Lect 5: Gravity: A Force of Attraction
Part One - (Chapter 5.4)

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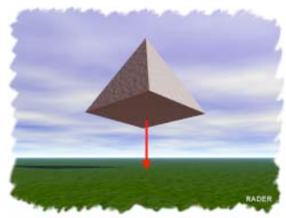
A story about an apple

One beautiful spring day in 1655, a man named ________________________ was sitting under an apple tree in his garden, enjoying a glass of tea. Suddenly, one of the apples fell and crashed on his head. That got Newton thinking (once the bump had gone down of course). “Why did the apple fall towards the Earth?” “Why did it not “shoot upwards" when it came away from the branch?” And, “why did I plant that stupid apple tree anyway?!!" Newton knew that unbalanced forces are necessary to move or change the motion of objects. So, he came up with the idea that the Earth must attract the apple towards it with some “unseen force". He named this force _______________.

Gravity is ____. We're not talking about finding someone really cute and adorable. We mean when the molecules of one object pull on the molecules of another object. It's like the Earth pulling on you and keeping you on the ground. That pull is gravity at work.

All matter is affected by gravity

Matter is anything that has mass and volume. Since all matter has mass, all matter is affected by gravity. Gravity (aka: ________________________________) ____ ___________________________________. It acts on anything with mass.



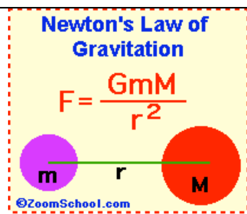
GRAVITY OF THE EARTH PULLS OBJECTS TOWARDS THE CENTER OF THE PLANET.

Ok, then why don’t we see objects being pulled towards one another?

This is because the mass of most objects is too small to cause an attraction large enough to cause the objects to move towards each other. Even though gravity is “pulling” the pencil you’re holding, its mass is so small that it’s not really moving. There is, however, one object that is big enough to cause a noticeable attraction… That’s right, the Earth! Earth has an enormous mass and thus an enormous gravitational force. When the Earth spins and gravity pulls on the clouds, weather can be affected. The Earth's gravity even holds the atmosphere close to our surface.

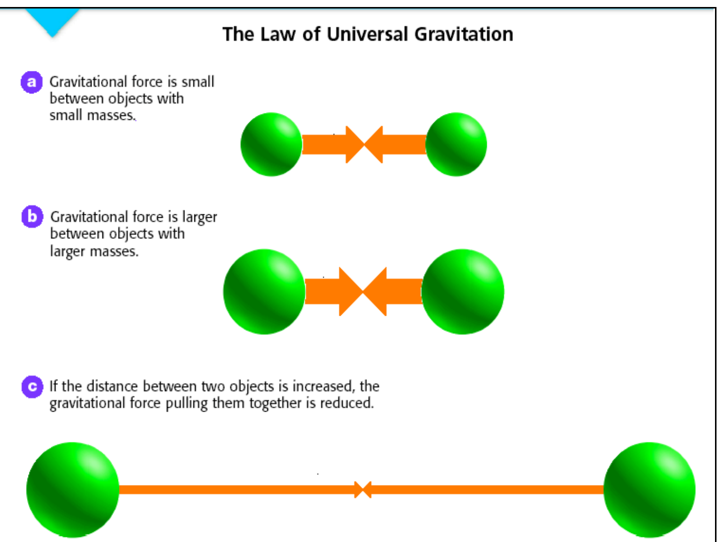
The Law of Universal Gravitation

Newton generalized his observation in something called the Law of ___________________ ________ This law states: All objects in the universe __________ each other through ____________________ The size of the gravitational force depends on two things: (1) _____________ of the objects and (2) ____________ between the objects.



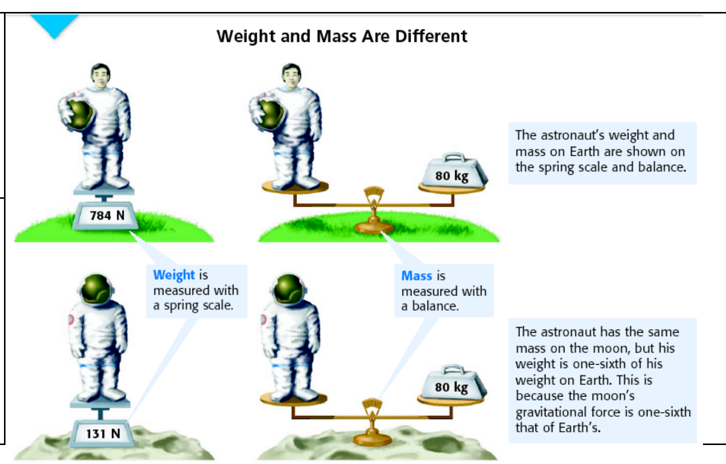
Basically, there are two major parts to this law that you need to know:

1. Gravitational force increases as mass increases
2. Gravitational force decreases as distance increases



Weight is a measure of the **gravitational force** exerted on an object. Most of the time, when we’re talking about weight, we’re referring to the *Earth’s* gravitational force on an object. Since gravity is a force and weight is a measure of gravity, weight is expressed in ____________________ On Earth, a 100 gram object would weigh 1 N.

