Sciencesplosion™

Curriculum Based Study Guide and Lesson Plan

K-5

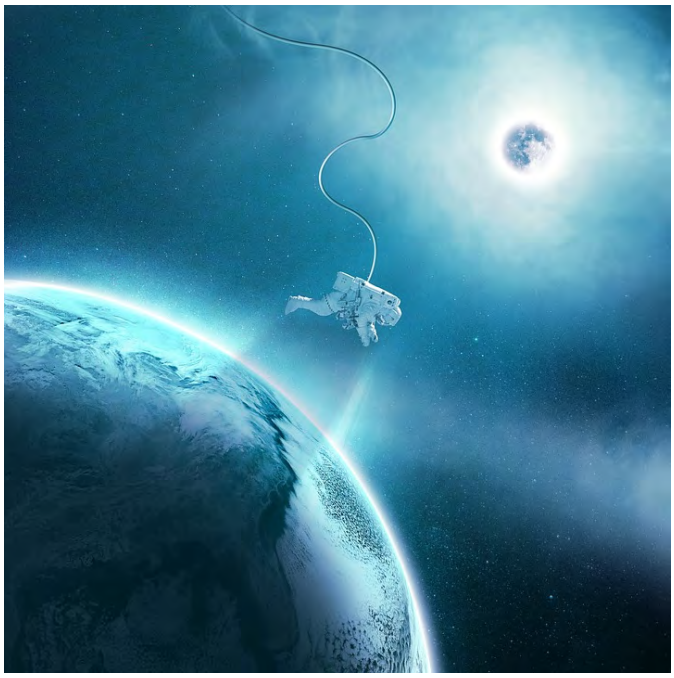
http://nizer.com

Sciencesplosion™ is an educational outreach science program that merges Mark Nizer's stage performance with scientific principles and school curriculum. This guide is for grades K-5 and will give you the background and material that Mark will cover in his Sciencesplosion™ show. The show is appropriate for ALL grades. Mark will adjust the scope and details based on grades attending.

We will cover:

- Gravity
- The Planets
- Light
- The Diversity of Life
- The Scientific Method

GRAVITY



What is gravity?

Gravity attracts all objects towards each other. Gravity has been around since the very beginning of the universe, and it works the same way everywhere in the universe, on all kinds of different objects, of all different sizes.

How much gravity an object has depends on how big it is (or to be specific, how much mass it has). It also depends on how close you are to the object; the closer you are, the stronger the gravity.

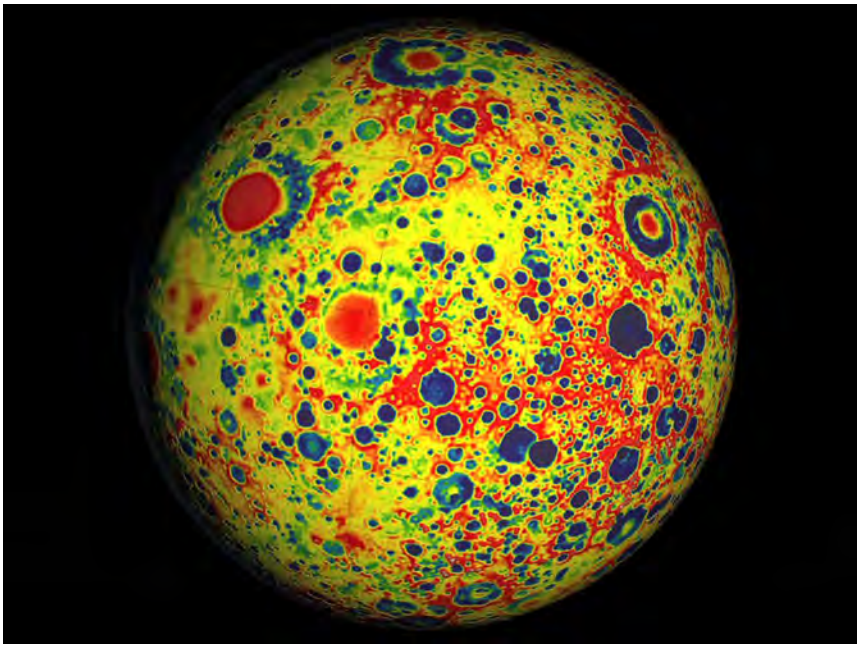
Gravity is very important to our everyday lives. Without Earth's gravity we would fly right off our planet! We'd all have to be strapped down all the time and if you kicked a ball, it would fly off forever. While it might be fun to try for a few minutes, we certainly couldn't live life on Earth without gravity.

