Grades 9-12 Life Science

Ecology

1. Human civilization has a negative impact on the environment. As a basis for understanding this concept, students know:
    a. how to discuss air, water and solid waste manage problems as they apply to their individual lives.
    b. how to identify specific things they can do to ameliorate these problems.

2. Food chains & webs are complex in nature. As a basis for understanding this concept, students know:
    a. how to create and interpret food chains and food webs from lists of organisms.
    b. how to interpret food pyramids' shapes and explain factors which limit the size and number of levels.
    a. how to predict the effects of a specific change in an ecosystem level.
    b. how to explain the important role that the producers play in all chains.
    c. how to give examples of the vital role that decomposers play.
    d. how to contrast the flow patterns of minerals and energy in any food chain.
    e. how to list several important minerals and demonstrate how they cycle through food webs.
    f. how to explain why herbivores can grow larger than carnivores.
    g. how to identify examples of parasitic, commensal and mutualistic relationships.

Cell Theory

3. Organisms are diverse but at the cellular level much is the same. As a basis for understanding this concept, students know:
    a. how to identify and describe the structure and function of various organelles including the nucleus, mitochondria, membrane, cytoplasm, ribosomes, endoplasmic reticulum, chloroplasts, cilia/flagella and ribosomes..
    b. how to use proper technique to view objects under the microscope.
    c. how to sequence different levels of organization from organelles to organism.
    d. how to define, give examples of, and differentiate between diffusion, osmosis and active transport in living cells.
    e. how to draw pictures of the different ways that cells transport materials through their membranes.
    f. how to describe the sites, steps and significance of mitosis as a means of growth and reproduction.
    g. how to sketch the structure of DNA, including base pairing relationships, and explain its roles in all lifeforms.
    h. how to discuss and give examples of proteins and their importance to life as enzymes and structural components.
    i. that all proteins are composed of up to 20 different types of AA's and that their properties are shape-dependent.
    j. how to demonstrate how an enzyme interacts with its substrate and why their relationship is so specific.
    k. how to outline the DNA replication process.
    l. how to describe the roles that mRNA, tRNA and rRNA play in protein synthesis.
    m. how to define and predict the potential ramifications of mutations.
    n. that gene expression is often affected by the environment.
    o. how to contrast the effects of germ cell vs somatic cell mutations.

Cell Theory (3. continued)

p. how to list some products of genetic engineering.
q. how to make sketches comparing the following: nucleotide, gene, chromosome, nucleus.

Energy Management at the Cellular Level

4. Fermentation is anaerobic respiration. As a basis for understanding this concept, students know:
   a. how to provide the reactants and products of the process as well as a description of its importance in the lives of various organisms.
   b. how to explain how fermentation is vital to the production of various food products including bread.

5. Cellular respiration is the process by which organisms obtain energy from the breakdown of nutrients. As a basis for understanding this concept, students know:
   a. how to list the net reaction of the process, sources of the reactants, and its significance in the support of life.
   b. how to describe how we manage the various components of the process in terms of their storage & release.
   c. how to describe and explain the differences between regulators and conformers.

6. Photosynthesis is a process by which light energy is absorbed by chlorophyll and used to synthesize organic compounds. As a basis for understanding this concept, students know:
   a. how to list the net reaction of the process and to describe how the various component substances are absorbed or released by plants.
   b. how to discuss the significance of this process to life on Earth.
   d. how to explain the possible fates of glucose produced.
   g. how to describe the roles of chlorophyll and accessory pigments.

Evolution

7. Natural selection is the process by which better-adapted organisms survive and reproduce more successfully than organisms that are less well adapted. As a basis for understanding this concept, students know:
   a. how to identify erroneous interpretations of evolutionary events.
   b. how to explain the importance of the fossil record to evolution.
   c. how to use the concepts of radioactive dating to "date" a fossil.
   d. how describe the mechanism behind an evolutionary event, in terms of natural and artificial selection.
   e. how to explain the difference between individual and species adaptations.
   f. how to explain how bacterial strains become immune to antibiotics.
   g. how to use info' from a variety of sources to create a cladogram.
   h. how to differentiate between punctuational and gradual evolution.
   i. how to use a model to explain the sequence of steps involved in speciation.
   j. how to cite the assumptions of the Hardy-Weinberg principle.
   k. how to predict the effect changes in any would have on a model gene pool.

Evolution (continued)

8. Human evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept, students know:

a. how to sequence different hominids by their features.
b. how to list and discuss physical and behavioral changes achieved by early hominids, which allowed them to progress.
c. how to discuss the importance of bipedalism, the opposable thumb and tool making, to human evolution.
d. how to laugh when someone says that "Man came from the apes".

The World of Heredity

9. Genetics is the branch of biology which deals with heredity. As a basis for understanding this concept, students know:

a. how to define and differentiate between the concepts of: nucleotides, DNA, chromosomes, genes, genotype and phenotype.
b. how to predict the genotypes, phenotypes and frequencies of offspring expected in mono and dihybrid crosses with autosomal and sex linked traits.
c. how to define and give examples of mutations and their significance.
d. how to inform anyone who asks, that the correct sequence of events is: marriage first, then sex and reproduction.
e. how to list some genetic diseases and describe their symptoms.
f. how to compare and contrast the processes of mitosis and meiosis in terms of location, frequency, and results.

