

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
Custom

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: HS-LS1-1,2,3,4,5,6; HS-LS4-1,2,3

- * 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: HS-LS1-2,3; HS-LS1-5,6,7; HS-LS2-1,2,3,4,5,6,7,8 ; HS-LS4-4, 5

- * 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: HS-LS1-1,4

- * 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: HS-LS1-1,4

- * 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: HS-LS1-1; HS-LS1-6; HS-LS3-1,2,3

- * 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: HS-LS1-2

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

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|----------------------|------------------------------|
| * Tissues | * Nervous System |
| * Circulatory System | * Sensory System |
| * Respiratory System | * Immune System |
| * Digestive System | * and/or Reproductive System |
| * Excretory System | |

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

Indiana Standard Titles

From Molecules to Organisms: Structures and Processes
Ecosystems: Interactions, Energy and Dynamics

Heredity: Inheritance and Variation of Traits
Biological Evolution: Unity and Diversity

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

2 semesters, 2 credits - Grades 11-12; a Core 40, AHD, and “Weighted” Course

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

Dual Credit “BIO 111” Information: Only for 11-12 Graders / GPA of 2.5 or greater / Chemistry I (Non-Concurrent Only; Otherwise, Instructor Consultation Required); 4 Credits; for College Science Majors or as a College Elective Towards any Major. This is though Ball State University, Muncie, Indiana.

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_o, 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 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)
(Botany and Zoology)

2 semesters, 2 credits - Grades 11-12; a Core 40, AHD, and “Weighted” Course

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

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*)

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

2 semesters, 2 credits - Grades 11-12; a Core 40, AHD, and “Weighted” Course

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

Dual Credit “BIO 231/241” Information: Only for 11-12 Graders / GPA of 2.5 or greater / Chemistry I (Non-Concurrent Only; Otherwise, Instructor Consultation Required); 6 Credits; for College Science Majors or as a College Elective Towards any Major. This is through Indiana State University, Terra Haute, Indiana.

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

Introduction: AP1 (Primarily Incorporated Throughout Curriculum)

- * Form, Function, and Adaptation (i.e. Natural Selection, Evolution and/or Trade-Off Phenomenon)
- * 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: AP1,2,3,4,5; AP8

- * 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: AP1; AP10

- * 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: AP1; AP8, 9

- * 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: AP1; AP11

- * 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: AP1; AP12

- * 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: AP1; AP13

- * Hormones (i.e., GnRH, FSH, LH, Oxytocin, Prolactin, Testosterone, Estrogen, Estradiol, and Progesterone)
- * Male and Female (Structure/Function/Anatomy; Sperm and Ovum Development and Ovulation/Fertilization/Cycle/Gestation)
- * Embryonic, Fetal, Toddler, and Teen Development (Trimesters/Birth/Puberty; Comparative Evolutionary Anatomy)

Nervous and Sensory Systems: AP1; AP5,6,7 (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: AP1; AP7 (Primarily Incorporated Throughout Curriculum)

**Curriculum Outline for Earth and Space Science (Lab / General)
(Earth and Space)**

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

Class Prerequisite: General Biology

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

Introduction:

- * Chemistry (*Atoms, Elements, Isotopes, Bonds, Compounds, Molecules, Water, Minerals*)
- * Lab Methods (*Scientific Method, Tools, Terminology, and Applications*)
- * Measurements (*Temperature, Force, Amounts, Maps, Spheres; Continually Addressed Throughout the Course*)

Physical Geology: HS-ESS1-5; HS-ESS2-1; HS-ESS3-1,2,3,4

- * Rock Types and Characteristics (*Igneous, Sedimentary, and Metamorphic*)
- * Earthquakes (*Waves, Instrumentation / Scales, Locations*); *Earth's Layers (Crust, Mantle, Core)*
- * Plate Tectonics (*Boundaries/Trenches, Continental Drift, Sea Floor Spreading, Forces*)
- * Volcanism (*Magma/Lava, Locations, Eruptions, Types (Shield, Cinder, Composite), Land Forms*)

