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Content Standards indicate what students should know, understand and be able to do in a specific content area.

Benchmarks define our expectations for students= knowledge, skills, and abilities along a developmental continuum in each content area. That continuum is focused at three points - the end of grade 4, the end of grade 8, and the end of grade 12.

MONTANA STANDARDS FOR SCIENCE

Content Standard 1BStudents design, conduct, evaluate and communicate scientific investigations.

Content Standard 2BStudents demonstrate knowledge of properties, forms changes and interactions of physical and chemical systems.

Content Standard 3BStudents demonstrate knowledge of characteristics, structures and junction of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Content Standard 4BStudents demonstrate knowledge of the composition, structures, processes and interactions of Earth=s systems and other objects in space.

Content Standard 5BStudents understand how scientific knowledge and technological developments impact society.

Content Standard 6BStudents understand historical developments in science and technology.

KEY FOR SCIENCE CURRICULUM

C.S. = Content Standard
I = Introduce
D = Develop
M = Master

Kindergarten

Content Standard 1-A student must be able to design, conduct, evaluate, and communicate scientific investigations.

a. Witness experiments and are introduced to the concept of variables. I
b. Expose students to cause and effect relationships and communicate observations with class discussions and graphs. I
c. Use simple tools such as rulers, magnifiers,blances and other non-standard units
d. estimate, measure and compare using standard and non-standard units

Content Standard 2- A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

a. group common objects according to their observed characteristics. I
b. compare two or more concrete objects using terms as length, width, size, weight, float and sink. I
c. observe that forms of objects can be changed. I

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

a. Recognize multiple attributes of living things. I
b. Will be introduced to attributes of living things based upon similarities and differences. I
c. Will be exposed to animal and plant interactions in a variety of biomes. I
d. Exposed to nutritional needs of the human body. I
e. Observe cause and effect relationships. I

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

a. Will explore the effect of the earth's rotation around the sun and identify various objects in the sky. I
b. Classify physical properties of Earth's basic materials: soil,water,air I
c. Observe and describe local weather and seasons. I

Content Standard 5-A student must be able to understand how scientific knowledge and technology developments impact society.

d. exposed to the benefit of scientific knowledge and technological developments, and their impact upon their lives. I
e. Recognize ways to conserve energy and natural resources. I

Content Standard 6-A student must be able to understand historical developments in science and technology.

a. Recognize that changes have taken place as a result of new technology. I

First Grade

Content Standard 1-A student must be able to design, conduct, evaluate and communicate scientific investigations.

a. Witness and conduct simple experiments and are exposed to variables. ie iceberg floats, tidal waves D
b. expose students to cause and effect relationships and communicate observations orally ie heat/melt, dry/freeze, hibernation/adaptation D

c. Identify and select appropriate devices for measurement of solids and liquids. D

Content Standard 2-A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

a. compare and describe two or more concrete objects using terms as length, width, size or weight. D
b. observe and describe that forms of objects can be changed. D

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and functions of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

a. recognize multiple attributes of living things. D
b. classify living things based upon similarities and differences. D
c. will be exposed to animal and plant interactions in a variety of biomes. D

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

d. will explore the effects of the earth's rotation around the sun on various biomes (i.e. polar regions, rain forest, deserts, etc.) I
e. Observe and describe local weather and systems. D
f. Classify physical properties of Earth's materials: air, water, soil

Content Standard 5-A students must be able to understand how scientific knowledge and technological developments impact society.

f. exposed to the benefit of scientific knowledge and technological developments, and their impact upon their lives. D
g. Recognize ways to conserve energy and natural resources. D

Content Standard 6-A student must be able to understand historical developments in science technology.

a. Recognize that changes have taken place as a result of new technology. I

Second Grade

Content Standard 1-A student must be able to design, conduct, evaluate and communicate scientific investigations.

a. conduct simple experiments and control the variable (observe and describe needs of plants by experimenting with environmental stimulus: climate, light , water, soil. Describe, measure, observe, compare motion of animals and objects, floaters verses sinkers) I

b. expose cause and effect relationships (observe, describe sound energy as it's caused by vibration motion. Describe ways some living things interact with non-living resources in their environment to meet their needs: swamp plants and animals as opposed to desert) D

c. communicate observations of scientific investigation (explain animal adaptation, hibernation, migration: snowshoe, Arctic tern, caribou, monarch) D

d. construct models that illustrate simple concepts.(Observe plant growth in a variety of biomes. Develop a model of Tertiary period including land water, plants and animals. D

e. Compare methods of capillary action using models of butterflies and plants. Observe and compare a micro environment for a tadpole, meal worm, and chick from its incubation period) I

Content Standard 2-A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

a. select appropriate devices for measurement of solids, liquids, time, and recognize physical changes.(Demonstrate use of non-standard, standard and metric systems for weight, liquid, length, time, and temperature: cup, pint, quart, half-gallon, milliliter, Liter , graduated cylinder, degrees F C, time increments of five minutes, quarter hour, half hour and hour to twenty-four hours using face and digital clocks. I
b. sort and classify objects. (Sort based on specific criteria: weight, height, length, plane/solid, locomotion, living/non-living, woodland/desert plant) D

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

c. recognize multiple attributes of living things and tangible objects.(recognize parts of green plants and explain function of root, stem, leaves, recognize animal body structures and their unique adaptation to environment. Classify objects from environment as living, once living, non-living. Compare life cycles of frog, butterfly, meal worm, fruit fly, and chick) D
d. classify living and non-living based upon similarities and differences.(define and illustrate the attributes of five classes of vertebrates) I
e. will engage in discussions and listen to various disciplines that inform students about the interaction between living and non-living things. (observe and compare life cycles of animals which go through complete metamorphosis, water cycle, rock cycles, and cycle of seasons. Describe what living things need to survive) I
f. Exposed to nutritional needs of the human body.(analyze the food pyramid. Practice constructing nutritional meals for eight year old boys and girls. Recognize characteristics of teeth which make them suitable for chewing verses shredding. Recognize and model the circulatory system.) D
g. Observe cause and effect relationships. D (see 1b)

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

a. demonstrate knowledge of the interactions between man, weather, plant and animal life in the physical world. (Identify cause of seasons and changes they bring. observe that the appearance of the moon changes and conclude that the changes repeat every twenty eight days. Use a globe to model changes that cause sunrise, sunset. Describe orbital patterns and changes from year to year) I
b. determine how man affects environmental factors. (Observe and classify heat as produced by rubbing, absorbing light energy and burning. Classify objects according to how light energy passes through tem. Describe properties of solid, liquid and gas. Identify natural resources and how they can be used to make heat or be conserved. Observe what happens when you put two kinds of matter in the same space. Recognize environmental changes by natural verses human sources.

c. Observe evaporation, wind, changes in liquid, temperature, and collect and record data on each)I

Content Standard 5-A student must be able to understand how scientific knowledge and technological developments impact society.

a. exposed through various media to the benefit of scientific knowledge and technological developments and their impact upon society. (illustrate, describe, and distinguish helpful verses harmful activities and substances and recognize conventional methods to prevent injury and sickness.)D

Content Standard 6-A student must be able to understand historical developments in science and technology.

b. observe, examine, describe, and record information about changes that have taken place over time as a result of technological enhancement. (View models of virus and bacteria under a microscope and discuss use of this information in germ study. Study and model scientific behavior by digging up and constructing fossilized remains and recognize the retrieval of this information and its historical significance to understanding prehistoric plant and animal relationships.) I

Third Grade

Content Standard 1-A student must be able to design, conduct, evaluate, and communicate scientific investigations.

a. conduct scientific investigations and control the variable. D
c. select and use appropriate tools for basic scientific investigation. D
d. communicate and display supporting evidence of scientific investigations. I
e. describe relationships among parts of a familiar system and identify and record changes and patterns of changes in the systems. I
f. construct models that illustrate simple concepts. D

Content Standard 2-A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

a. examine and classify tangible objects in terms of common physical properties. D
b. create mixtures and identify the different properties. D
c. Identify that matter exists as solids, liquids, and gases and can change from one form to another. D
d. Identify, build, and describe mechanical systems (e.g. simple and complex machines. D
e. Identify and predict what changes and what remains unchanged when matter experiences an external influence. D

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

f. identify that plants and animals have structures and systems. D
g. identify basic requirements of energy needed and nutritional needs for the human body. D
h. discuss the life cycles of different plants and animals. D

i. introduce cause and effect relationships in living systems and nonliving components within ecosystems. I

j. Discuss and use a classification system to group a variety of plants and animals according to their similarities and differences. D

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

k. describe earth's changing features. D

l. describe the physical properties of earth's basic materials (e.g., soil, rocks, water, gases). D

m. investigate fossils and make inferences about life and the environment long ago.D

n. observe and describe local weather and demonstrate how weather conditions are measured. D

o. identify seasons and explain the difference between weather and climate. D

p. Describe objects in the sky and explain that light and heat comes from a star called the sun. D

Content Standard 5-A student must be able to understand how scientific knowledge and technological developments impact society.

q. discuss how people use science and technology. I

r. model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings. D

s. use current scientific knowledge to make inferences and propose solutions for local environmental problems. (recycling, waste management). D

t. Identify a scientific or technological innovation that benefits the community. D

Content Standard 6-A student must be able to understand historical developments in science and technology.

a. discuss historical examples of scientific and technological contributions to society. D

b. discuss how scientific inquiry has produced much knowledge about the world. D

Fourth Grade

Content Standard 1-A student must be able to design, conduct, evaluate and communicate scientific investigations.

a. plan, design, and safely conduct a scientific investigation with identified variables when given a testable question. I

b. select appropriate tools to measure in common SI units for mass, volume and length. I

c. Represent, communicate, and provide supporting evidence of scientific investigations. D

d. Describe relationships among parts of a familiar system and identify and record changes and patterns of changes in the system. D

e. Construct models that illustrate simple concepts and compare those models to what they represent. I

f. Communicate results from a controlled experiment that are reproducible. I

g. communicate results of investigations, and question results of investigations if different from predicted. I

Content Standard 2-A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

h. Examine, describe, compare, and classify tangible objects in terms of common physical properties. D

i. Create mixtures and separate them based on different properties (e.g. salt and sand, iron fillings and soil, oil and water). ID

j. Model and explain that matter exists as solids, liquids, and gases and can change from one form to another. D

k. Identify and predict what changes and what remains unchanged when matter experiences an external influence. D

l. Identify, build, and describe mechanical systems (e.g. simple and complex machines). D

m. Describe the basic characteristics of light, heat, magnetism, and sound. ID

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

a. Identify that plants and animals have structures and systems, which serve different functions. M
b. Identify and describe basic requirements of energy needed and nutritional needs for each human body system. D
c. Develop models that trace the life cycles of different plants and animals and discuss how they differ from species to species. D
d. Explain cause and effect relationships in living systems and nonliving components within ecosystems. D
e. Discuss and use a classification system to group a variety of plants and animals according to their similarities and differences. D

