**Guided Notes: Gravitational Force**

**Big Idea**:

Gravitational force is the attractive force between objects due to their \_\_\_\_\_\_\_, with Earth's gravity causing objects to have \_\_\_\_\_\_\_.

**Key Concepts**:

• Gravitational force is the \_\_\_\_\_\_\_ force between any two objects with mass.

• The strength of gravitational force depends on the \_\_\_\_\_\_\_ of the objects.

• An object's weight is the \_\_\_\_\_\_\_ force exerted on it by Earth.

• Weight can change based on \_\_\_\_\_\_\_, but mass remains constant.

• Objects with greater mass have a \_\_\_\_\_\_\_ gravitational attraction.

• Earth's gravitational pull is much stronger than smaller objects due to its enormous \_\_\_\_\_\_\_.

• Gravitational force is always \_\_\_\_\_\_\_, pulling objects toward each other.

**Real World Examples**:

1. Amusement park rides: On a drop tower ride, you feel weightless for a moment at the top because you're falling at the same rate as the \_\_\_\_\_\_\_ is pulling you down.

2. Playing basketball: When you shoot a basketball, \_\_\_\_\_\_\_ causes the ball to follow a curved path (arc) back down to the hoop instead of continuing in a straight line.

**Guided Notes: Gravitational Attraction and Mass**

**Big Idea**:

Gravitational attraction between objects increases as their \_\_\_\_\_\_\_ increases.

**Key Concepts**:

• Gravitational attraction is the \_\_\_\_\_\_\_ force between all objects with mass in the universe.

• Objects with more mass experience \_\_\_\_\_\_\_ gravitational attraction toward Earth.

• The strength of gravitational attraction depends on the \_\_\_\_\_\_\_ of both objects.

• An object's weight on Earth is determined by its \_\_\_\_\_\_\_ and Earth's gravitational pull.

• On celestial bodies with less mass than Earth, like the moon, objects experience \_\_\_\_\_\_\_ gravitational attraction.

• The relationship between mass and gravitational attraction is \_\_\_\_\_\_\_.

**Real World Examples:**

1. Smartphone vs. Laptop: When holding a smartphone and a laptop, the laptop feels heavier because its greater \_\_\_\_\_\_\_ results in a stronger gravitational pull towards Earth.

2. Swimming pool vs. Ocean: It's easier to float in the ocean than in a swimming pool because the ocean's greater \_\_\_\_\_\_\_ creates a stronger upward gravitational force, counteracting Earth's downward pull.

**Guided Notes: Investigating Gravity**

**Big Idea:**

The effect of gravity on objects is the same regardless of their \_\_\_\_\_\_\_, causing all objects to accelerate towards Earth at the same rate.

**Key Concepts**:

• Gravity is the \_\_\_\_\_\_\_ force between all objects with mass.

• An object's \_\_\_\_\_\_\_ is the measure of how much matter it contains.

• The \_\_\_\_\_\_\_ of an object falling due to gravity is the same for all objects, regardless of mass.

• To investigate gravity's effects, objects of different masses should be dropped from the same \_\_\_\_\_\_\_.

• If objects of different masses hit the ground at the \_\_\_\_\_\_\_ time, it shows gravity's effect is independent of mass.

• The force of gravity between two objects depends on their \_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_ between them.

• Newton's law of universal gravitation states that gravitational force is proportional to the \_\_\_\_\_\_\_ of the objects and inversely proportional to the \_\_\_\_\_\_\_ of their distance squared.

**Real World Examples**:

1. Skydiving: A heavier skydiver and a lighter skydiver jump from the same plane at the same time. Despite their \_\_\_\_\_\_\_ difference, they will fall at the same rate due to gravity.

2. Dropping a pencil and textbook: When a pencil and textbook are dropped from the same height, they will hit the ground at the \_\_\_\_\_\_\_ time, demonstrating gravity's equal effect regardless of mass.

**Guided Notes: Analyzing Gravitational Data**

**Big Idea**:

Objects near Earth accelerate due to gravity at the same rate regardless of their \_\_\_\_\_\_\_, though air resistance can affect their fall.

**Key Concepts**:

• Gravity is the \_\_\_\_\_\_\_ force between objects with mass.

• Objects with different masses fall at the same \_\_\_\_\_\_\_ in the absence of air resistance.

• \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ is a force that opposes the motion of objects falling through air.

• To investigate gravity's effects, data on object \_\_\_\_\_\_\_, drop \_\_\_\_\_\_\_, and fall \_\_\_\_\_\_\_ should be collected.

• Critical thinking involves \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ evidence to solve problems.

• Experiments should be designed to \_\_\_\_\_\_\_ variables that could affect results.

• \_\_\_\_\_\_\_ data collection and analysis are crucial for drawing accurate conclusions.

**Real World Examples**:

1. Basketball and ping pong ball: When dropped simultaneously from the same height, a basketball and ping pong ball will hit the ground at the same time, despite their significant \_\_\_\_\_\_\_ difference.

2. Feather and coin in a vacuum: In a vacuum chamber with no air resistance, a feather and a coin dropped at the same time will fall at the same \_\_\_\_\_\_\_, demonstrating gravity's equal effect on objects of different masses.

**Guided Notes: Gravity and Air Resistance**

**Big Idea**:

The motion of falling objects is determined by the interaction between \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ \_\_\_\_\_\_\_.

**Key Concepts**:

• Gravity is the \_\_\_\_\_\_\_ force between all objects with mass.

• Air resistance is the force that \_\_\_\_\_\_\_ an object's motion through air.

• As an object falls, its speed \_\_\_\_\_\_\_ due to gravity until air resistance balances gravitational force.

• \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ is reached when the upward air resistance equals the downward gravitational force.

• Air resistance depends on an object's \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_.

• Opening a parachute greatly increases \_\_\_\_\_\_\_ \_\_\_\_\_\_\_, slowing the fall.

• A falling object experiences two different terminal velocities: one before and one after opening the \_\_\_\_\_\_\_.

**Real World Examples**:

1. Dropping homework papers: A flat sheet of paper falls more slowly than a crumpled paper ball due to greater \_\_\_\_\_\_\_ \_\_\_\_\_\_\_.

2. Long jump vs. high jump: Long jumpers can travel further horizontally than high jumpers can vertically because \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ has less time to slow their motion.