Boulder Valley School District
High School Science Curriculum

Introduction to High School Science Curriculum

The revised BVSD High School Science Curriculum for the Boulder Valley School District is designed to provide all students in the Boulder Valley schools with the learning experiences needed to acquire the science knowledge and skills described in the BVSD Academic Content Standards for Science, adopted by the Board of Education in February, 1999. In addition, the revised curriculum provides those students who choose to extend their study of science beyond what is required for graduation the opportunity to study one or more areas of science in depth or explore the application of science to a variety of topics. This curriculum guide also includes the course outlines for Advanced Placement Biology, Advanced Placement Chemistry, and Advanced Placement Physics that have been developed by the College Board so teachers, parents, and students know that these advanced sciences are available in the Boulder Valley science program.

Virtually all students are expected take courses in physical science and biology in order to fulfill their graduation requirements in science. This will prepare them to become proficient in the skills and knowledge identified in the science standards as what all students should know and be able to do in order to be scientifically literate citizens. Those students who choose to accelerate their science learning and begin their high school science program in biology are strongly encouraged to take both chemistry and physics before graduation so that they, too, will have a strong level of scientific literacy.

All of the courses offered in the BVSD High School Science Curriculum will help students understand the nature of science and science as a way of knowing. In addition, students will learn how to study science safely and how advances in technology apply to the study of science.

Specific Curriculum Task Forces worked under the coordination of the High School Science Curriculum Council to develop this document. The members of these groups are listed in the front of this document. The Essential Learning Results for each course are aligned with relevant sections of the national, state, and local content standards for science. These Essential Learning Results are organized by topic and represent agreement among teachers regarding instructional focus and emphasis. However, they are not intended to define the entire course of study and teachers are encouraged to continue to take advantage of current events, student interests, and their own experiences to pursue the study of relevant topics in addition to those specified in the curriculum. A matrix that shows the alignment of the essential learning results with the BVSD Academic Content Standards for Science will accompany the Outline of Topics and Essential Learning Results for each course.

Teachers need to obtain the more detailed curriculum guides for those specific courses where teacher resources and recommended laboratory experiences have been identified. These are available in the Division of Learning Services. In addition, teachers need to familiarize themselves with the Appendices to the BVSD Academic Content Standards for Science and use that information in designing their instruction.

Boulder Valley School District
High School Science Curriculum

Curriculum Council and Writing Team Members
2001

High School Science Curriculum Council

Michael Altenbern	Broomfield High School
Craig Boccard	Broomfield High School
Chris Conery	Broomfield High School
Barb Conroy	Learning Services
Sarah DiGiacomo	Fairview High School
Emily L. Haynes	Centaurus High School
Susan E. Lord	New Vista High School
Tamsen K. Meyer	Boulder High School
Alberto Real	Nederland High School
Kathy Vance	Arapahoe Ridge High School
Laszlo Vass	Monarch High School

Writing Team Members

Nick Barnes – Broomfield High School	(Global Science)
Sarah DiGiacomo – Fairview High School	(Physical Science, Global Science)
Matt Grigittis – Nederland High School	(Physical Science)
Karen Hyde – Broomfield High School	(Physical Science, Physical Science Advanced, Chemistry)
Charles Schoep – Monarch High School	(Physical Science, Physical Science Advanced)
Chris Pryor – Boulder High School	(Physical Science, Physical Science Advanced)
John Hubbard – Fairview High School	(Marine Biology, Botany)
Ben Boyer – Boulder High School	(Botany)
Al Real – Nederland High School	(Biology, Core Biology, Biology Advanced, Anatomy, Anatomy & Physiology, Science Research Seminar)
Mike Altenbern – Broomfield High School	(Biology)
Mark Little – Broomfield High School	(Biology, Anatomy, Anatomy & Physiology)
Tamsen K. Meyer – Boulder High School	(Biology, Biology Advanced, Core Biology)
Laszlo Vass – Monarch High School	(Anatomy, Anatomy & Physiology, Biology)
Emily Haynes – Centaurus High School	(Chemistry, Chemistry Advanced, Astronomy)
David Guilinger – Broomfield High School	(Astronomy)
Lynee Zajac – Fairview High School	(Astronomy, Geology)
Marcelle Partridge – Boulder High School	(Chemistry, Chemistry Advanced)

Cammie Wickham – Fairview High School	(Chemistry)
Julie Andrew – Monarch High School	(Chemistry, Science Research Seminar)
Roger Briggs – Fairview High School	(Physics, Physics Advanced)
Guy Kerouac – Centaurus High School	(Physics, Physics Advanced)
Ron Haddad – Centaurus High School	(Biology)
Mark Chavez – Fairview High School	(Biology)
Susan Lord – New Vista High School	(Biology)
Mike Fuchs – Boulder High School	(Physics, Physics Advanced, Science Research Seminar)
Kevin Lowe – Broomfield High School	(Physics, Physics Advanced)
William E. Daly – Centaurus High School	(Geology, Introduction to Earth Science, Introduction to Biology)
Francisco Salas – Boulder High School	(Geology)
Lawrence Crowley – Monarch High School	(Geology)
Eric Miller – Retired	(Geology)
Val Havlick - Learning Services	(Science Research Seminar)
Chris Conery – Broomfield High School	(Science Research Seminar)
Kristin Volle Donely –Fairview High School	(Science Research Seminar)
Jeff Writer – Centaurus High School	(Science Research Seminar)
Lisa Feldman – New Vista High School	(Science Research Seminar)

The work and contributions of these dedicated professionals are very much appreciated for without their expertise and effort, this document would not exist. The students in Boulder Valley School District are very fortunate to have the opportunity to learn from such knowledgeable and committed teachers.

Boulder Valley School District
High School Science Curriculum

Course Code: S10 Physical Science

Course Title: PHYSICAL SCIENCE

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Physical Science is an inquiry-oriented course involving principles and concepts concerning the physical world. Content areas explored include nature and behavior of matter, atomic theory, chemical and physical changes including bonding and reactions, mechanics, electricity and magnetism, light and sound, and energy. The course emphasizes the study and proper use of fundamental science tools including the metric system, periodic table, graphing techniques and applied technologies. Laboratory activities reinforce concepts and principles presented.

1. INTRODUCTION TO CHEMISTRY

I. The Framework of Science

A. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.

B. Tools of Science and Measurement

1. Use basic tools of measurement accurately.
2. Use the SI unit of measurement accurately.
3. Be able to convert between units.
4. Use computers and related technology in scientific investigations.

C. The Process of Science

1. Understand the process of scientific investigation.
2. Be able to design conduct and evaluate a simple investigation.
3. Use the scientific method in solving a problem.
4. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

II. General Properties of Matter

A. Matter

1. Know that matter has characteristic properties, which are related to its composition and structure.

B. Mass and Weight

1. Be able to observe, describe, and measure mass and weight.

C. Volume and Density

1. Be able to observe, describe, and measure volume.
2. Be able to observe, describe, and measure density.
3. Use graphs to aid in analysis.

III. Mixtures, Elements, and Compounds

A. Classes of Matter

1. Know that matter can be classified and described in terms of categories.

B. Elements, Mixtures, and Compounds

1. Recognize and be able to demonstrate the difference among mixtures, elements, and compounds.

IV. Physical and Chemical Changes

A. Phase Changes

1. Understand that interactions can produce changes in a system although the total quantities of matter and energy remain unchanged.
2. Use computers to aid in investigation.
3. Use graphs to aid in analysis.
4. Know that various states of matter exist in and on the earth.

B. Chemical Properties and Changes

1. Be able to observe, measure, and predict chemical changes, providing evidence for these changes.
2. Use a model to test for changes.

V. Atoms

A. An Atomic Model of Matter and the Structure of the Atom

1. Be able to use models, such as atomic structure, to explain properties, composition of matter.

2. Observe changes in samples of matter.
3. Be aware that current models are based on previous models that have evolved over time through different cultures.

VI: The Periodic Table

A. Arranging the Elements

1. Be able to use models, such as the periodic table, to explain properties, composition of matter.

B. Design of Periodic Table

1. Know that matter can be classified and described in terms of categories.
2. Know that the development of the periodic table had many contributors.

C. Chemical Families

1. Know that matter can be classified and described in terms of categories.
2. Be able to observe, describe, measure, classify, and predict common properties of substances.

D. Periodic Properties of the Elements

1. Be able to observe, describe, measure, classify and predict common properties of substances.

E. Cosmology

1. Know and understand the origin of elements.
2. Know that contributions to these theories have developed over a significant amount of time.

VII: Atoms and Bonding

A. Ionic Bonds

1. Identify factors that influence chemical interactions.
2. Know that matter has characteristic properties, which are related to its composition and structure.
3. Use models to explain changes in matter's atomic structure during bonding.

B. Covalent Bonds

1. Identify factors that influence chemical interactions.
2. Know that matter has characteristic properties, which are related to its composition and structure.
3. Use models to explain changes in matter's atomic structure during bonding.

VIII. Chemical Reactions

A. Nature of Chemical Reactions

1. Be able to observe, measure, and predict chemical changes.
2. Provide evidence for these changes with chemical equations.

B. Chemical Equations

1. Be able to observe, measure and predict chemical changes.
2. Provide evidence for these changes with chemical equations.

C. Types of Chemical Reactions

1. Identify and predict chemical changes by using chemical equations.

IX. Solution Chemistry

A. Acids and Bases and Salts

1. Be able to observe, predict, and measure the pH of a substance.
2. Identify and explain how the pH of water effects its quality.
3. Write chemical formulas in equations to represent matter and its changes.

X. Radioactive Elements

A. Introduction to Radioactive Elements

1. Be able to use models to explain and observe changes in radioactive elements.

B. Nuclear Reactions

1. Be able to observe, describe, measure, classify, and predict common properties of radioactive substances.
2. Be able to measure, calculate, and analyze quantities associated with nuclear energy.
3. Evaluate the impacts of natural events on human and natural systems.

C. Detecting Radioactivity

1. Select and use appropriate technologies to gather, process, and analyze data.
2. Be able to measure and analyze quantities associated with radioactivity.

D. Radiometric Dating

1. Use evidence to see how the earth has changed over periods of time.
2. Understand an exponential model.
3. Use graphs and equations to analyze a system and predict future events, identify and describe dynamics of a natural system.
4. Use computer to aid in this investigation.

2. INTRODUCTION TO PHYSICS

XI: Motion

A. Basics of Motion

1. Be able to observe and predict physical interactions, which result in changes in motion.

B. Frames of Reference

1. Be able to observe and describe changes in motion relative to a frame of reference.

C. Measuring Motion

1. Be able to describe and measure quantities that characterize a moving object.
2. Use computers to aid in investigation.
3. Use graphs to aid in analysis.

D. Changes in Velocity

1. Be able to observe, measure, and predict physical interactions, which result in changes in motion.
2. Use graphs and equations to analyze systems and extrapolate future events.
3. Use computers to aid in investigations.

E. Momentum

1. Be able to describe physical changes in terms of the law of conservation of energy.

XII Forces

A. Nature of Force

1. Be able to observe, measure, and predict physical interactions, which result in a change of force.

B. Friction

1. Be able to describe and measure quantities that characterize a moving object, such as friction.

.

C. Newton's Laws

1. Be able to describe and measure quantities that characterize a moving object, such as those applied in Newton's Laws.

D. Gravity/Law of Falling Bodies

1. Be able to describe and measure quantities associated with a falling body.
2. Use computers and graphs to aid in investigation.
3. Be able to describe the effects of gravitation on motions observed in the solar system and beyond.

XIII. Forces in Fluids

A. Charles' Law/ Boyle's Law

1. Be able to describe physical changes in terms of the conservation laws of matter and energy, using models to do so.

B. Fluid Pressure

1. Be able to observe, measure and predict physical interactions, which result in changes of fluid pressure.

2. Be able to describe factors that may influence weather and climate as a result of fluid pressure.

C. Hydraulic Devices, Pressure and Gravity, Buoyancy, Fluids in Motion

1. Be able to describe and measure quantities associated with fluids in motion.
2. Be able to measure and calculate quantities associated with energy transfer.

XIV. Work, Power, Simple Machines

A. Work/ Mechanical Advantage

1. Describe and measure quantities associated with doing work.
2. Describe physical changes in terms of the conservation laws.

B. Work

1. Be able to observe, measure and predict interactions, which result in changes in work.

C. Power

1. Be able to observe, measure and predict interactions, which result in changes in power.

D. Simple and Compound Machines

1. Describe and measure quantities associated with doing work, and how machines help humans.

XV. Waves

A. Nature of Waves, Characteristics of Waves

1. Be able to observe, describe and measure basic wave characteristics.

B. Types of Waves, Speed of Waves, Interaction of Waves

1. Apply the knowledge of waves to investigate the dynamic structure of Earth.

XV. Sound

A. Properties of Sound

1. Be able to describe and measure quantities that characterize sound.

B. Interactions of Sound Waves

1. Be able to describe and measure the interactions of sound wave.

C. Application of Sound

1. Be able to describe and measure sound waves and apply this knowledge.

XVII. Light & Electromagnetic Spectrum

A. Electromagnetic Waves

1. Be able to describe electromagnetic radiation produced by the sun and other stars.
2. Use the understanding of electromagnetic waves to gage the magnificent size of the solar system and universe.

B. The Electromagnetic Spectrum, Visible Light, Wave or Particle

1. Be able to measure, calculate and analyze quantities associated with energy transfer and transformation.
2. Understand that light is a form of energy.

XVIII. Energy

A. Types of Energy

1. Be able to identify, measure, calculate, and analyze quantities associated with energy forms, energy transfers, and energy transformations.

B. Kinetic & Potential

1. Be able to differentiate between various forms of potential and kinetic energy.
2. Describe and measure quantities that characterize moving objects.
3. Use computer to aid in investigation.

C. Energy Conversion

1. Be able to measure, calculate, and analyze quantities associated with energy transfer and transformation.
2. Analyze the cost, benefits, and consequences of natural resource consumption.

D. Energy Conversion Trails

1. Be able to describe physical and chemical changes in terms of the conservation laws of matter and energy.
2. Be able to explain the transfer of matter and energy between Earth's systems.
3. Describe how energy transfers within the atmosphere influences weather.

E. Conservation of Energy

1. Be able to measure, calculate and analyze quantities associated with energy transfer and transformation.
2. Know that matter and energy is transferred between Earth's systems.