Historical Geology: HS-ESS2-2; HS-ESS2-6; HS-ESS2-7

- * Uniformitarianism, Relative Dating (*Law of Superposition, Horizontality, Cross-Cutting*); *Rock Record (Inclusion, Unconformity, Correlation)*
- * Fossil Types (*Petrified, Molds/Casts, Carbon Film, Preserved, Trace, Index*)
- * Absolute Dating (*Radioactive Dating and Half-Life*)
- * Time Scale, History, and Examples (*Eon, Eras, Periods, and Epochs*)

Earth and Moon: HS-ESS2-3; HS-ESS2-5,6,7

- * History, Models (Geocentric vs Heliocentric), Laws (Aphelion and Perihelion; AU, Ellipse, Eccentricity; Orbital Period)
- * Earth-System (*Rotation and Revolution*); *Axis and Seasons (Magnetic Field and Precession), Properties*
- * Moon-System (*Apogee vs Perigee*); *Phases, Tides, Eclipses (Solar vs Lunar), Properties, Origin*

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

Solar System: HS-ESS1-4; HS-ESS1-6

- * Introduction, Terrestrial vs Jovian (*Interiors, Atmosphere, Formation*)
- * Inner Planets (*Mercury, Venus, Earth, Mars*)
- * Outer Planets (*Jupiter, Saturn, Uranus, Neptune*); *Dwarf Planet (Pluto)*; *Major Moons*
- * Asteroids, Comets, Meteors (*Meteoroids and Meteorites*); *Kuiper Belt, and Oort Cloud*

Stars, Galaxies, and Universe: HS-ESS1-1; HS-ESS1-2,3; HS-ESS2-6

- * Electromagnetic Spectrum, Light, and Doppler Effect
- * Sun Exterior (*Levels, Sunspots, Prominence, and Solar Flares*); *Sun Interior (Zones, Core, and Nuclear Fusion)*
- * Stars (*Color and Temperature*), *Distance (Parallax and Light Year)*; *Magnitudes (Apparent vs Absolute)*
- * Hertzsprung-Russel (H-R) Diagram: *Classes and Main-Sequence (color, giants, dwarfs)*
- * Cepheids, Nova, Nebula; *Constellations and Asterisms*
- * Stellar Evolution: *Low/Medium Mass vs High Mass Pathways; Lifetimes and Remnants (white dwarfs, neutron stars, pulsars, supernova, black holes)*; *Gravity and Space-Time*
- * *Galaxies and Types (spiral, barred spiral, elliptical, irregular) and Quasars*
- * *Universe: Hubble's Law, Big-Bang vs Big-Crunch*

Weather: HS-ESS2-4,5,6; HS-ESS2-8,9; HS-ESS3-1; HS-ESS3-5, 6

- * *Atmosphere (Troposphere, Stratosphere, Mesosphere, and Thermosphere (Exosphere))*
- * *Temperature vs Heat; Wind Chill, Moisture, and Humidity (absolute vs relative)*
- * *Clouds: Air Lift (orographic, frontal wedging, convergence, and convective) and Formation Types (cirrus, stratus, and cumulus); Levels (high, medium, and low); Fog*
- * *Precipitation and Forms; Rainbows*
- * *Air Pressure and Types (High vs Low; Cool vs Warm); Winds and Types (polar easterlies, prevailing westerlies, and trade)*
- * *Friction, Jet Stream, and Coriolis Effect; Masses and Fronts (Warm, Cold, Stationary, and Occluded)*
- * *Storms: Thunderstorms (stages, lightening, thunder), Mesocyclones, Tornadoes, and Hurricanes*

Oceanography: HS-ESS2-8 (*May Be Student Assigned Presentation*)

- * *Ocean Floor and Water*
- * *Ocean Life*
- * *Ocean Dynamics and Shorelines*