

Gravitational Interactions Mass & Distance Lesson

- ✓ **Comprehensive Content Overview** – Cover what gravity is, the relationship between gravity and mass as well as gravity and distance, the moon and tides, and gravity's role in the solar system.
- ✓ **Student-Friendly Format** – Clear visuals and comparisons support understanding of complex concepts.



Your Lesson

- ✓ **Covers Key Concepts** – This lesson covers what gravity is, the relationship between gravity and mass as well as gravity and distance, the moon and tides, and gravity's role in the solar system.
- ✓ **Complete Lesson Package** – Teacher and student presentations, embedded videos, and handout.
- ✓ **Active Student Engagement** – Fill-in-the-blank student notes support focus and classroom discussion.
- ✓ **Easy to Use** – No prep needed. Simply download and present.

Bonus Activity

Orbit Rope Model Activity

Objective: Model gravitational attraction using a hands-on demonstration to explore how mass and distance affect orbit.

Materials (per group):

- A ball of yarn or light rope (~2 meters)
- A heavy object (like a large rubber ball or weight) to represent the Sun
- A smaller object (like a tennis ball) to represent a planet
- Tape or chalk to mark positions

Procedure:

1. Place the "Sun" in the center of the room.
2. Tie one end of the string to the "planet" and the other to a fixed point near the "Sun."
3. Walk the planet in a circular path around the Sun to simulate orbit.
4. Try it again with a shorter string (closer orbit) and observe the speed.
5. Discuss what might happen if the planet were lighter or farther away.

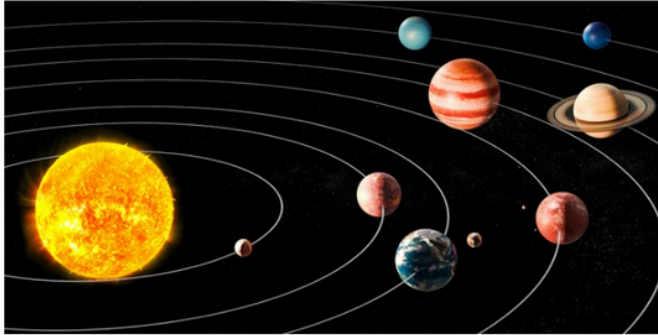
Discussion Questions:

1. Why does the "planet" move around the "Sun" instead of flying away?
2. What happened when the planet was farther from the Sun?
3. What would happen if gravity disappeared (if the string was cut)?

Reinforce concepts using this bonus activity included in your lesson

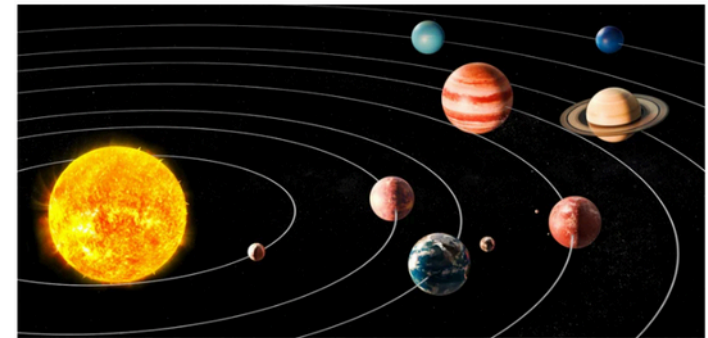
Gravity in the Solar System

- The Sun's gravity keeps planets in orbit
- Planets with more mass (like Jupiter) have stronger gravitational effects
- Gravity helps explain orbital speeds and distances



Gravity in the Solar System

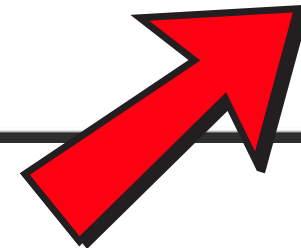
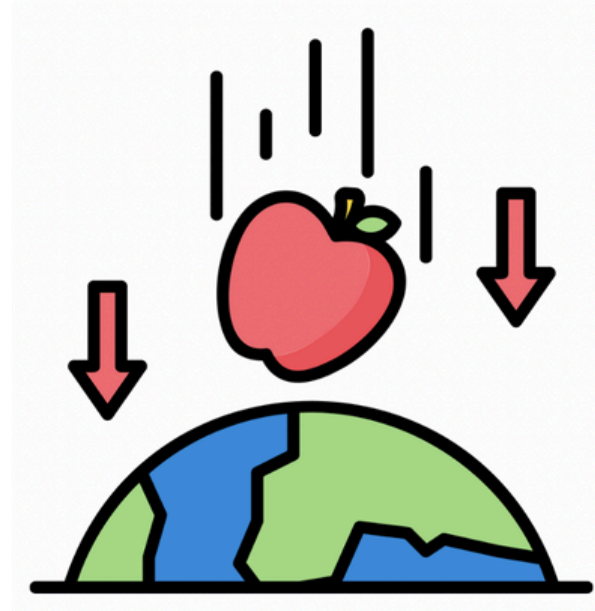
- _____
- Planets with more mass (like Jupiter) have stronger gravitational effects
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- Have your students complete the student version of the notes while you teach
- Student notes come mostly filled in so students can spend more time listening and less time copying notes.

