



K-8

STUDY GUIDE



INTRODUCTION



Dear Educators,

This study guide is a companion piece to the wacky, off-the-wall, and educational **Fun-Believable Science Show** starring **Professor Wow**. During the show, you and your students will see funny and informative vignettes in the areas of Life Science, Physical Science, Anatomy, Astronomy, and Ecology. Each vignette is packed with audience participation that keeps kids fully engaged and open to learning.

The show is specifically designed to be 100% supportive of core curriculum content and is tailored to the grade levels in attendance. Performances are 60-minutes long and written in two versions: one is appropriate for lower grade levels and the other for upper grade levels.

Regardless of the grade level you teach, this study guide will help you carry the learning experience into the classroom with great activities and ideas. Some pages are appropriate to reproduce for your students; others are designed especially with you, the teacher, in mind. We know every class is unique, so we encourage you to pick and choose the ideas that best meet the needs of your class.

Thank you for sharing this special experience with your students. We sincerely hope you enjoy the **Professor Wow's Fun-Believable Science Show** as much as we enjoy providing a high-quality, fun-filled, educational experience with your class.

See you at the show!

Professor Wow



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"The true sign of intelligence is not knowledge but imagination."

— Albert Einstein



SHOW SYNOPSIS



When Professor Wow unleashes the power and excitement of science, he creates an explosion of learning that K-8 kids can't resist! **Professor Wow's Fun-Believable Science Show** is an amazing show that keeps kids' eyes riveted to the stage and their brains bubbling with fantastic science concepts that are all based on core science principles.

Astonishing feats of science like the fantastic 12-foot tall **Foam Monster**, the impossible **Balloons in Orbit**, and the hysterically funny **Bernoulli TP Challenge** will keep kids talking about science long after the show has ended. It's an excitement that teachers can capitalize on when they return to the classroom!

During the show students will **SEE SCIENCE COME ALIVE** with some fun (and funny!) action on the stage. In the portion of the show that focuses on the **Human Body**, a realistic talking skull stops by to help students learn about the 22 bones in the cranium plus the mandible. In a comical dialog, students will discover human anatomy terms like sutures and sinus and why teeth are not bones. They'll also learn why the vertebrae are hollow and how the spine protects the fragile spinal cord. In another vignette about **Physical Science and Astronomy**, a 12 lb. bowling ball appears in an empty paper bag and then floats high into the air to help Professor Wow demonstrate the concept of gravitational interaction and why objects weigh more when they are on Jupiter than when they are on Earth. Then, when Professor Wow talks about **Life Science**, he grabs kids from the audience who like to eat living things and a giant living food chain is created on stage to provide a lasting impression—everything in a community is connected by food!

...and that's just a little bit of what kids will see when they attend **Professor Wow's Fun-Believable Science Show**. This totally awesome show is a whole new way for kids (and their families!) to discover science and excite their curiosity about the wonder-filled world we live in.

Science principles covered in the show include:

- Exothermic Reactions
- Bernoulli's Principle
- Kinetic Energy
- Chemical Bonds
- Human Body
- Ecosystems
- Classification
- Physical Science
- Life Science
- Astronomy





BERNOULLI'S PRINCIPLE states that the faster a fluid (or air) flows, the less pressure it exerts. An increase in the speed of moving air or flowing fluid is accompanied by a decrease in the pressure. One of the most dramatic everyday examples of Bernoulli's principle can be found in the airplane, which stays aloft due to the pressure differences on the surface of its wing.

Professor Wow creates a seemingly impossible suspension of balloons 15 feet into the air assisted only by the magic of air pressure.



FUN FACT:

"LIFT" is the magic that makes birds fly.

A MOLECULE is made up of a group of tiny atoms. A **chemical reaction** is when the molecules of one substance break apart and join together with those of another substance to create a different **compound**.

An **exothermic** reaction is a chemical reaction that releases energy in the form of heat. The opposite is **endothermic** which describes a reaction that absorbs energy in the form of heat.