XIX. Electric Charges and Currents

A. Electric Current

1. Be able to observe, describe, measure, and predict properties of electrical conductivity.

B. Static Electricity, Electric Circuits

1. Be able to measure, calculate, and analyze quantities associated with energy in the form of electricity.

XX. Magnetism

A. The Nature of Magnets

1. Be able to measure, calculate, and analyze quantities associated with energy in the form of magnetism.

B. The Earth as a Magnet

1. Be able to describe the composition and structure of the earth's interior.
2. Explain the transfer of matter and energy between the earth's systems.
3. Analyze the structure of and changes in the atmosphere and its significance for life on Earth.

XXI. Electromagnetism

A. Magnetism from Electricity, Electricity from Magnetism

1. Able to measure, calculate, and analyze quantities associated with energy transfer and transformation in regards to electricity and magnetism.

Boulder Valley School District
High School Science Curriculum

Course Code: S20 Physical Science Advanced

Course Title: PHYSICAL SCIENCE ADVANCED

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Physical Science Advanced is an inquiry-oriented course involving principles and concepts concerning the physical world. Content areas explored include nature and behavior of matter, atomic theory, chemical and physical changes including bonding and reactions, mechanics, electricity and magnetism, light and sound, and energy. The course emphasizes the study and proper use of fundamental science tools including the metric system, periodic table, graphing techniques and applied technologies. Laboratory activities reinforce concepts and principles presented. Physical Science Advanced places an emphasis on quantitative analysis whenever applicable in the curriculum. Physical Science Advanced requires substantial homework and the ability of a student to learn independently as well as cooperatively.

1. INTRODUCTION TO CHEMISTRY

I. The Framework of Science

A. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.

B. Tools of Science and Measurement

1. Use basic tools of measurement accurately.
2. Use the SI unit of measurement accurately.
3. Be able to convert between units.
4. Use computers and related technology in scientific investigations.
5. Emphasis on correct accuracy with significant figures.

C. The Process of Science

1. Understand the process of scientific investigation.
2. Be able to design conduct and evaluate a simple investigation.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

II. General Properties of Matter

A. Matter

1. Know that matter has characteristic properties that are related to its composition and structure.

B. Mass and Weight

1. Be able to observe, describe, and measure mass and weight.

C. Volume and Density

1. Be able to observe, describe, and measure volume.
2. Be able to observe, describe, and measure density.
3. Use graphs to aid in analysis.

III. Mixtures, Elements, and Compounds

A. Classes of Matter

1. Know that matter can be classified and described in terms of categories.

B. Elements, Mixtures, and Compounds

1. Recognize and be able to demonstrate the difference among mixtures, elements, and compounds.

IV. Physical and Chemical Changes

A. Phase Changes

1. Understand that interactions can produce changes in a system although the total quantities of matter and energy remain unchanged.
2. Use computers to aid in investigation.
3. Use graphs to aid in analysis.
4. Know that various states of matter exist in and on the Earth.

B. Chemical Properties and Changes

1. Be able to observe, measure, and predict chemical changes, providing evidence for these changes.
2. Use a model to test for changes

V. Atoms

A. An Atomic Model of Matter and the Structure of the Atom

1. Be able to use models, such as atomic structure, to explain properties, composition.
2. Observe changes in samples of matter.
3. Be aware that current models are based on previous models that have evolved over time through different cultures.
4. Develop a beginning understanding of Mole Theory and computations

VI: The Periodic Table

A. Arranging the Elements

1. Be able to use models, such as the periodic table, to explain properties, composition of matter.

B. Design of Periodic Table

1. Know that matter can be classified and described in terms of categories.
2. Know that the development of the periodic table had many contributors.

C. Chemical Families

1. Know that matter can be classified and described in terms of categories.
2. Be able to observe, describe, measure, classify, and predict common properties of substances.

D. Periodic Properties of the Elements

1. Be able to observe, describe, measure, classify, and predict common properties of substances

E. Cosmology

1. Know and understand the origin of elements.
2. Know that contributions to these theories have developed over a significant amount of time.

VII: Atoms and Bonding

A. Ionic Bonds

1. Be able to identify factors that influence interactions.
2. Know that matter has characteristic properties, which are related to its composition and structure.
3. Use models to explain changes in matter's atomic structure during bonding.
4. Use moles and chemical formulas in a computational manner.

B. Covalent Bonds

1. Be able to identify factors that influence chemical interactions.
2. Know that matter has characteristic properties that are related to its composition and structure.
3. Use models to explain changes in matter's atomic structure during bonding.
4. Use moles and chemical formulas in a computational manner.

VIII. Chemical Reactions

A. Nature of Chemical Reactions

1. Be able to observe, measure, and predict chemical changes.
2. Provide evidence for these changes with chemical equations.

B. Chemical Equations

1. Be able to observe, measure, and predict chemical changes.
2. Provide evidence for these changes with chemical equations.
3. Use moles and chemical in a computational manner.

C. Types of Chemical Reactions

1. Be able to identify and predict chemical changes by using chemical equations.

IX. Solution Chemistry

A. Acids and Bases and Salts

1. Be able to observe, predict, and measure the pH of a substance.
2. Identify and explain how the pH of water effects its quality.
3. Be able to write chemical formulas in equations to represent matter and its changes.
4. Mass Percent and molar solutions will be emphasized.

X. Radioactive Elements

A. Introduction to Radioactive Elements

1. Be able to use models to explain and observe changes in radioactive elements.

B. Nuclear Reactions

1. Be able to observe, describe, measure, classify, and predict common properties of radioactive substances.
2. Be able to measure, calculate, and analyze quantities associated with nuclear energy.
3. Evaluate the impacts of natural events on human and natural systems.

C. Detecting Radioactivity

1. Select and use appropriate technologies to gather, process, and analyze data.
2. Be able to measure and analyze quantities associated with radioactivity.

D. Radiometric Dating

1. Use evidence to see how the earth has changed over periods of time.
2. Understand an exponential model.
3. Use graphs and equations to analyze a system and predict future events, identify, and describe dynamics of a natural system.
4. Use computers to aid in this investigation.

2. INTRODUCTION TO PHYSICS

XI. Motion

A. Basics of Motion

1. Be able to observe and predict physical interactions, which result in changes in motion.

B. Frames of Reference

1. Be able to observe and describe changes in motion relative to a frame of reference.

C. Measuring Motion

1. Be able to describe and measure quantities that characterize a moving object.
2. Use computers to aid in investigation.
3. Use graphs to aid in analysis.

D. Changes in Velocity

1. Be able to observe, measure, and predict physical interactions, which result in changes in motion.
2. Use graphs and equations to analyze systems and extrapolate future events.
3. Use computers to aid in investigations.
4. Use vector analysis and resolution.

E. Momentum

1. Be able to describe physical changes in terms of the law of conservation of energy.

XII Forces

A. What is a force?

1. Be able to observe, measure, and predict physical interactions, which result in a change of force.

B. Friction

1. Be able to describe and measure quantities that characterize a moving object, such as friction.

C. Newton's Laws

1. Be able to describe and measure quantities that characterize a moving object, such as those applied in Newton's Laws.
2. Use trigonometric analysis and vector analysis.

D. Gravity/Law of Falling Bodies

1. Be able to describe and measure quantities associated with a falling body.
2. Use computers and graphs to aid in investigation.
3. Be able to describe the effects of gravitation on motions observed in the solar system and beyond.
4. Use trigonometric analysis and vector analysis

XIII. Forces in Fluids

A. Charles' Law/ Boyle's Law

1. Be able to describe physical changes in terms of the conservation laws of matter and energy, using models to do so.

B. Fluid pressure

1. Be able to observe, measure, and predict physical interactions, which result in changes of fluid pressure.
2. Be able to describe factors that may influence weather and climate as a result of fluid pressure.

C. Hydraulic Devices, Pressure & Gravity, Buoyancy, Fluids in Motion

1. Be able to describe and measure quantities associated with fluids in motion.
2. Be able to measure and calculate quantities associated with energy transfer.

XIV. Work, Power, Simple Machines

A. Work/ Mechanical Advantage

1. Describe and measure quantities associated with doing work.
2. Describe physical changes in terms of the conservation laws.

B. Work

1. Be able to observe, measure, and predict interactions, which result in changes in work.
2. Use trigonometric analysis and vector analysis.

C. Power

1. Be able to observe, measure, and predict interactions, which result in changes in power.
2. Use trigonometric analysis.

D. Simple and Compound Machines

1. Describe and measure quantities associated with doing work, and how machines help humans.

XV. Waves

A. Nature of Waves, Characteristics of Waves

1. Be able to observe, describe, and measure basic wave characteristics.

B. Types of Waves, Speed of Waves, Interaction of Waves

1. Apply the knowledge of waves to investigate the dynamic structure of the earth.

XV. Sound

A. What is Sound, Properties of Sound

1. Be able to describe and measure quantities that characterize sound.

B. Interactions of Sound Waves

1. Be able to describe and measure the interactions of sound wave.

C. Application of Sound

1. Be able to describe and measure sound waves and apply this knowledge.

XVII. Light and Electromagnetic Spectrum

A. Electromagnetic Waves

1. Be able to describe electromagnetic radiation produced by the sun and other stars.
2. Use the understanding of electromagnetic waves to gage the magnificent size of the solar system and universe.

B. The Electromagnetic Spectrum, Visible Light, Wave, or Particle

1. Be able to measure, calculate, and analyze quantities associated with energy transfer and transformation.
2. Understand that light is a form of energy.

XVIII. Energy

A. Types of Energy

1. Be able to identify, measure, calculate, and analyze quantities associated with energy forms, energy transfers, and energy transformations.

B. Kinetic and Potential

1. Be able to differentiate between various forms of potential and kinetic energy.
2. Describe and measure quantities that characterize moving objects.
3. Use computer to aid in investigation.

C. Energy Conversion

1. Be able to measure, calculate, and analyze quantities associated with energy transfer and transformation.
2. Analyze the cost benefits and consequences of natural resource consumption.

D. Energy Conversion Trails

1. Be able to describe physical and chemical changes in terms of the conservation laws of matter and energy.
2. Be able to explain the transfer of matter and energy between Earth's systems.
3. Describe how energy transfers within the atmosphere influences weather.

E. Conservation of Energy

1. Be able to measure, calculate, and analyze quantities associated with energy transfer and transformation.
2. Know that matter and energy is transferred between Earth's systems.

XIX. Electric Charges & Currents

A. Electric Current

1. Be able to observe, describe, measure, and predict properties of electrical conductivity.

B. Static Electricity, Electric Circuits

1. Be able to measure, calculate, and analyze quantities associated with energy in the form of electricity.

XX. Magnetism

A. The Nature of Magnets

1. Be able to measure, calculate, and analyze quantities associated with energy in the form of magnetism.

B. The Earth As a Magnet

1. Be able to describe the composition and structure of Earth's interior.
2. Explain the transfer of matter and energy between Earth's systems.
3. Analyze the structure of and changes in the atmosphere and its significance for life on Earth.

XXI. Electromagnetism

A. Magnetism From Electricity, Electricity From Magnetism

1. Able to measure, calculate, and analyze quantities associated with energy transfer and transformation in regards to electricity and magnetism.

INTEGRATED SCIENCE I

AND

INTEGRATED SCIENCE II

ARE STILL IN PROGRESS AND ARE BEING PILOTED

AT ARAPAHOE RIDGE HIGH SCHOOL

Boulder Valley School District
High School Science Curriculum

Course Code: S44 Introduction to Biology

1. Course Title: INTRODUCTION TO BIOLOGY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This one semester course provides the opportunity to develop knowledge and understanding about the relationships between the structure and function of organisms and the interaction of cells and organisms with each other and their environments over time. Units of study include 1) the process of science, including measurement and science safety; 2) the characteristics and chemical basis of life; 3) cytology; 4) genetics; 5) evolution; 6) taxonomy and classification; and 7) ecology. Laboratory activities reinforce concepts and principles presented in the course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct and evaluate an investigation.
2. Use the scientific method to solve problems.
3. Describe how the contributions of diverse individuals have affected scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement to convert between units.
4. Use technology to aid scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be infused throughout the year as the topics and essential aspects of biology are addressed.

II. Introduction to Biological Science

A. Characteristics of Life

1. Identify and understand the basic processes unique to life.
2. Use the life processes to differentiate living organisms from nonliving things.

III. Chemical Basis of Life

A. Fundamentals of Chemistry

1. Demonstrate an understanding of the structure of atoms.

B. Biochemistry

1. Explain the significance of carbon in biological molecules.

IV. Cell Biology

A. Structure and Function of Cells

1. Know that the cell is the basic unit of structure and function in living organisms and that cells come only from pre-existing cells.
2. Demonstrate a basic understanding of the Cell Theory.
3. Differentiate between prokaryotic and eukaryotic cells.
4. Understand the structure and functions of the major cell organelles. *(For example, describe the structure and function of a cell's nucleus.)*

B. Cell Energy

1. Describe the basic reaction of photosynthesis.
2. Describe the basic reaction of cellular respiration.
3. Describe how cellular respiration serves as a primary source of cellular energy.

C. DNA

1. Describe and model the structure and function of DNA.
2. Describe how various individuals contributed to the present model of DNA structure.
3. Explain the significance of DNA as the hereditary material.

V. Genetics

A. Meiosis

1. Compare and contrast the process of mitosis with meiosis.

B. Patterns of Inheritance

1. Calculate the probability that an individual will inherit particular traits using Mendel's Laws.
2. Recognize that there are various modes of inheritance.
3. Describe various types of genetic disorders and their treatments.

VI. Evolution

A. Origin of Life

1. Describe changes in the composition of the atmosphere and their significance for the presence and development of life on Earth.

B. Evidence for Evolution

1. Identify evidence (continental drift, fossil record, radioactive dating, morphological and biochemical evidence) that the earth and its organisms have changed over long periods of time.

C. Mechanisms of Evolution

1. Predict and describe the effect on an organism when its environment is altered.
2. Explain that adaptations affect how an organism lives in its environment.

VII. Unity and Diversity of Life

A. Taxonomy

1. Use one or more systems to classify organisms in terms of their evolutionary origins.

B. Microbiology

1. Compare and contrast the following four domains: viruses, bacteria, protists, and fungi.
2. Describe disorders caused by pathogens in each group.

