

Curriculum Outline for BIOLOGY I (Lab / General)
(General Biology)

2 semesters, 2 credits - Grades 9-12; A Core 40 and AHD Course

Class Prerequisite: Pass 8th Grade Science

Required for Graduation; “Accordance to Indiana State Standards and Benchmarks”

Semester #1: Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter

Introduction: (Standard 1: B.1.1 - B.1.3, B.1.5); (Standard 5: B.5.1-B.5.6)

* Biological Chemistry and Characteristics (Pyramid of Complexity, Classification, and Defining Life)

* Lab Methods (Scientific Method, Tools, Terminology, and Applications)

* Evolution ((Spontaneous Generation), History, Principles, Examples, and Evidence; Continually Addressed Throughout the Course)

Ecology: (Standard 2: B.2.1-B.2.4); (Standard 3: B.3.1-B.3.3)

* Ecological Interactions (Ecosystems, Biotic, Abiotic, and Energy)

* Energy Flow (Food Chains and Food Webs)

* Flow of Matter (Biogeochemical Cycles)

* Ecological Limits and Effects (Capacities, Populations, Stabilities, Fluctuations, Influences, Diversities)

Cytology: (Standard 1: B.1.1-B.1.5)

* Histories and Theories (Early Observations, Cell Theory and Evolutionary Implications)

* Size, Shape, and Differentiation (Examples (Monera, Protista, and Somatic Cells); Stem Cells)

* Organelles and Other Components (Structure and Function)

* Comparisons of Cell Types (Prokaryotes and Eukaryotes / Animal Cells vs. Plant Cells)

* Enzymes (Reactions)

* Cellular Fluids and Membrane Functions (Solutions, States, Diffusions, and Transport)

Semester #2: Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter

Cell Division: (Standard 1: B.1.1, B.1.2, B.1.4); (Standard 4: B.4.1, B.4.4, B.4.5)

* Cellular Reproduction (Asexual and Sexual; Evolutionary Advantages)

* Chromosomal Numbers and Structure (Haploid/Diploid, Histone Complex, Solenoids, Chromosome Anatomy)

* Cell Cycle (Interphase (G₁, S, G₂), Cell Division, Cytokinesis)

* Mitosis (Prophase, Metaphase, Anaphase, Telophase)

* Cancer (Growth Factors, Inhibition, Size, Tumors (Benign / Malignant), Causes, Types, Prevention, Gene Mutations)

* Meiosis (Meiosis I and Meiosis II, Spermatogenesis and Oogenesis, Genetic Recombination)

Genetics: (Standard 1: B.1.2, B.1.4); (Standard 4: B.4.1-B.4.3, B.4.5, B.4.6)

* DNA “Deoxyribose Nucleic Acid” (Structure and Function)

* Protein Synthesis (Fundamentals of Transcription and Translation)

* Terminology (Gene/Allele, Heredity, Genotype/Phenotype, Dominant/Recessive, Homozygous/Heterozygous)

* Mendel’s Principles (Dominance, Segregation, and Independent Assortment; Evolutionary Advantages with Darwin’s Theories)

* Punnett’s Squares (Monohybrid, Dihybrid, Trihybrid Tables)

* Probability (Principle of Chance, Product Rule, Monohybrid, Dihybrid, Trihybrid, and Polyhybrids)

* Others (Unknown Alleles, Test Cross, Incomplete Dominance, Co-Dominance, Multiple Alleles, Polygenics, Transposons)

Mammalian Anatomy and Physiology:

* Dissection Lab: (*Rattus norvegicus* (Norway Rat) highlighting comparative anatomy that correlates with mammalian evolution)

* Tissues

* Circulatory System

* Respiratory System

* Digestive System

* Excretory System

* Nervous System

* Sensory System

* Immune System

* and/or Reproductive System

Note: Optional activity for those who do not wish to participate or deemed not qualified to palatinate. An alternative assignment of equal value will be given.