Sometimes a third substance is used in a chemical reaction to speed up or slow down the reaction. A **catalyst** helps to speed up the rate of reaction. An **inhibitor** is used to slow down the reaction.

TRY THIS FUN TRICK!

Take a hair dryer and aim it so the air flow is pointed directly up. Place a ping pong ball in the airstream. It will appear to levitate. Carefully tilt the hairdryer from side to side - the ball will still stay in the airstream.

HOW DOES IT WORK?

The upward pressure from the hairdryer balances the downward force of gravity, keeping the ball "levitating." The stream of air sticks to the surface of the ball. This is a demonstration of the **Coanda Effect**, which occurs when fluids like air or water pass over curved surfaces. When the ball approaches the edge of the stream, air is curved around the ball and directed out of the stream. This has the effect of pushing the ball back into the stream. This is the process that enables the ball to balance inside the airstream and stay there as the hairdryer is moved around.





FOUR FORCES AFFECT THINGS THAT FLY:

Weight is the force of gravity. It acts in a downward direction—toward the center of the Earth.

Lift is the force that acts at a right angle to the direction of motion through the air. Lift is created by differences in air pressure.

Thrust is the force that propels a flying machine in the direction of motion. Engines produce thrust.

Drag is the force that acts opposite to the direction of motion. Drag is caused by friction and differences in air pressure.

ALL FOUR FORCES ACT ON AN AIRPLANE:

When an airplane is flying straight and level at a constant speed, the lift it produces balances its weight, and the thrust it produces balances its drag. However, this balance of forces changes as the airplane rises and descends, as it speeds up and slows down, and as it turns.

ONLY TWO FORCES AFFECT A SPACECRAFT IN SPACE:

A spacecraft has weight, even in orbit, and uses thrust to reach space and to maneuver. But lift and drag—both created by movement through air—are absent in the near vacuum of space.

DID YOU KNOW?

An airplane in flight is always in the middle of a tug-of-war with the four forces. For an airplane to takeoff, thrust must be greater than drag and lift must be greater than weight. To maintain level flight, lift must equal weight and thrust must equal drag. For landing, thrust must be less than drag, and lift must be less than weight.





Our **Sun** is only a single star among billions of stars that make up the galaxy we live in, which is called the **Milky Way**. Stars are huge balls of exploding gas made up of **hydrogen** and **helium**. The gases are held together by gravity.

Earth is one of the 8 planets that travel around the Sun. Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, their moons, and the other bodies in space whose movements are controlled by the Sun's gravity belong to our **Solar System**.

Gravity is a force between bits of matter, attracting every bit to every other bit. The Sun's gravity pulls on Earth and the other planets and keeps them in their orbits around the Sun. The Moon has less gravity than the Earth, so you would weigh 1/6 of what you weigh on Earth.

The **Moon** is one of the best studied objects in the **Solar System**. On July 20, 1969, **Neil Armstrong** became the first person to set foot on the Moon. As he stepped from his spacecraft onto the Moon's surface, he said, "That's one small step for a man, one giant leap for mankind". Armstrong brought back rocks from the Moon's surface.

The Moon **orbits** the Earth. It is a **satellite** of Earth. A satellite is any heavenly body that orbits another. All the Solar System planets except Mercury and Venus have moons.

Earth is the only planet in our solar system known to support life because of our atmosphere, temperature and water which makes it suitable for life. **Mercury** is the nearest planet to the Sun. Its surface gets over 800°F, hot enough to melt lead. **Venus** is called the Evening Star because it can be seen from Earth in the evening, just after sunset. **Mars** is called the red planet because of its rusty red color that comes from oxidized (rusted) iron in its soil. **Jupiter** is the biggest and has a very strong magnetic field, you would weigh two and a half times as much as you would on Earth. The **Great Red Spot** is a huge storm on Jupiter. **Saturn's** beautiful rings are made up of ice, dust and rock which orbit the planet around its equator. **Uranus** spins on its side. It is often described as "rolling around the Sun on its side." **Neptune** has the strongest winds in the Solar System. Storms have been spotted swirling around its surface with freezing winds that blow about ten times faster than hurricanes on Earth. In 2006, **Pluto** was reclassified as a dwarf planet because it hasn't "cleared the neighborhood" around its orbit, which means it has not become gravitationally dominant and it shares its orbital space with other bodies of a similar size.