C. Plants and Animals

1. Compare anatomical structures among different types of plants.
2. Compare body structures and systems among different types of animals including humans.
3. Describe basic processes for maintaining homeostasis.
4. Describe the process and types of reproduction in different types of plants.
5. Describe the process and types of reproduction and development in different animals including humans.

VIII. Ecology

A. Biosphere

1. Diagram how water, carbon, oxygen, and nitrogen are recycled through the environment.
2. Explain how energy flows throughout an ecosystem.
3. Describe biotic and abiotic factors that define and limit various biomes.

B. Populations and Communities

1. Identify patterns of population growth using graphical analysis.
2. Describe the factors that affect population growth and determine carrying capacity.
3. Describe the flow of matter and energy through the trophic levels.

C. Human Impact

1. Graph patterns of human population growth and consider its effects on the biosphere.
2. Describe how human beings and technology both positively and negatively affect the environment.
3. Explain how various pollutants affect the biosphere and consider their long-term effect.
4. Explain how biodiversity is essential to the health of the biosphere.

Boulder Valley School District
High School Science Curriculum

Course Code: S47 Introduction to Earth Science

Course Title: INTRODUCTION TO EARTH SCIENCE

OUTLINE OF TOPICS AND CONTENT OF INSTRUCTION

This one semester course provides the opportunity to develop knowledge and understanding of the structure, process, interactions and dynamics of the Earth and other objects in space. Units of study include 1) the process of science as well as measurement and science safety; 2) geology; 3) meteorology; 4) hydrology; and 5) astronomy and planetary science. Laboratory activities and field activities reinforce concepts and principles presented in the course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct and evaluate an investigation.
2. Use the scientific method to solve problems.
3. Describe how the contributions of diverse individuals have affected scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes, telescopes, and other scientific equipment.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement to convert between units.
4. Use technology to aid scientific investigations and research.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and delicate specimens and equipment.

Note: These topics and learning results will be infused throughout the year as the topics and essential aspects of earth science are addressed.

II. Geology

A. Composition/Structure of the Earth

1. Describe the earth's layers and their chemical/petrologic composition.
2. Identify common minerals using a variety of mineral properties.
3. Identify the three rock types, their compositions, and how they form in the context of the rock cycle.
4. Differentiate between the processes of erosion and weathering and identify the products of each.
5. Demonstrate knowledge of fault and fold types and the mechanisms of their formation.

B. Geologic History

1. Construct a geologic time scale and identify important events throughout geologic time.
2. Use relative dating techniques (fossils, sedimentary structures, cross-cutting relationships) to identify a sequence of geologic events.
3. Use absolute dating (radiometric dating) techniques to identify the actual age of geologic events and substances.

C. Natural Resources

1. Differentiate between renewable and nonrenewable resources.

D. Plate Tectonics

1. Discuss the scientific theories (continental drift, sea floor spreading) that led to plate tectonics theory.
2. Show the three main plate tectonic settings and the structures that occur there.
3. Describe the consequences of plate tectonics and its effects on humans. *(For example, explain how earthquakes and volcanoes occur, why they are where they are, and their potential for destruction of life and property.)*
4. Illustrate the rock cycle in terms of plate tectonics.

III. Meteorology

A. Weather and Human Activities

1. Differentiate between climate and weather.
2. Explain the relationship between meteorological phenomena and other natural processes such as flooding, landslides, and avalanches.
3. Describe methods meteorologists use to predict weather and explain the significance of weather maps and their symbols.

B. Earth's Atmosphere

1. Illustrate the structure and describe the composition of the atmosphere.

C. Physical Processes in the Atmosphere

1. Describe how isolation produces weather.
2. Explain the processes of conduction and convection with respect weather phenomena.
3. Illustrate the water cycle and describe how phase changes in water produce various types of weather.
4. Describe the formation of wind and storms.

IV. Physical Oceanography

A. Relationship of Hydrosphere to Other Earth Systems.

1. Show the distribution of the earth's waters.
2. Describe the chemical composition and physical properties of the earth's waters.
3. Identify the major sea floor structures and how they relate to lithospheric processes.
4. Show how the water cycle affects distribution and populations in the biosphere.

B. Ocean Dynamics

1. Explain the distribution of ocean currents and how the currents circulate.
2. Explain the formation and structure of waves.
3. Explain how the moon and the sun control the formation of ocean tides.

V. Astronomy/Planetary Science

A. Celestial Motions

1. Explain the Earth's place in the solar system and how the earth moves relative to the rest of the solar system.
2. Describe what earth motions and geometry control the length of days and the timing of seasons.
3. Describe the phases of the Moon.

B. Solar System Components and Celestial Motion

1. Describe how gravity effects motion in the solar system.
2. Describe the general composition and structure of the solar system (inner terrestrial planets, outer gas giants).
3. Identify the planets and moons that comprise the solar system and explain the important properties and features of each.
4. Explain the formation and significance of comets, asteroids, and meteoroids, and predict the potential for impacts from celestial bodies and the possible effects of such collisions in space.

C. Space Technology and Exploration

1. Describe the history of space exploration ranging from satellites and moon landings to current efforts to build an international space station.
2. List several of the technological offshoots of space exploration.

E. Evolution of the Universe and Our Solar System Through Time

1. Describe the Big Bang theory as a basis for the origin of the universe.
2. Explain the formation of nebulae and galaxies.
3. Characterize the formation of the solar system and planetary accretion.

F. Astronomical Measurements

1. Describe light years as a means of measuring distances between stars.
2. Explain how astronomical units are utilized to depict distances between planets.

G. Stars

1. Identify the star types.
2. Explain the evolution and formation of stars.
3. Indicate the composition and properties of stars.

Boulder Valley School District
High School Science Curriculum

Course Code: S31 Biology

Course Title: BIOLOGY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This class provides the opportunity to acquire knowledge and understanding about the relationships between the structure and function of organisms and the interaction of cells and organisms with each other and their environments over time. Units of study include: the process of science, including measurement and science safety; the characteristics and chemical basis of life; cell biology; genetics; evolution, taxonomies and classification; and, ecology. Laboratory activities reinforce concepts and principles presented in the course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units.
4. Use computers and related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be infused throughout the year as the topics and essential learnings of biology are addressed.

II. Introduction to Biological Science

A. Characteristics of Life

1. Identify and demonstrate an understanding of the characteristics of life.
2. Use the characteristics of life to differentiate living organisms from nonliving things.
3. Demonstrate an understanding of the complexity of differentiating between living and non-living things.

III. Chemical Basis of Life

A. Fundamentals of Chemistry
1. Demonstrate an understanding of the structure of atoms.
2. Describe the three major types of bonds (ionic, covalent, hydrogen) in biological molecules.
3. Use the pH scale to identify acids and bases and be able to describe their significance in biological systems.

B. Biochemistry
1. Explain the significance of carbon in biological molecules.
2. Identify monomers that comprise the organic polymers in cells.
3. Identify carbohydrates, lipids, proteins, and nucleic acids by structural formula.
4. Identify the roles of the four types of organic molecules in living organisms.

IV. Cell Biology

A. Structure and Function of Cells

1. Know that the cell is the basic unit of structure and function in living organisms and that cells come only from pre-existing cells.
2. Demonstrate an understanding of the Cell Theory.
3. Differentiate prokaryotic and eukaryotic cells.
4. Describe and model the structure and functions of cell organelles.
5. Understand that cells differentiate to perform specific tasks and how those tasks support the organism and are interdependent.
6. Describe the function of transport mechanisms (diffusion, osmosis, and active transport) and their role in maintaining homeostasis.
7. Describe the relationship and interactions among molecules, organelles, cells, tissues, organs, systems, and organisms.

B. Cell Energy

1. Describe the basic reaction of photosynthesis (reactants and products).
2. Describe how photosynthesis converts light energy to usable chemical energy.
3. Describe the basic reaction of cellular respiration (reactants and products).
4. Describe cellular respiration and identify how it serves as a primary source of cellular energy.
5. Compare and contrast energy reactions in both aerobic and anaerobic processes.

C. DNA and Protein Synthesis

1. Describe and model the structure and function of DNA.
2. Describe how the contributions of various individuals contributed to the present model of DNA structure.
3. Explain the significance of DNA as the hereditary material.
4. Describe the mechanism for genetic continuity (DNA replication).
5. Describe and/or model the process of protein synthesis (transcription and translation).

D. Cell Cycle

1. Describe the processes of mitosis and cytokinesis and how they relate to the cell cycle.
2. Describe how aging and cancer relate to the process of cell division.

V. Genetics

A. Meiosis

1. Compare and contrast the process of mitosis (somatic cell division) with meiosis (gamete production).
2. Describe chromosomal disorders and their treatments.

B. Patterns of Inheritance

1. Calculate the probability that an individual will inherit particular traits using Mendel's Laws (mono and de-hybrid crosses).
2. Demonstrate an understanding of the various modes of inheritance.
3. Describe various types of genetic disorders and their treatments.

C. Genetic Engineering

1. Describe the chemical and structural properties of DNA and its role in specifying the characteristics of an organism.
2. Describe how the genetic makeup of organisms can be altered by the insertion of DNA or RNA.

D. Bioethics

1. Provide examples to show that some gene expression can be affected by interaction with the environment.
2. Understand how the introduction of new biotechnology has affected or could affect human activity.
3. Understand how human attitudes and values have impacted the development and introduction of new biotechnology.

VI: Evolution

A. Origin of Life

1. Describe changes in the composition of the atmosphere and their significance for the presence and development of life on Earth.

B. Evidence for Evolution

1. Identify evidence (continental drift, Darwin's voyage, fossil record, radioactive dating, morphological and biochemical evidence) that the earth and its organisms have changed over long periods of time.

C. Mechanisms of Evolution

1. Predict and describe the effect on an organism when its environment is altered.
2. Explain that adaptations affect how an organism lives in its environment.
3. Describe how DNA serves as the vehicle for genetic continuity and the source of genetic diversity upon which natural selection can act.
4. Describe how species changed through time due to evolutionary mechanisms (geographic isolation, genetic drift, natural selection, convergent and divergent evolution).
5. Explain why variation within a population improves the chances that the species will survive under new environmental conditions.

VII: Unity and Diversity of Life

A. Taxonomy

1. Use one or more systems to classify organisms in terms of their evolutionary origins.

B. Viruses

1. Describe viral structure and reproduction.
2. Describe disorders caused by pathogens of this group.

C. Bacteria

1. Describe the processes of nutrition, reproduction, and growth patterns in bacteria.
2. Describe disorders caused by pathogens in this group.

D. Protists

1. Compare cellular structures among different types of protists.
2. Describe basic processes for maintaining homeostasis.

E. Fungi

1. Describe basic fungal structure and processes of nutrition and reproduction.
2. Describe the positive and negative impacts of members of this group on the biosphere.

F. Plants

1. Compare anatomical structures among different types of plants.
2. Describe basic processes for maintaining homeostasis.
3. Describe the process and types of reproduction in different types of plants.

G. Animals

1. Compare body structures and systems among different types of animals including humans.
2. Describe basic processes for maintaining homeostasis.
3. Describe the process and type of reproduction and development in different types of animals including humans.

VIII: Ecology

A. Biosphere
   1. Diagram how water, carbon, oxygen, and nitrogen are recycled through the environment.
   2. Explain how energy flows throughout an ecosystem.
   3. Describe biotic and abiotic factors that define and limit various biomes.

B. Populations and Communities

   1. Describe patterns of population growth using graphical analysis.
   2. Describe the factors that affect population growth and determine carrying capacity.
   3. Describe the flow of matter and energy through the trophic levels.

C. Human Impact

   1. Graph patterns of human population growth and consider its effects on the biosphere.
   2. Describe how human beings and technology both positively and negatively impact the environment.
   3. Explain how various pollutants affect the biosphere and consider their long-term impact.
   4. Explain how biodiversity is essential to the health of the biosphere.

Boulder Valley School District
High School Science Curriculum

Course Code: S27 Core Biology

Course Title: CORE BIOLOGY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Core Biology is designed to provide students with an overview of the core content of the biological sciences. The scope of the course is similar to that of Biology but depth and complexity of vocabulary have been reduced. Students, however, may choose to expand their knowledge and understanding of the concepts covered in the course. Units of study include: the process of science, including measurement and science safety; the characteristics and chemical basis of life; biochemistry; cell biology; genetics; evolution; taxonomy and classification; and ecology. Laboratory activities reinforce concepts and principles presented in the course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately.
4. Use computers to extend knowledge in the course of scientific investigations.

C. Safety in the Science Classroom

1. Know and follow current and appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be integrated throughout the year as the topics and essential learnings of biology are addressed.

II. Introduction to Biological Science

A. Characteristics of Life

1. Identify and demonstrate an understanding of the characteristics of life.
2. Use the characteristics of life to differentiate living organisms from nonliving things.

III. Chemical Basis of Life

A. Fundamentals of Chemistry

1. Demonstrate an understanding of the structure of atoms.
2. Describe the two major types of bonds (ionic, covalent) in biological molecules.
3. Use the pH scale to identify acids and bases and be able to describe their significance in biological systems (Acid rain).

B. Biochemistry

1. Identify monomers that comprise the organic polymers in cells.
2. Identify carbohydrates, lipids, proteins, and nucleic acids by structural formula.
3. Identify the roles of the four types of organic molecules in living organisms.
4. Discuss a model for enzyme substrate interactions.
5. Discuss factors that impact how enzymes alter reaction rates (Temperature, pH).

IV. Cell Biology

A. Structure and Function of Cells

1. Know that the cell is the basic unit of structure and function in living organisms and that cells come only from pre-existing cells.
2. Demonstrate an understanding of the Cell Theory.
3. Differentiate between prokaryotic and eukaryotic cells.
4. Describe and model the structure and functions of cell organelles.
5. Understand that cells differentiate to perform specific tasks and how those tasks support the organism and are interdependent.
6. Describe the fluid mosaic model of the plasma membrane.
7. Describe the function of transport mechanisms (diffusion, osmosis, and active transport).

8. Describe the processes that occur in cells that produce energy.
9. Describe the hierarchy of structure and function in living organisms.

B. Cell Energy

1. Describe the basic reaction for photosynthesis including the organelles involved.
2. Describe the basic reaction of cellular respiration (reactants and products).
3. Compare and contrast energy production in aerobic and anaerobic respiration.

