**Curriculum**

**Biology International**

**Course Overview**

This is a laboratory course based on the investigation of properties common to all living organisms through experimentation and classroom instruction. Special emphasis is placed on the development of appropriate vocabulary and descriptive skills. 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&BenchmarksK-12.docx)

**Performance Indicators**

**Biology International**

**Performance Indicators**

**First Quarter**

UNIT 1: DIGESTION

Classify organisms into kingdoms.

Understand differences in classification schemes.

Apply correct techniques for microscope use.

Differentiate between the appropriate use of stereo microscopes versus high

power microscopes.

Create and evaluate wet-mount microscope slides and produce a formal written

laboratory report.

Explain the behavior of water due to its polarity.

Differentiate monomers using molecular models.

Recognize monomer molecular & structural formulas.

Explain the significance of macromolecules in living systems.

Implement the use of indicators for carbohydrates, proteins and

lipids in foods; organize & analyze the results in a written laboratory report.

Execute a simple labeled diagram of the human digestive system.

Relate the parts of the digestive system to a model of the human torso.

Explain the processes of digestion and absorption.

Produce a poster on Favorite Food to evaluate the biological importance of the

various food items, and explain this in a spoken presentation to the class.

UNIT 2: CELLS

Differentiate between unicellular & multicellular organisms.

Contrast prokaryotic & eukaryotic cells.

Understand images and magnification produced by different kinds of microscopes.

Recognize the main features in a diagram of an animal cell.

Remember specific labels for the structures in an animal cell diagram.

Compare plant & animal cell structure, and recognize cells from other kingdoms.

Create and interpret a stained wet mount slide of onion epidermis.

Explain the universality of the cell theory.

Compare passive and active forms of transport between and within cells.

Execute procedure for Osmosis Lab; organize and interpret results and produce a

formal report.

UNIT 3: MOVEMENT

Explain how and why different organisms move.

Understand the hierarchical nature of animal structure, from cells to the

complete organism.

Understand the importance of the major body cavities in mammals.

Remember the names of the principal bones, and label them on a diagram of the human skeleton.

Explain the development of the human skeleton

Understand how joints work in relation to specific movements, using models, and label a diagram of a typical joint.

Differentiate the structure in relation to function of the different types of

muscle tissue.

Understand the importance of the human integumentary system, and annotate a diagram of human skin.

Apply microscope skills to a comparison of prepared slides from bones, muscles

and skin.

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

**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.

Compare the survival of evergreen and deciduous trees in winter.

Generate a list of plants useful to humans.

Write an essay on a chosen tree (often representing a home country) focusing on

uses and significance, but also including personal recollections, and make a

spoken presentation to the class.

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 and remember the balanced chemical equation for photosynthesis.

Explain the requirements for successful photosynthesis to occur.

Explain the source of the energy and emission of oxygen in the light reactions.

Summarize the pathway of carbon entering and leaving 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, using a labeled diagram for the apparatus.

UNIT 5: CIRCULATION

Execute a labeled 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

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 labeled 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 labeled 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.

**Fourth Quarter**

UNIT 10: RESPIRATION

Execute a labeled 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.

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.

UNIT 12: HOMEOSTASIS

Understand the importance of excretion for all animals.

Use labeled 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**

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**Assessments**

**First Quarter**

Formative Vocabulary Quiz on each unit

Formative Homework and Classwork exercises (ungraded)

Daily questions in class to check for understanding

Laboratory Reports: Microscope; Food Tests; Osmosis;

Summative Unit Tests

Project Presentation: Food

**Second Quarter**

Formative Vocabulary Quiz on each unit

Formative Homework and Classwork exercises (ungraded)

Daily questions in class to check for understanding

Laboratory Reports: Chromatography; Pulse Rate

Summative Unit Tests

Project Presentation: Trees

First Semester Examination (Quarter 1 and 2)

**Third Quarter**

Formative Vocabulary Quiz on each unit

Formative Homework and Classwork exercises (ungraded)

Daily questions in class to check for understanding

Laboratory Reports: Onion Mitosis; Nerve Responses

Summative Unit Tests

Project Presentation: Senses

**Fourth Quarter**

Formative Vocabulary Quiz on each unit

Formative Homework and Classwork exercises (ungraded)

Daily questions in class to check for understanding

Laboratory Reports: Flower Structure; Breathing Rates; Respirometers

Summative Unit Tests

Project Presentation: Primate Evolution

Second Semester Examination (Quarter 3 & 4)

**Core Topics**

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**Core Topics**

**First Quarter**

UNIT 1: DIGESTION

Introduction and Biochemistry

Human Digestive System

UNIT 2: CELLS

Cell Structure & Transport

UNIT 3: MOVEMENT

Biological Movement

Human Skeletal, Muscular & Integumentary Systems

**Second Quarter**

UNIT 4: PLANTS

Plant Structure & Transport

Photosynthesis

UNIT 5: CIRCULATION

Human Circulatory & Immune Systems

UNIT 6: MICROBES

Microbes: Viruses, Bacteria, Protists & Fungi

Human Diseases

**Third Quarter**

UNIT 7: CELL DIVISION

DNA Structure & Function

Cell Replication: Mitosis & Meiosis

UNIT 8: NERVES

Human Nervous System & Sense Organs

UNIT 9: GENETICS

Genetics: Mendelian Genetics

Chromosome Genetics

**Fourth Quarter**

UNIT 10: RESPIRATION

Human Respiratory System

Cellular Respiration

UNIT 11: EVOLUTION

Evolution

Human Origins

UNIT 12: HOMEOSTASIS

Human Excretory System

Endocrine & Reproductive Systems

**Specific Content**

**Biology International**

**Specific Content**

**First Quarter**

UNIT 1: DIGESTION

Characteristics of life

Kingdoms: Monera, Protists, Fungi, Plants, Animals

Properties of water: adhesion, cohesion, polarity

Carbohydrates, proteins, lipids, nucleic acids

Anatomy and functions of the human digestive system including accessory organs

Enzymes in the digestive system: amylase and pepsin

Diagram of the human digestive system

Laboratory work: Microscope; Food Tests

First Quarter Project on Food.