FUN FACT:

Atoms are the building blocks of the Universe and are so small that you could fit a billion on the period at the end of this sentence.





CLASSIFICATION is a method used to group and categorize organisms that are alike in important ways. There are seven main ranks: **KINGDOM, PHYLUM, CLASS, ORDER, FAMILY, GENUS, SPECIES.**

VERTEBRATES There are many different animal classes and every animal in the world belongs to one of them. There are 5 classes of vertebrates (animals with backbones): **MAMMALS, BIRDS, FISH, REPTILES** and **AMPHIBIANS.** They are all part of the phylum chordata. Vertebrates tend to be much more intelligent than invertebrates.



ECTOTHERMIC (cold blooded) is an animal that warms itself primarily by obtaining heat from the environment. Reptiles use the sun to warm up their bodies and speed up their blood. Amphibians and fish are also cold blooded.

ENDOTHERMIC (warm blooded) is an animal that produces most of its own heat metabolically. Humans, like many mammals and birds produce their own heat through the metabolic breakdown of food.



SKELETON is a structure that provides a rigid support for the body.

ENDOSKELETON means your skeleton is on the inside like the a bear or a man.

EXOSKELETON means that the "framework" of the creature is on the outside. All arthropods such as insects, spiders, lobsters, and centipeds have exoskeletons.



INVERTEBRATES are animals without backbones. They are part of the phylum arthropoda (arthropods). Two of the most commonly known classes in this phylum are arachnids (spiders) and insects. Invertebrates account for 97 percent of all known species.

CEPHALOPOD is in the class of mollusks where scientists classify octopuses and squid. They are the largest invertebrates on earth and considered the most intelligent of all invertebrates.

FUN FACT: Birds have something no other animal has – *feathers!*





ECOLOGY

ECOLOGY is the study of living things in their natural surroundings. And their surroundings are called their **environment**. Ecology is about seeing the whole picture as well as the pieces. By studying an animal's environment, scientists can begin to understand why the animal behaves in a particular way.

An **ecosystem** is a community of plants, animals and smaller organisms that live, feed, reproduce and interact in the same area or environment.

The living things in a community are linked through their food. For example, a snake, a mouse and a plant are linked because the mouse eats the plant and the snake then eats the mouse. These links are called **food chains**.

Each member in the food chain feeds on, and obtains energy from, the previous level. In this way, energy is transferred from level to level. When living things die, their bodies **decompose** (break down) and release nutrients into the ground, and the process begins all over again. Food chains follow a single path as animals eat each other. Food webs show how plants and animals are interconnected by different paths.

Animals and plants get the energy they need from their food. Plants use the Sun's energy to make their own food. When plants make their own food the process is called **photosynthesis**. They are called **producers**.

Animals cannot make their own food, so they have to eat plants or other animals. They are called **consumers**. Animals often eat more than one kind of food, so they are part of a number of food chains.

Herbivores are animals which only eat plant material. This means leaves, flowers, fruits or even wood. Horses, cattle, deer, pandas and elephants are all herbivores.

Omnivores eat both plants and meat. Bears, chickens, raccoons, skunks, and humans are a prime example of omnivores.

Carnivores eat meat. A carnivore is a **predator** because it has to find and catch its **prey**. Hawks, eagles, lions, and tigers are carnivores and fierce predators in the animals kingdom.

Many animal species are in danger of becoming extinct, either because of hunting or because their habitat is threatened.

FOOD CHAIN

WHAT AM I?