Indiana Standard Titles

Standard 1: Cellular Structure and Function

Standard 2: Matter Cycles and Energy Transfer

Standard 3: Interdependence

Standard 4: Inheritance and Variation in Traits

Standard 5: Evolution

**Curriculum Outline for Biology II (Lab / Advanced / Academic Dual Credit)
(Human Anatomy and Physiology)**

2 semesters, 2 credits - Grades 10-12; A Core 40 and AHD Course

Preferred Prerequisite: Biology I and Chemistry I (Non-Concurrent) with a “B” or Higher Highly Recommended; Otherwise Instructor Consultation Required

Dual Credit “BIO100” Information: Only for 11-12 Graders / Chemistry I Not Required but Highly Recommended; 3 Credits; Non-College Science Majors; However, Can Count as an Elective; if Take BIO111 and BIO112 Dual Credit, then Cannot Take for Dual Credit

Semester #1: Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter

Introduction: (AP.1.1-AP.1.4, AP.2.1-AP.2.5 (Primarily Incorporated Throughout Curriculum))

* Form, Function, and Adaptation (i.e. Natural Selection, Evolution and/or Trade-Off Phenomenon; Continually Addressed Throughout the Course)

* Tissues, Organs, and Systems (How Does Structure Correlate with Function? What Are Vestigial Structures?)

* Body Size Affect Animal Physiology (Function/Behavior, Surface Area/Volume, Proportions “Allometry”)

* Electrolyte and Acid-Base Balance (salt content and fluid volumes, pH, and alkalosis/acidosis)

* Homeostasis (Regulation/Feedback) and Temperature (Heat Source, Conservation; Ectothermy / Endothermy)

Histology: (AP.4.1-AP.4.5, AP.5.1-AP.5.6, AP.6.1-AP.6.10, AP.3.1-AP.3.4)

* Connective Tissues (Loose/Dense, Blood, Cartilage, Bone, Muscle, Nerve, and Epithelial)

* Bone (Skeleton; Anatomy/Structure/Disease/Joints)

* Muscle (Types: Skeletal, Cardiac, Smooth; Anatomy/Structure)

* Nerve (Types: Sensory, Motor, Association; Anatomy/Structure/Disease/Impulse)

* Epithelial (Layers: Subcutaneous, Epidermis, Dermis; Conditions; Membranes: Cutaneous, Mucosa, Serosa)

Digestive System: (AP.12.1-12.5)

* Biological Molecules and/or Nutrition (Review and Discussion)

* Oral Cavity (Mouth, Glands, and Pharynx) and Thoracic Cavity (Esophagus, Peristalsis, Bolus)

* Abdominal Cavity (Stomach, Small and Large Intestine, Pancreas, Liver, Rectum, Various Glands/Chemistry)

* Conditions, Biological Issues, and Implications (i.e. Ulcers, Anorexia Nervosa, and Bulimia)

Circulatory System: (AP.9.1-AP9.4, AP.10.1-AP.10.6, AP.11.1-AP.11.6)

* Heart (Pericardium, Septum, Chambers, Apex, and Pacemaker)

* Vessels (Arteries, Arterioles, Veins, Venules, Capillaries, and Lymphatic)

* Pathway (Blood through the System (Vessels/Chambers))

* Contraction, Pulse, and Pressure (Pacemaker, Systolic/Diastolic)

* Blood (Plasma, RBC, WBC, Platelets, Antibodies, Antigens, Blood Types, Rh Factor, Counter Current Heating)

* Conditions, Biological Issues, and Implications (i.e. Hypertension, Myocardial Infarction, and Leukemia)

Semester #2: Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter

Respiratory System: (AP.12.1.-AP.12.5)

* Pathway (Nostrils, Nasopharynx, Larynx, Glottis, Trachea, Bronchi, Lungs, Bronchiole, Alveoli)

* Gas Exchange (O_2/CO_2 , Hemoglobin, Oxyhemoglobin, HCO_3)