UNIT 2: CELLS

Unicellular & multicellular organisms

Images from light microscopes, scanning and transmission electron microscopes

Discovery of cells and cell theory

Prokaryotic cells

Animal & plant cell structure & organelles

Diagram of a generalized animal cell

Diffusion & osmosis; facilitated diffusion & active transport; endocytosis &

exocytosis

Laboratory work: Cells & Five Kingdoms; Osmosis; Plant cells.

UNIT 3: MOVEMENT

Survey of movement across the five kingdoms

Tissues, organs & organ systems in animals

Mammalian body cavities

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

types of joints

Smooth, cardiac & skeletal muscle structure & function

Human skin structure and functions

Laboratory work: Bone, Muscle & Skin Cells; Chicken Wing.

**Second Quarter**

UNIT 4: PLANTS

Plant tissues; Structure of roots, stems & leaves

Transport of water, food and gases in plants

Deciduous and evegreen trees

Survey of the plants useful to humans

Autotrophs & heterotrophs

General need for food in organisms

Photosynthesis: balanced chemical equation & requirements

Location of the main stages of photosynthesis

Outline of the stages: light reactions & Calvin cycle, without details of coenzymes

Laboratory work: Plant Anatomy; Chromatography

Field Trip to Kew Gardens (Fourth Quarter)

Second Quarter Project on Trees.

UNIT 5: CIRCULATION

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, including platelets and clotting

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

reference to transfusion

Human skin as a barrier to pathogens

Inflammatory reponse to infection: swelling, phagocytes and fever

Immune response by lymphocytes, and the general role of B cells, T cells and memory cells and vaccination to stimulate the immune system

Laboratory work: Heart Structure; Pulse Rate.

UNIT 6: MICROBES

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; Live Protists.

**Third Quarter**

UNIT 7: CELL DIVISION

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: GENETICS

Mendel’s 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: Flower Structure; Probability & Genetics; Human Genetics.

**Fourth Quarter**

UNIT 10: RESPIRATION

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: EVOLUTION

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.

UNIT 12: HOMEOSTASIS

Excretion in animals generally

Functions of the human kidneys

Diagram of the human 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)

Outline of male and female human reproductive organs

Control of levels of testosterone and estrogen

Summary of fertilization, implantation and early development

Laboratory work: Water Regulation; Mammal Anatomy.

**Resources**

**Biology International**

**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

Fossil collection

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 homework and classwork exercises

Journals: *New Scientist* and *Scientific American* (classroom and School Library)

**First Quarter**

UNIT 1: DIGESTION

*Modern Biology* Chapters 1-3, 17 and 48

Acrylic embedded small organisms set

Molecular models

Human torso model

Equipment & materials for Microscope and Food Tests labs

UNIT 2: CELLS

*Modern Biology* Chapters 4 and 5

Electron micrograph set

Equipment & materials for Cells & Five Kingdoms, Osmosis and Onion Cells labs

UNIT 3: MOVEMENT

*Modern Biology* Chapter 45

Laboratory handouts and preparation guides

Full-size skeleton, skull and joint modelsEquipment & materials for Bone, Muscle & Skin Cell and Chicken Wing labs

**Second Quarter**

UNIT 4: PLANTS

*Modern Biology* Chapters 29 and 6

Classroom and Library reference books on trees

TASIS grounds for leaf chromatography and deciduous vs evergreen trees

Royal Botanic Gardens, Kew (Field Trip in Fourth Quarter) for trees

Molecular models for production of glucose by photosynthesis

Equipment & materials for Plant Anatomy and Chromatography labs

UNIT 5: CIRCULATION

*Modern Biology* Chapters 46 and 47

Heart and torso models

Equipment & materials for Heart Structure and Pulse Rate labs

UNIT 6: MICROBES

*Modern Biology* Chapters 23-26

Display books with quality photographs of microbes

Equipment & materials for Live Protists and Diversity of Microbes labs

**Third Quarter**

UNIT 7: CELL DIVISION

*Modern Biology* Chapters 8 and 10

DNA, RNA and protein molecule models

Handout: Making a Protein for classwork on translation

Equipment & materials for Onion Mitosis and DNA Extraction labs

UNIT 8: NERVES

*Modern Biology* Chapter 49

Brain eye and ear models

Skeleton, skull and torso models

Equipment & materials for Nerve Responses and Vision labs

UNIT 9: GENETICS

*Modern Biology* Chapters 9 and 12

Handouts: Genetic problems

Equipment & materials for Flower Structure, Probability & Genetics and Human Genetics labs

**Fourth Quarter**

UNIT 10: RESPIRATION

*Modern Biology* Chapters 46 and 7

Human torso and skeleton models

Molecular models for respiration of glucose

Equipment and materials for Breathing and Respirometers labs

UNIT 11: EVOLUTION

*Modern Biology* Chapters 14-16 and 43

Sedimentary fossils and amber inclusions

Globes for biogeographical evidence

Equipment and materials for Fossil Display and Human Evolution labs

UNIT 12: HOMEOSTASIS

*Modern Biology* Chapters 48, 50 and 51

Kidney and torso models

Equipment and materials for Water Regulation and Mammal Anatomy labs