SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Orbit Onlookers	Grade 6 Earth and Space Systems - Space

Lesson Plan

Big Ideas

- The orbit of satellites around earth
- The difference between mass and weight
- The affect gravity has on objects

Learning Goals

- To understand the relation between gravity and objects in orbit
- Be able to differentiate mass and weight

Specific Expectations

E2.2 distinguish between the concepts of mass and weight
E2.3 describe the relationship between the force of gravity and the weight of a body
E2.6 identify various technologies used in space exploration, and describe how technological innovations have contributed to our understanding of space

Description

The goal of this lesson is to learn more about how natural and artificial satellites and planets orbit. There are many factors that contribute to the way an object orbits such as weight and gravitational pull. We will also get the chance to cover the difference between mass and weight and learn how the weight of an object can differ depending on the force of gravity. After covering these concepts, we can take a better look at how weight can affect the way something orbits.

Materials

- Washers
- String
- Straw
- Tape
- Ruler
- Pencil and paper
- Timer
- Rubber band

Safety Concerns

Swinging objects

Introduction

An orbit is like a path or a route that an object makes around another object that is usually bigger than the one moving. Earth is always going in circles around the Sun, that means that Earth is in orbit around the Sun. It takes one whole year for Earth to make a full circle around the Sun.

The Moon orbits around the Earth and makes one complete circle in almost one month (27 days). That is why we have full moons, half-moons, quarter moons and many more moon phases. The phase of the moon depends on where it is around the Earth and in relation to the Sun.

Things like satellites, the Earth, and the Moon can stay in orbit because of the force of gravity. Gravity is what keeps these satellites going around instead of flying away into space. Gravity is a force that holds things together. Picture yourself dancing around in a circle with a partner, to stay together you would hold hands. Instead of the Earth and the Moon holding hands, the force of gravity holds them together.

What happens when there is no gravity? You float! No matter how much you weigh on Earth, your body will become weightless in outer space. This is because gravity is not holding you to the Earth. You may have heard of the terms weight and mass and thought they were interchangeable. They are not the same thing even though they are measured using the same units. Mass refers to how matter is in an object and that will never change. Weight is how heavy an object is with the force of gravity acting on it. Weight will change from planet to planet depending on how much gravitational pull there is.

Action

Activity 1: Understanding Orbiting

Objective: Help students understand the concept of orbiting with a visual example.

Setup:
Use a large open space with at least two meters of clearance from the center in all directions.

Instructions:

1. Select two volunteers. Student 1 will stand in the center, representing Earth, and remain stationary.
2. Student 2 will walk around Student 1 as fast as possible without running.
3. Other students will time how long it takes for Student 2 to complete one circle around Student 1.

Round 1: Student 2 stands very close to Student 1.
Round 2: Student 2 stands an arm's length away from Student 1.
Round 3: Student 2 stands about 2 meters from Student 1.

Observation: Students should notice that the farther Student 2 is from Student 1, the longer it takes to complete a circle. This illustrates how gravitational pull affects orbiting speed: the closer a satellite is to Earth, the faster its orbit due to stronger gravity.

Activity 2: Circular Motion with Washers

Objective: Demonstrate how distance affects orbital speed.

Materials (per pair):

- 2 washers
- 60 cm of string
- 1 straw
- Paper and pencil

Instructions:

1. Tie one end of the string to a washer, thread the string through the straw, and tie the other end to the second washer.
2. One student holds the straw vertically while the other swings the washer in a circular motion, rotating their wrist like a lasso.
3. Count the rotations in 30 seconds and record the string length from the top of the straw and the number of rotations.
4. Shorten the string and repeat, noting observations each time.

Observation: As the string length shortens, the washer completes more rotations in 30 seconds, demonstrating how satellites orbit faster when closer to Earth due to stronger gravitational pull.

Activity 3: Mass vs. Weight
Objective: Understand the difference between mass and weight.

Instructions:

1. Hang objects of different weights from rubber bands and observe how much each band stretches.
2. Discuss what would happen in a zero-gravity environment like the ISS: the elastic wouldn't stretch, and the objects would float.

Observation: The heavier the object, the more the rubber band stretches. On the ISS, objects have the same mass but no weight due to lack of gravity. This illustrates that while mass remains constant, weight varies with gravitational force.

Supplementary Material:
Watch a NASA video demonstrating this activity on the ISS to reinforce the concept of mass versus weight.https://www.youtube.com/watch?v=QwADejaE6PY

French video: https://youtu.be/zw-mmd_b7Is?si=IXUOKKV95wTOVk4g

Consolidation/Extension

What are some factors that could influence the way that planets and satellites orbit?
Extension: how much would something weigh on different planets (can do 100lbs for general or just objects you would know the weight of)

Additional Resources

https://earthobservatory.nasa.gov/features/OrbitsCatalog#:~:text=An%20Earth%2Dorbiting%20satellite%27s%20motion,the%20satellite%20moves%20more%20quickly.

FR: https://parlonssciences.ca/ressources-pedagogiques/documents-dinformation/introduction-aux-satellites