



Science Unit: *Space*

Lesson 2: *Gravity - The Glue of the Universe!*

School year: 2006/2007

Developed for: Sexsmith Elementary School, Vancouver School District

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Grade level: Presented to grades 2 and 3, appropriate for grades 2-6 with age appropriate modifications.

Duration of lesson: 1 hour and 20 minutes

Objectives

1. Students will be able to understand that gravity is the force that pulls objects towards the centre of Earth
2. Students will be able to understand that gravity cannot be stopped
3. Students will be able to understand that gravity helps maintain planets in orbit
4. Students will be able to understand that amount of gravity depends on the mass of the object

Background Information

Many forces operate and maintain the universe in place. A force is an influence that may cause a body to accelerate. Forces have a magnitude and a direction, which can be experienced as a push, a pull or a lift. An important force in the universe is gravity. Gravity is the tendency of two objects of any mass to attract each other. Gravity occurs between planets, moons and stars, but it also occurs between a person falling from a tree and the ground, as well as between the atoms that make a molecule of water or oxygen. Rotational movement is another important phenomenon that is often observed in space. Rotation occurs when a body revolves around an axis. The axis can be within the body, such as the Earth spinning around itself, or the axis can be outside the body, such as the Earth spinning around the Sun.

Vocabulary

Orbit: The path that an object in space makes around another object.

Gravity: The force of attraction between particles or objects that occurs because of their mass.

Force: An influence that produces a change in the direction and speed of an object.

Materials for this lesson

- Puppet monster
- Plastic cups
- 1 rope
- Marbles
- Construction paper
- Hair dryer
- Ping pong ball
- Wood blocks
- Tape



In the Classroom

Introductory Discussion (Hook)

1. Bring the puppet monster back and tell the students that the monster is so happy with us that it decided to stay and learn about space with us. It will be our Space Mascot!
2. Our mascot needs a name since it cannot tell us (or we cannot 'understand' its name) – ask the children to suggest names and choose one by vote.
3. Ask: What do you think holds the universe together? Write their suggestions on the board – explain that is what we call a prediction
4. Explain that today we are going to learn a force that keeps the universe together.

Falling Blocks

5. Give each student a wooden block (that can be dropped on the ground) and ask them to slowly:
 - a. Push it
 - b. Pull it
 - c. Lift it
 - d. Push down on it
 - e. Remove from the table (so the block drops to the ground)
6. Ask: what happened when you pushed pulled or lifted the block? (the block moved) how did it move? (you used your arm to do it)
7. What happened when you removed the block from the table? (it fell) how did it move? (gravity pulled it)
8. Discuss why the block fell rather than floated.
9. Stop and summarize their new knowledge about gravity (gravity pulls objects to the centre of the Earth)

Floating Ball

10. Show them a ping pong ball and ask what would happen if you let it go
11. Ask how could we prevent it from falling?
12. Show them the hair dryer and ask what do they think will happen if you place the ball on a stream of air.
13. Turn the hair dryer on and place the ball on the stream of air, the ball should float in mid-air. Students should try placing the ball in the jet of air. Draw their attention to what happens when we block the hair dryer's air intake, or when we turn it off.
14. Ask them if we successfully stopped gravity from pulling the ball to the ground
15. Ask them how the stream of air is similar to the table holding the blocks
16. Summarize their knowledge about gravity (gravity cannot be stopped)