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

a. Describe and give examples of earth's changing features. D
b. Describe the physical properties of earth's basic materials. (e.g., soil, rocks, water, gases). D
c. Investigate fossils and make references about life and the environment long ago. D
d. Observe and describe local weather and demonstrate how weather conditions are measured. D
e. Identify seasons and explain the difference between weather and climate. D
f. Describe objects in the sky and explain that light and heat comes from a star called the sun. D

Content Standard 5-A student must be able to understand how scientific knowledge and technological developments impact society.

g. give examples of how people use science and technology. D
h. model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings. D

i. use current scientific knowledge to make inferences and propose solutions for local environmental problems (recycling, waste management). D
j. identify a scientific or technological innovation that benefits the community. D

Content Standard 6-A student must be able to understand historical developments in science and technology.

k. give historical examples of scientific and technological contributions to society. D
l. describe how scientific inquiry has produced much knowledge about the world. D

Fifth Grade

Content Standard 1-A student must be able to design, conduct, evaluate and communicate scientific investigations.

a. identify a question, formulate a hypothesis, devise and safely conduct experiments, predict outcomes, and compare and analyze results. I
b. select and accurately use appropriate tools to measure (in SI units) process, and analyze results of a basic scientific investigation. D
c. communicate results of investigations, and question results of investigations if different from predicted. D
d. describe and discuss relationships among parts of a familiar system and identify and record changes and patterns of changes in the systems. D
e. Construct models that illustrate simple concepts and compare those models to what they represent. D
f. Identify the difference between controlled and uncontrolled experiments. I

Content Standard 2-A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

g. examine and describe objects and substances based on common physical properties and simple chemical properties. I
h. classify, describe, and model matter in terms of elements, compounds, mixtures. I
i. model and explain that matter exists as solids, liquids, and gases and can change from one form to another. D
j. identify and predict what changes and what remains unchanged when matter experiences an external influence. D
k. identify, build and describe mechanical systems. (e.g., simple and complex machines). D
l. describe the basic characteristics of light, heat, magnetism and sound. D

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

m. compare the structure and function of cells. I
n. explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions and how they respond to stimuli (e.g., photosynthesis, respiration). ID

o. communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling.(e.g., Punnett squares). I
p. Investigate and explain the interdependent nature of biological systems in the environment and how they are affected by human interaction. D
q. Use a basic classification scheme to identify local plants and animals. D

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

a. model and explain the internal structure of the earth, the rock cycle and plate tectonics. I
b. describe the physical properties and classify rocks. D
c. Investigate fossils and make inferences about life and the environment long ago. D
d. Describe the water cycle, composition and structure of the atmosphere, and the impact of oceans on large scale weather patterns. D
e. Develop and model the motion and tilt of earth in relation to the sun, and explain the concept of day, night, seasons, year. D
f. Develop and describe the earth, moon, planets and other objects in space in terms of size, structure, and movement in relations to the sun. D

Content Standard 5-A student must be able to understand how scientific knowledge and technological developments impact society.

a. Identify how people use science and technology. D
b. Model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings. D
c. Use current scientific knowledge to make inferences and propose solutions for local environmental problems (recycling, waste management). D
d. Develop a scientific or technological innovation that benefits the community. D

Content Standard 6-A student must be able to understand historical developments in science and technology.

e. give historical examples of scientific and technological contributions to society. D
f. describe how scientific inquiry has produced much knowledge about the world. D

Sixth Grade

Content Standard 1-A student must be able to design, conduct, evaluate and communicate scientific investigations.

a. design and conduct a scientific experiment identifying variables and controls.
b. analyze data from an experiment and draw a conclusion.
c. construct model
d. predict outcomes of experiments
e. write hypothesis and test them
f. measure mass, volume, and distance using basic scientific equipment such as a balance, rulers, beakers, and graduate cylinders

g. communicate results in lab reports and class discussions

Content Standard 2-A student must be able to demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

r. recognize the atomic structure in matter(mass and weight, elements, compounds, acids and bases). D
s. Differentiate physical and chemical changes in Matter. D
t. Identify principles of light energy, sound energy, and electricity. D
u. understand mass, weight, matter density and their relationships
v. model and explain the three states of matter
w. understand matter in terms of elements and compounds
x. describe mixtures and solutions
y. describe and understand chemical and physical changes of matter
z. use indicator to differentiate between acids and bases
aa. Understand how acid rain is produced and its effects on the environment
bb. describe and measure motion in terms of direction, distance, speed and acceleration.
cc. understand gravity and its effect on weight
dd. describe the contributions of Newton and Galileo to the history of science.
ee. define Newton's 3 laws of motion.
ff. explain the basic principles of flight and rocketry
gg. describe buoyancy and buoyancy force
hh. model action/reaction forces.
ii. describe forces in terms of simple and complex machines.

Content Standard 3-A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

a. Identify the forms and function of organelles in plant and animal cells. D
b. distinguish between plant and animal cells D
c. understand osmosis and diffusion D
d. identify the products and reactants of photosynthesis and respiration. D
e. describe protists and their characteristics D
f. describe fungi and their characteristics D
g. classify the three types of bacteria by structure D
h. state how bacteria, fungi, protists, cause disease D
i. state how these organisms can be helpful D

Content Standard 4-A student must be able to demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

a. describe the internal structure of the earth using models of plate techtonics. D
b. Understand supporting evidence at the plate tectonics theory D
c. Describe the connection between plate tectonics, earth quakes, volcanoes and mountain building D
d. Classify the types of volcanoes and eruptions D
e. Understand how earthquakes are classified D

Content Standard 5-A student must be able to understand how scientific knowledge and technological developments impact society.

a. describe the internal structure of the earth using models of plate tectonics. D
b. Understand supporting evidence at the plate tectonics theory D
c. Understand how earthquakes are classified and the technology to predict earthquakes. D
d. State how bacteria, fungi, protests cause disease D
e. Explain what polymers are and how they are useful to humans D
f. Explain the basic principles of flight and rocketry D
g. Understand how a seismograph works D
h. Describe the technology used to predict volcanic eruptions

Content Standard 6-A student must be able to understand historical developments in science and technology.

a. Understand the history of the plate tectonics theory D
b. Understand the technology to predict earthquakes. D c.Understand the history of the plate tectonic theory D
c. Describe the contributions of Newton and Galileo to the history of science D
d. Understand the basic history of flight D
e. Understand how the wheel and other simple machines affected the advancement of civilization D
f. Describe how the microscope and its improvements led to the discovery and knowledge of cells D

Seventh Grade

D 1. Application of the scientific method: **CS 1**

A. Utilize the basic process skills and will be able to employ the integrated process skills as a basis for solving problems or answering questions about their environment.

-Develop basic process skills for:

D 1. Observing- - using the five senses
D 2. Measuring- - using metric lengths, area, volume, mass, and temperature as appropriate.
D 3. Classifying- - on the basis of observed differences and similarities
D 4. Communicating- - verbal, formal and informal writing, drawing, graphing, lab write-ups, and scientific papers.

-Develop integrated process skills for:

D 1. Inferring - - providing explanations.
D 2. Predicting - - from graphs, models and other representations.
D 3. Hypothesizing - - formulating testable explanations.
D 4. Modeling - - constructing models to explain or illustrate phenomena.
D 5. Interpreting data - - through graphs, charts, and other representations.
6. Experimenting - - controlling variables to test hypothesis and taking data.

D B. Demonstrate safe and appropriate use of scientific tools and equipment for making observations about the living environment.

1. Identify and know how to use tools and equipment such as hand lenses, metric rulers, graduated cylinders, balances, microscopes, dissecting instruments, and computer word processors, search engines, and the Internet, should be used.

I,D C. Exhibit evidence of personal growth and improvement toward being able to select, plan, implement, and evaluate increasingly complex science experiences, including setting up an original scientific experiment based on a hypothesis, with some guidance.

I,D 2. Develop skills in scientific literacy, computer/Internet, and communication. **CS 3,5**

D A. Investigate the ways on which human impact upon the environment affects living things.

D 1. Investigate topics such as extinct, endangered, and threatened species, destruction of habitat, decreasing bio diversity, game management, pollution, pests, and noxious weeds.

I,D B. Explore the relationships of life science interests, hobbies, career opportunities, and historical contributions to science.

1. Participate in activities such field trips, library and computer media, guest speakers, and personal interviews.

I,D C. Demonstrate proper handling and care of organisms and show respect for life and property. Provisions should be made for maintaining healthy organisms, providing for the safety of animals, and exhibiting conduct conductive to safe, on-task classroom and laboratory work.

I 1. Keep and care for one or more organisms throughout the year.

D D. Work independently and as a member of small and large groups within the classroom, in the laboratory, and during field experiences.

1. Develop independence and to develop cooperative skills and attitudes as a part of social growth and development.

I,D E. Use a word processor, the Internet and search engines to gather and write scientific information.

D 3. Define life and classify life using the 5 (or 6) kingdom system. **CS 3**

D A. Recognize the basis for standard classification schemes by grouping creatures according to their characteristics and by designing and using a dichotomus key.

D a. Examine characteristics including color, shape, texture, and size. Examine behavioral characteristics including locomotion and food getting.

I b. Know the scientific (binomial) system for naming living things, but will not be required to memorize numerous scientific names.

I c. Utilize various keys and field guides to classify and identify life.

D B. Become familiar with the local plants and animals.

1. Participate with field trips, plant or animal (insect) collections, guest speakers, video tapes, photographs, and computer/Internet media, so that the students may experience the diversity of life in their immediate locale.

D C. Determine the relationship between life needs and life functions.

D 1. Know that life needs include food, water, air, and space. Know that life functions include growth, reproduction, response to stimuli, and metabolism.

D 4. Demonstrate the unity (relatedness/interdependence) of all life. **CS 2,3,6**

D A. Illustrate the flow of energy and matter among organisms in food chains, webs, pyramids and other models.

D B. Investigate relationships among organisms in a biological community, using field and laboratory activities.

D 1. Know the basic roles (producer, consumer, and decomposer) of organisms and their ecological niches (predator-prey, parasite-host, symbiotic relationship) should be examined.

D C. Investigate the structural and functional organization of living things, using micro visual and visual equipment and models to examine cells, tissues, organs, and systems.

D D. Demonstrate knowledge of reproductive processes, genetics, and heredity of living things.

D 1. Know the topics that will include sexual and asexual methods of reproduction by plants and animals.

D 2. Define genetics and heredity, including Mendel's studies.

D E. Describe the utilization of matter and energy within an organism.

