Fifth Physical Science

GRAVITY ON EARTH: Gravitational Force

Background Information

Gravity is a curious property of our universe. Gravity causes objects to attract each other with a force. The strength of this force depends on the masses of the objects and their distance apart. The direction of the force is from the center of one object toward the center of the other. Although the force is invisible, we can observe its direction by watching how objects move in response to the force.

In this activity we consider only the force of attraction between the Earth and objects near its surface. All of the objects which surround us in daily life are being pulled with an attractive force (we call it weight) toward the center of the spherical Earth.

No matter where you stand on the planet, if you drop an apple it will fall toward the center of the Earth. As a matter of convention, we refer to this direction as "down". Of course, people on opposite sides of the Earth will point in opposite directions if you ask them to point "down". What they have in common is that both will be pointing to the center of the Earth.

Although this activity is intended to explore the direction of gravitational forces, there are two important ideas to reinforce with students.

- The Earth is not flat, but spherical.
- We live on the outer surface of the sphere, not the interior.

Performance Expectation

5-PS2-1 MOTION AND STABILITY: FORCES AND INTERACTION - Support an argument that the gravitational force exerted by Earth on objects is directed down.

https://www.nextgenscience.org/pe/5-ps2-1-motion-and-stability-forces-and-interactions

Disciplinary Core Ideas

PS2.B: Types of Interactions: The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

Science and Engineering Practices

Developing and using models: Develop and/or use models to describe and/or predict phenomena.

Engaging in arguments from evidence: Support an argument with evidence, data, or a model.

Crosscutting Concepts

Systems and system models: A system can be described in terms of its components and their interactions.

Materials

- Student Pages
- Gravity on Earth cutout sheet (1 per group of 3 or 4 students)
- Scissors
- Glue sticks
- A globe, ball, or other spherical object

Suggested Implementation

To pique interest and activate background knowledge, begin by asking the class:

- **If I drop this (object) I am holding, in what direction will it fall?**
- **Why does it fall in that direction and not some other?**
- **Do things fall the same in other places, like Africa or Australia?**
- **How could you test your idea without actually getting on a plane and going there?**

As the actual shape of the Earth will enter the discussion at some point, have a globe, ball, or other spherical object handy to hold up for reference.

Help students find partners (3 or 4 to a group) and pass out Student Pages.

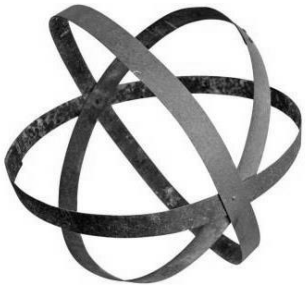
Ask for volunteers to read aloud the background information and Question.

Allow groups to proceed through the activity at their own pace. Their first task to assemble a flat strip of cardstock with three silhouette figures on it. At first, they will build, think, and answer questions individually. Then students will compare and discuss as a group.

Next, the strip is bent into a small ring. Again, students are allowed to think by themselves a moment before comparing their thoughts with partners in their group. You may then convene a whole-class discussion to have groups share their thoughts and questions.

Students within each group will combine their strips with partners to form one, larger ring for each group. The group will discuss this larger ring as a model for the Earth. Again, you may convene a whole-class discussion to have groups share-out their thoughts and questions.

Finally, as an entire class, students consider ways that the rings might be combined to form an even better model of the Earth. They might decide to cut their rings and re-glue them into one large ring. Alternately, they might wish to combine their individual rings in three dimensions around a common center, forming something closer to a sphere. Perhaps they will think of something else!



Assessment

The following single point rubric can be used to assess student understanding. For each of the four criteria listed below, either circle the proficient description or add notes to a box indicating why the student's performance was either lacking or exceptional.

Areas that need improvement. **Developing Performance**	Criteria for **Proficient Performance**	Evidence of exceeding standards. **Advanced Performance**
	Explained that the gravitational pull from the Earth is directed toward the center of the Earth.	
	Explained that this direction would be described as "down" by people living on any part of the Earth.	
	When asked "How do you know?" students reference observations from the perspective of silhouette people on their models.	
	When asked why objects fall down, students explain the downward motion is caused by a downward force.	

Accommodations

Constructing models with scissors and glue sticks requires **fine motor skills**. Students with difficulty can be paired with an appropriate partner.

Reading aloud instructions with students can help those still developing **grade-level reading** skills.

The final step of the activity brings then entire class close together around a single model. Consider **mobility issues** and the comfort of those with **personal space anxieties**. Perhaps moving to an open area without furniture will open up more space so all may participate.