* Breathing (Diaphragm, Intercostal Muscles, “Inspiration” / “Expiration”)

* Conditions, Biological Issues, and Implications (i.e. Asthma, Pneumonia, Emphysema, Bronchitis, and Tuberculosis)

Excretory System: (AP.14.1-AP.14.6)

* Excretion (Homeostasis)

* Organs (Liver, Kidney, Ureters, Urinary Bladder, and Urethra)

* Kidney Structures/Function (Renal Artery/Vein, Cortex, Medulla, Renal Pelvis, Nephron(s))

* Nephron (Glomerulus, Bowman’s capsule, Proximal Tubule, Loop of Henle, Distal Tubule, Collection Duct, etc...)

* Conditions, Biological Issues, and Implications (i.e. Kidney Stones and UTI)

Reproductive System: (AP.15.1-AP.15.7)

* Hormones (i.e. GnRH, FSH, LH, Oxytocin, Prolactin, Testosterone, Estrogen, Estradiol, and Progesterone)

* Male (Structure/ Function/Anatomy and Sperm Development)

* Female (Structure/Function/Anatomy and Ovum Development and Ovulation/Fertilization/Cycle/Gestation)

* Embryonic, Fetal, Toddler, and Teen Development (Trimesters/Birth/Puberty; Comparative Evolutionary Anatomy)

Nervous and Sensory Systems: (AP.2.2, AP.6.1-6.10) (May Be Student Assigned Presentation);

* Brain, Spinal Cord, Nerves (Electrical Signaling, Action Potential, Synapse, Peripheral System, CNS)

* Transduction of Sensory Organs (Hearing, Vision, Taste, Smell, and Touch)

Immune and/or Endocrine Systems: (AP.8.1- AP.8.5 (Primarily Incorporated Throughout Curriculum))

Mammalian Anatomy and Physiology Dissection Lab: (Felis catus (cat) or Alternative)

* Anatomical Systems and Physiology (Used as a Curriculum Review of Mammalian Ana/Phy)

Visit <http://www.doe.in.gov/standards/science-computer-science> for Details on Indiana Standards
(select correct grade and course)

Curriculum Outline for Biology II (Lab / Advanced / Academic Dual Credit)
(Advanced Biology)

2 semesters, 2 credits - Grades 10-12; A Core 40 and AHD Course

Preferred Prerequisite: Biology I and Chemistry I (Non-Concurrent) with a “B” or Higher Highly Recommended;
Otherwise Instructor Consultation Required

Dual Credit “BIO111” Information: Only for 11-12 Graders / Chemistry (Non-Concurrent Only; Otherwise Consultation
Mandatory) Required; 4 Credits; for College Science Majors

Semester #1: Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter

Biological Molecules:

- * Terminology (*Molecular Phrases*)
- * Hydrocarbons and Alcohols (*Liner, Chain, Ring Components, Hydroxyl Groups*)
- * Lipids (*Monomers, Fats, Phospholipids, and Steroids*)
- * Carbohydrates (*Monomers, Sugars, Starches, and Cellulose*)
- * Proteins (*Functions, Monomers, Primary, Secondary, Tertiary, and Quaternary Types, Enzymes, E_w, Inhibitors*)
- * Nucleic Acids (*Monomers and General Structure*)

Cellular Metabolism, Fermentation, and Respiration:

- * Terminology and Functions (*Enzymatic Hydrolysis, Anabolism/Catabolism, ATP / NAD⁺*)
- * Anaerobic Glycolysis (*Metabolism*)
- * Anaerobic Fermentation (*Lactic Acid (Lactate Formation) and Alcoholic (Ethanol Formation), Examples*)
- * Aerobic Respiration (*Pyruvate Conversion and Krebs’s Cycle and Electron Transport Chain*)
- * Chemiosmotic Theory (*ATP Production*)

Photosynthesis:

