

SOL Course Syllabus
for
BIOLOGY
(431000)

Grade: 9-12

Credit: One

Biology I is a laboratory-oriented course designed to give students a background in biological concepts as well as experience in using the methods of scientific inquiry. The course focuses on the life processes that occur within the cell, the anatomy and physiology of complex multicellular organisms, and the ways by which life forms reproduce, develop, and adapt to conditions in their environment. The course includes a unit on human life education and addresses the topics of human reproduction and human development. Parents have the option of withdrawing their children from any or all topics included in the state-mandated Family Life Education portion. Students opting-out will be provided with alternative biology lessons.

The use of technology is an integral part of the course. Many of the experiments use computers, simulation software, CD-ROM's, telecommunications, and probeware for the collection and analysis of data. Students are given the opportunity to acquire, manipulate and present data using these technologies.

Indicators correspond with the Virginia Standards of Learning for Biology. All Virginia Standards of Learning for Biology are included in this course.

Benchmarks and indicators are organized by the following strands:

- I. Scientific Investigation
- II. The Cell
- III. Molecular Basis of Life
- IV. Biological Evolution
- V. Interdependence of Organisms
- VI. The Function and Interactions of Human Body Systems

Course Content

I. Scientific Investigation

Benchmark

Students will know and understand the components of experimental design.

Indicators: (SOL BIO.1)

- a. Formulate hypotheses (If, Then Statement)
- b. Explain and use the following terms to design an experiment to test a hypothesis: dependent and independent variables, constants, experimental control, and repeated trials.

- c. Represent data using graphs
- d. Form conclusions based on data

II. The Cell

Benchmark

Students investigate and understand that cells have particular structures that underlie their functions, that most cell functions involve chemical reactions, and that cells go through a cycle which includes the stages of mitosis.

Indicators: (SOL BIO.1, BIO.2, BIO.4, BIO.5)

- a. Develop proficiency in the proper handling and use of the compound light microscope.
- b. Distinguish between prokaryotic and eukaryotic cells, and compare the similarities and differences between unicellular and multicellular organisms.
- c. Describe and identify basic elements of the micro-structure of cells and their functions.
- d. Demonstrate an understanding of hierarchy of cell specialization.
- e. Illustrate the development and history of the modern cell theory.
- f. Explain the similarities and differences between photosynthesis and cellular respiration.
- g. Examine the properties of water and explain their impact on life's processes.
- h. Describe and identify the structure and function of macromolecules.
- i. Explain the nature and role of enzymes in the biological processes of life.
- j. Analyze the reasons why cells are so small.
- k. Identify and describe the phases of the cell cycle including interphase, the phases of mitosis, and cytokinesis.

III. Molecular Basis of Life

Benchmark

Students investigate and understand that in all organisms, the instructions for specifying the characteristics of the organisms are carried in the nucleic acid DNA, and that a second nucleic acid, RNA, functions in the synthesis of protein. They investigate and understand that chromosomes are units of heredity composed of DNA molecule(s), and that the changes in DNA (mutations) occur spontaneously at low rates.

Indicators: (SOL BIO.1, BIO.2, BIO.3, BIO.4, BIO.5, BIO.6, BIO.7, BIO.8)

- a. Explain the structure of DNA and how it replicates.
- b. Contrast the structure and nature of DNA and RNA.
- c. Demonstrate an understanding of the chemical nature of a gene, and decipher and understand the genetic code and its uses in the cell.
- d. Understand protein synthesis.

- e. Investigate the structure of the chromosome and its role in the transmission of characteristics.
- f. Distinguish between autosomes and sex chromosomes in multicellular organisms.
- g. Summarize the genetic basis of variation.
- h. Explain the causes of genetic recombination, particularly the inheritance of linked traits and results of crossing over during meiosis.
- i. Describe how DNA changes as a result of mutation.
- j. Distinguish between point mutations and chromosomal mutations in human disease, and explain the role of mutagenic agents.