Gravity also is important on a larger scale. It is the Sun's gravity that keeps the Earth in orbit around the Sun. Life on Earth needs the Sun's light and warmth to survive. Gravity helps the Earth to stay just the right distance from the Sun, so it's not too hot or too cold.

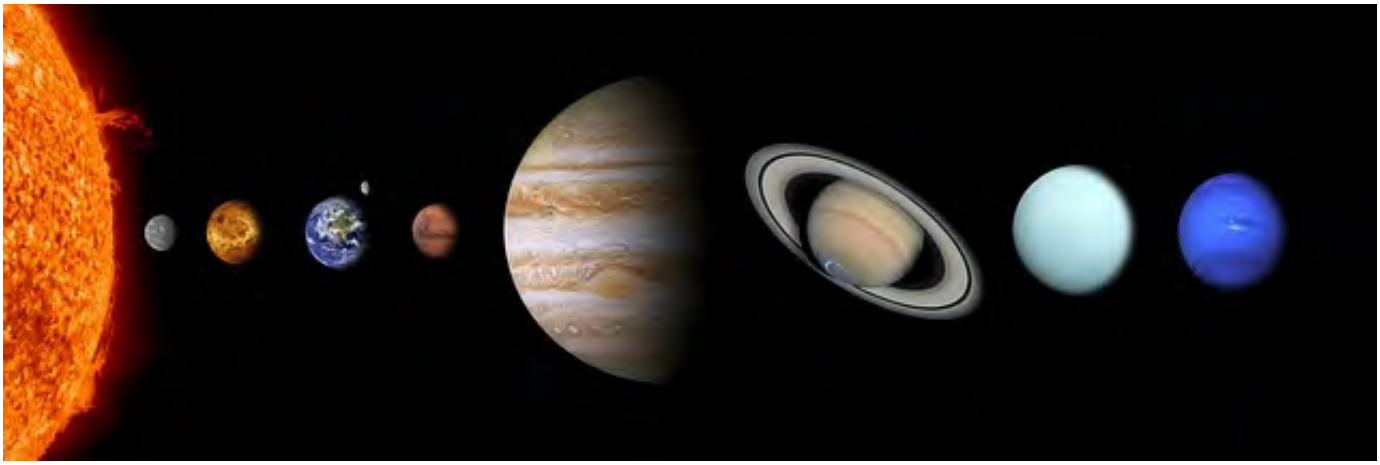
Top 10 facts

1. The bigger the object's mass, the more gravity it will have; the smaller the mass of the object, the less gravity it is subject to.
2. Gravity guides the growth of plants and other vegetation.
3. Black holes have the strongest gravitational pull in the entire universe.
4. The Earth is a giant magnet. Its magnetic field is like a bar magnet at its centre.
5. Sir Isaac Newton discovered gravity about 300 years ago. The story is that Newton saw an apple fall out of a tree. When this happened he realized there was a force that made it occur, and he called it gravity.
6. Ocean tides are caused by the gravity of the moon.
7. If you could travel from planet to planet your mass would stay the same, but your weight would vary depending on how the gravity of that planet pulled on you. Mars is smaller and has less mass than Earth and as a result it has less gravity. If you weigh 100 pounds on Earth, you would weigh 38 pounds on Mars.
8. At some point when falling, the friction from the air will equal the force of gravity and the object will be at a constant speed. This is called the terminal velocity. For a sky diver this speed is around 100 miles per hour!
9. We don't actually "feel" gravity. We only feel the effects of trying to overcome it by jumping or when we fall.
10. Gravity always pulls, it never pushes.

- You are shrinking right now. Every day you are taller in the morning than you are at night. In fact, at the end of each day you are about 1/2 inch (1.25 centimeters) shorter than when you got up that morning. If you don't believe it, have someone measure you when you get up in the morning and then again before you go to bed. This isn't because your heavy backpack has weighed you down. It happens because of gravity. As you walk around during the day, gravity is pulling you down, or more correctly, toward the centre of Earth. Lying down to sleep at night gives your spine a chance to stretch back to your full height.
- On Earth, gravity isn't entirely even. Because the globe isn't a perfect sphere, its mass is distributed unevenly, which means slightly uneven gravity.
- One mysterious gravitational anomaly is in the Hudson Bay of Canada. This area has lower gravity than other regions, and a 2007 study found that now-melted glaciers were to blame. The ice that once covered the area during the last Ice Age has long since melted, but the Earth hasn't entirely snapped back from the burden. Since gravity over an area is proportional to the mass on top of that region, and the glacier's imprint pushed aside some of the Earth's mass, gravity is a bit less strong in the ice sheet's imprint. The slight deformation of the crust explains the unusually low gravity in the area. In some places, it's almost half as strong as it is elsewhere!
- Black holes are some of the most destructive objects in the universe, named because nothing, not even light, can escape their gravitational clutches. At the centre of our galaxy is a massive black hole with the mass of 3 million suns. The black hole isn't really a danger to us Earthlings – it's both far away and it's remarkably calm.
- In the very beginning of the universe, after the Big Bang, gravity pulled atoms together to make stars and planets. Once the stars and planets had formed, gravity kept the planets in orbit around the stars, and moons orbiting around the planets. And on each planet that is large enough, gravity keeps an atmosphere around the planet.
- On Earth, gravity keeps the air around us (and everything else) from drifting off into space. Gravity also causes hot air to rise while colder air falls (which in turn causes wind).



