**Curriculum**

**Biology**

**Course Overview**

This is a laboratory course based on the investigation of properties common to all living organisms through experimentation and classroom instruction. Topics include molecular and cellular biology; respiration and photosynthesis; a survey of the kingdoms; microbiology; genetics and evolution; a detailed study of vertebrate systems with special reference to the human body. Students are introduced to ecology, the relationships of organisms to their habitats, and the human impact on the environment.

**Department Standards**

**STANDARD 1: THE NATURE OF SCIENCE**

**STANDARD 2: SCIENCE AND TECHNOLOGY**

**STANDARD 3: THE PHYSICAL SETTING**

**STANDARD 4: THE LIVING ENVIRONMENT**

**STANDARD 5: SCIENCE AND SOCIETY**

**Benchmarks**:

[Science Department Standards & Benchmarks](http://acidale.on-rev.com/dante/Science/Standards%26BenchmarksK-12.docx)

**Performance Indicators**

**Biology**

**Performance Indicators**

**First Quarter**

UNIT 1 : BIOCHEMISTRY

Classify organisms into their kingdoms 4.3, 4.5, 4.6

Understand the differences in classification schemes (3 domains vs. 6 kingdom vs. 5 kingdom) 4.3, 4.5, 4.6

Apply correct techniques for microscope use 1.31

Differentiate between appropriate use of stereo/dissecting versus high-power microscopes 1.31

Explain the behavior of water due to polarity 3.23-3.27, 3.35-3.37

Produce a formal written laboratory report 1.4-1.7, 1.28-1.34, 1.36, 1.37

Differentiate monomers using molecular models 3.23-3.27, 3.35-3.37

Recognize molecular and structural formulas of monomers 3.23-3.27, 3.35-3.37. 4.26

Explain the significance of macromolecules in living systems 3.23-3.27, 3.35-3.37, 4.5

Understand and implement the use of indicators for carbohydrates, proteins, & lipids; organize and analyze results and produce a written report 3.23-3.27, 3.35-3.37, 4.5

Create a presentation on a specifically assigned aspect of digestion 4.57

UNIT 2: CELLS

Create and evaluate wet-mount slide 1.31

Differentiate between unicellular and multicellular organisms, and between prokaryotic and eukaryotic cells 4.15-4.18, 4.26

Compare plant and animal cell structures and functions and recognize cells from other kingdoms 4.4-4.6, 4.16, 4.17

Explain the universality of the cell theory 4.5, 4.26

Compare passive and active forms of transport with cells 4.17

Execute procedures for the Osmosis Inquiry Lab, identify solution/solute concentration, and organize and analyze results in a written report 1.4-1.7, 1.28-1.34, 1.36, 1.37, 4.15, 4.17

UNIT 3: MOVEMENT

Explain how and why different organisms move 4.57

Understand the hierarchical nature of animal structure, from cells to the complete organism. 4.5, 4.26

Remember the names of the major bones of the human skeleton. 4.57

Explain the development of the human skeleton 4.57

Understand how joints work in relation to specific movements. 4.57

Differentiate the structure in relation to function of the different types of muscle tissue. 4.57

Understand the importance of the human integumentary system. 4.57

Apply microscope skills to a comparison of prepared slides from bones, muscles and skin. 1.31, 4.57

Understand the structure of a chicken wing through observation and dissection. 4.57

**Second Quarter**

UNIT 4: PLANTS

Compare cells in the different plant tissues.

Recognize different plant cells in prepared microscope slides of roots, stems and leaves.

Understand how each of the plant cell types contributes to the transport of water, food and gases in plant roots, stems and leaves.

Generate a list of plants useful to humans.

Explain the importance of food for materials and energy in organisms.

Recall the difference between autotrophs and heterotrophs, with examples from the five kingdoms.

Understand the summary equation for photosynthesis, and explain the requirements.

Explain the source of the energy and oxygen in the light reactions and summarize the pathway of carbon entering the Calvin cycle.

Analyze connections between plant structure and productivity.

Produce a chromatogram of plant pigments and analyze the banding pattern in a written laboratory report.

UNIT 5: HUMAN CIRCULATORY & IMMUNE SYSTEMS

Execute a labelled diagram of the human heart.

Understand the relationship between structure and function of the heart through dissection of a sheep’s heart.

Understand the systems controlling the heart rate, and evaluate the environmental and internal influences on the rate

Differentiate between the structure and function of arteries, capillaries and veins.

Produce a line graph of pulse rate against time based on measurements taken after exercise, and interpret the results in a written laboratory report.

Recall the major components of blood: plasma, red cells, white cells and platelets and their functions.