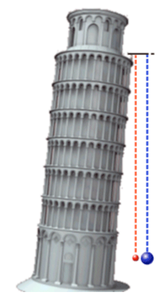
Mass is the amount of_________ in an object. This does not change… ever! Whereas _______________ changes when gravity changes, ________ always remains the same. Remember, mass is measured with a balance, where the mass of one object is *compared* to another object. On Earth, mass and weight are both constant since gravity is a constant force, which is why they seem like the same thing to us.



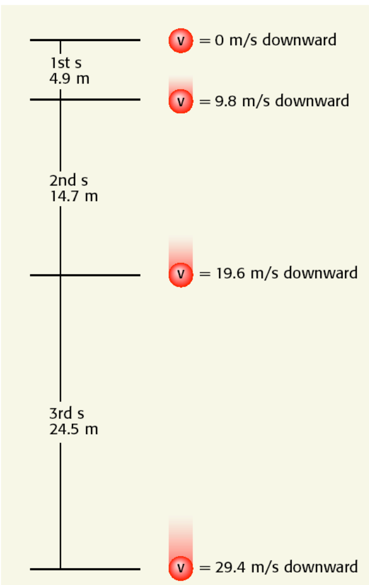
Gravity & Motion

Part 2 - Chapter 6.1

A story about a cannonball



Well, and before the cannonball, it started with a philosopher & scientist named ______________. In ancient Greece around 400 BC, he proposed that the rate at which an object falls depends on its mass. In other words, Aristotle believed that the heavier the object, the faster it falls. In the late 1500s, an Italian scientist named _______________ Galilei decided to prove Aristotle wrong. Galileo theorized that all objects will land at the same time when they are dropped from the same height. To prove this to his critics, he set up a little experiment. Galileo carried a cannonball and a wooden ball up the 300 steps of the Leaning Tower of Pisa. Dropping the two different balls at exactly the same time, the crowd was amazed with what they saw… The two balls, with extremely different masses, landed at the exact same time! What did Galileo prove? Objects fall to the ground at the same rate because _________________ due to_______________ is the _________ for all objects. For example, an elephant and a feather fall with the _____________________ even tough they have _________________

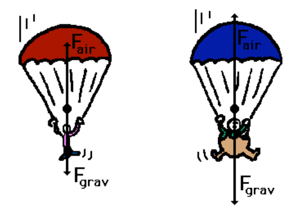


Gravity & Acceleration

The rate at which objects accelerate towards Earth is _________________ This acceleration is the same for all objects, regardless of their mass. In other words, falling objects accelerate at a _________________ of 9.8 m/s^2. Gravity = g = 9.8 m/s^2 Notice, the ball isn't traveling at 9.8m/s^2, it's _________________ at 9.8 m/s^2. It's velocity is continually increasing. Only the acceleration remains constant. Each picture was taken 1 second apart, but notice how the ball travels a greater distance between each second.

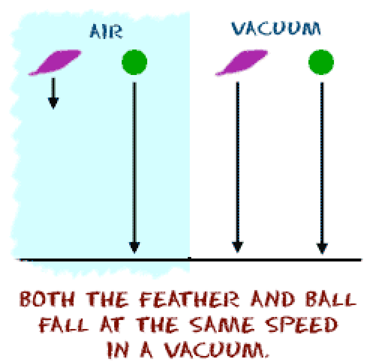
Air Resistance

Watch me drop two pieces of paper, one crumpled in a tight ball and the other kept flat. As you know, the crumpled paper has more velocity and hits the ground first, whereas the flat paper sashays slowly until it lands on the ground. You also know that air has friction & causes objects to move more slowly. The amount of air resistance depends on the size and shape of an object. Air resistance increases as an object's ______________ increases and its _________________ (or cross-sectional) increases. While gravity pulls an object down, towards the Earth, the air resistance pushes an object up, or away from the Earth.



Free Fall

When there is no air resistance, an object is in ________________ An object is in free fall only if gravity is pulling it down and no other forces are acting on it. Free fall can only occur where there is no air, such as in a _________________.



Summary

1. What is gravity?

2. What is weight?

3. What is the difference between mass & weight?