ADVANCED LIFE SCIENCE: ANIMALS (L) STANDARDS

Students investigate concepts that enable them to understand animal life and animal science as it pertains to agriculture. Through instruction, including laboratory and fieldwork, they recognize concepts associated with animal taxonomy, life at the cellular level, organ systems, genetics, evolution, ecology, and historical and current issues in animal agriculture.

Standard 1

Taxonomy and Classification

Students know that organisms are classified, concentrating on a general survey of all living things, then specifically how certain characteristics categorize animals in a taxonomic key.

AS.1.1 Explain the classification of organisms based on a hierarchical taxonomy including kingdom, division, class, order, family, genus, and species.

AS.1.2 Distinguish the five kingdoms of organisms, and more specific taxonomy of agricultural species of animals

AS.1.3 Identify animals using a taxonomic key.

AS.1.4 Identify the major features of chordates, identify the highlights of vertebrate evolution (development of jaws, cartilage to bone, and water to land), and identify the distinguishing characters of fish, birds, and mammals.

Standard 2

Molecules and Cells

Students know and understand the highlights of chemistry, biochemistry, and biological functions as they relate to the field of animalian agricultural science. Included in this study are functions of the cell, such as osmosis, genes, genomes, gene research, respiration, mitosis and cytolysis, and differentiation. Chemicals that assist in cellular determination and catalysts in this area are also to be understood.

Chemistry of molecules and cells

AS.2.1 Describe the major organic macromolecules (amino acids, proteins, nucleic acids, fats/lipids, and complex carbohydrates) found in all living organisms.

AS.2.2 Explain the concepts of monomers and polymers, and recognize the monomer and polymer for each class of macromolecule. In addition, describe the function of condensation and hydrolysis in the construction and breakdown of polymers.

AS.2.3 Compare and contrast three types of chemical bonds: hydrogen, ionic and covalent bonds.

AS.2.4 Compare and contrast single and double bonds.

AS.2.5 Predict the number and type of bonds an atom will form based on its valence electrons.

AS.2.6 Identify functional groups such as hydroxyl, amino and carboxyl.

AS.2.7 Compare and contrast hydrophilic vs. hydrophobic and polar vs. non-polar molecules.

AS.2.8 Predict what kinds of molecules dissolve in water and which do not. Define solute, solvent, and saturation.

Biochemistry of molecules and cells

AS.2.9 Identify essential and non-essential nutrients. In addition, describe the relationship between amino acids, vitamins and minerals in the health of cells and organs.

AS.2.10 Compare and contrast animal, plant, and bacterial cells at the biological and chemical levels.

AS.2.11 Describe the biochemistry and functions of animal cell membranes. In doing so, describe the fluid mosaic model of the membrane and the role of the cell membrane proteins in transporting materials in and out of cells.

AS.2.12 Define the terms hypertonic, hypotonic, and isotonic. Describe the phenomena of osmosis, and predict the direction that water will move given the concentrations of solutes in adjacent cells.

Biology of molecules and cells

AS.2.13 Define the term genome. Explain the function of coding regions and non-coding regions within the genome

AS.2.14 Describe the genomes in animal cell's nucleus and mitochondria.

AS.2.15 Explain the phenomenon in which differential gene expression determines which proteins are made, and how this determines the characteristics and functions of a particular cell.

AS.2.16 Using examples relevant to animal science, track the events involved in expression of individual genes and compartmentalization of the resulting proteins.

AS.2.17 Describe cellular respiration. Recognize that animals perform only respiration, while plants perform both photosynthesis and respiration. Also, describe the transformation of energy during respiration, and the role of ATP produced in respiration for other metabolic processes.

AS.2.18 Compare and contrast ATP and ADP.

AS.2.19 Define the cell as a basic unit of life (i.e. basic components of cell theory from Schleiden and Schwann; living unit that carries out functions, originates from pre-existing;). Differentiate between prokaryotic and eukaryotic cells.