IV. Biological Evolution

Benchmark

Students explore how scientists explain the great diversity of organisms and how species evolve over time. Students examine both the fossil records and the striking molecular, structural, and developmental similarities observed among the diverse species of living organisms.

Indicators: (SOL BIO.1, BIO.2, BIO.5, BIO.6, BIO.7, BIO.8, BIO.9)

- a. Follow the historical development of the modern theory of evolution.
- b. Understand Darwin's theory of natural selection. Include the evidence which he used to substantiate his theory.
- c. Recognize how adaptations lead to natural selection.
- d. Discuss the time span required for changes in species.
- e. Examine the factors affecting adaptations and speciation (how species emerge) including gene frequency, variability, struggle for survival, and isolation.
- f. Assess the role of DNA in the evolution of the species, and compare sequences in living organisms.
- g. Examine and interpret evidence found in fossil record of how organisms have changed over time.
- h. Compare the developmental stages in different organisms, and the protein similarities and differences among organisms.

Benchmark

Students investigate and understand that biological classifications indicate how organisms are related, and learn how scientists have grouped organisms into five kingdoms: monerans, protists, fungi, plants, and animals.

Indicators: (SOL BIO.1, BIO.2, BIO.4, BIO.5, BIO.7, BIO.8, BIO.9)

- a. Discuss systems of classification that are adaptable to new scientific discoveries.

- b. Explain structural similarities and differences of representative organisms in the five kingdoms.
- c. Compare the metabolic activities of representative organisms in the five kingdoms. These metabolic activities include obtaining energy, exchanging gases, and elimination wastes.
- d. Compare responses to the environment and maintenance of homeostasis in representative organisms from the five kingdoms.

V. The Interdependence of Organisms

Benchmark

Students investigate and understand that the atoms and molecules on Earth cycle among the living and nonliving components of the biosphere, that organisms both cooperate and compete in ecosystems, and that humans modify ecosystems as a result of population growth, technology, and consumption.

Indicators (SOL BIO.1, BIO.5, BIO.7, BIO.9)

- a. Illustrate the interdependence of living things using the concepts of matter and nutrient cycling.
- b. Explain how photosynthesis and cellular respiration are complementary processes for cycling carbon dioxide and oxygen within an ecosystem.
- c. Relate the concepts of individuals, populations, communities, and ecosystems to each other.
- d. Illustrate the interactions within and among populations including carrying capacities, limiting factors, and growth curves.
- e. Cite several examples of predation, parasitism, commensalism, mutualism, and competition.
- f. Compare biotic and abiotic features of various terrestrial and aquatic biomes.
- g. Illustrate the various succession patterns in ecosystems.
- h. Formulate ways of dealing with environmental problems such as air pollution and overpopulation.

VI. The Functions and Interactions of Human Body Systems

Benchmark

Students investigate and understand that functions and interactions of systems within the human body support and maintain a stable internal environment.

Indicators: (SOL BIO.1, BIO.2, BIO.3, BIO.4, BIO.5, BIO.6)

- a. Describe the primary tissues of the human body such as blood, lymph, and muscle and relate the structure to its function.
- b. Explore the major organ systems of the human body and understand their functions and interactions.

- c. Demonstrate an understanding of the functions and interactions of organ systems to maintain a stable internal environment that can resist disturbance from within or without (homeostasis).
- d. Understand microbial causes of disease.
- e. Formulate questions and discuss health issues based on the knowledge of human body systems and their functions.

* The human reproductive system is covered in the Biology I Family Life Education lessons.

Assessment:

All students will take the Virginia Standards of Learning Test for Biology.

SOL Course Syllabus
for
CHEMISTRY
(441000)

Grade: 10-12

Credit: One

Prerequisite: One laboratory science course

Chemistry I is a laboratory-oriented course designed to enable all students to acquire an understanding of how chemical theory is developed and how a chemist thinks and works. Students investigate the composition, properties and reactions of matter. The approach is inductive and mathematical, as well as conceptual.

Laboratory experiments and the use of technology are integral parts of the course. Many of the experiments use computers, CBL's (calculator based laboratory), and probeware for the collection and analysis of data. Simulation software and videodisks are also used. Students are given the opportunity to acquire, manipulate and present data using these technologies.