Examine and be knowledgeable of the following:

D 1. Use of the products of photosynthesis as building blocks for polymers including: carbohydrates, proteins, lipids, and nucleic acids.

D 2. Cellular respiration (energy yielding).

D 3. Growth, repair, and locomotion (energy using).

I,D 5. Explain the cell theory. **CS 3**

D A. Describe the cell theory and construct and interpret cell models.

1. Examine models that illustrate the following:

D a. Osmosis, diffusion, and active transport.

D b. Cells parts (organelles).

D c. Mitosis and meiosis.

D B. Describe the increasing complexity of life.

D 1. Demonstrate the hierarchy: atoms, molecules, macromolecule, complex molecules, cell organelles, cells, tissues, organs, organ systems, individuals, populations, and species. [communities, ecosystems, biomes, biosphere].

I,D 6. Describe the process of evolution by natural selection (EBNS) in terms of the great diversity of life. **CS 3**

I,D A. Describe the theory of evolution by natural selection including Darwin's 4 assumptions.

I 1. Examine and investigate the biological evidence for EBNS such as adaptation, mutation, change over time, Lamarck -vs- Darwin, and real life examples of EBNS.

D 7. Describe the gene theory of life. **CS 3,5,6**

D A. Examine the effects of heredity and environment upon organisms.

1. Investigate and become knowledgeable of:

D a. Mendelian genetics.

I b. genotype and phenotype.

D c. Mutations/cancers and their causes.
D d. The role of genes and chromosomes.
D e. Human ability to influence genetic patterns, including artificial selection, genetic engineering, and the human genome project.

I B. Illustrate and describe structure and function of DNA.

D 8. Describe the germ theory of disease and its consequences to humans. **CS 3,5,6**

D A. Understand the nature of infectious diseases.
D 1. Antigens, antibodies, and antibiotics.
D 2. Viruses, bacteria, and immunology.
I 3. The rising threat of bacterial resistance to antibiotics.

D 9. Explain the relationship between structure and function **CS 2,3**

D A. Demonstrate knowledge and understanding of human growth, development and structure such as:
D 1. Structure of the body systems
D 2. Functions of the body systems
D 3. Human heredity and family trees
I 4. Population genetics/human behavior
D 5. Social and emotional growth.

D B. Perform experiments and interpret data illustrating the process of photosynthesis with respect to:
D 1. Starting materials (carbon dioxide and water)
D 2. Reaction products (sugar, oxygen, and water)
D 3. Role of light (energy)
D 4. Role of chlorophyll (energy storage, catalyst)
D 5. Structure and function of a leaf.

D 10. Describe how life changes or causes change. **CS 3**

D A. Describe conservation as a necessary practice in human efforts to protect and use wisely the living resources of the earth including management of renewable resources (reforestation), solid waste, biodiversity, and protection of endangered species.

D 11. Develop a mastery of the following specific skills: **CS 1**

D 1. Graphing data on arithmetic and semi-logarithmic graph paper.
D 2. Using a microscope with living and prepared samples.
I 3. Sterile transfer and culture of bacteria.
D 4. Growth of plant from seed to maturity.
I,D 5. Using a word processor, the Internet and search engines to gather and write scientific information.
I,D 6. Making a hypothesis and test it, including controls, constants, variables and experimental.
I,D 7. Completing a lab write up.
D 8. Using a metric ruler to measure length, width, and area.
D,M 9. Using a balance to measure mass.
D 10. Using a graduated measuring device to measure volume and mix chemicals.
I,D 11. Keeping an organized class notebook with an up-to-date grade sheet.

I,D 12. Assembling apparatus.
I,D 13. Using keys and field guides to classify life.
D 14. Laboratory safety and clean up.

Eighth Grade

1. Application of the Scientific Method CS 1
    a. Apply cause and effect to such concepts as temperature vs. density of matter, earthquakes, etc. D
    b. Define dependent vs. independent variables. D
    c. Write an objective clearly stating why the experiment is to be done an how it is to be done. D
    d. Formulate data tables based on the experimental objective. D
    e. Collect the appropriate data based on the experimental objective. D
    f. Do appropriate mathematical manipulations – graph and equations – bsed on collected data. D
    g. Recognize faulty data based on a misfit in the pattern of data. ID
    h. Develop and apply models to various experimental situations representing the Earth. M
2. Science Literacy and Communication CS 1,5
    a. In the course of the year, write two reading summaries based on Earth Science articles obtained from magazines. D
    b. Use the reader's guide and other library resources to locate other Earth Science topics. M
    c. Locate various topics in Earth Science by using the internet. M
    d. Write an overall summary of an Earth Science or Physical Science book obtained from the library. D
    e. Complete an average of six written laboratory reports each quarter focusing on observations vs. interpretations. D
3. Mathematics in Science Method CS 1.2
    a. Use the metric system to make all laboratory measurements in mass, length, and volume. D
    b. Do metric to metric conversions on laboratory measurements. D
    c. Do rough metric to English conversions to relate metric measurements to their lives. I
    d. Graph data as they relate to mass vs. volume, time vs. temperature etc. D
    e. Do various calculations in determining density, C vs. F etc. I
4. Mapping and Time Method CS 4,6
    a. Stat latitude and longitude using a world globe or map M
    b. Correctly identify all continent and ocean locations on a blank world globe. DM
    c. Determine the latitude of Whitehall by use of the astrolabe. IDM
    d. Use topographic maps to identify such features as mountains, valleys, stream directions etc. IDM
    e. Construct a topographic map by use of land features for geographic area. IDM
    f. Determine the size of the globe and by inference, the Earth, based on erastothenes (shadow angle) method. IDM

g. Relate time zones to longitude and rotation of the Earth. M'
h. Define the astronomical basis of the length of the day, the month and the year. M
i. Define the two causes for seasons on Earth. M

5. Water CS 2,4
   j. Define the chemical basis of water in terms of elements, compounds, and solutions. I
   k. Observe and explain the polar nature via chemical explanations and lab observations. I
   l. Relate the Continental Divide to Montana and different U.S. watersheds. DM
   m. /relate water cable level to precipitation amounts vs. metropolitan and industrial well water use. DM
   n. Define basic motions of the ocean in terms of causes and effects of currents, waves and tides. DM
   o. Apply the cyclic and hot vs. cold nature of ocean currents in terms of heat distribution and effect on weather. DM
   p. Define the composition of fresh (land) vs. salt (ocean) water and why the difference. DM

6. Meteorology CS 1,3,4
   q. Identify INSOLATION and how it relates to the Earth's weather systems. DM
   r. Apply the hydrologic cycle and energy to evaporation, condensation, and precipitation of water. M
   s. Apply concepts of wind, barometric pressure, weather fronts, etc. by the completion of a five day lab on weather data and map collections. DM
   t. Apply humidity, temperature and matter to cloud types, locations and formations. M
   u. Define winds in terms of causation and local s. wind patterns. M
   v. Be able to predict the next day's weather by observing air masses weather fronts and jet streams. DM
   w. Define causes and effects of humidity. M
   x. Identify by experiment the difference in heating of land vs. water. M
   y. Identify the components of the atmosphere. D
   z. Diagram the CO2/ o2 cycle and the N cycle. Be able to describe the components including the interaction of plants and animals in the cycles. D

7. Geology CS 4
   aa. Relate minerals to their method of formation and basic crystalline and chemical make-up. D,M
   bb. Perform 4 basic mineral tests to identify 15-20 different types of minerals. D,M
   cc. Identify important industrial uses for different minerals. D
   dd. Relate the geologic aspects of heat, pressure, and erosion to the three basic rock forms. D,M
   ee. Identify 6-8 specific rocks types for each of the three basic forms. Then apply to a collection of rocks. D
   ff. Identify location, movement, and causes of geologic plates on Earth. M
   gg. Relate plate tectonics to types of earthquake faults, and types of volcanoes. M
   hh. Define the causes and effects of weathering and erosion; and relate to rocks. M

8. Paleontology CS 3,4,6
    ii. Identify fossils in terms of what they are and the four methods of formation. M
    jj. Define concepts of Uniformitarianism vs. Catastrophism as to how they relate to change. I,D,
    kk. Define change in life on Earth as seen in the geologic record. D
    ll. Apply to concepts of Superposition, Faunal Succession, and half life to identifying ages of fossils. I,D
    mm. Define the four geologic eras in order, and several periods in each era. D
    nn. Define 3-5 major geologic extinctions and possible causes. D
9. Astronomy CS 4,5,6
    oo. Name and state the relative locations of all major objects in our solar system. M
    pp. Apply Newton's Laws and Kepler's Laws to planetary motion I,D
    qq. Compare and contrast inner vs. outer planets in terms of structure and chemistry. M
    rr. Define the sun in terms of structure and composition. M
    ss. Define the process of nuclear fusion and relate to the sun. I,D
    tt. Define and apply the concept of the light spectrum to the stars. I,D
    uu. Define different stars in terms of color and magnitude. D,M
    vv. Define the types of galaxies and give examples. M

Science Content Standard 1

Students design, conduct, evaluate, and communicate scientific investigations.

Rationale **Students must understand the process of science—how information is gathered, evaluated and communicated to others. This process mirrors everyday life. The knowledge and skills related to scientific inquiry enable students to understand how science works and are powerful ways for students to build their understanding of the scientific facts, principles, concepts and application that are described in the other science standards. In addition, scientific inquiry stimulates student interest, motivation and creativity.**

Benchmarks

Students will:

End of Kindergarten	End of Grade 1	End of Grade 2
1. given a testable question students will witness experiments with variables to show cause and effect relationship 2. select and accurately use appropriate standard and nonstandard units of measure. 3. communicate results from controlled experiment through pictoral representation	1. be given a testable question, safely conduct a scientific investigation with identified variables. 2. select and accurately use appropriate standard and nonstandard units to measure solids and liquids. 3. communicate results from controlled experiment through pictorial and graphic representation	1. be given a testable question organize and safely conduct scientific investigation with identified variables. 2. accurately use appropriate standard and nonstandard units to measure, process, analyze, and infer results of a basic scientific investigation. 3. communicate a summary based on data acquired from scientific exploration. 4. generalize relationships among parts of a commonly grouped categories (ie seeds) 5. construct models that illustrate simple concepts and compare those models to what they represent

End of Grade 3	End of Grade 4	End of Grade 5
1. be given a testable question organize and safely conduct scientific investigation with identified variables. 2. select and accurately use appropriate standard and nonstandard units to measure, process, analyze, and infer results of a basic scientific investigation 3. communicate a summary based on data acquired from scientific exploration. 4. generalize relationships among parts of a commonly grouped categories (ie seeds) 5. construct models that illustrate simple concepts and compare those models to what they represent 6. communicate results from a controlled experiment.	1. be given a testable question organize and safely conduct scientific investigation with identified variables 2. select and accurately use appropriate tools to measure (in SI units) process and analyze results of a basic scientific investigation 3. represent communicate and provide supporting evidence of scientific investigations. 4. describe relationships between parts of a familiar system (digestive system, simple machines) and identify and record changes and patterns of changes in the systems. 5. Construct models that illustrate simple concepts and compare those models to what they represent 6. Communicate results from a controlled experiment and are reproducible.	1. identify a question, formulate a hypothesis, control and manipulate variables, devise and safely conduct experiments and predict outcomes. 2. select and accurately use appropriate equipment and technology to measure(in SI units) Gather, process and analyze data from a scientific investigation 3. Communicate results of investigations. 4. Analyze the processes, parts and subsystems ie electrical circuits and bacteria. 5. Create models to illustrate scientific concepts.