Balanced tug of war

17. Explain that gravity is also what prevents the Earth from leaving the Sun. Ask: How is that possible?



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18. Ask for three volunteers and give two one end of a short rope (size of a skipping rope) and the other end to the third kid. Try a tug of war (the larger team should win). Explain that the rope is the amount of gravitational pull one body has on another. Students should come to the conclusion that bigger objects have more gravity than smaller objects.
19. Have one kid sit down and take the rope, such that now we have two kids on one end and the teacher on the other. Try a tug of war (the teacher wins). Ask them to explain how is it possible that the smaller group could have more 'pull' than the larger group. Ask: what is different about the two groups? (teacher is heavier than the two students)
20. Guide them to a conclusion that it isn't size that causes an increase in gravity but mass (we can use the word weight so they understand better).
21. Summarize students knowledge about gravity (gravity increases with mass)
22. Once they have all these facts about gravity, ask:
 - a. Which will have more gravity the Sun or the Earth? And why? (heavier sun = more gravity)
 - b. If the Sun pull of the Earth is stronger than the Earth's pull of the sun, why doesn't the Earth go crashing onto the sun? What about the other planets?
 - c. What is it about the planets that prevent them from crashing?

Science Activity/Experiment

Activity Title: Satellite Crash Experiment

Purpose of Activity: To show how rotational movement allows planets/satellites to orbit another object and prevent them from being pulled by the object's gravity and crashing.

Activity Instructions:

- Form a group of 2 or 3 students and give them a plastic cup, a sheet of construction paper and tape to hold the paper into a cone shape and one marble
- Instruct them to make a cone that is as wide as possible and tape it.
- One student should hold the cone onto the cup (gently so the paper does not get crumpled) and the other student will roll the marble around the top of the cone as fast as possible.
 - The marble should go around the cone and slowly come to a stop at the bottom of the cone (or the cup)
- Encourage the students to also just drop the marble from the top of the cone and see how it differs from rolling the marble around the top of the cone.
- Discuss why the marble takes longer to stop when rolled around the cone as opposed to simply dropped from the top.
 - The marble rolling around the cone has a horizontal speed (the initial roll the student gave it) and a vertical speed (gravity). The paper cone prevents the marble from leaving on its tangent (it cannot go through the paper), so the marble must move in a circular path. As the marble rolls around the cone, it also loses horizontal speed because of the friction of the paper but the vertical speed (gravity) remains constant, so the marble moves down
- Discuss how the marble could represent the Earth and the bottom of the cone the sun.



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- What would happen to the Earth if it was stopped? (it would be pulled by the sun)
- Help the students reach the conclusion that gravity is what helps the Earth orbit the sun, but if the Earth was stopped in space, if it lost its ability to move around the sun, it would be pulled by the stronger gravitational pull of the sun.

Closure discussion:

Summarize the students' knowledge of gravity by reviewing the 4 experiments/demonstrations. The children should have the answers but if not, you can use these questions to guide them:

- Gravity is what makes us fall to the ground – (question: what does gravity do?)
- Gravity cannot be stopped – (question: how can we stop gravity?)
- Gravity is everywhere – (question: where would I find gravity?)
- Gravity prevents the Earth from escaping the Sun – (question: What helps the planets orbit the sun?)
- Gravity increases with the mass of the object – (question: which has more gravity the sun or the Earth?)
- Gravity is an invisible force – (question: did you see gravity?)

Scientific Report: ask them to write and illustrate with pictures of the 4 experiments/demo about what they have learned about gravity on their space journal.

References

1. Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work. Janice Pratt VanCleave. John Wiley & Sons Canada, Ltd., 1991.
2. <http://pbskids.org/zoom/activities/phenom/balancingballsonair.htm>. Zoom. Activities. Balancing Balls on Air. WGBH Education Foundation. Accessed on April 2007. [instruction for the floating balls demonstration]

Teacher Assessment of Learning

1. Can the students' describe gravity as a force?
2. Are the students able to say how we feel gravity on Earth?
3. Do the students understand that gravity is everywhere and cannot be stopped?
4. Are the students able to understand the correlation of gravity and mass?
5. Are the students able to explain how gravity helps the Earth orbit the sun?

Extension of Lesson Plan

1. Rotational movement could be added to the tug of war if you have enough space to have a pair of kids hold onto the ends of a rope and rotate around and let go of the rope. This would show how the rotation helps you stay in motion on a circular path.