Eighth Grade Science

Overview for Parents

Teacher: Peter Faletra

This year you will have a chance to learn what science is and how scientists go about their work. Most of what we will learn is the concepts of science and how scientists use deductive and inductive reasoning to come to sound logical conclusions. Concepts have more to do with how and why rather than what something is. Rather than simply learning the laws of nature we will explore how these laws were uncovered through imaginative experiments and enormous intellectual efforts.

Grades are based on:

Quizzes & notes	**25%**	
Exams	**25%**	**(about 1/month)**
Experimental reports	**25%**	**(about 2/month)**
Lab Practicals	**25%**	**(about 2/month)**

There are limited chances for extra credit

Notes (the Cornell Method):

You are required to bring your lined spiral-bound notebook to class every day. Your notes will be done in what is sometimes called the Cornell Method. You will be given detailed instructions in class on this method of taking and using notes.

Any notes taken in class will be written on the right-facing page. The same night of the day you take your notes, you should copy your notes to the opposite side of the same page (the left-facing page). When you copy over your notes you should use books, internet, or any reliable science resource to add information to your notes to make sure you thoroughly understand what you are copying. This method of note-taking has been shown to be a very dependable approach to remembering and understanding science (and non-science) information. Your notes will be checked periodically and along with quizzes account for 25% of your grade. YOUR NOTEBOOK IS POSSIBLY THE MOST IMPORTANT THING IN THIS CLASS…DO NOT LOSE IT!

Experiments & Experimental Reports:

Experimental reports will follow a standard format that will be explained to you in detail in class. The experimental report is composed of 4 main sections: 1) Introduction, 2) Materials And Methods, 3) Results, and 4) Discussion

Experimental reports account for 25% of your grade. The grade you receive has little to do with the outcome of your experiment. Many experiments yield uncertain results. Your grade will depend mostly on how you adhere to sound scientific reasoning and the format of standard scientific report. Some of the grade will derive from your skill and proper use of the lab equipment and working safely in the lab. This is probably the hardest part of science and will be your biggest challenge. It will require you to be logical, meticulous in your record keeping, and highly critical of your own work. Some portion of the experimental reports will be done at home.

We will be doing many short experiments and 1 long-term investigation. The short experiments are intended for you to understand certain scientific concepts and become accustomed to how scientists think and act in a laboratory setting. The long-term experiment is a long-term investigation made of numerous experiments of your design. The long-term investigation is intended to allow you to do authentic science. It could take up to 4 years (assuming you began in the 5th grade). You will work in groups of about 4 students and take some time to choose and design a long-term investigation. I hope that some of you will succeed in publishing your long-term investigation.

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Exams

You will have about 1 exam per month. Some of the exam questions will be multiple choice, and some will be short explanations where you can use a variety of ways on paper to get your point across, such as words, tables and drawings. Some exams will be oral. In this case, I will read questions to the class.

Practicals

A lab practical allows you to use your skill at doing science. Practical exams often ask you to observe something and interpret what is going on or identify something. Sometimes it will require you to actually perform a technique.

MAJOR CONCEPTS

Scientific Reasoning

Concept: Science operates on a set of logical intellectual processes with an ordered and systematic approach. Scientists collect data and make inferences on that data, by inductive logic. They form conclusions on groups of data by deductive reasoning. They then analyze the data with statistical tests of significance.

Concept: Cause and effect An effect being associated with a cause. The caveat being correlation is not causation.

Concept: Naïve reality What our senses tell us can be an illusion in that it will not be corroborated by other evidence. The Moon's apparent larger size on the horizon, the flash of lightening before the sound, the "seeing" of stars as if they exist.

Concept: Complex systems evolve. Species, environments, planets, solar systems, galaxies and the universe are all evolving

Concept: Science operates on a set of logical intellectual processes with an ordered and systematic approach. Experimentation is the most common approach in modern science to verify whether either an hypothesis or a theory is supported by the facts. Facts are simply those things that make statements true. Verification of a theory is usually from multiple perspectives…global warming is supported by, changes in CO2 levels in the atmosphere, deep ice cores, cave mud, coral deposits, and other geological evidence.

Concept: Scientific knowledge Evolves. Scientific knowledge is subject to change. Theories can only be proven false and cannot be proven true.