What Is Gravity?

- Gravity is a force that pulls objects toward each other
- It acts between all objects that have mass
- The more mass an object has, the stronger its gravitational pull



**Videos embedded in directly into
your lesson. One-click access.**

Gravitational Interactions - Exit Ticket

* Indicates required question

What causes gravitational attraction between two objects? *

1 point

- ☐ Their temperatures
- ☐ Their speed and direction
- ☐ The amount of sunlight they receive
- ☐ Their masses and the distance between them

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Clear form

Includes student notes in easy-to-fill-in formats.

4-Question, Auto-Graded Exit Ticket based on information from the lesson.

Gravitational Interactions: How Mass and Distance Affect Gravity in Space – Student Lesson Outline

What is Gravity?

- Gravity is a force that pulls objects toward each other
- The more mass an object has, the stronger its gravitational pull

Gravitational Forces Are Always Attractive

- All objects with mass attract each other with gravity
- Even you and your dog exert a small gravitational pull!

Gravity Depends on Mass

- Bigger objects (like planets and stars) have stronger gravity
- Earth has more gravity than the Moon because it has more mass

Gravity Also Depends on Distance

- Closer objects = stronger pull
- Distance between objects has a bigger effect than mass

How the Moon Influences the Tides

- There are 2 gravitational bodies that affect the tides on Earth - the Moon and the Sun

How the Moon Influences the Tides

- When the Moon, Sun and Earth are in line (full and new moons), the gravitational pull is stronger

How the Moon Influences the Tides

- This is called a neap tide
- There is always a tide at either end of the Earth

How the Moon Influences the Tides

- As the Earth spins over 24 hours, different parts of it face the Moon
- This causes Earth's tides to change
- The part facing the Moon experiences a high tide
- Coastal areas experience two low tides and two high tides every day

Gravity in the Solar System

- Planets with more mass (like Jupiter) have stronger gravitational pull
- Gravity helps explain orbital speeds and distances

Mass and Orbital Data

- Scientists use charts and simulations to study gravity
- Charts show mass, distance from the Sun (radius), and their gravity

Planet	Distance from Sun ($\times 10^6$ km)	Mass ($\times 10^{24}$ kg)	Orbital Period (days)	g (m/s^2)
Mercury	57.9	0.33	88	3.61
Venus	108.2	4.87	224.7	8.83
Earth	149.6	5.97	365.2	9.81
Mars	228.0	0.642	687	3.75
Jupiter	778.5	1,898	4,331	26.0
Saturn	1,432.0	568	10,747	11.2
Uranus	2,867.0	86.8	30,589	10.5
Neptune	4,515.0	102	59,800	13.3

Example – Earth and the Moon

- The Moon also pulls on Earth (causes tides)
- This is evidence of mutual gravitational attraction

Simulation Exploration

Answer the following questions in your notes prior to viewing the simulation.

- How does changing the Star Mass change the Gravity Force between the Star and the planet?
- How does changing the Planet Mass change the Gravity Force between the Star and the planet?
- How does changing the distance between the Planet and The Star change the Gravity Force between them?

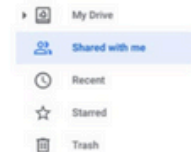
Click on the image to start the simulation. Make sure the Gravity Force box is checked, test out #1-3, check your answers.

Summary

- Gravity is a Universal Attractive Force.
- Gravitational Strength Increases with Mass. The more mass an object has, the stronger its gravitational pull. Larger celestial bodies like Earth or Jupiter exert stronger forces than smaller ones like the Moon.
- Gravity Shapes the Solar System. The Sun's gravity keeps planets in orbit. Planets with more mass, like Jupiter, have stronger gravitational effects that can even influence nearby objects.
- Scientists Use Models and Data to Study Gravity. Simulations and charts help scientists understand how mass and distance affect gravitational force. Evidence like orbital periods and tides show real-life effects of these interactions.

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TWF

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