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GOAL 3: CONCEPTS OF BIOLOGY

The student will demonstrate the ability to use the scientific skills and processes (Core Learning Goal 1) and major biological concepts to explain the uniqueness and interdependence of living organisms, their interactions with the environment, and the continuation of life on earth.

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1.   *Expectation: The student will be able to explain the correlation between the structure and function of biologically important molecules and their relationship to cell processes.*

Indicators of Learning

(1)   The student will be able to describe the unique characteristics of chemical substances and macromolecules utilized by living systems.

Assessment limits
- *water (inorganic molecule, polarity, density, and solvent properties)*
- *carbohydrates (organic molecule; monosaccharides are building blocks; supplier of energy and dietary fiber; structural component of cells: cell wall, cellulose)*
- *lipids (organic molecule; component of cell membranes; stored energy supply)*
- *proteins (organic molecule; amino acids are building blocks; structural and functional role, including enzymes)*
- *nucleic acids (organic molecule; nucleotides are building blocks - sugar, phosphate, & nitrogen bases; DNA is a double helix, RNA is a single strand; DNA replication;DNA role in storage of genetic information)*
- *minerals (inorganic substances essential for cellular processes)*
- *vitamins (organic molecule; role in human body: C – wound healing, K – blood clotting, D – bone growth)*

(2)   The student will be able to discuss factors involved in the regulation of chemical activity as part of a homeostatic mechanism.

Assessment limits
- *osmosis (predicting water flow across a membrane based on the cell's environment; explain role in living systems)*
- *temperature (effect upon enzyme activity and metabolic rate; effect upon rate of diffusion and states of matter)*
- *pH (pH scale: relative values for acids and bases; effect on living systems: cellular, organismal)*
- *enzyme regulation (effect of temperature, pH, and enzyme/substrate concentration on enzyme activity)*

(3) The student will be able to compare the transfer and use of matter and energy in photosynthetic and non-photosynthetic organisms.

Assessment limits

- ☐ *water cycle (movement of water between living systems and the environment)*
- ☐ *carbon cycle (movement of carbon between living systems and the environment, cyclic relationship between photosynthesis and respiration)*
- ☐ *nitrogen cycle (roles of bacteria; human impact)*
- ☐ *photosynthesis (energy conversion: light, chemical; basic molecules involved)*
- ☐ *cellular respiration (distinctions between aerobic and anaerobic, energy released, use of oxygen; basic molecules involved in aerobic)*
- ☐ *chemosynthesis (from inorganic compounds)*
- ☐ *ATP (energy carrier molecule)*

2. *Expectation: **The student will demonstrate an understanding that all organisms are composed of cells which can function independently or as part of multicellular organisms.***

Indicators of Learning

(1) The student will explain processes and the function of related structures found in unicellular and multicellular organisms.

Assessment limits

- • *transportation of materials (role of cellular membranes; role of vascular tissues in plants and animals; role of circulatory systems)*
- • *waste disposal (role of cellular membrane; role of excretory and circulatory systems)*
- • *movement (cellular – flagella, cilia, pseudopodia; interaction between skeletal and muscular systems)*
- • *feedback (maintaining cellular and organismal homeostasis – water balance, pH, temperature, role of endocrine system)*
- • *asexual (binary fission, budding, vegetative, mitosis: role in growth and repair, chromosome number remains the same) and sexual reproduction (angiosperms, mammals)*
- • *control of structures (cellular organelles and human systems) and related functions (role of nucleus, role of sensory organs and nervous system)*
- • *capture and release of energy (chloroplasts, mitochondria)*
- • *protein synthesis (ribosomes)*

(2)   The student will conclude that cells exist within a narrow range of environmental conditions and changes to that environment, either naturally occurring or induced, may cause changes in the metabolic activity of the cell or organism.

Assessment limits
- *pH*
- *temperature*
- *light*
- *water*
- *oxygen*
- *carbon dioxide*
- *radiation (role in cancer or mutations)*
- *toxic substances (natural, synthetic)*

3.   *Expectation: The student will analyze how traits are inherited and passed on from one generation to another.*

Indicators of Learning

(1)   The student will demonstrate that the sorting and recombination of genes during sexual reproduction has an effect on variation in offspring.

