links to more information on gravity that could help them in the learning centers. I would and or also provide the students with articles/information at the learning centers.
- <https://www.youtube.com/watch?v=ljRIB6TuMOU>
- http://www.physics4kids.com/files/motion_gravity.html
- <http://kidsvillenews.com/2014/06/kids/what-is-gravity/>
- <http://www.sciencekids.co.nz/sciencefacts/gravity.html>

Assessment Plan:

- **Formative:** The formative assessment would be the students' graphic organizers from each center.
- **Summative:** For a summative assessment the students would take a unit test. One prompt the students would have to answer would be: Is the gravitational force exerted by Earth on an object downward. If yes, why, how do you know?

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Observations

Feather	Rock

Similarities

How do your observations connect to Newton and Galileo's laws of motion?

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Challenge: Create an experiment that interrupts the path of gravity.

Explanation of Experiment	What happened when you preformed the experiment?

Is the gravitational force still directed down? Why/Why Not?

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aMAZEing Gravity

Documentation of Design

<p>Design (explain the design that you created with the task card or on your own)</p>	
<p>Justification (why did you choose the design you did/why does it work?)</p>	
<p>Connection to Newton's Law and Galileo's Law</p>	

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Creating Your Own Experiment

Explain the experiment that your group designed (materials used, how it will work, what will happen, why you chose what you did) -

How does your experiment display what we know about gravity?