- * Terminology and Functions (*Heterotrophs/Autotrophs, ATP/NADP⁺, Light-Dependent/Independent Reactions*)
- * Plastids (*Chlorophyll and Carotenoids*) and Light Energy (*Nature and Absorption*)
- * Photosystems (*Antenna Complex/Reaction Center, Systems I and II, Photophosphorylation, Z-Scheme*)
- * Calvin Cycle (*Fixation, Reduction, Regeneration*); Calvin-Benson Cycle (C₃) Pending Discussion

APA (American Psychological Association) Research Paper:

- * Guidelines and Instructions on Developing a Paper on Evolution (*Due by Year’s End*)

Semester #2: Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter

APA (American Psychological Association) Research Paper:

- * Continued Guidelines and Instructions on Developing a Paper on Evolution (*Due by Year’s End*)

DNA, RNA, and Protein Synthesis:

- * DNA (*History, Structure, Function; Evolutionary Impact on Expression*)
- * DNA Replication (*Protein and Enzymatic Preparation and Assembling of Complementary Strands*)
- * RNA (*Structure, Functions, and Types (mRNA, rRNA, tRNA)*)
- * Transcription “Eukaryotic” (*Initiation, Elongation, Termination, pre-mRNA Editing Phases*)
- * Translation “Eukaryotic” (*Codons/Anti-Codons, Ribosome; Initiation, Elongation, Termination Phases*)

Genetic Expression:

- * Gender Determination of Various Species (*Drosophila melanogaster, Humans, SRY (TDF) Gene*)
- * Gender-Linked Traits (*X-Linkage, Barr Bodies, Y-Linkage*)
- * Cytogenetic Disorders (*Non-Disjunction, Chromosomal Alterations, Gene Mutations*)
- * Human Genome (*History and Meaning*)
- * Gene Silencing and Influences (*Imprinting, Epigenetics, RNAi, Hardy-Weinberg Principle, Gene Frequencies*)

Organism Diversity/Development: (Student Driven Presentation(s))

- * Monera, Protista, and Fungi (*Characteristics of Bacteria, Protozoan, and Fungi*)
- * Plants (*Relationships between Plant Groups, Algae, Lower Plants and Higher Plants*)
- * Animals (*Defining Major (5) Features of Animals and Compare Features among Animal Groups*)

Evolution: (Presentation(s) and Discussions)

- * Charles Darwin (*Galapagos Islands, Origin of Species, Evolutionary Evidence*)
- * Historical Principles (*Mutation and Natural Selection*)
- * Kinship Similarities (*Convergences, Fossils, Anatomy and Physiology, Embryology, Genetics, Transitions*)

Curriculum Outline for Biology II (Lab / Advanced / Academic Dual Credit)
(Botany and Zoology)

2 semesters, 2 credits - Grades 10-12; A Core 40 and AHD Course

Preferred Prerequisite: Biology I and Chemistry I (Non-Concurrent) with a “B” or Higher Highly Recommended; Otherwise Instructor Consultation Required

Dual Credit “BIO112” Information: Only for 11-12 Graders / Chemistry Not Required but Highly Recommended; Both Semesters Required; 4 Credits; for College Science Majors

Semester #1: Botany *Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter*

Plant Diversity:

* Introduction to Plants (*Definition, Life Cycle, Survival, Early Plant (Evolutionary Adaptations, Advantages and Continually Addressed Throughout the Course)*)

* Bryophytes (*Groups, Life Cycle, Mosses*)

* Seedless Vascular Plants (*Evolution of Vascular Tissue, Club Mosses, Horsetails, Ferns*)

* Seed Plants (*Gymnosperms and Angiosperms, Cones/Flowers, Seeds, Fruit, Introduction to Monocots and Dicots*)

Roots, Stems, and Leaves:

* Plant Tissues (*Epidermal, Vascular (Xylem/Phloem), and Ground (Parenchyma, Collenchyma, Sclerenchyma)*)