Assessment limits
- *meiosis (process that forms gametes; chromosome number reduced by one-half; crossing-over occurs; new gene combinations)*
- *fertilization (combination of gametes to form zygote)*

(2)   The student will illustrate and explain how expressed traits are passed from parent to offspring.

Assessment limits
- *phenotypes (expression of inherited characteristics)*
- *dominant and recessive traits*
- *sex-linked traits (X-linked only; recessive phenotypes are more often expressed in the male)*
- *genotypes (represented by heterozygous and homozygous pairs of alleles)*
- *punnett square (use to predict and/or interpret the results of a genetic cross; translate genotypes into phenotypes - monohybrid only)*
- *pedigree (use to interpret patterns of inheritance within a family)*

(3) The student will explain how a genetic trait is determined by the code in a DNA molecule.

   Assessment limits
   - *definition of gene (a segment of DNA that codes for a protein or RNA)*
   - *sequence of nitrogen bases directing protein formation (role of DNA, mRNA, tRNA, rRNA)*
   - *proteins determine traits*

(4) The student will interpret how the effects of DNA alteration can be beneficial or harmful to the individual, society, and/or the environment.

   Assessment limits
   - *mutations*
   - *chromosome number (abnormalities)*
   - *genetic engineering (gene splicing, recombinant DNA, cloning)*

4. *Expectation: The student will explain the mechanism of evolutionary change.*

   Indicators of Learning

   (1) The student will explain how new traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.

      Assessment limits
      - *natural selection (definition; effects of environmental pressure)*
      - *adaptations (effects on survival)*
      - *variation (effects on survival and reproductive success)*

   (2) The student will estimate degrees of relatedness among organisms or species.

      Assessment limits
      - *classification (recognize relationships among organisms; distinguish between prokaryotes and eukaryotes)*
      - *anatomical similarities (evolutionary relationships; homologous structures)*
      - *similarities of DNA base and/or amino acid sequence (including results from gel electrophoresis)*

5. *Expectation: The student will investigate the interdependence of diverse living organisms and their interactions with the components of the biosphere.*

Indicators of Learning

(1) The student will analyze the relationships between biotic diversity and abiotic factors in environments and the resulting influence on ecosystems.

Assessment limits

Abiotic/ Biotic Factors
- *space*
- *soil*
- *water*
- *air*
- *temperature*
- *food*
- *light*
- *organisms*

Relationships
- *predator - prey*
- *parasite - host*
- *mutualism*
- *commensalism*
- *competition*

(2) The student will analyze the interrelationships and interdependencies among different organisms and explain how these relationships contribute to the stability of the ecosystem.

Assessment limits
- *diversity*
- *succession*
- *trophic level (producer; consumer: herbivore, carnivore, omnivore, scavenger; decomposer)*
- *niche(role of organism within an ecosystem)*
- *pyramid (energy, biomass)*

(3) The student will investigate how natural and man-made changes in environmental conditions will affect individual organisms and the dynamics of populations.

Assessment limits
- *depletion of food*
- *destruction of habitats*
- *disease*
- *natural disasters*
- *pollution*
- *population increase*
- *urbanization*

(4) The student will illustrate how all organisms are part of and depend on two major global food webs that are positively or negatively influenced by human activity and technology.

Assessment limits
- *oceanic food web*
- *terrestrial food web*

6. *Expectation: The student will investigate a biological issue and develop an action plan.*

Indicators of Learning

(1) [NTB]The student will analyze the consequences and/or trade-offs between technological changes and their effect on the individual, society, and the environment. They may select topics such as bioethics, genetic engineering, endangered species, or food supply.

(2) [NTB]The student will investigate a biological issue and be able to defend their position on topics such as animal rights, drug and alcohol abuse, viral diseases (e.g., AIDS), genetic engineering, bioethics, biodiversity, population growth, global sustainability, or origin of life.