End of Grade 6	End of Grade 7	End of Grade 8
1. identify a question, formulate a hypothesis, control and manipulate variables, devise and safely conduct experiments and predict outcomes, and compare and analyze results. 2. select and accurately use appropriate equipment and technology to measure(in SI units) Gather, process and analyze data from a scientific investigation 3.Communicate results of investigations. 4. Analyze the processes, parts and subsystems of familiar systems and infer cause and effect relationships. 5.Create models to illustrate scientific concepts.	1. identify a question, formulate a hypothesis, control and manipulate variables, devise and safely conduct experiments and predict outcomes, and compare and analyze results. 2. select and accurately use appropriate equipment and technology to measure(in SI units) Gather, process and analyze data from a scientific investigation 3.Communicate and defend results of investigations. 4. Analyze the processes, parts and subsystems of familiar systems and infer cause and effect relationships among components of a system. 5.Create models to illustrate scientific concepts and use the model to predict change. 6. distinguish between controlled and uncontrolled experiments by consistency of results.	1. identify a question, formulate a hypothesis, control and manipulate variables, devise and safely conduct experiments, predict outcomes, and compare and analyze results. 2. select and accurately use appropriate equipment and technology to measure (in SI units), gather, process, and analyze data from a scientific investigation. 3.communicate and defend results of investigations, and question results of investigations if different from predicted. 4. analyze the processes, parts and subsystems of familiar systems and infer cause and effect relationships among components of the system 5. create models to illustrate scientific concepts and use the model to predict change (ie computer simulation, a stream table, graphic representation.) 6. distinguish between controlled and uncontrolled experiments by consistency of results.

Science Content Standard 2

Students demonstrate knowledge of properties, forms, changes, and interactions of physical and chemical systems.

Rationale Everyone has experience with matter in a variety of forms. Energy is also a central concept in science because all physical interactions involve changes in energy. Therefore, knowledge of the forms of matter and energy is essential to interpreting, explaining, prediction, and influencing change in our world.

Benchmarks:

Students will:

End of Kindergarten	End of Grade 1	End of Grade 2
1. examine, describe, compare, and classify tangible objects in terms of common physical properties 2. observe that matter can exist in different states	1. examine, describe, compare, and classify tangible objects in terms of common physical properties. 2. observe that matter exists as solids, liquids, and gases, and can change from one form to another	1. examine, describe, compare, and classify tangible objects in terms of common physical properties. 2. model and explain that matter exists as solids, liquids, and gases, and can change from one form to another 3. explore changes that matter experiences under external influences 4. describe the basic characteristics of light heat and sound.

End of Grade 3	End of Grade 4	End of Grade 5
1. examine, describe, compare, and classify tangible objects in terms of common physical properties. 2.model and explain that matter exists as solids, liquids, and gases, and can change from one form to another 3. explore changes that matter experiences under external influences 4. describe the basic characteristics of light, heat, magnetism and sound. 5. identify, build, and describe mechanical systems (e. g. simple and complex machines.)	1. examine, describe, compare, and classify tangible objects in terms of common physical properties 2. create mixtures and separate them based on different properties (e. g. salt, sand, iron filings and soil, oil and water) 3. model and explain that matter exists as solids, liquids, and gases and can change from one form to another 4. identify and predict what changes and what remains unchanged when matter experiences an external influence 5. identify, build, and describe mechanical systems (e. g. simple and complex machines.) 6. describe the basic characteristics of light, heat, magnetism, and sound	1. examine,describe,compare and classify objects and substances based on common physical properties and simple and chemical properties. 2. classify, and describe matter in terms of elements, compounds, mixtures, atoms, and molecules. 3. explain that states of matter, solids, liquids, and gases are dependent upon quantity of energy present in the system. 4. predict what will change and what will remain unchanged when matter experiences an internal force or energy change. 5. identify, build, describe, and analyze mechanical systems (e.g., simple and complex machines) 6. define energy and the characteristics of light, heat, motion, magnetism, electricity, sound, and mechanical waves

End of Grade 6	End of Grade 7	End of Grade 8
1. examine, describe, compare, and classify objects and substances based on common physical properties and simple chemical properties. 2. classify, describe, and model matter in terms of elements, compounds, mixtures, atoms and molecules. 3. model and explain that states of matter, solids, liquids, and gases, are dependent upon the quantity of energy present in the system. 4. identify and predict what will change and what will remain unchanged when matter experiences an external force or energy change. 5. identify, build, describe, measure, and analyze mechanical systems (e.g., simple and complex machines). 6. define energy and compare and contrast the characteristics of heat, and motion.	1. examine, describe, compare, and classify objects and substances based on common physical properties and simple chemical properties. 2. classify, describe, and model matter in terms of elements, compounds, mixtures, atoms, and molecules.	1. examine, describe, compare, and classify bjects and substances based on common physical properties and simple chemical properties. 2 classify, describe, and model matter in terms of elements, compounds, mixtures, atoms and molecules. 3.model and explain that states of matter, solids, liquids, and gases, are dependent upon the quantity of energy present in the system. 4.identify and predict what will change and what will remain unchanged when matter experiences an external force or energy change. 5.identify, build, describe, measure, and analyze mechanical systems (e.g., simple and complex machines). 6.define energy and compare and contrast the characteristics of heat, and motion.

Science Content Standard 3

A student must be able to demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Rationale

Students gain a better understanding of the world around them if they study a variety of organisms, microscopic as well as macroscopic. Through the study of similarities and differences of organisms, students learn the importance of classification and the diversity of living organisms. The understanding of diversity helps students understand biological evolution and life's natural processes (cycles, growth and reproduction). Structure, function, body organization growth and development, health and disease are important aspects to the study of life. The study of living systems provides students important information about how humans critically impact earth's biomes.

Benchmarks

Students will:

End of Grade K	End of Grade 1	End of Grade 2
1. identify that plants and animals have structures and systems, which serve different functions. 2. explain cause and effect relationships in living systems. 3. Group plants and animals according to their similarities and differences.	1. identify that plants and animals have structures and systems, which serve different functions. 2.explain cause and effect relationships in living systems 3. Use a classification system to group a variety of plants and animals according to their similarities and differences.	1. Identify that plants and animals have structures and systems, which serve different function. 2. identify and describe basic requirements of energy needed and nutritional needs for each human body system. 3. develop models that trace the life cycles of different plants and animals and discuss how they differ from species. 4. explain cause and effect relationships in living systems and nonliving components within ecosystems. 5. create and use a classification system to group a variety of plants, and animals according to their similarities and differences.

End of Grade 3	End of Grade 4	End of Grade 5
1. Identify that plants and animals have structures and systems, which serve different function. 2. identify and describe basic requirements of energy needed and nutritional needs for each human body system. 3. explain cause and effect relationships in living systems and nonliving components within ecosystems. 4. create and use a classification system to group a variety of plants, and animals according to their similarities and differences.	1. Identify that plants and animals have structures and systems, which serve different function. 2. identify and describe basic requirements of energy needed and nutritional needs for each human body system. 3. develop models that trace the life cycles of different plants and animals and discuss how they differ from species. 4. explain cause and effect relationships in living systems and nonliving components within ecosystems. 5. create and use a classification system to group a variety of plants, and animals according to their similarities and differences.	1. Compare the structure and function of cells. 2. Explain how organisms and systems of organisms obtain and use energy (e.g., photosynthesis, respiration) 3. Communicate the differences in reproductive processes between plants and animals. 4. Investigate the interdependent nature of biological systems in the environment and how they are affected by human interaction 5. Create and use a classification system to group local plants and animals.

End of Grade 6	End of Grade 7	End of Grade 8
1. compare the structure and function of cells. 2. explain how organisms and systems of organisms obtain and use energy (e.g., photosynthesis, respiration) 3. communicate the differences in reproductive processes between plants and animals. 4. investigate the interdependent nature of biological systems in the environment and how they are affected by human interaction 5. create and use a classification system to group local plants and animals.	1. compare the structure and function of cells. 2. explain how organisms and systems of organisms obtain and use energy, resources to maintain stable conditions and how they respond to stimuli (e.g., photosynthesis, respiration).	1. Compare the structure and function of prokaryotic cells (bacteria) and eukaryotic cells (plant, animal, etc.). 2. explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions and how they respond to stimuli (e.g., photosyntheses, respiration). 3. Communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., Punet squares). 4. investigate and explain the interdependent nature of biological systems in the environment and how they are affected by human interaction. 5. use a basic classification scheme to identify local plants and animals.

Science Content Standard 4

A student must be able to demonstrate knowledge of the composition, structures, processes, and interactions of earth's system's and other objects in space.

Rationale:

By studying Earth, its composition, history and the processes that shape it, students gain a better understanding of the planet on which we live. The world's atmosphere and water are vital to life. Both subtle and wholesale changes in either can have a profound effect on human existence. Knowledge of the Sun and the rest of the Universe help students make predictions about Earth and informed decisions about the future of space exploration.

Benchmarks:

Students will:

End of Kindergarten	End of Grade 1	End of Grade 2
1. give examples of earth's changing features. 2. investigate fossils and make inferences about life and the environment long ago. 3. observe and describe local weather. 4. identify seasons through observations. 5. describe objects in the sky and explain that light and heat comes from a star called the Sun.	1. give examples of earth's changing features. 2. investigate fossils and make inferences about life and the environment long ago. 3. observe and describe local weather. 4. identify seasons through observations. 5. describe objects in the sky and explain that light and heat comes from a star called the Sun.	1. give examples of earth's changing features. 2. classify the physical properties of earth's basic materials (e.g soil, rocks, water , gases). 3. investigate fossils and make inferences about life and the environment long ago. 4. observe and describe local weather . 5. identify seasons and explain the differences between weather and climate. 6. describe objects in the sky and explain that light and heat comes form a star called the sun.