Construct a table of blood types showing which are compatible for transfusion.

Summarize the functions of the circulatory system.

Recognize the importance of the skin, the inflammatory response and the immune response in preventing infection by pathogens.

Differentiate between the various types of white blood cell involved in defences.

Explain how vaccination can reduce the chances of pathogenic infection.

UNIT 6: MICROBES & HUMAN DISEASES

Recognize the variety of microbes, including viruses, bacteria, protists and fungi through the examination of prepared microscope slides and electron micrographs.

Evaluate viruses in relation to their role as living organisms.

Recognize the basic structure of a virus, with its capsid, envelope, and genome.

Differentiate between bacteriophages, polyhedral viruses and helical viruses.

Understand how a bacteriophage reproduces in a host cell, through the lytic cycle, and consider how plant and animal viruses are dispersed.

Generate a list of human virus diseases, and list the ways in which the spread of viruses can be limited, and diseases treated.

Evaluate how viruses can be either harmful or beneficial to humans.

Recall from Unit 2 the structure of a bacterial cell as seen in the electron microscope.

Understand how and why bacteria are identified.

Evaluate the range of habitats and sources of nutrition and respiration for bacteria.

Explain how bacterial cells divide through binary fission.

Evaluate bacteria as harmful or beneficial to humans, and learn recall examples.

Recall the kingdom of Protists from Unit 1, and differentiate protozoa and algae.

Examine live specimens of live protists, using good microscope technique.

Compare movement in various types of protozoa and algae.

Evaluate protozoa and algae as harmful or beneficial, recalling some examples of each.

Compare the cells, cell walls, storage materials, and method of nutrition of fungi with both plants and animals.

Recognize various types of fungi, including yeasts, molds, mushrooms and lichens.

Evaluate fungi as harmful or beneficial to humans, recalling some examples.

**Third Quarter**

UNIT 7: CELL DIVISION

Explain why cells divide, with examples of processes from a variety of organisms.

Compare the processes and biological significance of asexual & sexual reproduction.

Recall from Unit 2 how prokaryotic cells divide by binary fission.

Summarize the main stages of the cell cycle: interphase, mitosis and cytokinesis.

Recognize and count cells in four mitosis stages in onion roots, creating a pie chart of class totals and writing a laboratory report to analyze the data.

Remember the behavior of the chromosomes in the four stages of mitosis.

Compare the process of cytokinesis in animal and plant cells.

Use molecular models to understand the structure of nucleic acids.

Participate in a group exercise to extract DNA from living onion cells.

Relate DNA replication to cell division in prokaryotes and eukaryotes.

Understand how the universality of the genetic code allows for gene technology.

Apply theoretical knowledge of transcription and translation to the construction of a real protein in a paper and pencil model.

Explain how meiosis and fertilization produce a variety of offspring.

UNIT 8: NERVES

Explain why animals need to have a nervous system.

Understand the structure of the human brain using labelled diagrams and models of the skeleton, skull and brain.

Compare the functions of the cerebrum, cerebellum and brain stem.

Summarize the ways in which the human central nervous system is protected.

Compare sensory neuron, interneuron and motor neuron structure and function.

Use models and diagrams to understand the wave nature of nerve impulses.

Evaluate the importance of synapses and reflexes in the nervous system.

Test humans nerve responses, using bar graphs to display the data, and write a full laboratory report to analyze the results.

Compare the central and peripheral nervous systems, with the cranial and spinal nerves, using skeleton and body models.

Contrast the somatic and autonomic nervous systems.

Perform vision tests, models and diagrams to support understanding of the structure and function of the human eye.

Use annotated diagrams to show the structure and function of the human ear and balance organs.

Write and present to the class an imaginative essay about how a wild mammal uses its sense organs for survival.

UNIT 9: GENETICS

Understand how Mendel’s experiments led to his theory explaining phenotype ratios in monohybrid and dihybrid crosses.

Extend Mendel’s theory to testcrosses and incomplete dominance.

Understand the connection between genes and chromosomes.

Recognize how sex chromosomes determine the sex of individuals.

Differentiate between sex linkage and gene linkage.

Recognize why mutations in genes and chromosomes can affect phenotypes.

Apply appropriate symbolic notation for dominant/recessive allele pairs, incomplete dominance and sex linkage.

Execute simple problems involving monohybrid and dihybrid crosses, incomplete dominance and sex linkage, using diagrams and Punnett squares as appropriate.

Execute a dissection of a flower, with a fully labelled drawing, and relate the parts to Mendel’s experiments.

Carry out tests of probablility using beads and coins, analyzing the class data.

Use information about families to complete pedigrees of human color blindness.