Indicators are notated with the Virginia Standards of Learning for Chemistry. All Virginia Standards of Learning for Chemistry are included in this course. The basic chemical principles are applied to organic chemistry, biochemistry, nuclear chemistry, and environmental chemistry.

Benchmarks and indicators are organized by the following strands:

- | | |
|------|-------------------------------------|
| I. | Inquiry in Chemistry |
| II. | The Structure of the Atom |
| III. | Structures and Properties of Matter |
| IV. | Interactions of Matter |

Course Content

I. Inquiry in Chemistry

Benchmark

Students will recognize the contributions made by scientists throughout culture, and explain how scientific knowledge builds and changes over time. Students will participate in the scientific process.

Indicators: (SOL CH.1)

- Consider how the world would be different without a specific discovery or advancement.
- Participate both as an individual and as a team member on scientific investigations.
- Create an experimental design diagram that identifies the various levels of the independent variable, dependent variable, the control, the constants, and the number of trials.
- Organize a set of data in a logical and coherent manner using appropriate tables, diagrams, charts, or graphs.
- Construct graphs and use the graph to determine trends and mathematical relationships.
- Write a conclusion for a scientific investigation that includes a statement of results, the relationship of the results to the hypothesis, an explanation and a defense of the results, and an analysis of possible sources of error.
- Follow appropriate laboratory techniques and use equipment and chemicals in a safe manner.

II. The Structure of the Atom

Benchmark

Students will explain the makeup of matter in terms of particles and forces.

Indicators: (SOL CH.2)

- a. Identify the three basic particles of matter and their charges, relative masses, and location.
- b. Describe the development of our concept of the atom through Dalton, Thomson, Rutherford, Bohr to our modern concept.
- c. Define the terms: atomic number, mass number, and isotope.
- d. Interpret the isotopic notation and use isotopic abundance data to calculate the average mass of the elements.
- e. Write and balance nuclear equations using appropriate notation for nuclear particles and emissions.
- f. Explain the concept of half-life and solve half-life problems.
- g. Write electron configurations and orbital notations for any atom or ion.
- h. Differentiate between core electrons and valence electrons.
- i. Classify elements as metals, nonmetals, or metalloids based on their position on the periodic table.
- j. Use the periodic table to predict and explain physical and chemical properties (including atomic size, electronegativity, shielding effect) based on the position of the element on the periodic table. Reference should be made to the period (series) and/or group (family) that the element is in on the periodic table.

III. Structures and Properties of Matter

Benchmark

Students will understand that the structure and properties of matter are dependent upon the structure and properties of the atoms and compounds that make up matter. This is dependent upon the intramolecular and intermolecular bonding that takes place.

Indicators: (SOL CH.2, CH.3, CH.4, CH.5)

- a. Differentiate between ionic and covalent bonding.
- b. Classify matter in terms of elements, compounds, and mixtures.
- c. Name and write formulas for covalent and ionic compounds.
- d. Differentiate between and determine molecular and empirical formulas.
- e. Draw Lewis structures for compounds.
- f. Predict whether a compound is polar or nonpolar and use polarity to account for properties of the compound.
- g. Use a solubility curve to determine the solubility of a solute at a given temperature and describe the effect of temperature on solubility for that substance.
- h. Relate solution concentrations to colligative properties.
- i. Describe with words and mathematical equations the interrelationships of temperature, volume and pressure.
- j. Calculate the partial pressure and vapor pressure of gases in a mixture.
- k. Interpret a diagram (heating curve) in terms of kinetic energy and potential energy.
- l. Calculate the enthalpy change associated with a phase change, using molar heats of fusion and vaporization.
- m. Use calorimetry to determine the specific heat capacity of a substance.

IV. Interactions of Matter

Benchmark

Students will understand that chemical reactions happen all around us. Students will be able to classify the various types of chemical reactions and quantify aspects of the reaction process.

