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Classroom Aquarium Education Program
Correlation with California Science Content Standards

[LS=Life Science, ES=Earth Science, PS=Physical Science]
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Section I.
The concepts listed below were identified for use by a DFG C.A.E.P. working group, with some concepts being noted additionally and described for consideration. Seek to incorporate these ideas into materials used with students at specific grade level. Some examples have been provided to suggest specific links to program applications. Elements of the Investigation and Experimentation strands are shown in Section II.
[LS=Life Science, ES=Earth Science, PS=Physical Science]

Grade 3

LS 3a – e
Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept:

- Plants and animals have structures that serve different functions in growth, survival, and reproduction.
- Identify examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
- Living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
- When the environment changes, some plants and animals survive and reproduce; others die or move to new locations.
- Some kinds of organisms that once lived on Earth have completely disappeared and some of those resembled others that are alive today.

Grade 4

LS 2b
All organisms need energy and matter to live and grow.

- Producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.

LS 3a – c
Living organisms depend on one another and on their environment for survival.

- Ecosystems can be characterized by their living and nonliving components.
- In any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
- Many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.

Grade 5

LS 2a – d

Plants and animals have structures for respiration, digestion, waste disposal and transport of materials.

- Many multicellular organisms have specialized structures to support the transport of materials.
- Blood circulates through the heart chambers, lungs (gills), and body. Carbon dioxide (CO_2) and oxygen (O_2) are exchanged in the lungs (gills) and tissues.
- Sequential steps of digestion involve the mouth (teeth if present), esophagus, stomach, and intestine (small/large and colon) in the function of the digestive system.
- The role of the kidney is to remove cellular waste from the blood and convert it into urine. Some organisms have a bladder for storing urine.

ES 3a – e

Water on Earth moves between the oceans and land through the processes of evaporation and condensation.

- Most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
- When liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.
- Water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.
- The amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and its availability can be extended by recycling and decreasing the use of water.
- Identify the origin of the water used by the local community.

Grade 6

Shaping Earth's Surface 2a – d

Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment.

- Water running downhill is the dominant process in shaping the landscape, including California's landscape. [e.g. Identify boundaries of a watershed; use maps to teach about topography]
- Rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns. [e.g. erosion and deposition over many years establish a soil profile that may be investigated and layers analyzed to understand past events (rushing water deposits only large sediments, slow moving water allows for deposition of fine sediments); siltation from disturbed upslope soils is destructive to gravel spawning beds]
- Beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves.
- Earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

Ecology 5a – e

Organisms in ecosystems exchange energy and nutrients among themselves and with the environment.

- Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.
- Matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.
- Populations of organisms can be categorized by the functions they serve in an ecosystem.
- Different kinds of organisms may play similar ecological roles in similar biomes.
- The number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

Resources 6a – c

Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation.

- The utility of energy resources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process.
- Identify different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests. Classify these as renewable or nonrenewable.
- Identify the natural origin of materials used to make common objects.

Grade 7

Cell Biology 1a

All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope.

- Cells function similarly in all living organisms. [e.g. compare organelles of single celled aquatic organisms such as paramecium or amoeba to cells in a fish tissue]

Genetics 2a – e

A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences.

- Identify differences between the life cycles and reproduction methods of sexual and asexual organisms.
- Sexual reproduction produces offspring that inherit half their genes from each parent.
- An inherited trait can be determined by one or more genes.
- Plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
- DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell. [e.g. establishment through DNA of evolutionary significant units (ESU) of Pacific salmon relative to patterns of ocean migration and return to specific watersheds]

Evolution 3a – e

Biological evolution accounts for the diversity of species developed through gradual processes over many generations.

- Both genetic variation and environmental factors are causes of evolution and diversity of organisms.
- Identify the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.
- Independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.
- Construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.
- The extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

Structure and Function in Living Systems 5a – d, g

The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function.

- Plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
- Organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
- Bones and muscles work together to provide a structural framework for movement. [e.g. primitive fish have cartilaginous vertebrae; rigid fins are also moved for aquatic locomotion]
- The reproductive organs of the female and male generate eggs and sperm which allow for external fertilization with most fish species.
- Relate the structures of the eye and ear to their functions. [e.g. senses of fish include eyes, olfactory sensors for chemical "tasting" of the environment, sound-sensitive internal ears, and a unique electro-magnetic sensor known as the lateral line running down the sides of their body. The latter helps them to "school" with uniform movements]

Physical Principles in Living Systems 6h – i

Physical principles underlie biological structures and functions. [refer to CDE standards, most of these relate to the physics of light with some exceptions below]

- Compare joints in the body (wrist, shoulder, thigh) with structures used in machines and simple devices (hinge, ball-and-socket, and sliding joints).
- Levers confer mechanical advantage. The application of this principle applies to the musculoskeletal system. [A fishing rod, as a simple lever, is an extension of the arm conveying a mechanical advantage in retrieving a fish.]

Grade 8

Chemistry of Living Systems 6a - c

Principles of chemistry underlie the functioning of biological systems.

- Carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms. [e.g. complex, carbon-based sugar molecules are broken down in cellular respiration releasing carbon dioxide as one waste product; water quality may be affected by oil products, a carbon based molecule, through non-point source pollution]
- Living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur. [e.g. nitrogen from agricultural runoff

(fertilizer/animal wastes) can result in an algae bloom in a stream and fish die-off; salmon carcasses provide an important one-way flow of phosphorus from ocean to inland ecosystems]

- Living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA

Reactions 5e

Chemical reactions are processes in which atoms are rearranged into different combinations of molecules.

- Determine whether a solution is acidic, basic, or neutral. [e.g. pH of water can be tested by an indicator - aquatic organisms survive within a given range, tolerance varies by species]

Density and Buoyancy 8c

All objects experience a buoyant force when immersed in a fluid.

- The buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced. [e.g. swim bladder influences swimming depth]

Section II.

Integrate elements of the Investigation and Experimentation strands at grade level where possible. These stimulate the scientific thinking process and are valuable in development of problem-solving skills.

Grade 3

Investigation and Experimentation 5

Scientific progress is made by asking meaningful questions and conducting careful investigations.

- Repeat observations to improve accuracy and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods being used, or uncertainty in the observation.
- Differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.
- Use numerical data in describing and comparing objects, events, and measurements.
- Predict the outcome of a simple investigation and compare the result with the prediction.
- Collect data in an investigation and analyze those data to develop a logical conclusion.

Grade 4

Investigation & Experimentation 6a – f

Scientific progress is made by asking meaningful questions and conducting careful investigations.

- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the weight, length or volume of objects.

- Formulate and justify predictions based on cause-and-effect relationships.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Construct and interpret graphs from measurements.
- Follow a set of written instructions for a scientific investigation.

Grade 5

Investigation & Experimentation 6a – I

Scientific progress is made by asking meaningful questions and conducting careful investigations.

- Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- Develop a testable question.
- Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- Identify the dependent and controlled variables in an investigation.
- Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.
- Select appropriated tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.
- Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

Grade 6

Investigation & Experimentation 7a – h

Scientific progress is made by asking meaningful questions and conducting careful investigations.

- Develop a hypothesis.
- Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
- Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
- Communicate the steps and results form an investigation in written reports and oral presentations.
- Recognize whether evidence is consistent with a proposed explanation.
- Read a topographic map and a geologic map for evidence provided on the maps and construct and interpret a simple scale map.
- Interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions).

- Identify changes in natural phenomena over time without manipulating the phenomena (e.g. a tree limb, a grove of trees, a stream, a hillslope).

Grade 7

Investigation & Experimentation 7a – e
Scientific progress is made by asking meaningful questions and conducting careful investigations.

- Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
- Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.
- Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
- Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).
- Communicate the steps and results from an investigation in written reports and oral presentations.

Grade 8

Consider: Investigation & Experimentation 9a – g
Scientific progress is made by asking meaningful questions and conducting careful investigations. [e.g. investigate a hypothesis; distinguish between variables and controlled parameters in a test; interpret graphs constructed from data, and develop quantitative statements about the relationships between variables; distinguish between linear and nonlinear relationships; apply mathematical relationships (i.e. speed = distance / time, density = mass / volume, force = pressure x area)]