AS.2.20 Compare and contrast animal and plant cells; be able to identify the parts of a cell (nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, vesicles, lysosomes).

AS.2.21 Discuss permeability of a membrane and identify the three types of transport through membranes and the types of molecules and energy required for successful movement across a membrane.

AS.2.22 Describe processes in which cells recycle or deal with defective and old structures. Also, discuss the life span of a cell and what happens when it dies.

AS.2.23 Explain the importance of DNA and differentiate the following terms, genome, gene, chromatin, chromosome, and chromatids.

AS.2.24 Describe process of cell duplication. Describe the major events of mitosis and cytokinesis.

AS.2.25 Compare various cells functions including the differential expression of genes and protein synthesis (i.e. meat production and milk production)

AS.2.26 Explain the roles of various specialized cells in terms of how those cells use common cell mechanisms to carry out specialized roles

AS.2.27 Compare generic and specialized cells that are found in most organisms.

AS.2.28 Compare the benefits of non-motile and motile cells. Describe how cells move and maintain their shape.

AS.2.29 Describe the process of cell communication/signaling and the relationship to electro-chemical compounds. Describe how cells communicate with neighboring cells.

AS.2.30 Describe the process cells use to differentiate one from another, i.e. protein synthesis and DNA replication

AS.2.31 Explain how animal cells exchange/convert energy as part of cell metabolism through processes including glycolysis, fermentation (lactic acid), and oxidative respiration.

AS.2.32 Describe the role of an enzyme catalyst in cell metabolism.

Standard 3

Development and Function of Animal Organ Systems

Students know the major vertebrate animal organ systems and the role that the cells and their development play in the function of that system. Various chemicals also influence the function of the system. It is also understood by the students how important the general health and well being of animal is, how systems are maintained by the animal; disease and parasite fighting; and organ/system communication.

Organs and Tissues

AS.3.1 Identify the major organ systems found in vertebrate animals (fish, birds, and mammals).

AS.3.2 Describe the organization of the animal body, cells, tissues, organs and organ systems.

AS.3.3 Discuss four basic tissue types: epithelial, connective, muscle, and nervous.

AS.3.4 Discuss the integumentary, skeletal and muscular systems.

AS.3.5 Identify and describe the two layers of skin: epidermis and dermis.

AS.3.6 Explain the functions of the skeletal system in terms of body support, mineral storage, and marrow functions.

AS.3.7 Identify the three cell types found in bones: osteoblasts, osteocytes, and osteoclasts

AS.3.8 Identify the type of joints that are moveable or immovable.

AS.3.9 Describe how muscles are formed from repeating units called sarcomeres, and explain how actin and myosin are used to create movement.

AS.3.10 Describe the chemical process in the formation of bones and muscles and the process of calcification and its impact on animal growth.

AS.3.11 Compare and contrast muscle function under anaerobic and aerobic conditions.

AS.3.12 Identify the organs that make up the endocrine and nervous systems.

AS.3.13 Describe the relationship between endocrine, neural and brain functions.

AS.3.14 Describe the relationship between the senses and the nervous system.

AS.3.15 Describe the role of hormones on behavior and in maintaining electrolyte balance (water volume and salt). In addition, discuss how growth hormones affect the endocrine and nervous systems.

AS.3.16 Identify the organs that make up the circulatory and respiratory systems

Reproduction

AS.3.17 Compare and contrast the reproductive organs for male and female domesticated animal species.

AS.3.18 Describe ectoderm, endoderm, and mesoderm as three germ layers that give rise to tissues and organs. Describe blastula and gastrula formation, and the function of morphogens, and recognize their importance in the developmental processes of vertebrates.

AS.3.19 Define and describe estrous cycle(s). Describe how hormones act during the estrous cycle and how they are used to suppress it.

AS.3.20 Discuss the social implications of reproductive and genetic technologies used in animal husbandry (e.g. embryo transfer, artificial insemination, gene transfer, cloning).