End of Grade 3	End of Grade 4	End of Grade 5
1. describe and give examples of earth's changing features. 2. describe the physical properties of earth's basic materials (e.g soil, rocks, water , gases). 3. investigate fossils and make inferences about life and the environment long ago. 4. observe and describe local weather . 5. identify seasons and explain the differences between weather and climate. 6. describe objects in the sky and explain that light and heat comes form a star called the sun.	1. describe and give examples of earth's changing features. 2. describe the physical properties of earth's basic materials (e.g soil, rocks, water , gases). 3. investigate fossils and make inferences about life and the environment long ago. 4. observe and describe local weather and demonstrate how weather conditions are measured. 5. identify seasons and explain the differences between weather and climate. 6. describe objects in the sky and explain that light and heat comes form a star called the sun.	1. model a the internal structure of the earth. Look at the formation and composition of earth's external features in terms of the rock cycle and plate tectonics. 2. differentiate between rocks and classify rocks by how they are formed. 3. describe how fossils are used as evidence of climatic change over time. 4. describe the water cycle and the impact of oceans on large scale weather patterns. 5. describe the motion and tilt of earth in relation to the sun and explain the concept of day, night, seasons, year. 6. describe the earth, moon, planets, and other objects in space in relation to the sun.

End of Grade 6	End of Grade 7	End of Grade 8
1. model a the internal structure of the earth. Look at the formation and composition of earth's external features in terms of the rock cycle and plate tectonics. 2. differentiate between rocks and classify rocks by how they are formed. 3. describe how fossils are used as evidence of climatic change over time. 4. describe the water cycle and the impact of oceans on large scale weather patterns. 5. describe the motion and tilt of earth in relation to the sun and explain the concept of day, night, seasons, year. 6. describe the earth, moon, planets, and other objects in space in relation to the sun.	1. explain the internal structure of the earth and describe the formation and composition of earth's external features in terms of the rock cycle and plate tectonics. 2. differentiate between rocks and classify rocks by how they are formed. 3. explain scientific theories about the origin and evolution of the earth by describing how fossils are used as evidence of climatic change over time. 4. describe the water cycle, the composition of the atmosphere, and the impact of oceans on large scale weather patterns. 5. describe the motion and tilt of earth in relation to the sun and explain the concept of day, night, seasons, year. 6. describe the earth, moon, planets, and other objects in space in terms of size, structure, and movement in relation to the sun.	1. model and explain the internal structure of the earth and describe the formation and composition of earth's external features in terms of the rock cycle and plate tectonics. 2. differentiate between rocks and classify rocks by how they are formed. 3. explain scientific theories about the origin and evolution of the earth by describing how fossils are used as evidence of climatic change over time. 4. describe the water cycle, the composition of the atmosphere, and the impact of oceans on large scale weather patterns. 5. describe the motion and tilt of earth in relation to the sun and explain the concept of day, night, seasons, year. 6. describe the earth, moon, planets, and other objects in space in terms of size, structure, and movement in relation to the sun.

Science Content Standard 5

Students understand how scientific knowledge and technological developments impact society.

Rationale

Our world and human activity is shaped in many ways by the advances in science and technology, which involves the application of science. Because these advances affect all of Earth's living and nonliving systems, it is vital that students understand the interrelationships of science, technology and human activity.

Benchmarks

Students will:

End of Grade K	End of Grade 1	End of Grade 2
1. Give examples of how people use science and technology. 2. model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings. 3. Use current scientific knowledge to make inferences and propose solutions for local environmental problems (recycling, waste management).	1. give examples of how people use science and technology. 2. model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings. 3. Use current scientific knowledge to make inferences and propose solutions for local environmental problems.	1. give examples of how people use science and technology. 2. model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings. 3. Use current scientific knowledge to make inferences and propose solutions for local environmental problems.

End of Grade 3	End of Grade 4	End of Grade 5
1. Give examples of how people use science and technology. 2. model scientific collaboration by sharing and communicating ideas and solutions in variety of cooperative settings. 3. Use current scientific knowledge to make inferences and propose solutions for local environmental problems (recycling, waste management). 4. identify a scientific or technological innovation that benefits the community.	1. Give examples of how people use science and technology. 2. model scientific collaboration by sharing and communicating ideas and solutions in variety of cooperative settings. 3. Use current scientific knowledge to make inferences and propose solutions for local environmental problems (recycling, waste management). 4. identify a scientific or technological innovation that benefits the community.	1. identify the specific fields of scientific endeavor and related occupations within those fields. 2. model collaborative problem solving and give examples of how scientific knowledge is shared, critiqued, and scrutinized by other scientists and the public. 3. investigate local problems and/or issues and propose solutions or products that address a need, which considers variables (e.g., environmental risks). 4. apply scientific knowledge and process skills to understand issues and everyday events.

End of Grade 6	End of Grade 7	End of Grade 8
1. identify the specific fields of scientific endeavor and related occupations within those fields. 2. model scientific collaboration by sharing and communicating ideas and solutions in a variety of cooperative settings and understand how scientific knowledge is critiqued. 3. investigate local problems and/or issues and propose solutions or products that address a need, which considers variables (e.g., environmental risks). 4. apply scientific knowledge and process skills to understand issues and everyday events.	1. identify the specific fields of scientific endeavor and related occupations within those fields. 2. model collaborative problem solving and give examples of how scientific knowledge is shared, critiqued, and scrutinized by other scientists and the public. 3. investigate local problems and/or issues and propose solutions or products that address a need, which considers variables (e.g., environmental risks). 4. apply scientific knowledge and process skills to understand issues and everyday events.	1. identify the specific fields of scientific endeavor and related occupations within those fields. 2. model collaborative problem solving and give examples of how scientific knowledge is shared, critiqued, and scrutinized by other scientists and the public. 3. investigate local problems and/or issues and propose solutions or products that address a need, which considers variables (e.g., environmental risks). 4. apply scientific knowledge and process skills to understand issues and everyday events.

Science Content Standard 6

Students understand historical developments in science and technology.

Rationale

Students need to understand that scientific knowledge was influenced greatly by societal influences. They also need to know that scientific advances have influence society. For instance the development of the atom bomb and the discovery that microbes cause disease, both had a major impact on society. Therefore, the use of history in school science programs is necessary to clarify different aspects of scientific discovery to understand that scientific knowledge is publicly shared and understand the role that science has played in the development of various cultures.

Benchmarks

Students Will:

End of Kindergarten	End of Grade 1	End of Grade 2
1. be exposed to historical examples of scientific and technological contributions to society 2. be introduced to ways scientific inquiry has produced much knowledge about the world	1. be exposed to historical examples of scientific and technological contributions to society 2. be introduced to ways scientific inquiry has produced much knowledge about the world	1. be exposed to historical examples of scientific and technological contributions to society 2. describe ways scientific inquiry has produced much knowledge about the world
End of Grade 3	**End of Grade 4**	**End of Grade 5**
1. give historical examples of scientific and technological contributions to society. 2. describe ways scientific inquiry has produced much knowledge about the world.	1. give historical examples of scientific and technological contributions to society. 2. describe how scientific inquiry has produced much knowledge about the world.	1. trace developments that scientific knowledge is subject to change as new evidence becomes available. 2. identify major milestones in science that have impacted science, technology and society.

End of Grade 6	End of Grade 7	End of Grade 8
1. trace developments that demonstrate scientific knowledge is subject to change as new evidence becomes available. 2. identify major milestones in science that have impacted science, technology and society.	1. trace developments that demonstrate scientific knowledge is subject to change as new evidence becomes available. 2. identify major milestones in science that have impacted science, technology and society.	1. trace developments that demonstrate scientific knowledge is subject to change as new evidence becomes available. 2. identify major milestones in science that have impacted science, technology and society.

High School Science – Grades 9-12

Environmental Biology

M 1. Apply the scientific method in lab, bio ethical and real life situations. C.S.1

M A. Use scientific methods to investigate biological phenomena. Computer, laboratory and field investigations will be used to stress the inquiry approach to learning. Students will make hypothesis, perform experiments to test hypothesis, interpret data and draw conclusions.

M B. Utilize appropriate safety techniques in handling materials, equipment and organisms.

M C. Use specialized equipment for the collection of data.

1. Some of the equipment used will include:
    1. microscopes
    2. balances
    3. computers
    4. chemical reagents & indicators
    5. field sampling apparatus
    6. miscellaneous lab apparatus
    7. sterile techniques

M 2. Develop skills in scientific literacy and communication while writing summaries, research papers, lab writeups, reading scientific writing/research and giving talks. C.S. 1 & 5

M A. Understand biological concepts well enough to relate them to scientifically significant current issues and events.

1. Through the use of a variety of media, students will be exposed to important science-related current issues and events, and will relate them to effects on the biosphere.

M B. Be aware of career opportunities in biology.

1. Reading, field trips and discussion will be used to introduce the diverse career opportunities in biological sciences.

D C. Demonstrate an awareness of the importance of historical contributions in the development of the biological sciences.

1. Utilize appropriate library and internet skills when studying the contributions in the development of scientists such as Leeuwenhoek, Darwin, Pasteur, Watson, Crick, Salk and others.

M 3. Describe the process of evolution by natural selection (EBNS) in terms of the great diversity of life, with examples. C.S. 3

M A. Categorize organisms representing the various (5 or 6) kingdoms.

D 1. The examination of structural and biochemical evolutionary similarities which forms the basis of our classification system will be investigated. The concepts of environmental adaption will be emphasized in understanding the diversity of life.

D B. Apply the theory of evolution to explain adaptation and speciation.

1. Labs, readings, and audiovisual materials will be used to investigate the current scientific ideas of the origin of life and the effect of the environment on the natural selection of populations.

M 4. Demonstrate the unity (relatedness/interdependence) of all life at the biochemical, cellular, structural, population, community, and biosphere levels. C.S. 3

M A. Describe the characteristics & processes which define life.

D M B. Identify the relationship between organic compounds [proteins, lipids, carbohydrates, and nucleic acids] and the physiological needs of living organisms.

M 1. Show the relationship between organisms needs and their environment by the study of food chains, nutrient cycles and the structure and function of the cells.

D M C. Recognize the relationship and balance between cell respiration and photosynthesis in food chains.

D 1. Study processes by using investigations to compare the raw materials required and the products formed in each. Relationships and cycles can then be established.

M D. Relate the principles of genetics to heredity in plants and animals and explain how there is continuity from generation to generation.

D M 1. Making lab observations and computer simulations will supplement the problem solving approach used to study heredity concepts including mitosis, meiosis, Mendelian inheritance, chromosome theory, genetic diseases, genetic engineering, the human genome project, and their implications.

M E. Know both biochemical and structural similarities and the interdependence of all life.

M 5. Describe the germ theory of disease, its consequences to humans, other populations and how modern medicine is dealing with germs and nonpathogenic diseases. C.S. 3, 4 & 6

DM A. Investigate the diversity of microorganisms and their roles in the environment.