C. DNA and Protein Synthesis

1. Describe and model the structure and function of DNA.
2. Describe how the contributions of various individuals contributed to the present model of DNA structure.
3. Explain the significance of DNA/RNA as the hereditary material.
4. Describe the mechanism for genetic continuity (DNA replication).
5. Describe and/or model the process of protein synthesis (transcription and translation).
6. Discuss various forms of chromosomal and gene mutation.

D. Cell Cycle

1. Demonstrate an understanding of the cell cycle and its components (interphase, mitosis, and cytokinesis).
2. Describe how aging and cancer relate to the process of cell division.

V. Genetics

A. Meiosis

1. Compare and contrast the process of mitosis (somatic cell division) with meiosis (gamete production).
2. Explain the role of crossing-over in genetic diversity.
3. Explain meiotic chromosomal disorders.

B. Patterns of Inheritance

1. Calculate the role of probability in the inheritance of particular traits using Mendel's Laws (mono and de-hybrid crosses).
2. Demonstrate an understanding of the various modes of inheritance.
3. Classify common genetic disorders based on the form of inheritance.

C. Genetic Engineering

1. Describe the chemical and structural properties of DNA and its role in specifying the characteristics of an organism.
2. Explain how the environment affects phenotypic expression.
3. Explain the impact that genomic research could have or has had on present day society.

D. Bioethics

1. Understand how the introduction of new biotechnology has affected or could affect human activity.
2. Understand how human attitudes and values have impacted the development and introduction of new biotechnology.
3. Discuss the ethical implications of genetically manipulating life forms to generate new species.

VI: Evolution

A. Origin of Life

1. Describe changes in the composition of the atmosphere and their significance for the presence and development of life on Earth.
2. Discuss the contributions of individuals, such as Oparin and Miller to our present understanding of how life could have evolved on primitive earth.

B. Evidence for Evolution

1. Identify evidence (continental drift, Darwin's observation, fossil record, radioactive dating, morphological and biochemical evidence) that the earth and its organisms have changed over long periods of time.

C. Mechanisms of Evolution

1. Predict and describe the effect on an organism when its environment is altered.
2. Explain that adaptations affect how an organism lives in its environment.
3. Describe how natural selection serves as a mechanism for evolution.
4. Describe how species changed through time due to evolutionary mechanisms (geographic isolation, natural selection, artificial selection).
5. Explain why variation within a population improves the chances that the species will survive under new environmental conditions.

VII: Unity and Diversity of Life

A. Taxonomy

1. Use a current system to classify organisms in terms of their evolutionary origins.
2. Explain why we classify living organisms.

B. Viruses

1. Describe viral structure, mode of infection and reproduction.
2. Describe disorders caused by pathogens in this group.

C. Bacteria

1. Describe the processes of nutrition, reproduction, and growth patterns in bacteria.
2. Describe the positive and negative impacts of bacteria on society.
3. Describe disorders caused by pathogens in this group.
4. Describe the different modes through which bacteria cause disease.
5. Explain how bacterial evolution has affected the efficacy of many antibiotics.

D. Protists

1. Contrast various protist including their cellular structure and their habitats.
2. Discuss the environmental and socioeconomic impact of protists (Malaria, red tides, African sleeping sickness).

E. Fungi

1. Describe basic fungal structure and processes of nutrition and reproduction.
2. Describe the positive and negative impacts of members of this group on the biosphere.

F. Plants

1. Describe the various characteristics of members of the Plantae kingdom.
2. Explain the adaptations developed by plants in order to adapt to life on land.
3. Describe the process and types of reproduction in different types of plants.

G. Animals

1. Compare body structures and systems among different types of animals including humans.
2. Describe basic processes for maintaining homeostasis.
3. Describe the process and type of reproduction and development in different types of animals including humans.

VIII: Ecology

A. Biosphere

1. Diagram how water, carbon, oxygen, and nitrogen are cycled through the environment.
2. Explain how energy flows throughout an ecosystem.
3. Describe biotic and abiotic factors that define and limit various biomes.

B. Populations and Communities

1. Describe patterns of population growth using graphical analysis.
2. Describe the factors that affect population growth and determine carrying capacity.
3. Describe the flow of matter and energy through the trophic levels (food webs and chains).

C. Human Impact

1. Graph patterns of human population growth and consider its effects on the biosphere.
2. Describe how human beings and technology both positively and negatively impact the environment (deforestation, ozone depletion, greenhouse effect, loss of species, decreasing emissions, conservation, environmental restoration).
3. Explain how biodiversity is essential to the health of the biosphere.

Boulder Valley School District
High School Science Curriculum

Course Code: S39 Biology Advanced

Course Title: BIOLOGY ADVANCED

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This class provides the opportunity to acquire in depth knowledge and understanding about the relationships between the structure and function of organisms and the interaction of cells and organisms with each other and their environments over time. Units of study include: The process of science, including measurement and science safety; the characteristics and chemical basis of life; biochemistry; cell biology; genetics; evolution; taxonomy and classification; immunology and disease; and ecology. These units of study are developed in more depth than in regular Biology (S31). Laboratory activities reinforce concepts and principles presented in the course. Biology Advanced requires substantial homework and the ability of the student to learn independently as well as cooperatively.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units by employing dimensional analysis.
4. Use computers and related technology (ex. Probe ware/Simulations) in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow current appropriate laboratory and safety procedures.

2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be integrated throughout the year as the topics and essential learnings of biology are addressed.

II. Introduction to Biological Science

A. Characteristics of Life

1. Identify and demonstrate an understanding of the characteristics of life.
2. Use the characteristics of life to differentiate living organisms from nonliving things.
3. Demonstrate an understanding of the complexity of differentiating between living and non-living things.
4. Discuss and debate organisms often described as 'borderline' cases of life (Viroids, virus, prions, seeds).

III. Chemical Basis of Life

A. Fundamentals of Chemistry

1. Demonstrate an understanding of the structure of atoms.
2. Describe the three major types of bonds (ionic, covalent, hydrogen) in biological molecules.
3. Use the pH scale to identify acids and bases and be able to describe their significance in biological systems.
4. Discuss the role of buffers in homeostasis.
5. Define the chemical roles of acids and bases.

B. Biochemistry

1. Explain the significance of carbon in biological molecules.
2. Identify monomers that comprise the organic polymers in cells.
3. Identify carbohydrates, lipids, proteins, and nucleic acids by structural formula.
4. Identify the roles of the four types of organic molecules in living organisms.
5. Discuss the induced fit model for enzyme substrate interactions.
6. Discuss factors that impact how enzymes alter reaction rates (Temperature, pH).

IV. Cell Biology

A. Structure and Function of Cells

1. Know that the cell is the basic unit of structure and function in living organisms and that cells come only from pre-existing cells.
2. Demonstrate an understanding of the Cell Theory.
3. Differentiate between prokaryotic and eukaryotic cells.
4. Describe how the relationship between volume and surface area limits cell size.
5. Describe and model the structure and functions of cell organelles.
6. Discuss the endomembrane system including the organelles involved and their specific tasks
7. Explain the endosymbiont hypothesis.
8. Understand that cells differentiate to perform specific tasks and how those tasks support the organism and are interdependent.
9. Describe the fluid mosaic model of the plasma membrane.
10. Describe the function of transport mechanisms (diffusion, osmosis, and active transport) and their role in maintaining homeostasis.
11. Describe the processes that occur in cells that produce energy.
12. Describe the relationship and interactions among molecules, organelles, cells, tissues, organs, systems, and organisms.

B. Cell Energy

1. Describe the reactants, products, and organelles involved in photosynthesis.
2. Contrast the light and dark reactions on the basis of their reactants and products.
3. Describe the basic reaction of cellular respiration (reactants and products).
4. Describe the reactants, products, and organelles involved in glycolysis, Krebs cycle, and the electron transport chain (chemiosmosis).
5. Discuss fermentation and oxygen debt.
6. Compare and contrast energy production in aerobic and anaerobic respiration.

C. DNA and Protein Synthesis

1. Describe and model the structure and function of DNA.
2. Describe how the contributions of various individuals contributed to the present model of DNA structure.
3. Explain the significance of DNA/RNA as the hereditary material.
4. Discuss the enzymatic role of RNA.
5. Describe the mechanism for genetic continuity (DNA replication).

6. Describe and/or model the process of protein synthesis (transcription and translation).
7. Discuss various forms of chromosomal and gene mutation.

D. Cell Cycle

1. Describe the processes of binary fission and conjugation in prokaryotes.
2. Demonstrate an understanding of the cell cycle and its components (interphase, mitosis, and cytokinesis).
3. Describe how aging and cancer relate to the process of cell division.

V. Genetics

A. Meiosis

1. Compare and contrast the process of mitosis (somatic cell division) with meiosis (gamete production).
2. Explain the role of crossing-over in genetic diversity and evolution.
3. Contrast spermatogenesis and oogenesis.
4. Explain meiotic chromosomal disorders.

B. Patterns of Inheritance

1. Calculate the role of probability in the inheritance of particular traits using Mendel's Laws (mono and de-hybrid crosses).
2. Demonstrate an understanding of the various modes of inheritance.
3. Describe various types of genetic disorders and their treatments.

C. Genetic Engineering

1. Describe the chemical and structural properties of DNA and its role in specifying the characteristics of an organism.
2. Explain how the environment affects phenotypic expression.
3. Describe how the genetic makeup of organisms can be altered by the insertion of DNA or RNA.
4. Explain the impact that genomic research could have or has had on present day society.

D. Bioethics

1. Explain the role of DNA in determining the path and origins of human life.
2. Understand how the introduction of new biotechnology has affected or could affect human activity.

3. Understand how human attitudes and values have impacted the development and introduction of new biotechnology.
4. Discuss the impact of DNA technology on the criminal justice system.
5. Understand the processes of PCR, electrophoresis, and related technologies.
6. Discuss the ethical implications of genetically manipulating life form to generate new species.

VI: Evolution

A. Origin of Life

1. Describe changes in the composition of the atmosphere and their significance for the presence and development of life on Earth.
2. Discuss the contributions of individuals, such as Oparin, Miller, Urey and Fox, to our present understanding of how life could have evolved on primitive earth.

B. Evidence for Evolution

1. Identify evidence (continental drift, Darwin's observation, fossil record, radioactive dating, morphological and biochemical evidence) that the earth and its organisms have changed over long periods of time.

C. Mechanisms of Evolution

1. Predict and describe the effect on an organism when its environment is altered.
2. Explain that adaptations affect how an organism lives in its environment.
3. Describe how DNA serves as the vehicle for genetic continuity and the source of genetic diversity upon which natural selection can act.
4. Describe how species changed through time due to evolutionary mechanisms (geographic isolation, genetic drift, natural selection, artificial selection convergent and divergent evolution).
5. Explain why variation within a population improves the chances that the species will survive under new environmental conditions.
6. Consider the various explanations for the process of evolution (Gradualism, punctuated equilibrium).

VII: Unity and Diversity of Life

A. Taxonomy

1. Use one or more current systems to classify organisms in terms of their evolutionary origins.
2. Create and employ dichotomous keys.

B. Viruses

1. Describe viral structure, mode of infection and reproduction.
2. Contrast Lytic and Lysogenic cycles.
3. Describe disorders caused by pathogens in this group.

C. Bacteria

1. Describe the processes of nutrition, reproduction, and growth patterns in bacteria.
2. Describe the positive and negative impacts of bacteria on society.
3. Describe methods used to identify and differentiate bacteria (Gram staining).
4. Describe disorders caused by pathogens in this group.
5. Describe the different modes through which bacteria cause disease.
6. Explain how bacterial evolution has affected the efficacy of many antibiotics.

D. Protists

1. Contrast various protist including their cellular structure and their habitats.
2. Describe basic processes for maintaining homeostasis in protists.
3. Discuss the environmental and socioeconomic impact of protests (Malaria, red tides, African sleeping sickness).

E. Fungi

1. Describe basic fungal structure and processes of nutrition and reproduction.
2. Describe the positive and negative impacts of members of this group on the biosphere.

F. Plants

1. Contrast bryophytes and tracheophytes.
2. Explain why a vascular system was essential in the evolution of tracheophytes.

3. Contrast angiosperms and gymnosperms.
4. Contrast monocots and dicots.
5. Describe why angiosperms were so highly successful on land.
6. Describe basic processes for maintaining homeostasis.
7. Describe the process and types of reproduction in different types of plants.

G. Animals

1. Compare body structures and systems among different types of animals including humans.
2. Describe basic processes for maintaining homeostasis.
3. Describe the process and type of reproduction and development in different types of animals including humans.

VIII: Ecology

A. Biosphere

1. Diagram how water, carbon, oxygen, and nitrogen are recycled through the environment.
2. Explain how energy flows throughout an ecosystem.
3. Describe biotic and abiotic factors that define and limit various biomes.

B. Populations and Communities

1. Describe patterns of population growth using graphical analysis.
2. Describe the factors that affect population growth and determine carrying capacity.
3. Describe the flow of matter and energy through the trophic levels.

C. Human Impact

1. Graph patterns of human population growth and consider its effects on the biosphere.
2. Describe how human beings and technology both positively and negatively impact the environment (deforestation, ozone depletion, greenhouse effect, loss of species, decreasing emissions, conservation, environmental restoration).
3. Explain how various pollutants affect the biosphere and consider their long-term impact.
4. Explain how biodiversity is essential to the health of the biosphere.

Boulder Valley School District
High School Science Curriculum

Course Code: S50 Chemistry

Course Title: CHEMISTRY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This course provides the opportunity to develop knowledge and understanding about the relationships between the structure and properties of matter and the interaction of mass and energy. Units of study include: matter and its changes, atomic structure, chemical composition, nomenclature, reactions, stoichiometry, gas laws, periodicity, bonding, molecular geometry, and thermochemistry. Laboratory activities reinforce concepts and principles presented in the course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Develop, evaluate, and/or apply a conceptual model both mathematical and descriptive.
4. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of laboratory equipment.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units using dimensional analysis.
4. Write and use chemical equations to represent matter and its changes.
5. Describe sources of error in investigation and report results with the appropriate number of significant figures.
6. Use computers and/or related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.

2. Know and follow precautions necessary when working with laboratory tools and chemicals.

Note: These topics and learning results will be infused throughout semester the year as the topics and essential learning of chemistry are addressed.