THE PLANETS



In the Solar System alone there are seven other planets (RIP, Pluto), many dwarf planets, satellites and moons, and of course, the Sun.
Our solar system is in a galaxy called the Milky Way. In the Milky Way is it estimated that there are approximately 30 billion solar systems. We think that there are 100 billion galaxies in the universe. This means that the universe is much bigger than we can even imagine!

There are eight planets in the Solar System that all orbit the sun. Each of the planets are different: some have moons, some have rings, some are made of rock, and some are made of gas. Read on for fascinating facts about each of the planets starting with the one closest to the sun, moving outwards.

MERCURY
Mercury is the smallest planet and it is closest to the sun. It takes 59 Earth days to rotate once, and 88 Earth days to orbit the sun. This means that there are fewer than two days in one year on Mercury!

VENUS
Venus spins in the opposite direction to all of the other planets in the solar system. Its surface is covered in volcanoes and it has more volcanoes than any other planet in the solar system.

EARTH
Our home planet! Earth is the only planet in our solar system that humans can live on. Did you know that three-quarters of the Earth is covered with water? We have one moon that is very important in controlling the tides of the sea.

MARS
Mars is known as the ‘red planet’ because of its reddish appearance. The tallest mountain in the solar system, Olympus Mons, is on Mars and it is 21km tall.

JUPITER
Jupiter is the largest planet in our solar system and it is so big that you could fit all of the other planets inside it! Jupiter has 62 moons and one of them, Ganymede, is the largest moon in the solar system.

SATURN
Saturn is the second biggest planet in the solar system but it is also the lightest as it is made almost entirely of gas. Saturn is very well known for its rings that circle around it. The rings are made up of chunks of rock and ice.

URANUS
Uranus is the coldest planet in the solar system with a minimum temperature of -224°C. Unlike all of the other planets, Uranus spins on its side!

NEPTUNE
Neptune is the planet that is furthest away from the sun. One year in Neptune is 165 Earth years! The wind on Neptune is the fastest in the solar system and can travel at more than 1,500 miles per hour.

LIGHT

What is light made of?

This is not an easy question. Light has no mass and is not really considered matter. So does it even exist? Of course it does! We couldn't live without light. Today scientists say light is a form of energy made of photons. Light is unique in that it behaves like both a particle and a wave.

Why does light go through some things and not others?

Depending on the type of matter it comes into contact with, light will behave differently. Sometimes light will pass directly through the matter, like with air or water. This type of matter is called transparent. Other objects completely reflect light, like an animal or a book. These objects are called opaque. A third type of object does some of both and tends to scatter the light. These objects are called translucent objects.

Light helps us to survive

Without sunlight our world would be a dead dark place. Sunlight does more than just help us see (which is pretty great, too). Sunlight keeps the Earth warm, so it's not just a frozen ball in outer space. It also is a major component in photosynthesis which is how most of the plant life on Earth grows and gets nutrients. Sunlight is a source of energy as well as a source of vitamin D for humans.

The speed of light

Light moves at the fastest known speed in the universe. Nothing moves faster than (or even close to) the speed of light. In a vacuum, where there is nothing to slow it down, light travels 186,282 miles per second! Wow, that's fast! When light travels through matter, like air or water, it slows down some, but it's still pretty fast.

To give you an idea as to how fast light is, we'll give you some examples. The Sun is almost 93 million miles from the Earth. It takes around 8 minutes for light to get from the Sun to the Earth. It takes around 1.3 seconds for light to go from the moon to the Earth.

Diversity of Life

Cells—The Building Blocks of Life

We are all made of trillions of cells. There are around 2.5 billion cells in one of your hands, but they are tiny. So tiny that we cannot see them. If every cell in your hand was the size of a grain of sand, your hand would be the size of a school bus!
Each cell has its own job, just like humans do. Some cells help us detect light and see, other cells help us touch, some cells help us hear, other cells carry oxygen around, other cells help us digest food by secreting enzymes. There are over 200 cell types in the body - that is 200 different jobs!
But how does each cell know what job to do ? Well how do we (humans) know what job to do? Someone tells us. Our cells are also told what to do, but not by a person or a computer! Our cells are told what to do by a very special molecule called DNA.