Classification

10. Systems that group various plants and animals together help make sense of the great variety of living things observed in our world. As a basis for understanding this concept, students know:

a. how to describe several classification systems at work in their lives and to discuss their utility.
b. how to discuss different criteria used to create various systems.
c. how to create and use dichotomous keys.
d. how to list and use the different levels of the Linnaean system.
e. how to interpret scientific names of species provided.
f. how to identify select organisms to their Kingdoms.

Survey of Lifeforms

11. A virus is not a cell but it can reproduce inside a living host cell, but outside the cell, it shows no sign of life. As a basis for understanding this concept, students know:

a. how to list human viral diseases.
b. how to identify the parts of a virus.
c. how to draw the life cycles of a virus.
d. how to explain why virus are hard to fight.
e. how to explain how the human body fights virus.
f. how to explain why we have the problem of emerging virus.
g. how to explain the contents and mechanism of vaccinations.

Survey of Lifeforms (continued)

12. Bacteria - they're not all bad - are very small cells that degrade organic compounds to inorganic one. As a basis for understanding this concept, students know:
    a. how to list and discuss examples of different modes of disease transmission.
    b. how to make lists of both harmful and beneficial bacteria.
    c. how to use relatively sterile technique to culture bacteria.
    d. how to explain the origins of and mechanisms by which antibiotics cure bacterial disease.
13. Protozoans - one-celled lifeforms - are animal-like nutrition. As a basis for understanding this concept, students know:
    a. how to define and differentiate between prokaryotic and eukaryotic cells.
    b. how to list some protozoan diseases and outline their life cycles.
    c. how to differentiate between ciliates, flagellates and sarcodines.
    d. how to use a microscope to locate these in a pond water sample.
14. Algae are chiefly aquatic nonvascular plants, pond scums, stoneworts with chlorophll often masked by a brown or red pigment. As a basis for understanding this concept, students know:
    a. how to list the three types of algae and differentiate between them.
    b. how to explain why the above live at different depths.
    c. how to give examples of how algae are used in their lives by eating algae and agar.
15. Fungi are larger than bacteria but most of its constituent cells are in direct contact with the environment. As a basis for understanding this concept, students know:
    a. how to use a dichotomous key to identify mold they culture.
    b. how to list products in their lives which are generated.
    c. how to discuss the roles fungi play in the ecosystem.
    d. how to discuss the life cycle of a typical basiodiomycete.
    e. how to identify lichen when they see it.
    f. how to know when to eat a fungus and when not to.
16. Plants - our green friends - are keepers of the planet. As a basis for understanding this concept, students know:
    a. how to describe the important roles plants play in their daily lives.
    b. how to list edible plant parts.
    c. how to list terrestrial adaptations developed by plants.
    d. how to differentiate between monocot and dicot plants by observing their seeds, leaves, roots and stems.
    e. how to describe how different types of plants reproduce.
    f. how to identify the parts of a flower and their roles in reproduction.
    g. how to identify the parts of a seed and reveal their fates.
    h. how to explain the role fruits play in seed dispersal.
    i. how to list the type of animals which pollinate various flowers.
    j. how to give examples of seed dispersal strategies.
    k. how to eat different types of seeds.
17. Invertebrates are spineless but fun. As a basis for understanding this concept, students know:
    a. how to differentiate and discuss advantages of radial vs bilateral symmetry.
    b. how to make sponge models out of PlayDoh.
    c. how to list key characteristics of each of the major invertebrate phyla.
    d. how to list common examples of each of the invertebrate phyla.
    e. how to describe how the above reproduce.

Survey of Lifeforms (17. continued)

f. how to compare the merits of asexual and sexual reproduction.
g. how to describe how the anatomy of parasitic species adapts them to their lifestyle.
h. how to list (and eat) edible species in each of the phyla we study.
i. how to list examples of segmented animals and describe some of the specialization seen in these segments and their appendages.
j. how to identify to phylum, any species provided them.

18. Vertebrates are animals with a segmented spinal column. As a basis for understanding this concept, students know:

a. how to list the 5 classes of vertebrates and provide examples.
b. how to list some of the terrestrial adaptations animals have developed.
c. how to list key characteristics of each vertebrate class.
d. how to differentiate between regulators & conformers.
e. how to describe the different modes of reproduction in vertebrates.
f. how to describe the different types of hearts and circulatory systems and their relative merits.
g. how to give examples of social behaviors in animals and evaluate their origins and benefits.

Organ Systems, with Emphasis on Humans

19. Support & movement of the skeletal system allows the internal environment of the human body to remain relatively stable. As a basis for understanding this concept, students know:

a. how to compare and give examples of hydrostatic, exo and endoskeletons.
b. how to name the major bones of the human skeleton.
c. how to locate examples of and contrast the control and contraction mechanisms of the three muscle types.
d. how to identify the ligaments and tendons in a joint.
e. how to list the chemicals needed and released by active muscles.
f. how to diagram the cellular basis of muscle contraction.