II. Topics and Content

A. Structure of Matter

1. Compare and contrast physical and chemical changes.
2. Know physical and chemical methods used to separate mixtures based on the properties of the substances.
3. Atomic theory and atomic structure.
   a. Describe evidence for the modern view of atomic theory.
   b. Calculate atomic number and mass number of isotopes.
   c. Calculate the average atomic mass of an element.
   d. Explain observations of atomic spectra using modern atomic theory, including electron energy levels, atomic orbitals, and electron configurations.
   e. Describe the periodic relationships of elements based on the following properties: atomic radii, ionization energies, electronegativity, and oxidation states.

B. Nomenclature and Chemical Bonding

1. Determine chemical formulas from ions and from the names of substances.
2. Name substances given IUPAC formulas.
3. Binding forces.
   a. Discriminate between ionic compounds and covalently bonded molecules based on the electronegativity differences between the atoms in the compound.
   b. Understand the continuum between purely non-polar covalent, polar covalent and ionic substances.
   c. Describe the nature of intermolecular attractive forces: dispersion forces, hydrogen bonding, dipole-dipole interactions and Van der Waals interactions.
   d. Distinguish between a chemical bond and an intermolecular attractive force.
   e. Explain certain observations of chemical and physical properties according to the nature of bonding within the substance.

4. Molecular Models
   a. Use models to represent relationships of atoms in substances.
   b. Represent positions of electrons in compounds using Lewis

Structures, including the concept of resonance structures.

c. Use VSEPR (Valence Shell Electron Pair Repulsion Theory) to represent the three-dimensional geometry of atoms in covalently bonded substances.

C. States of Matter

1. Gases
   a. Examine observations relating pressure, temperature and volume of a gas using Charles', Boyle's, Dalton's, Avagadro's, and the combined gas laws.
   b. Compare the behavior of an Ideal gas to a real gas.
      i. Apply the ideal gas law to problems involving gases near ideal conditions.
      ii. Describe deviations of real gases from the ideal gas law.
2. Kinetic-molecular Theory
   a. Describe solids, liquids and gases using kinetic-molecular theory.
   b. Interpret gas behavior on the basis of kinetic-molecular theory.
   c. Use kinetic-molecular theory to explain the pressure of gases and the dependence of the kinetic energy of molecules on temperature.
3. Solutions
   a. Describe types of solutions and factors affecting solubility of solutes in solvents.
   b. Calculate the concentration of solutions using molarity and percent by mass.

D. Chemical Reactions

1. Reactions types
   a. Describe, give examples of and predict products for different types of reactions: syntheses, decomposition, single replacement, double replacement and combustion.
   b. Acid-base reactions
      i. Define and compare concepts of acids and bases according to Arrhenius and Bronsted-Lowry.
      ii. Perform a neutralization reaction between an acidic and a basic substance.
2. Stoichiometry
   a. Be able to represent ionic and molecular species present in chemical systems using a chemical equation.
   b. Explain Avogadro's hypothesis and the mole concept.
   c. Balance chemical equations to illustrate mole ratios and conservation of mass in a chemical reaction.
   d. Calculate the mass and volume relationships of substances with emphasis on the mole concept, including percent composition, empirical formulas, limiting reactants and percent yield.

3. Equilibrium
   a. Observe and explain the concept of dynamic equilibrium in both physical and chemical systems.
   b. Observe and explain Le Chatelier's Principle as it applies to a chemical system.
   c. Predict shifts in the concentrations of substances in equilibrium.
   d. Write the equilibrium expression for a given reaction and be able to solve for concentrations of substances and/or the equilibrium constant.
4. Kinetics
   a. Explain the concept of Rate of Reaction.
   b. Observe the effect of temperature change on the rate of reaction and explain using kinetic-molecular theory.
   c. Define the Energy of Activation and use it to explain the role of catalysts in a chemical reaction.
5. Thermochemistry
   a. Describe different forms of energy and their interconversions.
   b. Calculate enthalpy change in a chemical reaction.
   c. Use calorimetry to calculate the specific heat of a substance and the amount of heat change in a chemical reaction.
6. Descriptive Chemistry
   a. Describe relative chemical reactivity of substances and predict the products of chemical reactions.

III. Chemical Calculations

A. Calculate the percentage composition of an element or compound in a substance, percent yield, and percent error.

B. Calculate the empirical formula and molecular formula of a substance from experimental data.

C. Calculate the molar mass of a gas from its measured density.

D. Use gas laws, including the ideal gas law, to calculate the volume, pressure, temperature, or the molar amount of a gas.

E. Use mole ratios in a balanced chemical equation to determine stoichiometric relations of reactants and products including titration calculations.

F. Calculate concentrations of substances using mole fractions and molarity.

G. Determine the speed and concentrations of substances in a chemical reaction using kinetics.

Boulder Valley School District
High School Science Curriculum

Course Code: S51 Chemistry Advanced

Course Title: CHEMISTRY ADVANCED

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Chemistry Advanced is a first year chemistry course that includes more independent thinking and laboratory work than S50 Chemistry. As with the Chemistry course, this course provides the opportunity to develop knowledge and understanding about the relationships between the structure and properties of matter and the interaction of mass and energy. Units of study include: matter and its changes, atomic structure, chemical composition, nomenclature, reactions, stoichiometry, gas laws, periodicity, bonding, molecular geometry, and thermochemistry. Laboratory activities reinforce concepts and principles presented in the course. Additionally, more depth of understanding is expected of students than in the Chemistry course. The culminating activity is an independent research project.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Develop, evaluate, and/or apply a conceptual model both mathematical and descriptive.
4. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of laboratory equipment.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units using dimensional analysis.
4. Write and use chemical equations to represent matter and its changes.
5. Describe sources of error in investigation and report results with the appropriate number of significant figures.
6. Use computers and/or related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools and chemicals.

Note: These topics and learning results will be infused throughout the semester as the topics and essential learnings of chemistry are addressed.

II. Topics and Content

A. Structure of Matter

1. Compare and contrast physical and chemical changes.
2. Know physical and chemical methods used to separate mixtures based on the properties of the substances.
3. Atomic theory and atomic structure.
   a. Describe evidence for the modern view of atomic theory.
   b. Calculate atomic number and mass number of isotopes.
   c. Calculate the average atomic mass of an element.
   d. Explain observations of atomic spectra using modern atomic theory, including electron energy levels, atomic orbitals, and electron configurations.
   e. Describe the periodic relationships of elements based on the following properties: atomic radii, ionization energies, electronegativity, and oxidation states.

B. Nomenclature and Chemical Bonding

1. Determine chemical formulas from ions and from the names of substances.
2. Name substances given IUPAC formulas.
3. Binding forces.
   a. Discriminate between ionic compounds and covalently bonded molecules based on the electronegativity differences between the atoms in the compound.
   b. Understand the continuum between purely non-polar covalent, polar covalent, and ionic substances.
   c. Describe the nature of intermolecular attractive forces: dispersion forces, hydrogen bonding, dipole-dipole interactions, and Van der Waals interactions.
   d. Distinguish between a chemical bond and an intermolecular attractive force.
   e. Explain certain observations of chemical and physical properties according to the nature of bonding within the substance.

4. Molecular models
   a. Use models to represent relationships of atoms in substances.
   b. Represent positions of electrons in compounds using Lewis Structures, including the concept of resonance structures.
   c. Use VSEPR (Valence Shell Electron Pair Repulsion Theory) to represent the three-dimensional geometry of atoms in covalently bonded substances.

5. Organic Compounds
   a. Describe the bonding present in organic compounds.
   b. Name alkanes and their derivatives produced by the addition of common functional groups.
   c. Predict products of common organic reactions.

C. States of Matter

1. Gases
   a. Examine observations relating pressure, temperature, and volume of a gas using Charles', Boyle's, Dalton's, Avagadro's, and the combined gas laws.
   b. Compare the behavior of an Ideal gas to a real gas.
      i. Apply the ideal gas law to problems involving gases near ideal conditions.
      ii. Describe deviations of real gases from the ideal gas law.

2. Kinetic-Molecular Theory
   a. Describe solids, liquids and gases using kinetic-molecular theory.
   b. Interpret gas behavior on the basis of kinetic-molecular theory.
   c. Use kinetic-molecular theory to explain the pressure of gases and the dependence of the kinetic energy of molecules on temperature.

3. Solutions
   a. Describe types of solutions and factors affecting solubility of solutes in solvents.
   b. Calculate the concentration of solutions using molarity and percent by mass.
   c. Measure results and describe the colligative properties of solutions.

4. Solids
   a. Describe the bonding in metals and ionic substances.
   b. Show modes of the packing of atoms and ions in solids

c. Calculate solubility products and predict precipitate formation in a solution

D. Chemical Reactions

1. Reactions types
   a. Describe, give examples of, and predict products for different types of reactions: syntheses, decomposition, single replacement, double replacement, and combustion.
   b. Acid-base reactions
      i. Define and compare concepts of acids and bases according to Arrhenius and Bronsted-Lowry.
      ii. Perform a neutralization reaction between an acidic and a basic substance.
      iii. Describe the effect of buffers on the pH of solutions.
   c. Oxidation-Reduction reactions
      i. Assign oxidation states to atoms in substances.
      ii. Write half reactions and use to balance net chemical equations.
      iii. Experimentally measure potentials in electrochemical cells.

2. Stoichiometry
   a. Be able to represent ionic and molecular species present in chemical systems using a chemical equation.
   b. Explain Avogadro's hypothesis and the mole concept.
   c. Balance chemical equations to illustrate mole ratios and conservation of mass in a chemical reaction.
   d. Calculate the mass and volume relationships of substances with emphasis on the mole concept, including percent composition, empirical formulas, limiting reactants, and percent yield.

3. Equilibrium
   a. Observe and explain the concept of dynamic equilibrium in both physical and chemical systems.
   b. Observe and explain Le Chatelier's Principle as it applies to a chemical system.
   c. Predict shifts in the concentrations of substances in equilibrium.
   d. Write the equilibrium expression for a given reaction and be able to solve for concentrations of substances and/or the equilibrium constant.

4. Kinetics
   a. Explain the concept of Rate of Reaction.
   b. Observe the effect of temperature change on the rate of reaction and explain using kinetic-molecular theory.

c. Define the Energy of Activation and use it to explain the role of catalysts in a chemical reaction.

5. Thermochemistry
   a. Describe different forms of energy and their interconversions.
   b. Calculate enthalpy change in a chemical reaction.
   c. Use calorimetry to calculate the specific heat of a substance and the amount of heat change in a chemical reaction.
   d. Calculate heat required for temperature and phase changes

6. Descriptive Chemistry
   a. Describe relative chemical reactivity of substances and predict the products of chemical reactions.
   b. Identify ions in an unknown mixture from results of a chemical reaction.

7. Polymerization
   a. Describe hydrolysis and condensation reactions and predict products of reactions of monomers to produce polymers.
   b. Give examples of synthetic and biochemical polymerization.

III. Chemical Calculations

A. Calculate the percentage composition of an element or compound in a substance, the percent yield, and percent error.

B. Calculate the empirical formula and molecular formula of a substance from experimental data.

C. Calculate the molar mass of a gas from its measured density.

D. Use gas laws, including the ideal gas law, to calculate the volume, pressure, temperature, or the molar amount of a gas.

E. Use mole ratios in a balanced chemical equation to determine stoichiometric relations of reactants and products including titration calculations.

F. Calculate concentrations of substances using mole fractions and molarity.

G. Determine the speed and concentrations of substances in a chemical reaction using kinetics.

IV. Independent Research Project

A. Ask appropriate questions and use resources in the chemical literature to gather information about a project in chemistry.

B. Design a written experimental plan to investigate a topic in chemistry.

C. Select and use appropriate technologies to gather, process, and analyze data.

D. Report results using appropriate graphs and equations for the chemistry of the project.

E. Communicate effectively the results of an independent chemistry investigation, both in oral and written presentation.

S58 Consumer Chemistry

is not yet completed.

The district is waiting

for the new version of

Chem Comm

before deciding

whether to continue to

offer this course.

Boulder Valley School District
High School Science Curriculum

Course Code: S61 Physics

Course Title: PHYSICS

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This course helps students understand the basic physical laws of our world. The course includes: scientific methods and measurement, forces, motion, energy, light, waves, electricity, magnetism, and atomic physics. Laboratory work serves to promote understanding and to illustrate the experimental nature of physics.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Develop, evaluate, and/or apply a conceptual model both mathematical and descriptive.
4. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of laboratory equipment.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units using dimensional analysis.
4. Use computers and/or related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools.

II. Kinematics

A. Define and show an understanding of position, velocity, and acceleration in one dimension.

B. Construct velocity versus time graphs depicting real motions, and interpret acceleration versus time graphs and position versus time graphs.

C. Write and solve the equations of one-dimensional motion with constant acceleration.

III. Newton's Laws

A. State Newton's 1st and 3rd Laws and give examples from the real world illustrating them.

B. Understand the concept of force as a vector and find all the forces acting on a chosen body.

C. Write and solve Newton's 2nd Law to describe the motion of a body in one and two dimensions.

IV. Conservation of Energy

A. Define and describe basic forms of energy such as kinetic energy, gravitational potential energy, thermal energy, elastic potential energy, and work.

B. Identify the forms of energy within a simple closed system.

C. Write and solve the equation of energy conservation for a simple closed system.

V. Planetary Mechanics

A. Understand the basic history of models of the Solar System.

B. Use Kepler's 3rd Law to relate the period of an orbit to its radius.

C. Define and describe uniform circular motion intuitively and mathematically.

D. State the Universal Law of Gravitation and use it to describe and analyze circular orbits.

E. Show how to find the mass of the Earth using the Moon's radius and period of orbit.

VI. Conservation of Linear Momentum

A. Write and solve the equations for conservation of linear momentum within a closed system in one and two dimensions.

B. Understand the relationship between force, time, impulse, and momentum.

C. Find the center of mass of a body or system and describe the motion of the center of mass.

VII. Electricity

A. Explain basic phenomena of “static electricity” using the electron model.

B. Define and show an understanding of electric force, electric field, electric potential, and electric potential energy for stationary point charges.

C. Describe and define potential difference mathematically and using gravitational parallels.

D. Find the energy and speed of a charged particle which has fallen through a potential difference.

E. Use the Special Theory of Relativity to describe the mass, length, and age of high-speed particles.

F. Understand the basic components of the oscilloscope and use one to find the frequency and amplitude of an electronic signal.