DM 1. Use microscopic examinations, laboratory investigations and audio/visual presentations to describe the various kinds of microorganisms and their uses including genetic engineering and their roles in ecosystems.

D 2. Include an introduction to microbial diseases and the human immune system.

M 6. Describe the relation of structure to function at the biochemical, cellular, structural, and ecosystem levels. C.S. 3

DM A. Gain an understanding of the cell theory, cellular transport, cell structure and cell function.

M 1. Use laboratory investigation, visual aids, and class discussion to describe organelles, active and passive transport, and cell physiology, etc.

M 2. Know that all cells come from other cells, and cells are the basic unit of structure and function of all life.

D M B. Relate structures in organisms to their specific functions.

1. Use experimentation, charts, dissections, audiovisual materials,

and discussions are to correlate structure with function.

M C. Be able to differentiate between sexual and asexual reproduction.

D 1. Be aware that a variety of reproductive methods used to ensure the continuation of a species will be explored. Special attention is devoted to various representative life cycles and to the physiology of human reproduction.

M D. Understand the structure of DNA and its importance in all living systems.

D 1. Through the use of classroom discussions, audiovisuals, laboratory observations, and literature review, explore the importance of DNA as genetic material.

D 2. Study the mechanism and application of genetic engineering and the human genome project.

M 7. Show how life changes and how life causes changes in the living and nonliving systems around itself, with emphasis on how humans change the environment. C.S. 3

M A. Explain the concept of homeostasis in cells, individuals, populations, communities, and ecosystems.

1. Explain the steady state condition by Illustrating topics such as food webs, succession, carrying capacity, symbiosis, diffusion, and osmosis.

M B. Trace the development of the major functions through the various kingdoms.

D 1. Studying topics such as microbiology, plant physiology, animal physiology, and reproduction, will be used to compare the life processes in different biota.

M 8. Apply basic ecology to population/energy relationships, diversity/stability, the interconnectedness of life, and ecological cycles. C.S. 3 & 5

M A. Develop an understanding of important ecological principles.

D 1. Examine, through the liberal use of fieldwork, the concepts of basic ecology, population dynamics, bioenergetics and biotic succession

M B. Recognize the role of humans in the biosphere.

D 1. Investigations of ecological principles will include their application to humans and relate our dependence on the environment to our impact on it.

M C. Explain the concept of bio diversity.

M 1. Give examples showing how diversity tends towards stability from the cellular to the biosphere level.

Molecular Biology

M 1. Apply the scientific method in lab, bio ethical and real life situations. C.S. 1

D A. Use scientific methods to investigate biological phenomena. Computer, laboratory and field investigations will be used to stress the inquiry approach to learning. Students will make hypothesis, perform

experiments to test hypothesis, interpret data and draw conclusions.

M B. Utilize appropriate safety techniques in handling materials, equipment and organisms.

M C. Use specialized equipment for the collection of data.

1. Some of the equipment used will include:
    1. microscopes
    2. Balances
    3. Computers
    4. Chemical reagents and indicators
    5. field sampling apparatus
    6. miscellaneous lab
    7. sterile techniques

M 2. Develop skills in scientific literacy and communication while writing summaries, research papers, lab write-ups, reading scientific writing/research and giving talks. C.S. 1

M A. Understand biological concepts well enough to relate them to scientifically significant current issues and events.

D 1. Expose oneself to important science-related current issues and events, and will relate them to effects on the biosphere using various sources of media.

D B. Be aware of career opportunities in biology.

1. Reading, field trips and discussion will be used to introduce the diverse career opportunities in biological sciences.

M C. Demonstrate an awareness of the importance of historical contributions in the development of the biological sciences.

M 1. Utilize appropriate library and internet skills when studying the contributions in the development of scientists such as Leeuwenhoek, Darwin, Pasteur, Watson, Crick, Salk and others.

M 3. Describe the process of evolution by natural selection (EBNS) in terms of the great diversity of life, with examples. C.S. 3 & 6

M A. Categorize organisms representing the various (5 or 6) kingdoms.

M 1. Examine structural and biochemical evolutionary similarities which forms the basis of our classification system will be investigated. The concepts of environmental adaption will be emphasized in understanding in understanding the diversity of life.

D B. Apply the theory of evolution to explain adaptation and speciation.

D 1. Labs, readings, and audiovisual materials will be used to investigate the current scientific ideas of the origin of life and the effect of the environment on the natural selection of populations.

M C. Recognize the increasing complexity of life and the matter involved.

D 1. Subatomic particles, atoms, molecules, macromolecules, complex molecules, cell organelles, cells, tissues, organs, organisms, populations, species, communities, [ecosystems], biomes, and the biosphere.

M 4. Demonstrate the unity (relatedness/interdependence) of all life at the biochemical, cellular, structural and ecosystem levels. C.S. 3

M A. The student will describe the characteristics process which define life.

M B. Identify the relationship between organic compounds [proteins, lipids, carbohydrates, and nucleic acids] and the physiological needs of living organisms.

M 1. The study of food chains, nutrient cycles and the structure and function of the cells will be used to show the relationship between organisms needs and their environment.

D M C. Recognize the relationship and balance between cell respiration and photosynthesis in food chains.

D 1. Study vital processes using investigations to compare the raw materials required and the products formed in each. Relationships and cycles can then be established.

M D. Relate the principles of genetics to heredity in plants and animals and explain <u>how</u> there is continuity from generation to generation.

D M 1. Lab observations and computer simulations will supplement the problem solving approach used to study heredity concepts including mitosis, meiosis, Mendelian inheritance, chromosome theory, genetic diseases, genetic engineering, the human genome project, and their implications.

M E. Know both biochemical and structural similarities and the interdependence of all life.

M 5. Describe the germ theory of disease, its consequences to humans and how modern medicine is dealing with germs and nonpathogenic diseases. <u>C.S. 3, 5 & 6</u>

D M A. Investigate the diversity of microorganisms and their roles in the environment.

D 1. Microscopic examinations, laboratory investigations and audio/visual presentations will be used to describe the various kinds of microorganisms and their uses including genetic engineering and their roles in ecosystems. **D** 2. An introduction to microbial diseases and the human immune system will also be included.

M 6. Describe the relation of structure to function at the biochemical, cellular, structural, and ecosystem levels. <u>C.S. 3</u>

M A. Understand the cell theory, cellular transport, cell structure and cell function.

D 1. Laboratory investigation, visual aids, and class discussion will be used to describe organelles, active and passive transport, and cell physiology, etc.

M 2. All cells come from other cells, and cells are the basic unit of structure and function of all life.

M B. Relate structures in organisms to their specific functions.

1. Experimentation, charts, dissections, audiovisual materials, and discussions are to be used to correlate structure with function.

M C. Differentiate between sexual and asexual reproduction.

D,M 1. A variety of reproductive methods used to ensure the continuation of a species will be explored. Special attention is devoted to various representative life cycles and to the physiology

of human reproduction.

M D. Understand the structure of DNA and its importance in all living systems.

D 1. Through the use of classroom discussions, audiovisuals, laboratory observations, and literature review, the importance of DNA as genetic material will be explored.

D 2. The mechanism and application of genetic engineering and the human genome project will be studied.

M 7. Show how life changes and how life causes changes in the living and nonliving systems around itself. C.S. 3 & 5

M A. Explain the concept of homeostasis in cells, individuals, populations, communities, and ecosystems.

D 1. Topics such as food webs, succession, carrying capacity, symbiosis, diffusion, and osmosis will be used to illustrate the steady state condition.

M B. Trace the development of the major functions through the various kingdoms.

D 1. Topics to be studied (microbiology, plant physiology, animal physiology, and reproduction) will be used to compare the life processes in different biota.

M 8. Apply basic ecology to population/energy relationships. C.S. 3 & 5

D A. The student will develop an understanding of important ecological principles.

D 1. The concepts of basic ecology, population dynamics, bioenergetics and biotic succession will be examined through the liberal use of fieldwork to enhance classroom experience.

M B. Recognize the role of humans in the biosphere.

D 1. Investigations of ecological principles will include their application to humans and relate our dependence on the environment to our impact on it.

M C. Explain the concept of biodiversity.

M 1. Give examples showing how diversity tends toward stability from the cellular to the biosphere level.

Pre Chemistry/Physics

1. Scientific Method C.S. 1

M a. apply the steps of the scientific method to everyday situations.

D b. apply the steps to laboratory activities throughout the year.

D c. apply to data collection and data manipulation such as rearranging and graphing.

D d. determine if laboratory data is in error, then give causes for that error.

M e. accurately use the triple beam balance, graduated cylinder, and meter stick togather laboratory data.

D f. apply models to basic atomic and energy concepts.

M g. differentiate between direct and indirect evidence.

M h. when observing data, identify direct, inverse, and no relationships.

2. Communication C.S. 1, C.S. 5

D a. do formal written laboratory reports dealing with chemistry and physics concepts using the procedures used since 7th grade.

D b. write at least 2 science summaries taken from science magazines.

D c. write one formal Aterm@ paper relating to any area of physical science where information is combined from at least 3 different sources.

D d. write one cause and effect report based on information obtained from a library science book.

I e. use the Internet to obtain information relating to a specific area of chemistry or physics.

3. Mathematics C.S. 2

I a. algebraically rearrange then use 3 and 4 variable equations to solve word type problems especially in the 2nd semester physics section.

I,D b. solve all word problems using the 4 step set-up method.

D c. use metric mass, distance, volume, and temperature measurements in all experimental and problem solving situations.

4. General matter C.S.2

D a. classify matter as elements, compounds, mixtures, or solutions.

D b. compare and contrast the 4 phases of matter

D c. differentiate a physical change from a chemical change.

I d. plan and experimentally separate parts of a mixture or solution.

5. Atomic theory C.S. 2, C.S. 6

I a. define experimental evidence supporting evidence for subatomic particles.

I,D b. use the periodic table to determine atomic structures and family groupings of elements.

I,D c. draw atomic models for any of the first 20 elements on the periodic table.

D d. write atomic symbols from memory for at least 20 different elements.

I e. write electron dot formulas for any element on the periodic table.

I f. determine the correct chemical formulas for any binary compound based on the table or on polyatomic charts. And apply to experiment.

I g. write name parts and balance simple chemical equations.

D h. demonstrate the conservation of mass by experiment.

I i. define properties and patterns of 3 key families on the periodic table.

D j. distinguish between acids and bases, and apply to experiment.

6. Machines C.S. 2, C.S. 5

D a. define and sketch the 5 basic parts of any simple machine

D b. compare and contrast the 6 classes of simple machines.

D c. apply the concept of work, force and distance involved in levers and

pulleys by experiment as well as quantitative calculations.

I d. apply concepts of efficiency and mechanical advantage to levers and pulleys.

7. Energy C.S.2, C.S. 5

D a. distinguish between kinetic and potential energy.