Fun Fact
If every cell in your hand was the size of a grain of sand, your hand would be the size of a school bus!

DNA—Life's Instruction Manual

DNA is a record of instructions telling the cell what its job is going to be. A good analogy for DNA as a whole is a set of blueprints for the cell, or computer code telling a PC what to do. It is written in a special alphabet that is only four letters long! Unlike a book or computer screen, DNA isn't flat and boring - it is a beautiful curved ladder. We call this shape a double helix. The letters of the DNA alphabet (called bases) make up the rungs, special sugars and other atoms make up the handrail.
The rungs are very special. Each one has a name, but they prefer to be called by their initials: A, T, C and G They don't like to be by themselves so they always pair up with a friend. But they are very choosy about their friends:

- A and T are best friends and always hang out together
- G and C are best friends and always hang out together

Another way of looking at it is that A, T, G and C are like jigsaw pieces. A and T fit together, C and G fit together. You cannot force a puzzle piece into the wrong place!

Four Letter Alphabet

Think of all the words you can spell. I bet there are loads. But each word is made using the same selection of letters. Yes, sometimes we leave letters out, sometimes we repeat letters, but we always have the same selection of letters. Depending on how we arrange the letters of the alphabet we can make new words. The same is true in the four letter alphabet of DNA.

If you look at a length of DNA, you can read out the letters all in a row:
ATGCGTGGTCAGTCGATATATGGCCCC

These letters make up words that are always three letters long. These are called codons.
ATG CGT GGT CAG TCG ATA TAT GGC CCC

These words make up sentences that the cell understands. These sentences are called genes.
[ATG CGT GGT CAG] [TCG ATA TAT GGC CCC]

Each sentence tells a cell to make a special molecule called a protein. These proteins control everything in a cell. In this way, DNA is like the boss of a company, and not the brain of the cell. It issues instructions, but doesn't do very much of the actual work :) These proteins help each cell do its job. Each gene makes one protein, and only one protein.

Exercise: Just Four Letters?

How can four letters make something as complicated as a human body? Let us take a trip back to my favourite childhood toy—Lego.
Give a child 80 pieces of one color and ask them to build a tower. No matter how they try, they can only make one possible combination of colors.
Now give a child a box of Lego with 20 lots of 4 different colors and ask them to make a tower. The size is still the same, but the combination and order of colors is different each time they build. The possibilities are endless...well not quite, but still quite large.
Remember it is the sequence of letters (order of the colors in this analogy) that stores the information. Each set of 3 letters is a word. With four different letters, there are 64 possible three-letter-words. Imagine how many combinations of these words there are in a sentence just 100 letters long!

DNA Elegantly Simple, Wickedly Complicated

I hope this has shown you that the basics of DNA are simple and straightforward. Whenever you are trying to convey complex ideas to young children, analogies are your friend. Just make sure they know what the analogy means, and they are not just saying "DNA is like Lego" or "cells are like buses."

Scientific Method

What is the Scientific Method?

The scientific method is a way for scientists to study and learn things. It doesn't matter what the scientist is trying to learn, using the scientific method can help them come up with an answer.

The first thing to do with the scientific method is to come up with a question. You can't find the answer until you know the question after all!

Next you need to observe and gather information in order to come up with a guess (called a hypothesis) or a number of guesses to the answer.

Now you run experiments to see if your guess is right. As you run experiments you can change your guess, or hypothesis, to fit your results. A key to good experiments is to only change one thing, or variable, at a time. This way you can check your results and know what you changed that changed the answer.

Finally, after running all the tests you can think of, you present your final answer.

By going through this process, scientists have a way to verify their guesses and to double check each other. Another scientist can take a look at your tests and add some more tests and continue to refine your answer to the question.

Scientific Method Steps

As described above there are steps you take when using the scientific method. Here is an example of the steps:

1 Ask a question
2 Gather information and observe (research)
3 Make a hypothesis (guess the answer)
4 Experiment and test your hypothesis
5 Analyze your test results
6 Present a conclusion

Why is the Scientific Method Important?

The scientific method is the cornerstone to modern science. Without a formal method of determining questions and their answers, we wouldn't have science or the knowledge we have today.

ABOUT

Mark Nizer has been performing and teaching juggling for over 40 years. His passion of both juggling and science has led to a life of learning and invention.

Mark can adapt the amount and focus of each of these components to better suit the ages and students present.

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