G. Use Ohm’s Law and Kirchoff’s Rules to describe DC circuits with combinations of resistors in series and parallel.

VIII. Magnetism

A. Use the1st and 2nd right hand rules to describe magnetic field and magnetic force.

B. Explain how the magnetic force causes motors to spin.

C. Explain how the mass spectrograph led to the discovery of isotopes.

F. Describe basic nuclear processes, including nuclear fission, nuclear fusion, alpha decay, beta decay, and gamma decay.

G. Discuss the pros and cons of nuclear power plants and coal-fired power plants.

H. Understand the reasons for using AC power in our homes and the importance of transformers for transmitting electrical power.

IX. Geometric Optics

A. Write and solve Snell's Law to model the behavior of light passing from one medium to another.

B. Find real and virtual images formed by a converging lens using ray drawings.

C. Find real and virtual images formed by a converging lens using the thin lens formula.

D. Solve problems involving combinations of converging lenses, and understand the basic operation of the telescope and microscope.

X. Waves and Interference

A. Define and relate velocity, frequency, and wavelength of a periodic wave.

B. Show that standing waves are a one-dimensional interference pattern, and create standing waves on a spring, in water, and in an air-filled tube.

C. Describe the two-dimensional interference pattern that is created by two point sources of waves.

D. Compare and contrast the double slit interference pattern with the single slit diffraction pattern.

E. Describe Maxwell's electromagnetic wave model of light.

F. Understand the electromagnetic spectrum, and explain the origin of these broad types of radiation: radio waves, visible light, x-rays, and gamma rays.

XI. Atomic Structure

A. Describe the Franck-Hertz Experiment and what it revealed about the nature of atoms.

B. Explain the connection between the emission spectrum of a particular atom and the energy levels of that atom.

C. Understand why the emission spectrum is a unique fingerprint of an atom which can be used to identify the atom.

D. Explain what Hubble discovered about the spectra of galaxies and what this suggests about the Universe.

Boulder Valley School District
High School Science Curriculum

Course Code: S63 Physics Advanced

III. **Course Title: PHYSICS ADVANCED**

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Physics Advanced will acquaint students with the basic physical laws of our world. The major areas of study are in measurement, light, waves, motion, forces, energy, electricity, magnetism, and atomic physics. Laboratory work serves to promote understanding and to illustrate the experimental nature of physics. A high degree of skill in algebra and geometry is necessary for success in this course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Develop, evaluate, and/or apply a conceptual model both mathematical and descriptive.
4. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of laboratory equipment.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units using dimensional analysis.
4. Use computers and/or related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools.

II. Kinematics

A. Define and show an understanding of position, velocity, and acceleration in one dimension.

B. Construct velocity versus time graphs depicting real motions, and generate the corresponding acceleration versus time graphs and position versus time graphs.

C. Use the equations of one-dimensional kinematics to describe and analyze two-dimensional projectile motion.

III. Newton's Laws

A. State Newton's 1st and 3rd Laws and give examples from the real world illiustrating them.

B. Understand the concept of force as a vector and find all the forces acting on a chosen body.

C. Write and solve Newton's 2nd Law to describe the motion of a body in one and two dimensions.

IV. Conservation of Energy

A. Define and describe basic forms of energy such as kinetic energy, gravitational potential energy, thermal energy, elastic potential energy, and work.

B. Identify the forms of energy within a simple closed system.

C. Write and solve the equation of energy conservation for a simple closed system.

D. Understand the behavior of ideal springs and how springs cause Simple Harmonic Motion.

V. Planetary Mechanic

A. Understand the basic history of models of the Solar System.

B. Use Kepler's 3rd Law to relate the period of an orbit to its radius.

C. Define and describe uniform circular motion intuitively and mathematically.

D. State the Universal Law of Gravitation and use it to describe and analyze Circular orbits.

E. Show how to find the mass of the Earth using the Moon's radius and period of orbit.

VI. Conservation of Linear Momentum

A. Write and solve the equations for conservation of linear momentum within a closed system in one and two dimensions.

B. Understand the relationship between force, time, impulse, and momentum.

C. Find the center of mass of a body or system and describe the motion of the center of mass.

VII. Electricity

A. Explain basic phenomena of “static electricity” using the electron model.

B. Define and show an understanding of electric force, electric field, electric potential, and electric potential energy for stationary point charges.

C. Describe and define potential difference mathematically and using gravitational parallels.

D. Find the energy and speed of a charged particle which has fallen through a potential difference.

E. Use the Special Theory of Relativity to describe the mass, length, and age of high-speed particles.

F. Understand the basic components of the oscilloscope and use one to find the frequency and amplitude of an electronic signal.

G. Use Ohm’s Law and Kirchoff’s Rules to describe DC circuits with combinations of resistors in series and parallel.

VIII. Magnetism

A. Use the 1st and 2nd right hand rules to describe magnetic field and magnetic force.

B. Explain how the magnetic force causes motors to spin.

C. Show that the magnetic force on a charged particle moving across a magnetic field causes circular motion.

D. Write and solve the equations to find the mass of a particle which has passed through a mass spectrograph.

E. Explain how the mass spectrograph led to the discovery of isotopes.

F. Describe basic nuclear processes, including nuclear fission, nuclear fusion, alpha decay, beta decay, and gamma decay.

G. Discuss the pros and cons of nuclear power plants and coal-fired power plants.

H. Understand the reasons for using AC power in our homes and the importance of transformers for transmitting electrical power.

IX. Geometric Optics

A. Write and solve Snell's Law to model the behavior of light passing from one medium to another.

B. Find real and virtual images formed by a converging lens using ray drawings.

C. Find real and virtual images formed by a converging lens using the thin lens formula.

D. Solve problems involving combinations of converging lenses, and understand the basic operation of the telescope and microscope.

X. Waves and Interference

A. Define and relate velocity, frequency, and wavelength of a periodic wave.

B. Show that standing waves are a one-dimensional interference pattern, and create standing waves on a spring, in water, and in an air-filled tube.

C. Derive Snell's Law for waves and use it to model the behavior of any waves passing from one medium to another.

D. Describe the two-dimensional interference pattern that is created by two point sources of waves which are in phase and out of phase.

E. Calculate the angles of the nodal lines for a given two-dimensional interference pattern.

F. Show that wavelength can be determined from an interference pattern and determine the wavelength of light using Young's double slit method.

G. Compare and contrast the double slit interference pattern with the single slit diffraction pattern.

H. Describe Maxwell's electromagnetic wave model of light.

I. Explain polarization of an electromagnetic wave.

J. Understand the electromagnetic spectrum, and explain the origin of these broad types of radiation: radio waves, visible light, x-rays, and gamma rays.

XI. Wave-Particle Duality

A. Explain how the discovery of the Photoelectric Effect destroyed the wave model as the exclusive model of light.

B. Find the photon energy, in Joules and in electron volts, for light of a given frequency or wavelength.

C. Explain the Photoelectric Effect accounting for the role played by frequency of light, intensity of light and the binding energy of the atom.

D. Describe the nature of light in terms of wave-particle duality.

E. Describe the Franck-Hertz Experiment and what it revealed about the nature of atoms.

F. Explain the connection between the emission spectrum of a particular atom and the energy levels of that atom.

G. Understand why the emission spectrum is a unique fingerprint of an atom which can be used to identify the atom.

H. Explain what Hubble discovered about the spectra of galaxies and what this suggests about the Universe.

I. Describe the connection between wave-particle duality and the Bohr Model of the atom.

Boulder Valley School District
High School Science Curriculum

Course Code: S26 Anatomy

Course Title: ANATOMY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Anatomy is a one semester course that provides students the opportunity to explore the intricate and sophisticated relationship between structure and function in the human body. The course offers students an environment in which they may probe topics such as *Homeostasis, Anatomical and Physiological Disorders* and a survey of the remarkable array of *Body Systems* that comprise the human body. Laboratory activities reinforce concepts and principles presented in the course. Emphasis in this course is on mammalian dissection.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use computers and related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be infused throughout the year as the topics and essential learnings of Anatomy are addressed.

II. Intoduction to Anatomy

A. Language of Anatomy and Physiology

1. Define anatomical position and describe its value.
2. Demonstrate an understanding of the necessity for having a language specific to Anatomy and Physiology (Unambiguous, Universal)
3. Demonstrate the ability to apply knowledge of the directional terms typically employed in the study of Anatomy.
4. Demonstrate the ability to apply knowledge of the planes and sections typically employed in the study of Anatomy (sagittal, transverse, and frontal).
5. Demonstrate the ability to apply knowledge of the terminology typically employed in the study of Anatomy when describing the various body cavities.
6. Demonstrate the ability to apply knowledge of the terminology typically employed in the study of Anatomy when describing the abdominopelvic regions and quadrants.

III. III. Histology

A. Introduction to Tissues

1. Define tissue and compare and contrast the four general forms.

IV. IV. Body Systems

A. Body Systems – General Survey

1. Describe the major components of each of the systems.
2. Describe the major functions of each of the systems.
3. Describe basic processes for maintaining homeostasis for each of the systems.

B. Dissection Practical

1. Identify all organs visible in the mammalian dissection specimen.
2. Identify the major features of each organ in the mammalian dissection specimen.
3. Identify all major blood vessels in the mammalian dissection specimen.
4. Identify all the major nerves in the mammalian dissection specimen.
5. Identify all the major bones in the mammalian dissection specimen.
6. Identify all the major superficial and deep muscles in the mammalian dissection specimen.

Boulder Valley School District
High School Science Curriculum

Course Code: S33 Anatomy/Physiology

Course Title: ANATOMY/PHYSIOLOGY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Anatomy/Physiology is a year-long course that provides students the opportunity to explore the intricate and sophisticated relationship between structure and function in the human body. The course offers students an environment in which they may probe topics such as *Homeostasis, Anatomical and Physiological Disorders, Medical Diagnosis and Treatment, Modern and Past Medical Imaging Techniques, Biochemistry, Cytology, Histology* and a survey of the remarkable array of Body Systems that comprise the human body. Laboratory activities reinforce concepts and principles presented in the course. Students are expected to have taken Biology prior to taking this course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

C.

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use computers and related technology in scientific investigations.

D. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be infused throughout the year as the topics and essential learnings of Anatomy/Physiology are addressed.

II. Introduction to AnatomyPhysiology

A. Fields of Anatomy and Physiology

1. Demonstrate knowledge that Anatomy and Physiology are broad and diverse fields of study.
2. Identify some of the divisions of Anatomy and of Physiology.

B. Life Processes

1. Identify and demonstrate an understanding of the life processes (metabolism, responsiveness, movement, growth, development differentiation, and reproduction).
2. Define homeostasis and provide an example of how homeostasis preserves physiological thresholds within the human body.
3. Identify and provide an example of each of the components (receptor, control center, effectors) that constitute a feedback loop.
4. Contrast positive and negative feedback loops.
5. Describe how positive and negative feedback loops impact homeostasis.
6. Describe an example of a positive and negative feedback loop.
7. Describe the role of homeostasis in disease.

C. Language of Anatomy and Physiology

1. Define anatomical position and describe its value.
2. Demonstrate an understanding of the necessity for having a language specific to Anatomy and Physiology (unambiguous, universal)
3. Demonstrate the ability to apply knowledge of the directional terms typically employed in the study of Anatomy/Physiology.
4. Demonstrate the ability to apply knowledge of the planes and sections typically employed in the study of Anatomy/Physiology (sagittal, transverse, and frontal).
5. Demonstrate the ability to apply knowledge of the terminology typically employed in the study of Anatomy/Physiology when describing the various body cavities.
6. Demonstrate the ability to apply knowledge of the terminology typically employed in the study of Anatomy/Physiology when describing the abdominopelvic regions and quadrants.

D. Medical Imaging

1. Describe how an x-ray image is formed.
2. Describe the benefits and harmful effects of x-rays.

3. Explain how radioisotopes have changed the fields of medical diagnostic imaging.
4. Describe the basis for ultrasounds and provide one application for this technology.

III. Biochemistry

A. Inorganic Chemistry

1. Demonstrate an understanding of the structure of atoms.
2. Identify the major elements that comprise the human body.
3. Describe the three major types of bonds (ionic, covalent, hydrogen) in biological molecules.
4. Use the pH scale to identify acids and bases and be able to describe their significance in biological systems.
5. Describe the role of buffers in the maintenance of pH homeostasis.

B. Organic Chemistry

1. Explain the significance of carbon in biological molecules.
2. Identify monomers that comprise the organic polymers in cells.
3. Identify carbohydrates, lipids, proteins, and nucleic acids by structural formula.
4. Identify the roles of the four types of organic molecules in living organisms.
5. Describe enzymes and explain their importance.
6. Describe how various factors, such as pH and temperature, affect enzyme function.
7. Discuss how enzymatic failure can lead to disease. (*For example, Galactosemia, Phenylketonuria*).
8. Describe the role of hydrolysis and dehydration synthesis in metabolism.

IV. Cytology

A. Anatomy and Physiology of Cells

1. Describe the hierarchy of structure.
2. Describe and model how the structure of cell organelles is related to their functions.
3. Understand that cells differentiate to perform specific tasks and how those tasks support the organism and are interdependent.
4. Describe the function of transport mechanisms (diffusion, osmosis, facilitated diffusion, and active transport) and their role in maintaining homeostasis.

5. Explain the structure of the plasma membrane and how it relates to its function.
6. Describe how tonicity may impact cell shape.
7. Describe how a failure at the cellular level results in disease at the level of the organism.

Boulder Valley School District
High School Science Curriculum

Course Code: S42 Astronomy

Course Title: ASTRONOMY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This one semester course provides the opportunity to develop knowledge and understanding about the solar system, galaxy, and universe in which we live. Much attention is given to an appreciation for how we have obtained this information about the universe. Students use tools of observation to learn about space themselves and learn how other astronomers past and present have used tools available. Areas of study include: the process of science, including use of the tools used to observe the sky; stellar astronomy and how stars change over time; and planetary astronomy and how interstellar spacecraft are obtaining information about other bodies in the solar system.