AS.3.21 Describe spermatogenesis and sperm motility. List and explain factors that affect both.

AS.3.22 Describe the steps in lactation.

AS.3.23 Describe parturition and the method(s) used to predict when it occurs.

AS.3.24 Discuss puberty and its relation to sexual maturation and reproduction in animals.

AS.3.25 Compare and contrast different mating systems and predict which would be successful with agricultural species

AS.3.26 Describe homeostasis and how it is controlled. List the organs involved in the homeostatic process. Explain how pH-buffering capacity contributes to homeostasis. Describe how negative feedback acts to regulate homeostasis. Explain how organs systems interact to control body temperatures. Describe how disease agents impact homeostasis. Discuss the role of membrane receptors in the control of homeostasis. Compare and contrast how the embryo, fetus, and adults each moderate homeostasis. Compare multi-cellular systems and single cell systems.

Organ Development

AS.3.27 Compare the advantages and disadvantages of a single cell/multi-cellular system and the relationship to organ development.

AS.3.28 Describe the development of organs (organogenesis).

AS.3.29 Explain processes in which organ systems communicate and exchange materials. Identify the role of organs in the distribution of nutrients and energy. Compare and contrast communication and material exchange in neo-natal, juvenile, and adult animals. Describe aging and its relationship to communication and material exchange among cells.

AS.3.30 Compare the impact of various organs and organs system on an overall organism.

Health

AS.3.31 Discuss the role of the endocrine system in host defense.

AS.3.32 Explain action potentials and the fact that they contribute to variables that aid in homeostasis.

AS.3.33 Identify the different leukocytes (white blood cells) available for immune response.

AS.3.34 Compare and contrast non-specific (skin, mucous, chemical, inflammation, pain, fever, swelling, and leukocytes) and specific immunity (humoral-antibody mediated, and cellular immunity). Compare and contrast antigens and antibodies. Distinguish between active and passive immunity. Discuss immune system disorders and their role in animal husbandry.

AS.3.35 Describe the function of the animal/host defense mechanism.

AS.3.36 Describe the use of antibiotics in animal health, and describe how antibiotics work. Discuss the impact improper use of antibiotics has on antibiotic resistance.

AS.3.37 Describe the role of blood in the exchange of materials throughout the body including its chemical makeup, and identify the structure and explain the function of hemoglobin. In addition, describe the chemical process of material exchange in blood

AS.3.38 Describe the primary and secondary functions of the respiratory system.

AS.3.39 Explain partial pressure of oxygen and its role in gas exchange in the body.

AS.3.40 Discuss the role of blood in host defense.

AS.3.41 Explain the chemical process of digestion and its products. Compare energy availability of proteins, carbohydrates, lipids, sugars, etc. Discuss the role of vitamins in the utilization of energy. Compare and contrast the chemical makeup of cellulose and starch. Describe how the digestive tract adapts to diet

AS.3.42 Discuss the impact of disease on animal health.

AS.3.43 Describe the various parasites and their impact on organ systems. Discuss host specificity and the importance of it.

AS.3.44 Describe the interactions of various organisms such as *Archaea* in the ruminant gut.

Standard 4

Animal Genetics and The Environment

Students learn more in-depth detail of the importance of genetic information and determining biological inheritance. Touching on evolutionary forces and theory of genetic diversity through the past, present, and future is mapped or predicted. Additionally, meiosis, mitosis, genetic transcription and frequency are understood, as well as the biotechnological developments and ecological impacts of cloning, domestication, hybridization, and selection.

Genes

AS.4.1 Explain the flow of genetic information, and identify the central dogma: DNA-transcription-mRNA-translation-protein. Describe the purpose, function, and production of RNA, and explain how protein synthesis works.

AS.4.2 Explain why organisms rely on meiosis for reproduction, and describe the steps in meiosis. Explain the purpose of synapsis and crossing over. Compare and contrast the formation of and roles of sperm and eggs.