Indicators: (SOL CH.3, CH.4, CH.5)

- a. Classify a reaction as synthesis, decomposition, single replacement, double replacement, neutralization, oxidation-reduction, or dissociation /ionization.
- b. Compare exothermic and endothermic reactions in terms of bond making, bond breaking, and potential energy changes.
- c. Differentiate between oxidation and reduction and assign oxidation number for each element in a compound.
- d. Use collision theory to explain how the rate of a reaction is influenced by the nature of the reactants (activation energy), temperature, concentration, surface area, and catalysis.
- e. Identify and interpret the components of a potential energy diagram, and explain how a catalyst affects it.
- f. Describe chemical equilibria.
- g. Define the term mole and Avogadro's number.
- h. Use the mole, molar mass, and Avogadro's number in problems that require the calculation of the number of grams, molecules, atoms, of moles of a given substance.
- i. Calculate solution concentrations.
- j. Balance a chemical equation and interpret the equation in terms of moles, representative particles, masses and volumes of gases.
- k. Determine the reactivity of a metal compared to other metals.
- l. Determine the enthalpy change for various reactions using calorimetry and/or Hess's Law.
- m. Describe acid/base solutions by writing the appropriate dissociation (ionization) equations and calculate the pH and/or pOH of the solution.
- n. Explain how the terms strong and weak are used to describe acids, bases, and other electrolytes.
- o. Classify a solution as acidic, basic, or neutral, based on the pH of the solution.

Assessment:

All students will take the Virginia Standards of Learning Test for Chemistry.

SOL Course Syllabus
for
PHYSICS
(451000)

Grade: 11-12

Credit: One

Prerequisite: Two laboratory science courses

Physics I introduces the central concepts of physics, including the dual wave-particle nature of light, the conservation laws (mass, energy, and momentum) and atomic theory. This laboratory-centered course utilizes an approach that is inductive and mathematical as well as conceptual.

Laboratory experiments and the use of technology are integral parts of the course. Many of the experiments use computers, CBL's (calculator based laboratory), and probeware for the collection and analysis of data. Simulation software and videodisks are also used. Students are given the opportunity to acquire, manipulate and present data using these technologies.

Indicators are notated with the Virginia Standards of Learning for Physics. All Physics standards are included in this course.

Benchmarks and indicators are organized by the following strands:

- I. Inquiry in Physics
- II. Classical Mechanics
- III. Waves
- IV. Electricity and Magnetism
- V. Nuclear and Quantum Physics

Course Content

I. Inquiry in Physics

Benchmark

Students will recognize the contributions made by scientists throughout culture, and explain how scientific knowledge builds and changes over time. Students will participate in the scientific process.

Indicators: (SOL PH.3, PH.5)

- a. Gather and analyze data in an open system, which relates to the concepts of impulse and momentum.
- b. Use laboratory data to derive the relationships between radius, force, speed, and acceleration for objects moving in uniform circular motion.
- c. Apply universal gravitational theory and centripetal force theory to deduce Kepler's laws of planetary motion using a mathematical derivation.
- d. Using experimental data from motion detectors, calculate velocity and/or acceleration graphs using the slope of the line.
- e. Investigate and summarize the results of an experiment involving free-fall or projectile motion and analyze the limitations of the experimental apparatus.
- f. Devise an experiment to calculate the efficiency of an electric motor as it lifts a mass.
- g. Devise and conduct an experiment to investigate Joule heating in an electric circuit.

- h. Analyze primary sources to develop and refine research hypothesis.
- i. Incorporate data gathered from non-SI instruments by using conversions and appropriate significant figures.

II. Classical Mechanics

Benchmark

The students will explain the interrelationship of motion, forces and energy.

