The Gravity of the Matter

Intended for Grade: First

Subject: Science

Description: This project introduces the concept of gravity through a playground demonstration, a simple classroom exploration, and a brief media presentation.

Objective: The students will be able to understand gravity as a force of attraction between all material in the universe. They will be able to identify the Earth's gravity as the force pulling everything near the Earth's surface downward and understand that astronauts in orbit or on the Moon experience a different force of gravity.

Mississippi Frameworks addressed:
- Science Framework 9b: Compare the weight of objects (heavy/light).

National Standards addressed:
- Content Standard B: Physical Science

Materials:
- Balls of Styrofoam and marbles of similar sizes
- Balls of Styrofoam and golf balls of similar sizes
- Plastic coins and real coins
- Other items of similar size and differing weight
- Gravity PowerPoint

Background:
Gravity is the force of attraction that all matter feels toward all other matter. All matter in the universe has a certain amount of gravity, everything from an atom to a human to the planet Earth to the stars. The
force of gravity is so weak in most things we encounter that we do not notice it in our everyday lives. It takes something very, very large to have enough gravity for us to feel. We feel the gravity that holds us to the Earth because the Earth is so large compared to us.

Gravity is what controls most of the large-scale structure of the universe. We are held to Earth by gravity, and this gravity is what causes things to fall “down” towards the Earth’s center. The Moon is held in orbit around the Earth by gravity. The Earth is held in orbit around the sun by gravity. The stars we see in the night sky are all held together in the galaxy by gravity. Even galaxies are attracted to one another by gravity.

The more matter (material) something has inside it, the more it experiences the force of gravity. This is what makes certain things feel heavier than others. A feather doesn’t contain much matter, so it experiences the force of gravity more weakly than something with a lot of matter like a brick or an elephant.

When astronauts are in space, they experience gravity differently. The farther away from the Earth, the less force of gravity is experienced. This is part of the reason that astronauts experience weightlessness in space. Also, when astronauts traveled to the Moon, they experienced less gravity than they would on Earth because the Moon is smaller than the Earth. Because the Moon has less matter than the Earth does, it pulls things toward it with less force. This is what allowed the astronauts to “bounce” easily on the Moon.

Procedure:

1. Throw something into the air or push something off a desk to get the students’ attention. Ask the students why the object was pulled downward.

2. Once the answer of “gravity” is obtained, ask the students what other roles gravity plays in their lives. (It holds stuff down, it makes things heavy, etc.)

3. Tell the students that gravity is a force. Ask them to think of what properties the force of gravity has. (It always pulls things downwards, it pulls some things downwards harder than others, etc.)
4. Explain to the students that everything has gravity, even them. Tell them that small things have so little gravity we can’t feel it but that big things like the Earth have enough gravity for us to feel.

5. Explain that it is the Earth’s gravity which pulls things down (towards the Earth) and makes them feel heavy.

6. If possible, take the students out to the playground with backpacks containing a few books.

7. Have the students hang from the monkey bars or a jungle-gym without their backpacks on. Ask them to describe how gravity is pulling them.

8. Now have them hang again, this time wearing a backpack full of books. Ask them to describe the difference. (If the class is unable to go outside or the playground is unavailable, have them jump up and down indoors with and without the backpack to demonstrate the difference.)

9. Ask the students if they are heavier or lighter when they have their backpacks on. Why?

10. Explain that the more matter something has, the more gravity it can experience. Explain that matter is the amount of substance in a thing. When they were carrying the extra books in their bag, they were carrying more matter and so they experienced greater gravity.

11. Take the students back inside and pass out equal-sized balls of Styrofoam and either marbles or golf balls.

12. Ask the students which feels heavier. Then ask the student which is experiencing a greater force of gravity.

13. Ask the students which must have more matter.

14. Show the students the Gravity PowerPoint with video clips of the astronauts experiencing weightlessness and the astronauts on the moon. Ask them to explain what they are seeing.

15. Tell the students that when astronauts are orbiting the Earth, they do not experience gravity. This gives the sensation of weightlessness and allows them to float around like on the video.

16. Explain to the students that when astronauts visit the Moon, they feel gravity but it is less than what they feel on Earth. Ask the class if they can guess why.
17. Explain that the Moon is much smaller than the Earth (it has less matter) so it can’t pull things toward it as strongly as the Earth can. This is why the astronauts are able to “bounce” in the low gravity of the Moon.

Evaluation:

The students participate in all the activities and class discussion. They are able to identify gravity and the effect it has on them and other things. They also respond to the videos by identifying situations with “no” gravity and “less” gravity than normally felt on Earth.

Extended Activities:

Have the students measure each other’s weight on a bathroom scale. Record the different weights of all the students and arrange them from lightest to heaviest. As a class determine which weight would experience the most gravity and which weight would experience the least. Ask the class to identify which weight indicates the most amount of matter and which indicates the least.

You can also calculate how much the students would weigh on other planets. For example, the surface gravity of the Moon is only 0.166 that of the Earth. To find out how much a student would weigh on the Moon multiply their weight by 0.166. For the planets in the solar system, the numbers are given in the table below. Multiply the student’s weight by the number to find their weight on that planet. Remember: the larger the planet, the more the student would weigh.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>0.38</td>
</tr>
<tr>
<td>Venus</td>
<td>0.89</td>
</tr>
<tr>
<td>Mars</td>
<td>0.38</td>
</tr>
<tr>
<td>Jupiter</td>
<td>2.54</td>
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<tr>
<td>Saturn</td>
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<tr>
<td>Uranus</td>
<td>0.88</td>
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<tr>
<td>Neptune</td>
<td>1.14</td>
</tr>
<tr>
<td>Pluto</td>
<td>0.063</td>
</tr>
</tbody>
</table>
The following sites provide more video clips of astronauts experiencing low gravity on the Moon or weightlessness in orbit:

Space Settlement Video Library
<http://lifesci3.arc.nasa.gov/SpaceSettlement/Video/>

NASA Fortieth Anniversary Audio and Video Clips
<http://www.hq.nasa.gov/office/pao/History/40thann/videos.htm>

The Project Apollo Archive
<http://www.apolloarchive.com/>

Sources:


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