UNIT 10: RESPIRATION

Execute a labelled diagram of the human lungs, and relate the structures to the human torso model, tracing the air pathway from nostrils to alveoli.

Apply knowledge of muscle action to understand the human breathing mechanism.

Recognize the importance of breathing, and of gas exchange in all organisms.

Apply knowledge of diffusion to the exchange of gases across membranes.

Compare the transport of oxygen and carbon dioxide in mammalian circulation.

Evaluate the effects of exercise on breathing rates and respiratory minute volumes using lung volume bags, producing bar graphs of the results.

Write a laboratory report to explain how and why breathing changes with exercise.

Recognize the universal importance of cellular respiration to organisms.

Understand and remember the balanced chemical equation for aerobic respiration.

Trace the pathways of carbon atoms in anaerobic and aerobic respiration.

Recognize the importance of mitochondria in eukaryotic aerobic respiration.

Measure respiration rates in pea seeds using respirometers, and evaluate the results using a line graph and written analysis as part of a formal laboratory report.

Create a poster on smoking

UNIT 11: EVOLUTION

Evaluate the various types of evidence of evolution.

Use real fossils and casts of fossils to understand how living organisms can be preserved for very long periods of time.

Summarize Darwin’s theory of evolution by natural selection.

Use example to compare coevolution, convergent evolution and divergent evolution.

Differentiate between species and populations.

Use a simple diagram to explain speciation through geographic isolation.

Recognize the reasons for reproductive isolation.

Summarize the evolution of modern humans from distant ancestors.

Measure and analyze scale drawings to compare the skulls of humans, great apes and a variety of hominids.

Create a poster, with a time line from 65 million year ago, to illustrate the evolution of a chosen primate, and explain it in a spoken presentation to the class.

**Fourth Quarter**

UNIT 12: ENVIRONMENTAL SCIENCE

Understand the concept of biodiversity and the reliance of ecosystems on it

Use the ‘Oh Deer’ activity to explain limiting factors and carrying capacity

Create a foodweb project that illustrates understanding of trophic levels, consumer roles, and interconnections between species and biomes.

Review the flow of energy within food chains with a yarn activity

Compare the biogeochemical cycles of nitrogen, carbon, and water.

Understand the mechanisms of global warming

Explore the anthropogenic sources of global warming gasses and understand the benefits of the reduction on these gasses

Summarize the impact of rapid climate change on ecosystems

Compare the different biomes and summarize the characteristics of each including wildlife, climate, and geography

Project illustrating renewable energy 2.22-2.25, 3.9

Differentiate impacts of incinerators and recycling in a debate format 2.22-2.25, 3.9, 5.1, 5.2, 5.8

Summarize the life cycle of a common product 2.14, 2.15, 5.8

UNIT 13: HOMEOSTASIS

Understand the importance of excretion for all animals.

Use labelled diagrams of the human excretory system, the kidney and a nephron to explain the function and operation of kidneys.

Review the principles of osmosis through an experiment on water regulation.

Compare endocrine and exocrine glands, and protein and steroid hormones.

Understand and remember the function of one hormone from each of the following human endocrine glands: thyroid, adrenal, pituitary, pancreas, and gonads.

Understand the main functions of human male and female reproductive systems.

Compare the control systems for male and female reproductive hormones.

Summarize fertilization, cleavage, implantation and early development.

Carry out a dissection of a small mammal, recalling the body systems (optional).

**Assessments**

**Biology**

**Assessments**

**First Quarter**

Summative Unit Tests

Formative Warm-up QuestionsStudent Generated Class Presentations

Laboratory reports: Macromolecules; Osmosis

**Second Quarter**

Summative Unit Tests

Formative Warm-up QuestionsStudent Generated Class Presentations

Laboratory Report: Chromatograpy of Plant Pigments; Pulse Rate; ProtistsFirst Semester Examination

**Third Quarter**

Summative Unit Tests

Formative Warm-up QuestionsStudent Generated Class Presentations

Laboratory reports: Mitosis; Nerve responses; Lungs; Flower structureProject on genetics