Indicators: (SOL PH.1, PH.2, PH.5, PH.6, PH.7, PH.8, PH.14)

- a. Analyze the interaction of objects in a closed system according to conservation of energy.
- b. Perform an experiment to analyze the interaction of objects using the work-energy theorem.
- c. Construct and analyze free body diagrams describing the forces on various objects within a system of objects.
- d. Apply Newton's laws of motion to analyze and predict the effects of applied forces on bodies.
- e. Calculate the momentum of a moving object.
- f. Derive the relationship between impulse and change in momentum.
- g. Qualitatively describe the nature of gravitational force and inverse square law.
- h. Combine universal gravitational theory and centripetal force theory to solve orbital motion problems.
- i. Relate mass, speed, momentum, and kinetic energy of a moving body.
- j. Calculate gravitational and electrical potential energy.
- k. Define heat and distinguish between heat and temperature and describe experiments showing the production of heat from mechanical and/or electrical forms.
- l. Describe the model of the kinetic theory of a gas.
- m. Use the kinetic theory to predict quantitative relationships between pressure and volume, particle speed, number of particles and temperature.
- n. Describe the concept of temperature as that which decides the direction of spontaneous energy transfer by conduction, convection, or radiation.

III. Waves

Benchmark

Students will understand the nature of waves, and quantify the interactions that occur between waves and matter.

Indicators: (PH9, PH10, PH11)

- a. Develop a wave model for mechanical energy transfer.
- b. Relate wavelength, wave speed, and frequency.
- c. Compare and contrast transverse and longitudinal waves.
- d. Use the wave model to explain diffraction, polarization, and interference to include standing waves.
- e. Produce and analyze interference patterns using sound, light, or water waves.
- f. Explain the Doppler shift for moving wave sources.
- g. Predict and produce real and virtual images using light and mirrors and record using ray diagrams.
- h. Construct ray diagrams demonstrating how images are formed by lenses and mirrors.

- i. Explore the relationship between wavelength, frequency, and energy of electromagnetic waves.

IV. Electricity and Magnetism

Benchmark

Students will use the field concept to explain electric and magnetic fields. Students will construct basic electrical circuits and explain the various circuit components.

Indicators: (PH4, PH8, PH12, PH13, PH14)

- a. Analyze energy transformations in electrical circuits using the law of conservation of energy.
- b. Formulate the relationship between power, energy, and time.
- c. Construct a model of charge that explains how objects become electrically charged through friction, induction, and direct contact.
- d. Qualitatively describe the nature of the electrostatic force.
- e. Calculate electric field strengths around various charge configurations and sketch the field lines.
- f. Compare the ratio of electric force to gravitational force between charged objects and classify forces as either gravitational or electrical.
- g. Combine various electrical components to diagram and construct electrical circuits and compare to solid state components.
- h. Apply ohm's law in solving various circuit problems.
- i. Compare and contrast the properties of insulators, conductors, semiconductors, and superconductors.
- j. Create or understand a model for magnetism to explain the existence of magnetic fields around permanent magnets and current carrying wires.
- k. Apply the right-hand rule to determine the circulation and orientation of magnetic field lines around current carrying wires and the deflection of charged particles moving through magnetic fields.
- l. Explore the relationship between voltage and current generated by a changing magnetic field.
- m. Relate magnetic field theory to the operation of devices such as motors, generators, transformers, and magnetic resonance imagers.

V. Nuclear and Quantum Physics

Benchmark

Students will understand the structure of the atom and nuclear forces. Students will understand how these concepts led to the theory of relativity and quantum mechanics.

Indicators: (SOL PH.3, PH.4, PH.14)

- a. Qualitatively describe the operation of a cathode ray tube and predict the deflection of the electron beam.
- b. Apply the wave/particle model of light to explain experimental results such as diffraction, photoelectric effect, and interference.
- c. Connect the wave/particle duality of light to matter.
- d. Compare and contrast different wavelengths and energies of the electromagnetic spectrum
- e. State and apply Einstein's mass energy equivalence.
- f. Define mass defect and binding energy.
- g. Describe the process of nuclear fission/fusion with a simple example.
- h. Describe the characteristics of atomic emission and absorption spectra.
- i. Describe the characteristics of alpha, beta and gamma particles.

Assessment:

There is no Virginia Standard of Learning Test for Physics.