* Structures, Types, Adaptations (*Anatomy and Physiology of Mainly Roots, Stems, and Leaves*)

* Water and Nutrient Transport (*Root Pressure, Capillary Action and Cohesion-Tension Theory*)

* Hormones and Plant Growth (*Auxins, Cytokinins, Gibberellins, Ethylene*)

Reproduction and Development of Seed Plants:

* Gymnosperms (*Cones, Pollination, Fertilization, Development and Evolution*)

* Structure of Flowers (*Sepals, Petals, Stamens, and Carpels*)

* Angiosperms (*Pollination, Fertilization, Development and Evolution*)

* Seed and Fruit Development (*Dispersal, Dormancy, Germination*)

Semester #2: Zoology *Topics Subject to Change / Labs and/or Projects Will Complement Each Area, Subject, and/or Chapter*

Introduction to Zoology:

* Introduction to Animals (*Definition, Life Cycle, Survival, Early Plant (Evolutionary Adaptations, Advantages and Continually Addressed Throughout the Course)*)

* Evolution (*Cell Specialization and Levels of Organization, Early Development, Body Symmetry, Cephalization*)

Sponges and Cnidarians:

* Form and Function (*Body Plan, Feeding, Respiration, Circulation, Excretion, Response, Reproduction,*)

* Ecology of Sponges and Cnidarians (*Temperature, Water Depth, Light, etc...*)

* Groups of Cnidarians (*Jellyfishes, Hydras, Sea Anemones and Corals*)

Worms and Mollusks:

* Flatworms (*Form and Function: Feeding, Respiration, Circulation, Excretion, Response, Reproduction; Types*)

* Roundworms (*Form and Function: Feeding, Respiration, Circulation, Excretion, Response, Reproduction; Types*)

* Annelids (*Form and Function: Feeding, Respiration, Circulation, Excretion, Response, Reproduction; Types*)

* Mollusks (*Form and Function: Feeding, Respiration, Circulation, Excretion, Response, Reproduction; Types*)

* Ecology of Worms and Mollusks (*Aerating / Mixing of Soil; Food Provision*)

Arthropods and Echinoderms:

* Arthropods (*Evolution; Form and Function: Feeding, Respiration, Circulation, Excretion, Response, Reproduction*)

* Groups of Arthropods (*Crustaceans, Spiders, Mites/Ticks, Scorpions, Insects (Form and Function)*)

* Echinoderms (*Evolution; Form and Function: Feeding, Respiration, Circulation, Excretion, Response, Reproduction*)

* Groups of Echinoderms (*Sea Urchins, Sand Dollars, Brittle Stars, Sea Cucumbers, Sea Stars, Sea Lilies*)

* Ecology of Arthropods and Echinoderms (*Devastations; Distributions and Predation*)

Fishes and Amphibians:

* Non-vertebrate Chordates (*Definitions, Characteristics, Groups, and Evolution*)

* Fishes (*Definition, Evolution, Forms and Functions, Groups (Jawless, Sharks, Bony Fish); Ecology*)

* Amphibians (*Definition, Evolution, Forms and Functions, Groups (Salamanders, Frogs/Toads, Caecilians); Ecology*)

Reptiles and Birds:

* Introduction (*Definition and Evolution*)

* Forms and Functions (*Temperature, Feeding, Respiration, Circulation, Excretion, Response, Reproduction*)

* Groups of Reptiles (*Lizards, Snakes, Crocodylians, Turtles/Tortoises, Tuataras*)

* Groups/Types of Birds (*Pelicans, Birds of Prey, Parrots, Cavity-Nesting, Perching, Herons, Flightless Birds*)

Mammals (Discussion):

* Introduction (*Definition and Evolution*)

* Forms and Functions (*Temperature, Feeding, Respiration, Circulation, Excretion, Response, Reproduction*)

* Groups of Mammals (*Monotremes, Marsupials, Placental, and Others*)