I. The Framework of Science

A. The Process of Science

1. Understand how astronomical data support the concepts that make up the body of knowledge comprising the science of astronomy.
2. Organize, analyze, evaluate, make inferences, and predict trends from data.
3. Analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information.
4. Communicate valid conclusions.
5. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in orienting in the night sky. Use simple tools to measure the position of objects in the sky and use star charts to predict how the sky will look at specific times or locations.
2. Understand the electromagnetic spectrum and the use of different spectral types in instrumentation and analysis, specifically use of images generated in different wavelengths from the sun, stars, and other astronomical objects.
3. Generate raw astronomical data or qualitative observations through his/her own measurements of phenomena directly and/or measurements of photographic images. Manipulate raw astronomical data through calculation and/or graphing in order to draw conclusions.

4. Demonstrate the use of units of measurement in astronomy such as the Astronomical Unit and the light year.
5. Use computers and/or related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with astronomical tools which may include how to care for optical equipment during field and laboratory investigations.

Note: These topics and learning results will be infused throughout the semester as the topics and essential learnings of astronomy are addressed.

II. Observational Astronomy and the Historical Development of Current Ideas.

A. The Position and Motion of the Sun, Moon, Stars, and Planets in the Sky

1. Observe and record data and/or model phases of a moon or planet.
2. Explain the causes of seasons on the earth and the relative positions of the sun, earth, and moon that result in both lunar and solar eclipses
3. Analyze a model that simulates planetary motion and universal gravitation.
4. Describe and/or observe movements of the planets relative to the stars in the night-time sky.
5. Observe and describe bright stars and constellations in the night sky.
6. Describe the relative brightness of objects in the sky and how they relate to the distance from the earth.

B. Historical Development of Astronomical Models and Their Impact on Society

1. Identify the historical origins of the perceived patterns of constellations and their role in ancient and modern navigation.
2. Evaluate the impact of research on scientific thought, society, and the environment.
    a. Discuss the human understanding of astronomy prior to the Middle Ages and how it related to the culture at that time.

b. Describe the impact the Copernican revolution and the invention of the telescope had on Western culture.
c. Describe how Einstein's theories of general and special relativity have created another revolution in our understanding of the universe.

3. Research and/or describe the historical development of the laws of universal gravitation and planetary motion and the theory of special relativity.
4. Research and/or describe the history of astronomy and how the impact of the space program has changed society's views on human's place in the universe.

III. Stellar Astronomy and Cosmology

A. Nature of the Sun

1. Identify the approximate mass, size, motion, temperature, structure, and composition of the sun.
2. Identify the source of energy within the sun and explain that the sun is the major source of energy for the earth in a variety of types of electromagnetic radiation.
3. Describe the sun's affects on the earth.

B. Nature and Life Cycle of the Stars

1. Describe nuclear reations in stars and the processes that create heavier elements within stars.
2. Identify the characteristics of stars such as temperature, age, relative size, composition, and radial velocity using spectral analysis and describe the Hertzsprung-Russell diagram.
3. Identify and describe the stages in the life cycle of stars by examining the Hertzsprung-Russell diagram.

C. Deep Sky Objects Including Galaxies and the Structure of the Universe

1. Describe the structure and composition of our Milky Way galaxy.
2. Interpret data concerning the formation of galaxies.
3. Characterize and describe spiral, elliptical, and irregular galaxies.
4. Describe the distribution of galaxies in the universe and their relative motion.
5. Research and analyze scientific empirical data on the estimated age of the universe.
6. Research and describe the historical development of the Big Bang Theory of the origin of the universe and how it will continue to change in the future.

IV. Planetary Astronomy and Interplanetary Science Missions

A. Planets, Their Moons, and Other Bodies in the Solar System

1. Compare the planets in terms of orbit, size, composition, rotation, atmosphere, moons, and geologic activity.
2. Compare and contrast Terrestrial and Gas Giant planets.
3. Identify and characterize objects other than the planets that orbit the sun. Compare and contrast the orbital paths of different objects in the solar system and describe any effects different orbital paths may have on that object.
4. Relate the role of gravitation to the motion of the planets around the sun and the motion of moons and satellites around the planets as described in Kepler's Laws of Planetary Motion.
5. Know current theories of origin of the solar system
    a. Know current theories of origin for the various moons and ring systems in the solar system.
    b. Discuss the role of minor objects of the solar system (i.e., comets, asteroids, and planetesimals) in analyzing the formation of the solar system.
6. Compare the factors essential to life on Earth such as temperature, water, mass, and gases to conditions on other planets.
7. Determine the affects of the earth's rotation, revolution, and tilt on its environment.
8. Identify the affects of the moon on Earth's ocean tides.

B. Geologic Processes of the Planets

1. Describe the nature of collisions in the solar system and cratering.
2. Know the characteristics of a geologically active planet.
3. Compare and contrast geological processes on other planetary bodies to geological processes on the earth, including a comparison of the time scales of these processes with that of stars, the universe, and human activity.

C. Exploration of the Solar System

1. Identify the missions of interplanetary spacecraft in increasing our understanding of planets and other bodies in our solar system.

Boulder Valley School District
High School Science Curriculum

Course Code: S32 Botany

Course Title: BOTANY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Botany is the scientific study of plants and their relationship to the environment. In this course students investigate the growth, reproduction, anatomy, morphology, physiology, biochemistry, taxonomy, genetics, and ecology of plants. Laboratory and outdoors experiences complement classroom activities. Students are expected to have taken Biology before taking this course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Use the scientific method in solving a problem.
3. Describe how the contributions of individuals of various ethnic and cultural origins have impacted scientific advancement.

B. Tools of Science and Measurement

1. Demonstrate competency in the use and care of microscopes.
2. Use basic tools of measurement accurately.
3. Use the SI system of measurement accurately and be able to convert between units by employing dimensional analysis.
4. Use computers and related technology in scientific investigations.

C. Safety in the Science Classroom

1. Know and follow current appropriate laboratory and safety procedures.
2. Know and follow precautions necessary when working with laboratory tools, chemicals, and both live and preserved specimens.

Note: These topics and learning results will be integrated throughout the year as the topics and essential learnings of Botany are addressed.

II. Life Cycles and Reproduction

A. Reproductive Strategies

1. Understand the basics of plant reproduction: sexual and asexual, vegetative propagation, tissue culture and cloning.
2. Describe patterns of plant life cycles: annual, biennial and perennial.
3. Describe alternation of generations and the evolution of a dominant diploid generation

B. Pollination

1. Understand the role of pollinators and pollinating agents and give examples.

2. Describe the importance of pollination to humans.

3. Explain the nature of pollinator/agent interaction with flowers, especially the effect of color and other characteristics.
4. Describe how native flower characteristics are related to the presence or absence of certain pollinators.

C. Fertilization

1. Describe the growth of the pollen tube and double fertilization.
2. Explain the development of the embryo, endosperm, seed, and fruit.

D. Fruit Dispersal

1. Describe the function of fruit/seed dispersal and give examples of different types and agents of dispersal.
2. Define and give examples of major fruit types, fleshy and dry, and their subtypes.
3. Describe the function of a seed and the conditions that influence seed germination.

III. Anatomy and Morphology

A. Non-Reproductive Plant Anatomy

1. Identify the parts of a leaf and describe the function of each: cuticle, upper epidermis, vein, xylem, phloem, palisade parenchyma, spongy mesophyll, stomata, air space, and lower epidermis.
2. Identify the parts of a stem and describe the function of each: cork, cork cambium, phloem, vascular cambium, and xylem, pith.
3. Identify the parts of a root and describe the function of each: epidermis, cortex, vascular cylinder, endodermis, phloem, vascular cambium, xylem, root cap, meristematic region, elongation region, zone of maturation, and root hair.

B. Reproductive Plant Anatomy

1. Identify the parts of a flower and describe the function of each: peduncle, sepal, petal calyx, corolla, filament anther, ovary, style, stigma, stamen, and pistil.
2. Be able to describe the events involving flowers: pollination, fertilization, relationship of ovule to seed formation, and relationship of pistil to fruit formation.
3. Identify the parts of a seed and describe the function of each: hypocotyl, epicotyl, cotyledeon, radicle, endosperm, seed coat, hilum, and micropyle.

IV. Biochemistry and Physiology

A. Photosynthesis/Respiration

1. Define photosynthesis/respiration using both words and the chemical formula.
2. Describe where and when photosynthesis/respiration occurs in a plant.
3. Summarize the light and dark reactions.
4. Describe light as an energy source and the role of chlorophyll and accessory pigments in converting light energy into chemical energy.
5. Explain the dependence of heterotrophs on autorophs.

B. Water Relations

1. Describe briefly the water pathway in plants, where it enters, where it leaves, and in what internal pathway.
2. Explain the structure and role that xylem plays in the movement of water.
3. Diagram the structure of a water molecule showing the charges on the atoms.
4. Explain how water can travel to the top of a tree including: transpiration, osmotic pressure, cohesion, and adhesion.

V. Taxonomy

A. Classification of Green Plants

1. Explain the advantages and disadvantages of scientific names and common names; correct usage of the scientific names; and the role of type specimen.
2. Define the terms: family, genus, species, subspecies, and variety.
3. Explain how a cultivar is different from a species.
4. Use one or more current systems to classify organisms in terms of their evolutionary origins.
5. Demonstrate the use of a dichotomous key to identify an unknown vascular plant.

B. Classification of Vascular Plants

1. Give examples and define sub-groups by key characteristics: mosses (bryophytes), ferns (pteridophytes), cone-bearing plants (gymnosperms), and flowering plants (angiosperms).
2. Compare and contrast gymnosperms/angiosperms and moncotyledeons/dicotyledeons.

VI. Genetics

A. Inheritance

1. Explain the role of DNA, genes and chromosomes in heredity.
2. Describe genetic variability and its role in nature especially in terms of biodiversity.
3. Define hybrid.

B. Evolution

1. Understand the role of genetics in the process of evolution, and how changes over time (evolution) can be brought about by changes in the environment, by isolation , and by hybridization.
2. Describe Darwin's theory of evolution as it relates to plants and their pollinators. (coevolution)

C. Technology

1. Explain the relationship between heirloom plants and hybrids.
2. Explain the role of modern DNA techniques in developing new plant varieties.

VII. Ecology

A. Energy Flow

1. Describe and define two aspects of the environment that impacts plant life: abiotic (non-living) and biotic (living).
2. Explain the role that green plants play in energy flow through an ecosystem.
3. Diagram how water, carbon, oxygen, and nitrogen are recycled through the environment.

B. Plant Populations

1. Explain soil structure, its source, function, and the role of soil in plant growth.
2. Describe the five life zones found in Colorado (plains, foothills, montane, subalpine, and alpine) in terms of: rainfall, temperature, elevation, unique features, and dominant plant community.

Boulder Valley School District
High School Science Curriculum

Course Code: S36 Marine Biology

Course Title: MARINE BIOLOGY

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This one semester course provides an opportunity for students to explore biological concepts and scientific skills using an ecological approach. Students will conduct their studies from the standpoint of a marine biologist. Beginning with the study of the physical characteristics of marine habitats and how they influence the living communities that inhabit them. It then centers on specific marine life groups, their structure and function, and their interdependence on each other and their environment. A common thread throughout the course is how human interaction impacts marine ecosystems. Students are expected to have taken Biology prior to taking this course.

I. The Physical Characteristics of the Marine Habitats

A. Aquatic Ecosystems

1. Compare and contrast the aphotic and photic zones in the ocean.
2. Describe the differences between the neritic zone and the oceanic zone.
3. Explain how organisms in various marine habitats obtain energy.
4. Describe the relationships between marine and freshwater habitats.

B. Ocean Topography

1. Describe the various topographic features of the global ocean.
2. Using a topographic model, show how sonar is used to determine topographic features.
3. Explain how the topographic features determine the numbers and kinds of organisms inhabiting those areas.

C. Wind-Driven ocean circulation

1. Describe the sun's role in the surface circulation of the ocean.
2. Explain how the unequal heating of the atmosphere produces winds
3. Explain how the rotation of the earth creates the coriolus effect.
4. Describe the typical gyre circulation pattern found in each of the major ocean basins.
5. Describe the relative speeds, temperatures, and directions of the currents comprising a typical gyre.
6. Explain how upwelling leads to increased biological productivity.

D. Ocean Tides

1. Explain how the gravitational attraction between the earth, moon, and sun forms ocean tides.
2. Explain some of the different types of ocean tides the moon helps generate.

E. Shallow-Water Ocean Waves

1. Describe the major characteristics of shallow-water waves.
2. Measure and calculate wave characteristics using a wave tube.
3. Describe the water motions associated with shallow-water ocean waves.

F. Deep-Water Ocean Waves

1. Describe the major characteristics of deep-water waves.
2. Measure and calculate wave characteristics.
3. Describe the water motions associated with deep-water ocean waves.

G. Density-Driven Ocean Circulation

1. Describe how the downward transfer of heat from the warm ocean surface creates the layed structure of the ocean.
2. Explain how small variations in temperature and salinity create the themohaline (deep ocean) circulation.

H. Coastal Upwelling

1. Demonstrate the causes of coastal upwelling and downwelling
2. Explain how coastal upwelling and downwelling can lead to changes in biological productivity.

I. Ocean Sound

1. Describe the effect of temperature, pressure, and salinity on the speed of sound in seawater.

J. Measuring Sea Level from Space.

1. Describe the use of a radar altimeter to measure sea surface height.
2. Describe the relationship between sea floor topography and the height of the overlying sea surface.
3. Explain how sea level measurements are being applied to help better understand global events such as global warming and El Nino

K. Current Research on the Physical Characteristics of the Ocean and Its Life Forms

1. Summarize the findings discussed in various scientific media about the physical characteristics of the ocean and how they impact marine organisms and/or human interaction with the ocean.

L. Additional Topics.

1. Describe how marine organisms use echolocation.
2. Explain the danger of barotrauma and how to avoid it.
3. Describe how hurricanes are formed and the impact they have on humans.
4. Describe the historical exploration of the ocean.

II. The Intertidal/Neritic Zones of the Marine Environment.

A. Habitats With the Intertidal/Neritic zones

1. Compare and contrast various habitats such as kelp beds, coral reefs, rocky shores, sandy beaches, tide pools, and coastal wetlands.

B. Marine Life Groups

1. Describe the common characteristics of the major marine phyla.
2. Design and conduct a lab experiment to observe animal behavioral patterns in an intertidal/neritic organism and describe the significance of those behaviors to survival.
3. Explain how current human actions are impacting these marine life groups and their habitats and speculate as to what can be done to lessen and/or eliminate the negative impacts.