20. Digestion and nutrition sustain the life of the human body. As a basis for understanding this concept, students know:

a. how to compare the traditional and modern food pyramids.
b. how to list the names, roles and good sources of the three nutrient types.
c. how to explain the role various minerals and vitamins play in our diet.
d. how to create a balanced sample menu (they'll never actually eat it!).
e. how to identify and describe the roles of different tooth types.
f. how to draw and label the parts of the human digestive system.
g. how to describe the roles each of the following have in digestion: stomach, small intestine, pancreas, liver, gall bladder, and colon.
h. how to define the symptoms and causes of anorexia and bulemia.

21. The cardiovascular system allows the blood to flow throughout the body thereby allowing gas exchange as well. As a basis for understanding this concept, students know:

a. how to list the components of human blood and define the functions of the plasma and formed elements.
b. how to explain the roles these components play in our bodies.
c. how to provide an example of a homeostatic mechanism.

Organ Systems, with Emphasis on Humans (21. continued)

d. how to describe the levels of protection afforded us by our immune systems.
e. how to describe the structure and function of antibodies in the immune response.
f. how to explain how vaccines are made and how they work.
g. how to draw and compare the structure of a capillary, vein and artery.
h. how to draw and label the parts of a human heart.
i. how to trace the path of blood flow through their bodies.
j. how to explain a blood pressure reading.
k. how to explain what getting in shape means.
l. how to list the net reaction of cellular respiration.
m. how to trace the path air follows in the human system.
n. how to differentiate between inspiration and writing objectives.
o. how to draw and alveolus and describe its role in gas exchanges.
p. how to describe the process of CPR.

22. The excretory system removes cellular and digestive wastes from the body. As a basis for understanding this concept, students know:

a. how to identify the parts of the human system
b. how to list the main components of urine
c. how to list the three types of nitrogenous wastes and their relative advantages.
d. how to explain the structure and function of a nephron
e. how to describe the sources of various human waste products.
f. how to list the components of human sweat and their origins.
g. how to discuss the dangers of UV exposure to human skin.
h. how to explain why B.O. occurs.

23. The nervous system interacts with the endocrine system to regulate the human body. As a basis for understanding this concept, students know:

a. how to label the parts of a neuron and describe their functions.
b. how to describe the nerve impulse as electrochemical.
c. how to explain the function of a neurohumors at synapses.
d. how to differentiate and give examples of reflexes vs conscious movement.
e. how to point out and describe the general functions of the cerebrum, cerebellum, medulla and hypothalamus.
f. how to explain how each of several types of receptors operate.
g. how to compare sensory, inter and motor neurons.
h. how to explain how the brain differentiates between different locations, intensities and durations of stimulation.
i. how to describe, first hand, what it's like to be blind.
j. how to explain, in general terms, the effects of various drugs on the human brain.
k. that alcohol and nicotine are drugs.

24. The endocrine system is made up of the endocrine glands, which secrete hormones directly into the blood where they move to act on various organs and tissues throughout the body. As a basis for understanding this concept, students know:

a. how to locate and list the functions of most of the endocrine glands.
b. how to provide examples of how hormones act as chemical messengers.
c. how to give an example of feedback control in regulating blood sugar at the cellular and organismal level.

Organ Systems, with Emphasis on Humans (continued)

25. The reproductive system enables the survival of each species. As a basis for understanding this concept, students know:
    a. how to label the parts of the male and female reproductive system.
    b. how to explain the hormonal changes in puberty.
    c. how to explain the roles each of the reproductive hormones play.
    d. how to explain the physiological changes involved in the menstrual cycle.
    e. how to explain what menopause is.

Investigation and Experimentation

26. In the context of investigations designed to develop understanding of the content of the other strands students will:
    a. select and use appropriate tools and technology (such as computer linked probes, spread sheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
    b. identify and communicate the sources of error inherent in experimental design.
    c. identify discrepant results and identify possible sources of error or uncontrolled conditions.
    d. formulate and revise explanations using logic and evidence.
    e. apply mathematical relationships involving quadratic equations, simple trigonometric relationships, exponential growth and decay laws, and logarithmic relationships to scientific situations.
    f. distinguish between a guess, a hypothesis and a theory as these terms are used in science.
    g. recognize the use and limitations of models and theories as scientific representations of reality.
    h. read and interpret a topographic map, and a geologic map for evidence.
    i. identify natural events by sequence and time from natural phenomena (e.g., relative ages of rocks and intrusions).
    j. recognize the issues of statistical variability and the need for controlled tests.
    k. recognize the cumulative nature of scientific evidence.
    l. analyze situations and solve problems that require combining concepts from more than one topic area of science and applying these concepts to real world situations.
    m. investigate a science-based societal issue by researching the literature, analyzing data where appropriate and communicating their findings. Examples include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions (including California).