**Fourth Quarter**

Summative Unit Tests

Formative Warm-up QuestionsStudent Generated Class Presentations

Laboratory Report on Evolution

Project on Environmental Science Unit

Second Semester Exam

**Core Topics**

**Biology**

**Core Topics**

**First Quarter**

UNIT 1

Introduction to Biology

Biochemistry

Human Digestive System

UNIT 2

Cells

Cell Transport

UNIT 3

Biological Movement

Human Skeletal, Muscular, & Integumentary Systems

**Second Quarter**

UNIT 4

Plants

Photosynthesis

UNIT 5

Human Circulatory & Immune Systems

UNIT 6

Microbes

Human Diseases

**Third Quarter**

UNIT 7

DNA Structure and Function

Cell Replication

UNIT 8

Human Nervous System

UNIT 9

Genetics

UNIT 10

Cellular Respiration

Human Respiratory System UNIT 11

Evolution

**Fourth Quarter**

UNIT 12

Environmental Science

UNIT 13

Human Excretory and Endocrine System

**Specific Content**

**Biology**

**Specific Content**

**First Quarter**

UNIT 1

Characteristics of Life

Five Kingdoms of Life

Laboratory: Introduction to microscope

Properties of Water: adhesion, cohesion, polarity, hydrogen bonding

Monomers & Macromolecules: proteins, lipids, nucleic acids, carbohydrates

Laboratory: Food Tests

Anatomy, accessory organs, digestive enzymes & functions of the human digestive system

Understand a diagram and model of the digestive system and explain the processes of digestion and absorption

UNIT 2

Laboratory: Cell Lab

Cell Theory: multicellular, unicelluar

Prokaryote, Plant, & Animal Cell Structure and organelles Diffusion, osmosis, facilitated diffusion, active transport, endocytosis, exocytosis

Laboratory: Egg Lab and Osmosis

UNIT 3

Survey of movement across the five kingdoms

Tissues, organs and organ systems in animals

Mammalian body cavities

Human skeleton: cartilage, bone and ligaments; development of the skeleton; types of joints

Smooth, cardiac and skeletal muscle structure and function

Laboratory: Bone, Muscle and Skin

Laboratory: Chicken Wing

Human skin structure and functions

**Second Quarter**

UNIT 4

Plant tissues and the structure of roots, stems and leaves

Transport of water, food and gases in plants

Laboratory: Plant Anatomy

Survey of the various uses of plants to humans

Autotrophs, heterotrophs and the need for food in organisms generally

Summary equation and general requirements for photosynthesis

Outline of the main stages of photosynthesis: light reactions and Calvin cycle, and their location in the plant

Laboratory: Chromatography

UNIT 5

Diagram of the human heart, illustrating blood flow and connections

Functions of the components of the heart, and their roles in the mechanism and control of the heartbeat

Blood vessel types and circulation to the lungs and body

Blood components and their functions, inlcuding platelets and clotting

Blood types A B AB O and the interaction of antigens and antibodies, with reference to transfusion

Functions of the circulatory system

UNIT 6

Viruses: basic structure, shapes and host specificity

Reproduction, focusing on the lytic cycle of bacteriophages

Human viral diseases; use of viruses in gene technology

Bacteria: identification by shape & color

Habitats, nutrition, respiration and reproduction of bacteria

Treatment of bacterial infection in humans

Examples of bacteria useful or harmful to humans

Protists: protozoa and algae

Examples of protists useful or harmful to humans

Fungi: cells, storage materials, nutrition and reproduction

Types of fungi: molds, mushrooms, yeasts and lichens

Examples of fungi useful or harmful to humans

Laboratory work: Diversity of Microbes

**Third Quarter**

UNIT 7

Reasons for cell division in unicellular and ulticellular organisms

Asexual and sexual reproduction

Binary fission in prokaryotes

Cell cycle: interphase; mitosis; cytokinesis in animal and plants

Stages of mitosis: prophase; metaphase; anaphase; telophase

DNA structure and replication

RNA structure and types, and the universal genetic code

Protein synthesis: transcription and translation in outline

Meiosis: functions and stages

Fertilization and sources of variety in sexual reproduction

Laboratory work: Onion Mitosis; DNA Extraction.

UNIT 8: NERVES

Central nervous system in mammals and diagram of the human brain

Functions of cerebrum, cerebellum, brain stem, hypothalamus and pituitary

Protection of the central nervous system by meninges, bones and cerebrospinal fluid

Sensory neurons, interneurons, motor neurons

Spinal cord, cranial and spinal nerves, somatic and autonomic nerves

Nerve impulses, synapses and neurotransmitters

Spinal and cranial reflexes

Diagram of the human eye; functions of the components

Diagram of the human ear; functions of the components for hearing and balance

Laboratory work: Nerve Responses; Vision

Third Quarter Project on Senses.