SOL Course Syllabus
for
GEOSYSTEMS
(424000)

Grade: 11-12

Credit: One

Prerequisite: Two years of a laboratory science

Geosystems integrates content from geology, astronomy, oceanography, and meteorology with various forms of technology, social and environmental issues, and hands-on experiments. Students explore concepts using computers, telecommunications equipment, graphing calculators, probeware, CD-ROM's and image processing software.

The use of technology is an integral part of the course. Many of the experiments use computers, CD-ROM's, telecommunications equipment, and probeware for the collection and analysis of data. Students acquire, manipulate, and present data using these technologies.

Indicators are notated with the Virginia Standards of Learning for Earth Science. All Earth Science Standards are included in this course.

Benchmarks and indicators are organized by the following strands:

- I. Astronomy
- II. Fluid Earth Dynamics (the earth's atmosphere and water)
- III. Solid Earth
- IV. The Environment
- V. Science, Technology, and Communication Skills

I. Astronomy

Benchmark

Students will examine the origins of stars and stellar systems to include the Big Bang Theory, solar nebular theory, stellar evolution, constellations, and galaxies. Students will investigate the origin and development of the solar system to include the characteristics and mechanics of the sun, the planets, their moons, and other lesser bodies within the solar system. The key is to understand the earth's place in the universe.

Indicators: (SOL ES.2, ES.4, ES.14)

- a. Explain the origin of the Universe as postulated by the Big Bang Theory.
- b. Explain how the force of gravitational attraction resulted in the clumping of matter led to galactic, stellar, and planetary formation.
- c. Describe the Milky Way galaxy – its size, shape, rotation, and the Sun's location in it – and indicate how scientists obtained this information.
- d. Explain the various ways distances to stars are measured and calculate distances in space.
- e. Discuss how changing technology is helping astronomers explore the universe and determine its characteristics.
- f. Explain the mechanics of a star in terms of opposing nuclear and gravitational forces.
- g. Use Newton's and Kepler's laws to describe the motion of the planets.
- h. Describe the gravitational causes of the Earth's tides.
- i. Describe how the mechanics of the earth's rotation and revolution determine days, seasons, and variations in received solar energy.
- j. Access current geologic and atmospheric data about the planets from real time data sources on the Internet.

- k. Discuss the Earth's place in the "habitability zone" and its ability to support planetary life.

II. Fluid Earth Dynamics (the earth's atmosphere and water)

Benchmark

Students will understand how weather and climate are made and their interrelationships with the oceans and the earth's energy budget. Students will investigate how the atmosphere has changed over time and how it may continue to change and what factors may cause that change. Students will understand that the oceans are complex, interactive physical, chemical, and biological systems and they will investigate short-term and long-term variations.

Indicators: (SOL ES.4, ES.9, ES.11, ES.12, ES.13)

- a. Describe the composition and structure of the atmosphere.
- b. Compare and contrast the four methods of energy transfer: conduction, convection, radiation, and advection and discuss how unequal heating and the Coriolis effect produces the winds.
- c. Describe different types of clouds and the conditions under which they form, and the weather associated with each.
- d. Interpret remote sensing data that has been collected by satellites.
- e. Describe the causes of the various severe weather phenomena (cyclonic high winds, hurricanes, and tornadoes), evaluate when and where they are likely to occur, and predict their future once in motion.
- f. Describe the shape and composition of the ocean's basins and contrast those features with the shape and composition of the continents.
- g. Compare and contrast the movement of surface and deep ocean currents.
- h. Explain the phenomenon of light penetration in water and energy transfer through the process of photosynthesis.
- i. Explain the relationships between floating, swimming, and bottom dwelling sea organisms.
- j. Describe the ways in which energy is cycled from the sun to and between the atmosphere and oceans.
- k. Investigate the relationships of the energy cycle with the hydrologic cycle.
- l. Explain the relationships of surface water and groundwater in terms of erosion, deposition, water quality, and water availability.
- m. Discuss the variables (i.e., altitude, latitude, mountains, cloud cover, human activity, and nearness to water) which affect the climate of an area.
- n. Discuss the factors which may have caused the ice ages, and explain the mechanics of glaciation.