HUMAN BODY



Your **skeleton**, from head to toe, no matter how big or small you are, is made up of 206 bones. The biggest bone in your body is the thighbone, also called the **femur**. The **spinal cord** is the main pathway for information connecting the brain and **nervous system**. The human spinal cord is protected by a hollow spinal column made up of bones called **vertebrae**.

Cartilage covers the ends of bones in joints, and forms part of the skeletal system itself in the ear and nose, and between the **sternum** (breastbone) and ribs.

The **ball and socket joint** is what allows us to move our leg in many directions in relation to the body.



The skull forms the basic shape of the head and protects the brain. It consists of 22 bones. Eight cranial bones make up the **cranium**, which supports and protects the brain. There are 14 facial bones that form the structure of the face. All but the **mandible** (lower jawbone) are linked by fixed joints called **sutures**. The mandible is able to move freely, allowing the mouth to open and close. The skull also houses the **ossicles**, or ear bones.



Your outer ear channels sound waves into the eardrum, making it vibrate. Next, those vibrations travel through three bones deep inside the ear. They're called the **hammer**, **anvil** and **stirrup**. These are the tiniest bones in our body. The brain sorts the signals into sounds that you hear.

Fixed Joints are locked together and cannot move. These are found in your skull between the bones that protect your brain. When the skull first forms, its bones are separate. They gradually grow together, forming wiggly lines called **suture lines**.

X rays are electromagnetic radiation that differentially penetrates structures within the body and creates images of these structures on photographic film.



FUN FACT:

If the human eye were a digital camera it would have 576 megapixels.



PHYSICAL SCIENCE

Molecule – a group of tiny atoms.

Chemical Reactions – occurs when two or more molecules interact and the molecules change.

Compound – a substance formed when two or more chemical elements are chemically bonded together.

Exothermic Reaction – a chemical reaction that releases energy in the form of heat.

Endothermic Reaction – a reaction that absorbs energy in the form of heat.

Catalyst – helps to speed up the rate of reaction.

Inhibitor – used to slow down the reaction.

Coanda Effect – occurs when fluids like air or water pass over curved surfaces.

Centrifugal Force – the outward force on a body moving in a curved path around another body.

Centripetal Force – the inward force on a body moving in a curved path around another body.

Trajectory – the curved path something takes as it moves through space.

Thrust – the act of applying force to propel something.

Velocity – the rate of change of position along a straight line with respect to time.

ASTRONOMY

Astronomy – the study of the Universe and the changes that take place in and around all objects moving through space.

Galaxy – a large group of stars, dust, gas and dark matter held together by gravity.

Solar System – includes the Sun and all the objects that orbit around it due to its gravity, including Earth.

Milky Way – the Galaxy in which we live.

Star – a huge, bright ball of burning gas that is held together by gravity.

Sun – a typical star that is the source of light and heat for the planets in the solar system.

Gravity – what keeps you on the ground and what causes objects to fall. Gravity is what holds the planets in orbit around the Sun and what keeps the Moon in orbit around Earth.

Orbit – to follow a circular or elliptical path around a central body.

Moon – a natural satellite which orbits a planet.

Satellite – a moon, planet or machine that orbits a planet or star.

Dwarf planet – an object orbiting the Sun that is large enough to be rounded by its own gravity, but is not gravitationally dominant in its orbital area and is not a moon.



Life SCIENCE

Classification – a method used to group and categorize organisms that are alike in important ways.

Vertebrates – animals with backbones.

Invertebrates – animals without backbones.

Endoskeleton – the skeleton is on the inside like a bear or a man.

Exoskeleton – means that the "framework" of the creature is on the outside.

Ectothermic – an animal that warms itself primarily by obtaining heat from the environment.

Endothermic – an animal that produces most of its own heat metabolically.

Metamorphosis – a change into something new, or the process of an insect or amphibian maturing into adult form.

ECOLOGY

Ecology – is the study of living things in their natural surroundings.

Ecosystem – is a community of plants, animals and smaller organisms that live, feed, reproduce and interact in the same environment.

Environment – everything in the world around us which can affect our lives.

Consumers – an animal that cannot make its own food, so it eats plants and/or animals.