AS.4.3 Compare sexual and asexual reproduction including the processes and procedures, advantages/disadvantages of each

AS.4.4 Be able to distinguish between autosomes and sex chromosomes.

AS.4.5 Describe the relationship between genotype and phenotype.

AS.4.6 Explain the process of DNA replication and the relationship between DNA replication and cell division (mitosis and meiosis).

Evolution

AS.4.7 Identify the following Darwin principles: principle of variation, principle of heredity, and the principle of selection (differential reproductive success). Be able to explain the concept of a gene pool.

AS.4.8 Be able to explain the following evolutionary forces: mutation, genetic drift, and gene flow.

AS.4.9 Compare and contrast the types of selection: natural selection (directional, stabilizing, and disruptive), sexual selection, and artificial selection

AS.4.10 Explain processes through which populations of organisms naturally maintain genetic diversity and the significance of genetic diversity to evolution. Recognize that both meiosis and fertilization contribute to diversity within a gene pool. Explain how outcrossing promotes diversity.

AS.4.11 Describe ways that animals prevent inbreeding, and discuss how genetic diversity is preserved among both herds and wild animals. Explain the disadvantages of lack of diversity in the wild and domestic animals.

AS.4.12 List the assumptions of the Hardy-Weinberg Principle

AS.4.13 Compare and contrast natural selection with artificial selection, as used by humans to domesticate animals and breed improved varieties. Describe some of the traits that have been selected in the domestication of animals. Also, contrast the rates at which gene frequencies change during natural selection, artificial selection involving traditional breeding, and breeding programs involving biotechnology (e.g. cloning).

AS.4.14 Compare and contrast adaptations of animals for survival in different environmental conditions.

AS.4.15 Describe the Mendelian theory (law of segregation and the law of independent assortment) and understand its importance.

AS.4.16 Describe genetic diversity and natural selection and their contributions to a population's ability to adapt to environmental change. Describe the relationship between genes and alleles, and define terms including incomplete dominance, partial dominance, codominance, pleiotropy, and sex linkage.

AS.4.17 Describe the role of biotechnology on the process of selection. Discuss the impact of biotechnology on heritability and how genes are passed on, the introduction of novel genetic information, and the use of genes from any source. Explain the role of gene markers in biotechnology applications. Describe and evaluate reproductive technology techniques inherent in biotechnology. Also, describe the impact of biotechnology on the production and synthesis of drugs.

AS.4.18 Describe the importance of random and non-random sampling in a biotechnological environment.

AS.4.19 Explain the science behind mammalian cloning. Compare and contrast cloning a gene and an animal.

Ecology

AS.4.20 Explain the role of resources in every ecosystem. Define trophic level. Explain the concept of energy flow: primary producers, primary consumers, secondary consumers, tertiary consumers, and decomposers.

AS.4.21 Describe the impact humans have on the capacity of any system to support life. List the factors that limit the capacity of an ecosystem. Discuss the interactions that occur between birth rate, population growth, and carrying capacity of the ecosystem. Identify the demographic (birth, death and fecundity rates) components that are used to construct a life history curve. Explain how demographic components are used in animal husbandry.

AS.4.22 Explain difference between exponential and logistic growth curves. Define carrying capacity. Describe the impact of carrying capacity on an ecosystem (community ecology). Predict the impacts of overcrowding, disease, and waste on animal health

AS.4.23 Predict the impact of animal agriculture on the various nutrient cycles including nitrogen, carbon, phosphorus, etc.

AS.4.24 Compare various inputs (fertilization, liming, weed prevention, etc.) in a human-managed system as opposed to a natural system.

AS.4.25 Compare and contrast natural and human managed systems.

Agricultural and Technological Issues

AS.4.26 Evaluate the impact of biotechnology on increased production and the development of exotic species.

AS.4.27 Compare the process of domestication of different species of animals. Recall the history domestication and its role in the development of human societies.