D b. apply the concepts of conservation of energy to energy transformations.

D,M c. identify specific kinds such as heat, sound, light, chemical, and electrical.

8. Force C.S.2, C.S. 6

D a. identify and apply to everyday situations, and experiments, Newton=s 3 laws of motion.

I,D b. quantitatively apply the 2^{nd} law to word problems.

I c. apply Newton=s laws to circular motion.

I,D d. qualitatively and quantitatively apply momentum and its conservation to problems.

9. Heat C.S. 2

I,D a. differentiate between solids, liquids, and gases based on the kinetic theory of matter.

I b. qualitatively and quantitatively define heat in terms of mass, change in temp, and heat capacity.

I c. apply differing heat capacities to experiment and problems.

10. Sound C.S. 2

I,D a. identify and diagram the 2 basic forms of waves.

I b. define wavelength, frequency and wave speed; then apply to word problems.

I c. define physical vs. physiological factors affecting sound.

I d. determine factors affecting the speed of sound.

11. Light C.S. 2

I,D a. define the parts and pattern of the electromagnetic spectrum.

I b. define light in terms of its speed, wavelength and frequency.

I,D c. compare and contrast light to sound.

I d. define light and the EM spectrum in terms of energy; then relate to biological effects.

I e. identify the 7 color components of light.

I f. explain how objects produce color.

12. Electricity C.S. 2, C.S. 5, C.S. 6

I a. identify the causes of electricity in terms of the atom and charge.

I,D b. distinguish between current and static electricity.

D c. determine the basic components of a circuit by experiment.

D d. diagram a series circuit vs. a parallel circuit.

13. Ecology C.S. 2, C.S. 3, C.S. 5

D a. differentiate between producers and consumers in terms of energy production.

D b. identify and apply to real world situations, key parts of the food chain.

I c. apply the 2 laws of thermodynamics to the food chain.

I d. identify the food, and energy pyramids in terms of energy conversions and heat.

I e. using the food chain, diagram the recycling nature of matter and the one way trip of energy.

D f. identify several key aquatic and terrestrial biomes.

Chemistry

1. Dimensional analysis (factor label) and math processes C.S. 2

D,M a. define the underlying algebra and fraction concepts to D.A.

D b. apply D.A. to general everyday life situations.

D,M c. apply D.A. to all quantitative chemical problems including stoichiometry, etc.

I,D,M d. Define and apply the concepts of significant digits in all data collected, and calculations.

D e. apply the concept of percent to percent error, and percent yield to various laboratory investigations as well as quantitative problems.

D,M f. apply scientific notation to all calculations

D g. define and apply base 10 logarithms to pH calculations.

D h. quick rough math calculations on all problems without the use of the calculator.

2. The Mole C.S. 2

I,D,M a. define what the mole is.

I,D,M b. apply the mole to quantities of atoms and molecules.

I,D,M c. apply the mole to mole: mole ratios and the equation.

I,D,M d. apply the mole to reactants use vs. products produced in a number of experiments.

3. Conservation of mass C.S. 2 C.S. 5

D,M a. define and apply mass conservation by reactant: product comparisons by experiment.

D b. relate to the balancing of chemical equations.

D,M c. apply to stoichiometric chemical problems.

4. Gases, liquids and solids C.S. 2

D a. compare and contrast with each other in terms of energy and position of particles.

D,M b. apply to phase changes by experiment and algebraic calculations

D c. apply gases to stoichiometric calculations and the equation.

5. Compound formation. C.S. 2, C.S. 5

D a. make compounds by use of experimental techniques such as precipitation and filtration.

D b. define ionic vs. covalent compounds in terms of formation, and properties.

I,D c. apply ionic compounds to empirical formulas and the net ionic equation.

I,D d. apply covalent compounds to carbon and organic chemistry.

D e. relate compound formation to electron movement.

D f. memorize the names and formulas for a number of anion and cation ions, and polyatomics.

6. The atom C.S. 2, C.S. 6

D a. trace the historical and experimental development of Mans= concept of the atom from Dalton through Quantum Mechanical.

D b. apply to the concept of modeling.

D,M c. define in terms of protons, neutrons, electrons, and isotopes.

D d. apply the concept of the orbital and electron configuration to the atom.

7. Chemical families C.S. 2, C.S. 6

D a. compare and contrast the alkali metals, halogens, and noble gases in terms of chemical and physical properties.

I,D,M b. apply to periodic trends in electro negativity, ionization energy, reduction potential and atomic radii.

D c. define in terms of metallic vs. nonmetallic properties.

8. Nuclear chemistry C.S. 2, C.S. 3 C.S. 5, C.S. 6

I,D a. define in terms of nucleus instability due to 3 different factors.

I,D b. define and apply various nuclear decays such and alpha and beta.

D c. compare and contrast with typical chemical reactions.

D d. relate to radiation sources and threats in the modern world.

D e. relate ionizing radiation to effects on the human body, and chemistry

9. Bonding C.S. 2, C.S. 5

D a. define the bonds in terms of electrons and their role in endothermic and exothermic processes.

D,M b. identify ionic, covalent, polar covalent, and hydrogen types of bonds.

D c. relate to chemical and physical properties of various types of molecules of each bond type.

D d. relate collision theory to basic factors affecting rate of bond formation by problems as well as experiments such as the iodine clock.

I,D e. apply rate of bond formation to the energy diagram.
I,D f. relate the reversible nature of bonds to the concept of equilibrium.
I,D g. apply the reversibility of equilibrium to LeChatelier's principle and experiment.

10. Acids, bases, and salts C.S. 2
D a. compare and contrast these compounds with each other in terms of chemistry, and physical traits.
D b. apply to the neutralization reaction experiment, and related stoichiometric calculations.
I,D c. apply to operational vs. conceptual definitions as used in science.
I,D d. define in terms of Ahrreneus vs, Bronsted-Lowry
I,D e. relate to Ksp, Ka, Kb, Kw, and pH.

11. Electrochemistry C.S. 2, C.S. 5
I,D a. apply to a series experimental redox reactions.
I,D b. relate reduction, reducing strength, and the electron to acids, Ka, and the proton.
I c. write spontaneous redox reactions given 2 element ion pairs.
I d. relate reduction potential to patterns on the periodic table.

12. Organic chemistry C.S. 2, C.S. 3, C.S.5
I a. define the central role of carbon in organics
I b. give basic names of simple hydrocarbons.
I c. identify structures of basic functional groups.
I d. identify and draw isomeric structures.
I e. apply to the synthesis of an organic compound such as aspirin.

13. Experimentation. C.S. 1, C.S. 2, C.S. 5
D a. do approximately 5 experiments each quarter.
D b. preplan their work by preparing objectives and their own data tables before lab work is to be done.
D c. carry out their experiment by following the given text procedures.
D d. write a final lab report showing title, objectives and procedures, data given accurately and completely, analysis done qualitatively and quantitatively, and a conclusion.
D e. carry out a final qualitative identification of an unknown solution by designing their own process of data collection.

14. Science equipment C.S. 1,
D a. safely use to the correct place accuracy such tools as the metric ruler, triple beam and electronic balances, beakers vs. graduated cylinders, gas collecting tubes, and burets, pH paper and pH meters, thermometers
D b. safely use Bunsen burners, ring stands, and centrifuges.
D c. safely mix to the correct molarity acids, and various chemical

solutions.

D d. use goggles and aprons when needed.

D e. general do's and don'ts of behavior in the lab room.

Physics

1. Application of math processes C.S. 1, C.S. 2

D,M a. apply algebra with dimensional analysis to solve all quantitative problems encountered

D b. apply trigonometry in the form of the Pythagorean theorem and law of sines and cosines to force and projectile motion problems.

D c. apply vectors to graphical as well as trigonometric problem solving.

D,M d. integrate dimensional analysis, and equations in all lab reports done through the year

I,D e. derive equations from graphs based on individually collected laboratory data.

D f. demonstrate a knowledge of the problem solving process by showing all mathematical steps in any quantitative problems done in class or homework.

2. Historical development C.S. 1, C.S. 5, C.S. 6

D a. relate the development of scientific theories from the purely physical Aristotelian to the highly abstract Einsteinian.

D b. apply the concept of theory development as a process of building rather than discarding.

D c. define the philosophical underpinnings of physics theories in terms of a product of the social environment.

D d. discuss the paradigm shift in our understanding of physical reality by the completion of a short research paper based on class work and Internet research.

3. Motion C.S. 2

D,M a. qualitatively, quantitatively, and graphically apply to speed, velocity, and acceleration

D b. apply to linear as well as 2 dimensional projectile situations.

D,M c. relate Newton=s 3 laws to the cause of all motion

D d. apply motion and force to experiments dealing with constant acceleration, force, and centripetal acceleration.

4. Conservation C.S. 2, C.S. 4, C.S. 6

D a. define conservation in terms of mass, velocity energy, and momentum.

D b. discover conservation through experiments showing conservation of velocity, energy, and momentum.

I,D c. apply to quantitative algebraic, and vector problems.

D d. apply to energy systems where the whole equals the sum of the parts, such as EK + EP + Heat = Total Energy.

5. Thermodynamics C.S. 2, C.S. 3, C.S. 5

I,D a. define in terms of macroscopic and microscopic views of heat

I,D b. relate to 3 laws of thermodynamics.

D,M c. apply to the concept of entropy.

D d. apply to systems where the whole is more than the sum of its parts, such as Matter + Energy < Life.

6. Waves C.S. 2, C.S. 4

D,M a. define waves in terms of wavelength, frequency, amplitude, etc. qualitatively, quantitatively, and graphically by experiment.

D b. apply to sound and experimental wavelength determination.

D c. apply to wave-surface interactions such as reflection, etc.

I,D d. apply to the wave-wave interactions of superposition.

7. Light C.S. 2, C.S. 6

D a. relate and apply by experiment to such processes as reflection, and refraction.

I,D b. relate and apply by experiment to diffraction (Young=s experiment) and polarization.

I,D c. apply to such quantitative equations as wavelength, Snell=s law, and diffraction.

D d. define the progression of light theory from Newton to Young to Maxwell.

D,M e. identify in terms of electromagnetic waves; their causes and production.

D f. relate to energy, charge, the atom, and the electromagnetic spectrum.

8. Electricity C.S. 2, C.S. 5, C.S. 6

D a. define in terms of the atom and net charge.

D,M b. define in terms of static and current electricity.

D,M c. derive coulombs law by experiment.

D d. compare and contrast the law of charge vs. the law of gravitation.

I,D e. define and apply in terms of the field.

I,D f. relate electric fields to the production of magnetic fields.

I,Dg. relate fields to the production of EMF and electrical current.

I,D h. relate electric and magnetic fields to the production of light.

I,D i. qualitatively and quantitatively determine the strength of E and B fields by experiment.