Producer – an organism that produces its own food.

Photosynthesis – the process by which plants make their own food.

Food Chain – follows a single path as animals eat each other.

Food Web – shows how plants and animals are interconnected by different paths.

Herbivore – animals that only eat plant material.

Carnivore – an animal that gets food from killing and eating other animals.

Omnivore – a kind of animal that eats either other animals or plants.

Predator – a person or an animal that hunts a smaller weaker person or animal.

Prey – animal hunted or caught for food.

Decomposer – an organism, (bacterium or fungus), that breaks down the cells of dead plants and animals into simple substances.



HUMAN BODY

Skeleton – a structure that provides a rigid support for the body.

Femur – the thighbone and the biggest bone in our bodies.

Sternum – the breast bone, located in the center of the chest and connects with the ribs to form a protective "cage" around the chest.

Cranium – the skull of a vertebrate.

Mandible – lower part of the skull called the jawbone.

Ball-and-Socket Joints – a joint in which a ball moves within a socket so as to allow rotary motion in every direction within certain limits.

Fixed Joints – a type of joint that is locked together and cannot move.

Sutures – a type of joint between the bones of the skull where the bones are held tightly together by fibrous tissue.

Cartilage – a strong, flexible type of connective tissue found within a body.

Ossicles – the three tiny bones in the middle ear; hammer, anvil and stirrup.

Eyeball – the organ of sight in vertebrates.

Nervous System – the highway along which your brain sends and receives information about what is happening in and around the body.

Spinal Cord – the main pathway for information, connects the brain and nervous system.

TYPES OF SCIENTISTS

Astronomer – studies the planets, stars, and galaxies.

Botanist – studies plant life.

Chemist – studies chemistry and the behavior, properties, and composition of matter.

Ecologist – studies the relationship between living organisms and the environment.

Microbiologist – studies microscopic life forms such as bacteria and protists.

Meteorologist – studies the Earth's atmosphere including the weather.

Physiologist – studies the nature of living organisms.

Zoologist – studies animals.

"Science is a way of thinking much more than it is a body of knowledge."

James Burke



ABOUT



Coollest Kids Science Projects: 40 Fun & Easy Science Experiments for Kids

by Bill Evans

Published 2014 by DK

TIME for Kids Super Science Kit: Step-by-Step

by Editors of TIME for Kids Magazine

Published 2012 by TIME for Kids Magazine

Naked Eggs and Flying Potatoes

by Steve Spangler

Published 2010 by Greenleaf Book Group Press

Myth Busters Science Fair Book

by Samantha Margles

Published 2011 by Scholastic, Inc.

TIME for Kids Super Science Book

by Editors of TIME for Kids Magazine

Published 2009 by TIME for Kids Magazine

365 Simple Science Experiments

by E. Richard Churchill, Louis V. Loeschig

Published 2014 by Black Dog & Leventhal Publishers, Inc.

Big Book of Science Experiments: Step-by-Step

by TIME for Kids Magazine

Published 2011 by TIME for Kids Magazine

The Everything Kids Science Experiments Book

by Tom Robinson

Published 2014 by Adams Media Corporation

GREAT WEBSITES FOR KIDS:

<http://gws.ala.org/category/sciences>

kidsites.com

tryscience.org

howstuffworks.com

scitoys.com

billnye.com

tryscience.org

National Geographic Animal Encyclopedia

by Dr. Lucy Spelman

Published 2012 National Geographic

5,000 Awesome Facts (About Everything)

by National Geographic

Published 2009 by National Geographic

Girls Think of Everything: Stories of Ingenious

by Catherine Thimmesh & Melissa Sweet

Published 2002 by Houghton Mifflin Company Boston

Big Book of Why

by Richard Freinman

Published 2010 by TIME for Kids Magazine

National Geographic for Kids: Space Encyclopedia

by David A. Aguilar

Published 2013 by National Geographic

101 Great Science Experiments

by Neil Ardley

Published 2014 by DK