The Physical Universe

Concept: The laws of nature apply everywhere. The laws of physics apply to everything we do…large school systems are harder to change than small school systems…first law of motion…INERTIA

Concept: Nature can be looked upon as made of two worlds: the atomic/subatomic, and the macro-larger-than-atomic. The larger world operates under different parameters than the atomic world. The subatomic world operates under radically different paradigms than the macroscopic world.

Concept: The atomic universe is non-deterministic, non-local and digital.

CONTENT

EXPERIMENTATION:
Design and execution of a long-term experiment (groups of 2-4)
Reading of scientific papers
Writing a scientific research report based on original research
Scientific statistics

GENERAL SCIENCE
Basic Logic reasoning both inductive and deductive
Scientific instrumentation

ASTRONOMY
Observational astronomy of the day and night sky
Coordinate systems
Apparent versus real images: The Moon illusion in size (naive reality)
Basic laws of astronomy: Kepler's laws; Wein's Law, Hubble's law, red shift
Application of laws of motion, gravity and the four fundamental force to the solar system, stellar development and galactic evolution
Stellar evolution and the main sequence
Stellar fusion: proton-proton chain and the emission of light after fusion in stellar cores
Birth of heavy elements in stars
Application of laws of motion, gravity and the four fundamental force to the solar system, stellar development and galactic evolution
Basic cosmology

PHYSICS
Details of the four fundamental forces of the universe: gravity; electromagnetism; the strong force and the weak force
Elementary particle physics: The Standard Model Of Particle Physics
How elements are created in the universe: from radioactive decay and particle accelerators to stars
Great experiments and instruments used in the discovery of atomic particles
Newtonian mechanics
Density And Buoyancy
Work and simple machines
Energy: Forms of energy generation now and future. Humans and their environment sustainable technologies and scientific practices
Food chemistry and cellular respiration
Power: Mechanical power and "power" of life forms
Electromagnetism And Electricity
Sound & Waves & Light
Mechanics and solar cars

SCIENCE BIOGRAPHIES
Henrietta Leavitt
Annie Jump Cannon
Georges Lemaitre
Nikola Tesla
Enrico Fermi
Emily Noether
Paul Dirac
Edwin Hubbell
Maxwell
Albert Einstein
Wolfgang Pauli
E. Rutherford
J. J. Thompson
Al Ghiorso
Glenn Seaborg
Alan Guth
The carbon atom

BENCHMARKS

By the end of the school year the students will be able to:

- employ deductive and inductive reasoning and recognize fallacies of induction and deduction
- apply statistical analyses to data and present data in graphic form
- read scientific papers with some assistance and understand the important findings
- design and execute an original experiment
- organize and present data in graphic or table forms
- connect conclusions with data when arguing scientifically whether it be verbally or in writing
- identify key asterisms, stars and constellations
- recognize the phases of the Moon and how they progress
- recognize and describe the major celestial bodies
- interpret apparent and real motions
- describe general theories of how the universe was born and expanded, providing experimental or observational evidence to support those theories
- show proficiency in celestial measurement systems
- express the relative size and scale of celestial objects in our universe
- utilize the coordinates of the celestial sphere to describe the motions of celestial objects
- use a gnomon to generate a shadow plot, and determine local noon
- solve problems using Kepler's laws,
- interpret an H-R diagram
- express how stars evolve and diagram the proton-proton chain
- explain Hubble's law
- demonstrate the relationships among the 4 fundamental forces and what they govern
- describe the subatomic structure of atoms and identify general classes of particles according to the Standard Model
- express what radioactivity is, why it happens and what happens in the decay of various isotopes
- recognize and describe when and how matter and energy interact
- solve simple problems of density, buoyancy, work, and simple machines
- solve simple problems using the laws of motion
- identify the properties of waves and their behavior
- recognize and express the behavior of sound in different media
- solve simple problems involving sound transmission
- identify different forms of energy generation and their sustainability
- analyze sustainable human practices
- recognize and express the behavior of light in different media
- solve problems involving light transmission, refractive index, and simple optics
- illustrate and explain the basic mechanisms and sequences in intermediary metabolism
- apply laws of physics and chemistry to explain how life forms generate and utilize food
- apply the laws of physics to construct a model solar car
- measure and analyze the acceleration and power of a model solar car