UNIT 9

Mendel’ experiments with garden peas, and the use of Punnett squares

Monohybrid crosses and the 3:1 F1 phenotype ratio

Dihybrid crosses and the 9:3:3:1 F1 phenotype ratio

Testcrosses and incomplete dominance

Genes, chromosomes and mutations

Sex determination (X and Y chromosomes)

Sex linkage, focussing on eye color in fruit flies and human color blindness

Simple genetic problems: monohybrid, dihybrid, incomplete dominane, sex linkage

Gene linkage and chromosome mapping: the general principles

Simple pedigree problems, with examples including sex linked traits

Laboratory work: Probability & Genetics; Human Genetics

UNIT 10

General functions of breathing, and gas exchange across five kingdoms

Diagram of the human lungs: breathing mechanism and muscles

Pathway of the air from the nasal cavity to the alveoli

Gas exchange by diffusion in the alveoli and body tissues

Transport of oxygen and carbon dioxide in the blood

Control of breathing rates by stretch receptors, chemical receptors and the brain

General function of cellular respiration in all organisms

Anaerobic respiration: basic principles of glycolysis and fermentation

Overall balanced chemical equation for aerobic respiration

Outline of the Krebs cycle, focussing on the location and fate of carbon atoms

Basic principles and location of the electron transport chain, without details

Laboratory work: Breathing; Respirometers

UNIT 11

Evidence of evolution: fossils, biogeography and similarities in related organisms

Darwin’s theory of evolution: the concepts of variation, competition and selection

Coevolution, convergent evolution and divergent evolution

Biological species concept, and speciation by geographic isolation

Outline of the main reasons for reproductive isolation between populations

Human evolution: a brief survey from the origin of life to fully modern man

Laboratory work: Fossil Display; Human Evolution

Fourth Quarter Project on Primates

**Fourth Quarter**

Unit 12

Definition and application of Environmental Science and Ecology

Biodiversity and biological hotspots

Levels of organization and niches

Energy flow, food webs, trophic levels

Species interactions

Biogeochemical cycles

Terrestrial and aquatic biomes

Global warming and the consequences of rapid climate change

Perspectives and philosophies on environmental issues

Food and agricultural issues

Sources of nutrition

Environmental degradation and impact of agriculture and livestock

Types of anthropogenic waste, solid waste, and municipal waste

Waste disposal methods, open dumps, sanitary landfills, incineration

Methods and technology to reduce solid waste

Types of energy resources

Fossil fuel reserves and impact of fossil fuels on environment

Nuclear energy, advantages and disadvantages of nuclear energy

Renewable energy sources , advantages and disadvantages

Unit 13

Excretion in animals generally

Functions of the human kidneys

Diagram of the humans excretory system

Operation of the kidneys: filtration, reabsorption and secretion

Comparison of endocrine & exocrine glands, and the nervous & endocrine systems

Protein and steroid hormones and their general mode of action

Function of one hormone for each gland: thyroid (thyroxine), adrenal (adrenaline), pituitary (ADH), pancreas (insulin), gonads (testosterone and estrogen)

**Resources**

**Biology**

**Resources**

Main textbook: *Modern Biology* by Postlethwait & Hopson (Holt 2006)

Laboratory with lab stations and full laboratory equipment for biology

Library of microscope slides with full inventory

Video and DVD resources on a variety of topics

Laboratory handouts for students with preparation protocols for teachers

Test, quiz and exam materials on all units

Handouts for various homework homework and classwork exercises

**First Quarter**

UNIT 1

Modern Biology 2006

Powerpoints and podcasts posted to StudyWiz

'Powers of Ten' Video Clip

Demo: 'Drops on a Penny'

Molecular models

UNIT 2

Microscope slide sets of Onion root mitosis

Video on Plant Cells

Brainpop website 'Cell Structures'

'Hyper/Hypo' Video Clip

Demonstration: Iodine/Starch diffusion with dialysis bags

UNIT 3

Full-size skeleton, skull and joint models

Microscope slide sets of bone, muscle and skin'Flexible Frame' Video

**Second Quarter**

UNIT 4

Microscope slide sets of stems, roots and leaves

TASIS grounds for leaf chromatography and deciduous vs evergreen trees

Unit 5

Microscope slide sets of blood vessels

Hearts from local butcher

Heart and torso models

Video on Circulation

Pulse rate and blood pressure monitors

Unit 6

Microscope slide sets of Monera, Protists and Fungi

‘Guns, Germs, and Steel’ video clip

‘Evolutionary Arms Race’ video clip

**Third Quarter**

Unit 7

Online mitosis lab

Allium cell slides for mitosis

DNA models and manipulatives

DNA extraction activity

Bead models and activity for protein synthesis

**Fourth Quarter**

Unit 8

Nerve Response Lab

Nervous System Flash Animations from book CD-Rom

Brainpop Website

Unit 9

Flower Dissection Lab

Colorblind Lab

‘Design a Species’ Project

Probability Lab

Packet of external Genetics Problems

Unit 10