III. The Oceanic Zone and the Ocean Bottom of the Marine Environment

A. Habitats within the Oceanic Zone and Ocean Bottom

1. Compare and contrast various habitats within the oceanic zone and ocean bottom with those of the intertidal/neritic zones.

B. Marine Life Groups

1. Describe the common characteristics and diversity of fishes that inhabit marine environments.
2. Describe the common characteristics and behaviors of mammals than inhabit marine environments.

Boulder Valley School District
High School Science Curriculum

Course Code: S81 Geology

Course Title: GEOLOGY

OUTLINE OF TOPICS AND ESSSENTIAL LEARNING RESULTS

This course acquaints students with basic scientific principles that apply to the earth and our natural environment. Emphasis is placed on current and historical geologic processes of North America with particular emphasis on the Rocky Mountain States and the Boulder area. Laboratory work includes exercises with maps, rock structures, minerals, fossils, and energy resources. New discoveries and environmental issues are discussed. Field experiences are an integral part of the course. Students are expected to have enrolled in Physical Science prior to taking this course.

I. The Framework of Science

A. The Process of Science

1. Understand the process of scientific investigation and be able to design, conduct, and evaluate an investigation.
2. Understand the process of scientific advancement from historical, cultural, and ethnic perspectives.
3. Develop problem-solving skills.
4. Know and follow appropriate laboratory and safety procedures.
5. Demonstrate an understanding of the tentative nature of scientific knowledge.

B. Tools of Science

1. Use appropriate tools of measurement accurately and understand uncertainty in measurement.
2. Define and use the SI system of units and be able to convert between units.
3. Select and use appropriate apparatus and techniques to investigate geologic processes and phenomena.
4. Use computers and related technology in scientific investigations.

II. Physical Geology

A. Introduction

1. Begin to formulate a personal definition of geology.

2. Articulate the cosmological connection to geology.
3. Describe Earth as a planet.
4. Demonstrate an awareness of the geological/universal timescale

B. Earth Materials and Matter

1. Demonstrate an understanding of the basic physical nature of matter and
2. Describe how characteristic properties are determined by atomic composition and structure.
3. Identify common rock-forming minerals by their physical properties.
4. Use models to illustrate the relationship between atomic structure and crystal structure .

C. The Rock Cycle

1. Demonstrate an understanding that earth materials are constantly changing.
2. Describe the formation and classification of igneous, sedimentary, and metamorphic rocks.
3. Explain the difference between weathering and erosion.
4. Use various tests and classification keys to identify igneous, sedimentary, and metamorphic rocks.
5. Discuss the relationship between a rock's characteristics and the processes involved in its formation.
6. Define mineral and rock and differentiate between the two.
7. Use the rock cycle diagram to explain how rocks can have complex past histories.

D. Plate Tectonics

1. Discuss the historical development of the Theory of Plate Tectonics.
2. List the major pieces of evidence that lend support to the Theory of Plate Tectonics.
3. Show how the pattern of earthquakes and volcanoes can be explained by plate tectonics.
4. Describe the basic physical structure of the planet Earth.
5. Use illustrations to discuss possible mechanisms for plate tectonics.

E. Physical Oceanography

1. Describe the composition and movement of sea water.
2. Discuss the connection between plate tectonics and the characteristics of the ocean basins.
3. Demonstrate an understanding of the interdisciplinary nature of

Oceanography.

F. Geomorphology

1. Describe the forces and agents of erosion that shape the earth's landscapes.
2. Discuss the time factors involved in producing the surfaces of the earth.

III. Historical Geology

A. Introduction

1. Demonstrate an understanding of the vastness of geologic time on Earth as well as the relationship to cosmological time.

B. Geologic Time

1. Construct a model that illustrates geologic time.
2. Discuss the relationships among time, the conditions of the surface of the planet, and the progression of life.
3. Describe the difference between relative and absolute dating techniques.

C. Keys to the Past

1. Interpret the nature of past environments by analysis of rocks and fossils.
2. Discuss the role of using knowledge about present processes when interpreting events that occurred in the past.

D. Fossils

1. Describe the basic fossil types and mechanisms of fossil formation.
2. Compare the structure of fossils and present day life forms.
3. Identify unknown fossils by using references.

.

E. Life Through Time

1. Discuss the evolutionary progression of life as determined by fossils.
2. Use a time line to compare the span of human existence to other life forms and the age of Earth.
3. Demonstrate comprehension of the role of mass extinctions in the
4. evolution of life on Earth.

F. Mineral and Energy Resources

1. Describe how mineral and energy resources form.
2. Demonstrate an understanding of the differences between renewable and non-renewable resources.
3. Discuss the cause and effect relationships between the acquisition and use of natural resources and environmental quality.

G. Geology of the Boulder Valley Region

1. Explain the geologic principles and processes that produced the geologic setting of the Boulder Valley region.
2. Apply what you have learned on either an individual or group field trip to local sites of geological interest.

H. Geology of Selected National Parks

1. Demonstrate an understanding of the physical and historical geology of one or more national parks.

I. Current and Future Geologic Topics

1. Apply previously acquired knowledge, skills, and understandings to current geologic problems and issues.
7. Know the role of geology in understanding natural hazards such as earthquakes, volcanoes, landslides, tsunamis, and metoerite impacts.
8. Demonstrate an understanding of the role of geology in determining quality of life.
9. Develop an awareness of the current opportunities in the geological sciences.

Boulder Valley School District
Senior High Science Curriculum

Course Code: S85 Global Science

Course Title: GLOBAL SCIENCE

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

Global Science is an inquiry-oriented course involving principles and concepts concerning the planet earth. Content areas explored include land, air, atmosphere, weather, climate, water, energy, population growth, ecosystems, and a sustainable future. In addition Global Science addresses the earth place in the solar system, galaxy and universe. The course emphasizes the study and proper use of fundamental science tools including the metric system, graphing techniques and applied technologies. Laboratory activities reinforce concepts and principles presented

I. The Framework of Science

A. Safety in the Science Classroom

1. Know and follow appropriate laboratory and safety procedures.

B. Tools of Science and Measurement

1. Use basic tools of measurement accurately.
2. Use the SI unit of measurement accurately.
3. Use computers and related technologies in scientific investigations.

C. The Process of Science

1. Understand the process of scientific investigation.
2. Be able to design, conduct and evaluate a simple investigation.
3. Use the scientific method in solving a problem.

II. Land

A. Geology

1. Be able to describe the composition of the Earth's interior.
2. Be able to use evidence (fossils, rock layers, radiometric dating) to investigate how the Earth has changed over long periods of time.
3. Explore the impact of plate tectonics upon societies or civilizations.
4. Evaluate the impact on natural events (earthquakes, floods, and landslides) on human and natural systems.

B. Land Use

1. Investigate the various ways land in used (e.g. urbanization, farming, ranching, and mining).
2. Analyze the cost, benefits and consequences of natural resources exploration, development, and consumption.
3. Analyze the effects of laws and policies, technology and economics on management of natural resources.
4. Identify cause-effect relationships within a system.

III. Air

A. Atmosphere

1. Know the structure and composition of Earth's Atmosphere.
2. Understand that the Earth's atmosphere has evolved over time.

B. Weather

1. Be able to describe how energy transfer within the atmosphere influences weather (e.g. conduction, radiation, convection, and heat of condensation in clouds, precipitation wind, and storms)
2. Be able to describe and explain the factors that may influence weather such as prevailing winds and proximity to oceans.

C. Climate

1. Be able to describe and explain the factors that act as climate controls such as proximity to water, topography, and latitude.
2. Be able to explain the interrelationship between the circulation of oceans and weather and climate.

D. Human Involvement & Influence

1. Analyze the effects of laws and policies, technology and economics on management of natural air resources.
2. Investigate and explain the occurrence and effects of storms on human populations and the environment.
3. Be able to describe and explain the factors that may influence climate and weather such as burning fossil fuels, acid precipitation, greenhouse effect, ozone layer depletion.
4. Identify cause-effect relationships within a system.

IV. Water

A. Water Resources

1. Be able to identify and explain factors that influence the quality of water needed to sustain life.

2. Explain interaction between the hydrosphere and other earth systems (Biosphere, lithosphere, and atmosphere).

B. Water Usage

1. Be able to identify and analyze the costs, benefits and consequences of using water resources

C. Water Pollution

1. Be able to identify and explain various ways in which fresh water is polluted and how this effects humans and the environment.
2. Be able to identify and explain various ways in which ocean water is polluted and how this effects humans and the environment.
3. Identify cause-effect relationships within a system.

V. Energy

A. Energy Transfer

1. Understand the law of Conservation of Energy.
2. Be able to describe and measure quantities that characterize moving objects.
3. Be able to analyze quantities associated with energy transfer and transformation.
4. Be able to analyze quantities associated with energy forms such as radiant, mechanical, electrical, thermal, chemical and nuclear.
5. Be able to explain the transfer of energy between Earth's systems (e.g., lithosphere, hydrosphere, atmosphere, and biosphere).

B. Energy Sources

1. Know and understand that energy is found in a variety of sources (e.g. mechanical, electrical, thermal, chemical and nuclear.)
2. Be able to differentiate between various forms of potential and kinetic energy.
3. Analyze the costs, benefits and consequences of natural resource exploration, development and consumption.
4. Analyze the costs, benefits and consequences of producing solid and hazardous waste.
5. Analyze the costs, benefits and consequences of limiting solid and hazardous waste, and the process of recycling.

C. Alternative Energies

1. Analyze the costs, benefits and consequences of alternative energy (e.g., wind, hydroelectric, biomass) exploration, development and consumption.

VI Population Growth

A. Populations and Communities

1. Describe population growth using graphical analysis
2. Describe the factors that effect population growth and determine carrying capacity

VII. Ecosystems

A. Living Things in Ecosystems

1. Understand that living things are connected within an ecosystem.
2. Analyze how species interact with each other within an ecosystem.
3. Explain the relationship between bio-diversity and global sustainability.
4. Understand the importance of adaptation to the environment.
5. Identify cause-effect relationships within a system

B. How Ecosystems Work

1. Be able to diagram how water, carbon, oxygen and nitrogen are recycled though the environment
2. Be able to explain how energy flows throughout an ecosystem
3. Be able to explain how simple molecules can be built into larger organic molecules within living organisms in processes (photosynthesis, respiration)

VIII. Sustainable Future

A. International Cooperation

1. Understand that the ability to ensure a sustainable future on Earth is an international affair.
2. Investigate international efforts to maintain a stable planet.

B. Environmental Policies in the United States

1. Investigate the United States' effort to maintain a stable planet.
2. Critically evaluate print and visual media relating to environmental policies for scientific evidence, bias or opinion

IX. Earth's Place in Space

A. History of Views

1. Know that many contributions of individuals and cultures have helped to develop the current theories of astronomy.
2. Understand that current theories are based on an accumulation of data over time.
3. Understand that the current theories have been thoroughly critiqued and represent a consensus at this time, but as all theories in science, may refined in time**.**

B. Solar System

1. Know the history and structure of the solar system.
2. Understand the causes of lengths of days, seasons and phases of the moon.

C. Beyond the Solar System

1. Understand the vast nature of time and space as related to the universe.
2. Identify and describe the impact of recent space technology.
3. Understand that electromagnetic radiation is produced by the sun and other stars, and how this helps in the understanding of space and time.

Boulder Valley School District
High School Science Curriculum

Course Code: S99 Research Seminar in Science

Course Title: Research Seminar in Science

OUTLINE OF TOPICS AND ESSENTIAL LEARNING RESULTS

This highly structured year-long science research course offers highly motivated students of various achievement levels an opportunity to perform authentic science research of their own choosing. Students participate in the community of scientific research and scholarship as part of their high school experience. This program directly addresses student need to perform hands-on scientific research. It requires students to identify their own topic of research; read relevant and appropriate scientific literature; create testable hypotheses; design, analyze and discuss results; and state clear conclusions directly dependent on the results. Each student will have the opportunity to enter their research into local, state and national competitions.

A. Measurement and Laboratory Skills

1. Review the metric system and employ dimensional analysis.
2. Demonstrate the ability to safely and accurately use some laboratory equipment basis to biology, chemistry, physics or other scientific disciplines.
3. Keep a detailed lab book and journal.
4. Review significant digits.
5. Use error analysis

B. Statistics

1. Understand the difference between descriptive and inferential statistics.
2. Understand frequently used statistical terms.
3. Demonstrate familiarity with the Bell and Logarithmic distribution curves.
4. Recognize various graph types and their uses.
5. Report variation in a set of data.
6. Determine statistical significance, level of significance, degree of freedom, and probability of error.
7. Demonstrate a general understanding of probability.
8. Understand the importance of calibration and what it is, and identify examples.
9. Set up a spread sheet and use to analyze research.

C. Research Methods

1. Know how to browse articles on unfamiliar topics for helpful information.

2. Formulate questions to increase understanding of research and identify the most important points of an article.
3. Know how to conduct a valid literature search on a topic of research interest.
4. Know how to identify a problem and design a procedure to solve the problem, with emphasis on scientific discovery rather than the steps of the "scientific method."

D. Ethics

1. Know the importance of documenting sources and the meaning of plagiarism.
2. Evaluate one's motivation when choosing a topic to research.
3. Know the correct due process when conducting research, giving credit where due to colleagues, original sources of data, and other materials used.
4. Understand the International Science and Engineering Fair rules and regulations that govern the use of animals and human tissues in projects.
5. Avoid conflicts of interest when choosing a research project topic.

E. Presentation Skills

1. Deliver an oral report based on the selected research project that is clear, concise, well organized, and captivating.
2. Display the skills essential in effective public speaking.
3. Prepare a written report that is clear, concise, well organized, grammatically correct, and interesting.
4. Create a multimedia presentation that clearly displays the components of the study.
5. Develop skills in Excel, Power Point, and other visual media.

F. Professional Social Skills

1. Be able to give criticism politely in a constructive fashion, avoiding making it personal.
2. Be able to accept criticism without taking it personally , avoiding the tendency to give criticism in return.
3. Understand that open and honest exchanges of ideas are important.
4. Understand that courteous behavior and language promote productive interactions.
5. Practice making cold contacts on the phone.
6. Know how to participate effectively in an interview, whether answering or asking questions.