III. Solid Earth

Benchmark

Students will understand the theory of plate tectonics and its historical derivation. Students will investigate key aspects of minerals based on their physical and chemical properties and will relate that information to igneous, sedimentary, and metamorphic rocks of the rock cycle. Students will investigate the dynamic nature of the earth's crust due to seismic events, weathering, erosion, and deposition. Students will be conversant with the means by which the history of the planet are known.

Indicators: (SOL ES. 2, ES. 4, ES. 5, ES. 6, ES. 8, ES. 10)

- a. Compare the processes that are responsible for the Earth's internal heat.
- b. Cite evidence supporting the theories of continental drift, sea-floor spreading, and plate tectonics, and discuss the relationships between these theories.

- c. Interpret various graphical representations of surface and subsurface data sets to determine the location and types of plate boundaries.
- d. Relate how seismic data is used in regard to earthquakes, volcanoes, and the earth's overall internal structure.
- e. Relate fold and fault structures to compressional, tensional, and shear forces, to the theory of isostasy, and to the principles of superposition, uniformitarianism, and cross-cutting relationships.
- f. Explain the distinguishing characteristics, such as atomic structure and cooling rates, which can be used to categorize minerals into different groups.
- g. Describe the types of weathering and explain their relationship to erosional agents and resulting erosional landforms.
- h. Relate erosion and weathering processes to the physical and chemical properties of soils.
- i. Relate deposition to the formation of sedimentary rocks.
- j. Explain how fossils, geologic structures, and radioactive decay can be used together to determine the age of rocks.
- k. Interpret the physiographic patterns of North America and in particular the Mid-Atlantic Region.
- l. Interpret the local geologic history.

IV. The Environment

Benchmark

The student will examine the interrelationship between the earth's physical environment (air, water, and land) and the biosphere. This examination includes issues of air and water pollution and uses of water and earth resources.

Indicators: (SOL ES.7, ES.11, ES.12)

- a. Explore the economic, political, and geologic importance of earth resources, their uneven distribution, and the environmental consequences of their extraction and use.
- b. Relate how past environments formed the nonrenewable resources used today.
- c. Investigate the interrelationships between environmental conditions and the carrying capacity of biological populations.
- d. Assess the role of meteorite collisions and plate tectonics on biologic diversity and mass extinction.
- e. Examine the role of human activity on earth systems in areas such as: tropospheric ozone, stratospheric ozone, acid rain, warming gas accumulation, water pollution, water redistribution, oil spills, urbanization and land use decisions, waste management (hazardous, non-hazardous, nuclear), consequences of coastal engineering structures, and deforestation/reforestation.

V. Science, Technology, and Communications Skills

Benchmark

A key element of the Geosystems course is that students integrate a variety of science, technology, and communications skills and demonstrate these acquired capabilities throughout their academic work in the content areas listed in strands I through IV, above.

Indicators: (SOL ES.1, ES.2, ES.3)

- a. Locate and use text, data, and images from reference books, periodicals, CD-ROMs, electronic databases, local area networks, world wide web sites, remote sensing, and geographic information systems (GIS) databases.
- b. Interpret writing and do writing that integrates visuals such as charts, graphs, maps, diagrams, images, and symbols with text.

- c. Conduct experiments by following instructions from manuals or given orally from an experienced user.
- d. Conduct experiments using self-generated experimental design to develop valid models to investigate problems.
- e. Analyze and draw conclusions from scientific data that is both continuous and discontinuous.
- f. Obtain, read, and interpret information using CBL instruments, probes, and graphing calculators.
- g. Describe scientific findings or a viewpoint orally to other students or to an instructor.
- h. Use graphing calculators and computers to produce numerical models, tables, graphs, and spreadsheets that describe and compare data obtained from scientific observations and use that information to make scientific predictions.
- i. Share information electronically through local area networks.
- j. Publish information electronically through a home page on the WWW.

Assessment:

All students will take the Virginia Standards of Learning Test for Earth Science.