D j. qualitatively and quantitatively apply electric current to series vs. parallel circuits by experiment.

I,D k. define and apply EMF causes and effects of generator vs. motor action.

9. Modern physics and cosmology C.S. 1, C.S. 2, C.S. 4, C.S. 5, C.S. 6

I,D a. define and apply Einstein=s photoelectric equation.
I,D b. define and apply the reversal of the continuous vs noncontinuous nature of matter vs. waves via DeBroglie=s wave-particle duality equation.
I c. define the atom and the electron in terms of standing wave patterns.
D d. compare and contrast Newtonian vs. Einsteinian relativity and apply to problems.
I,D e. Apply the Einsteinian relativistic correction factor to dilation of time and mass, and to the contraction of space.
I f. apply cosmological concepts to a hypothetical analysis of the creation of the universe.

10. Science equipment C.S. 1
D,M a. safe and appropriate use of electrical equipment such as meters, transformers, and power supply units
M b. safe and correct use of mass balances, thermometers, and volumetric glassware.

Advanced Placement Biology

-Differentiate, experiment, understand, and be able to explain the following entities of the following life examples and processes:

I. Molecules and Cells.....25%
D,M A. Chemistry of Life....7% **CS 2,3,4**
M 1. Water
M 2. Organic molecules in organisms
M 3. Free energy changes
M 4. Enzymes
M B. Cells....10% **CS 2,3**
M 1. Prokaryotic and eukaryotic cells
M 2. Membranes
M 3. Subcellular organization
M 4. Cell cycle and its regulation
D,M C. Cellular Energetics....8% **CS 1,2,3**
D,M 1. Coupled reactions and pathways
D,M 2. Fermentation and cellular respiration
M 3. Photosynthesis
II. Heredity and Evolution.....25%
M A. Heredity....8% **CS 1,2,3,5**
M 1. Meiosis and gametogensis
M 2. Eukaryotic chromosomes
M 3. Inheritance patterns
M B. Molecular genetics....9% **CS 1,2,3,5,6**
D,M 1. RNA and DNA structure and Function
D,M 2. Gene regulation

D,M 3. Mutation
D,M 4. Viral structure and replication
I,D,M 5. Nucleic acid technology and applications

M C. Evolutionary Biology....% **CS 3,5,6**

M 1. Early evolution of life
M 2. Evidence for evolution
M 3. Mechanisms of evolution

III. Organisms and Populations.....50%

M A. Diversity of Organisms....8% **CS 3,5,6**

D,M 1. Evolutionary patterns
M 2. Survey of the diversity of life
I,D,M 3. Phylogenetic classification
D,M 4. Evolutionary relationships

M B. Structure and Function of Plants and Animals.....32% **CS 3,5**

M 1. Reproduction, growth, development
D,M 2. Structural, physiological, and behavioral adaptations
D,M 3. Response to the environment

D C. Ecology.....10% **CS 2,3,5,6**

D 1. Populations dynamics
D,M 2. Communities and ecosystems
D 3. Global issues

IV. Suggested Laboratory Topics **CS 1,2,3,5,6**

M A. Diffusion and Osmosis*
M B. Enzyme Catalysis*
M C. Mitosis and Meiosis*
M D. Plant Pigments and Photosynthesis*
M E. Cell Respiration*
M F. Molecular Biology

I,D,M 1. Genetic engineering of *E. coli* (plasm id transformation)
I,D,M 2. Electrophoresis of protein or DNA using restriction enzymes (DNA finger print)

D,M G. Genetics of Organisms
D,M H. Population Genetics and Evolution (EBNS)
D,M I. Transpiration
D,M J. Physiology of the Circulatory System
D,M K. Animal Behavior
D,M L. Dissolved Oxygen and Aquatic Primary Productivity
D,M M. Dissection of Fetal Pig

- = covered in 10^{th} grade (must add if not already covered in 10^{th} grade).

Benchmarks - Molecular Biology

-Ask scientific questions, formulate hypothesis, test them with controlled experiments, analyze data, interpret results, draw conclusions, present and defend them.

-evaluate and apply the ideas of change and homeostasis (equilibrium) to systems from the sub cellular to the biosphere level, basic ecology, biotic and abiotic factors, food chains, web of life, and population interactions.

-describe how life changes and causes change and demonstrate the unity (interdependence/relatedness) of all life.

-list and describe the cell theory, describe the structure and function of cell organelles, the macromolecules of life (carbohydrates, proteins, lipids and nucleic acids) and body systems.

-list and describe the laws of thermodynamics and explain how energy flows through cells, body systems and ecosystems.

-list and explain the gene theory, describe the structure and functions of DNA, replication, transcription, translation and the importance of biodiversity.

-classify life, define life, list and describe the 5 kingdoms, describe the increasing complexity of life from the subatomic to the biosphere levels, and apply the theory of evolution by natural selection (ebns) to the classification of life.

-identify and explain some of the major historical milestones in biological science such as Darwin's theory of ebns, the germ theory, the cell theory, Mendelian genetics (the gene theory), and technological advancements such as the electron microscope and genetic engineering. Explain how these have affected the acceptance of scientific thought.

-differentiate science from pseudoscience, evaluate scientific methods and models, argue for and against scientific theories and look for patterns and use bioethics and reasoning to evaluate the consequences of new biological and technological advancements.

Benchmarks - Environmental Biology

-Ask scientific questions, formulate hypothesis, test them with controlled experiments, analyze data, interpret results, draw conclusions, present and defend them.

-evaluate and apply the ideas of change and homeostasis (equilibrium) to systems from the sub cellular to the biosphere level, basic ecology, biotic and abiotic factors, food chains, web of life, and population interactions.

-describe how life changes and causes change and demonstrate the unity (interdependence/relatedness) of all life.

-list and describe the cell theory, describe the structure and function of cell organelles, the macromolecules of life (carbohydrates, proteins, lipids and nucleic acids) and body systems.

-list and describe the laws of thermodynamics and explain how energy flows through cells, body systems and ecosystems.

-list and explain the gene theory, describe the structure and functions of DNA, replication, transcription, translation and the importance of biodiversity.

-classify life, define life, list and describe the 5 kingdoms, describe the increasing complexity of life from the subatomic to the biosphere levels, and apply the theory of evolution by natural selection (ebns) to the classification of life.

-identify and explain many of the major historical milestones in biological science such as Darwin's theory of ebns, the germ theory, the cell theory, Mendelian genetics (the gene theory), and technological advancements such as the electron microscope and genetic engineering. Explain how these have affected the acceptance of scientific thought.

-differentiate science from pseudoscience, evaluate scientific methods and models, argue for and against scientific theories and look for patterns and use bioethics and reasoning to evaluate the consequences of new biological and technological advancements.

Benchmarks - Advanced Placement Biology

-Ask detailed scientific questions, formulate hypothesis, test them with controlled experiments, analyze data, interpret results, draw conclusions, present and defend them.

-evaluate and apply the ideas of change and homeostasis (equilibrium) to systems from the sub cellular to the biosphere level, basic ecology, biotic and abiotic factors, food chains, web of life, and population interactions.

-describe how behaves, life changes and causes change and demonstrate the unity (interdependence/relatedness) of all life.

-list and describe the cell theory, describe the structure and function of cell organelles, the macromolecules of life (carbohydrates, proteins, lipids and nucleic acids) and body systems.

-describe the biochemical basis of life processes.

-list and describe the laws of thermodynamics and explain how energy flows through cells, body systems and ecosystems.

-list and explain the gene theory, describe the structure and functions of DNA, replication, transcription, translation and the importance of biodiversity.

-classify life, define life, list and describe the 5 kingdoms, describe the increasing complexity of life from the subatomic to the biosphere levels, and apply the theory of evolution by natural selection (ebns) to the classification of life.

-identify and explain some of the major historical milestones in biological science such as Darwin's theory of ebns, the germ theory, the cell theory, Mendelian genetics (the gene theory), and technological advancements such as the electron microscope and genetic engineering. Explain how these have affected the acceptance of scientific thought.

-differentiate science from pseudoscience, evaluate scientific methods and models, argue for and against scientific theories and look for patterns and use bioethics and reasoning to evaluate the consequences of new biological and technological advancements.

-complete or be able to explain all the Advanced Placement labs.

Benchmarks -- Prechemistry/prephysics

1. Select appropriate means for communicating scientific information in terms of tables, graphs,
mathematical/chemical equations and verbal summaries.

2. Use the experimental process to do modeling, formulate hypothesis, identify dependent vs. in dependent
variables, collect data, do interpretations, and then relate these results to the real word.

3. Classify and predict chemical and physical properties of simple compounds, acids, bases, in terms of
chemical reactivity and observable changes.

4. Describe and explain interactions of matter by predictions based on laws of conservation, the periodic table
and the use of quantitative equations.

5. Relate conservation of energy and potential vs. kinetic energy transformations to production of speed and
acceleration, heat vs. temperature, change of phase, light, sound, and electricity.

6. Relate the laws of matter and energy to ideal vs. natural living systems as well as the photosynthesis/respiration cycle.

7. Define historical progress in thought and technology to the development of atomic theory, conservation
laws, and laws of motion.

Benchmarks -- Chemistry

1. Analyze and apply the concepts of change and equilibrium as well as enthalpy and entropy to physical
as well as chemical transformations.

2. Investigate and evaluate scientific hypotheses and experimental design in terms of historical experiments
leading to atomic theory, molecular kinetic theory, gas laws, and conservation of mass, and charge laws.

3. Classify and predict fundamental properties of elements and compounds in terms of solubility,

conductivity, melting behavior, etc. by use of patterns in bonding, and the periodic table.

4. Symbolize physical and chemical changes in terms of phase change, dissolving, precipitation, net ionic,
oxidation, acid - base, nuclear, electrolytic and equilibrium, equations.

5. Define the basic make up of matter in terms of subatomic particles, quarks, and the nuclear forces.

6. Apply mathematical operations to predict and/or confirm quantitative properties of matter as well as
interactions of matter.

Benchmarks -- Physics

1. Identify a testable question and its variables, formulate a hypothesis, conduct an experiment to collect and
analyze data on such topics as a pendulum, momentum, heat, electric current, etc.

2. Identify, measure, calculate, and analyze quantitative and qualitative relationships associated with constant
vs. accelerated motion, forces, momentum, energy, heat, light, electricity, waves, and fields.

3. Question conclusions of scientific studies and paradigms over the ages from Aristotelian to modern
Einsteinian theories especially as they relate to forces vs. fields, matter and energy.

4. Describe and explain physical interactions of matter, energy, and waves in terms of such concepts as
conservation, interconversion, and superposition.

5. Define and apply the concept of gradual evolution of theories from narrow to general as they relate to shifts
in paradigm over the ages especially as they pertain to our concept of the atom, gravity, and light.