# Zoology Core Curriculum

## Intended Learning Outcomes for Zoology

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.

The main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence. By the end of science instruction in high school, students will be able to:

### 1. Use Science Process and Thinking Skills

a. Observe objects, events and patterns and record both qualitative and quantitative information.

b. Use comparisons to help understand observations and phenomena.

c. Evaluate, sort, and sequence data according to given criteria.

d. Select and use appropriate technological instruments to collect and analyze data.

e. Plan and conduct experiments in which students may:

- Identify a problem.
- Formulate research questions and hypotheses.
- Predict results of investigations based upon prior data.
- Identify variables and describe the relationships between them.
- Plan procedures to control independent variables.
- Collect data on the dependent variable(s).
- Select the appropriate format (e.g., graph, chart, diagram) and use it to summarize the data obtained.
- Analyze data, check it for accuracy and construct reasonable conclusions.
- Prepare written and oral reports of investigations.

f. Distinguish between factual statements and inferences.

g. Develop and use classification systems.

h. Construct models, simulations and metaphors to describe and explain natural phenomena.

i. Use mathematics as a precise method for showing relationships.

j. Form alternative hypotheses to explain a problem.

### 2. Manifest Scientific Attitudes and Interests

a. Voluntarily read and study books and other materials about science.

b. Raise questions about objects, events and processes that can be answered through scientific investigation.

c. Maintain an open and questioning mind toward ideas and alternative points of view.
d. Accept responsibility for actively helping to resolve social, ethical and ecological problems related to science and technology.
e. Evaluate scientifically related claims against available evidence.
f. Reject pseudoscience as a source of scientific knowledge.

**3. Demonstrate Understanding of Science Concepts, Principles and Systems**

a. Know and explain science information specified for the subject being studied.
b. Distinguish between examples and non-examples of concepts that have been aught.
c. Apply principles and concepts of science to explain various phenomena.
d. Solve problems by applying science principles and procedures.

**4. Communicate Effectively Using Science Language and Reasoning**

a. Provide relevant data to support their inferences and conclusions.
b. Use precise scientific language in oral and written communication.
c. Use proper English in oral and written reports.
d. Use reference sources to obtain information and cite the sources.
e. Use mathematical language and reasoning to communicate information.

**5. Demonstrate Awareness of Social and Historical Aspects of Science**

a. Cite examples of how science affects human life.
b. Give instances of how technological advances have influenced the progress of science and how science has influenced advances in technology.
c. Understand the cumulative nature of scientific knowledge.
d. Recognize contributions to science knowledge that have been made by both women and men.

**6. Demonstrate Understanding of the Nature of Science**

a. Science is a way of knowing that is used by many people, not just scientists.
b. Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one "scientific method."
c. Science findings are based upon evidence.
d. Understand that science conclusions are tentative and therefore never final. Understandings based upon these conclusions are subject to revision in light of new evidence.

e. Understand that scientific conclusions are based on the assumption that natural laws operate today as they did in the past and that they will continue to do so in the future.
f. Understand the use of the term "theory" in science, and that the scientific community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.
g. Understand that various disciplines of science are interrelated and share common rules of evidence to explain phenomena in the natural world.
h. Understand that scientific inquiry is characterized by a common set of values that include logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results and honest and ethical reporting of findings. These values function as criteria in distinguishing between science and non-science.
i. Understand that science and technology may raise ethical issues for which science, by itself, does not provide solutions.

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| Science language<br><br>students should use: | generalize, conclude, hypothesis, theory, variable, measure, evidence, data, inference, infer, compare, predict, interpret, analyze, relate, calculate, observe, describe, classify, technology, experiment, investigation, tentative, assumption, ethical, replicability, precision, skeptical, methods of science |

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**Spectrum Academy**

Science Benchmark

Evolution is central to modern science's understanding of the living world. The basic idea of biological evolution is that Earth's present day species developed from earlier species. Evolutionary processes allow some species to survive with little or no change, some to die out altogether, and other species to change, giving rise to a greater diversity of species. Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism, as science strives for explanations of the world.

**Standard I: Student will understand that biological diversity is a result of evolutionary processes.**

Objectives 1: Relate principles of evolution to biological diversity.

a. Describe the effects of environmental factors on natural selection.
b. Relate genetic variability to a species' potential for adaptation to changing environment.
c. Research the career opportunities available in the biological or zoological sciences.

Objective 2: Cite evidence for changes in populations over time and use concepts of evolution to explain these changes.

a. Cite evidence that supports biological evolution over time (e.g, geological and fossil records, chemical mechanisms, DNA structural similarities, homologous and vestigial structures).
b. Identify the role of mutations and recombination in evolution.
c. Relate the nature of science to the historical development of the theory of evolution.
d. Distinguish between observations and inferences in making interpretations related to evolution.
e. Analyze population data and relate the changes to evolution.

Objective 3: Classify organisms into a hierarchy of groups based on similarities that reflect their evolutionary relationships.

a. Classify organisms using a classification tool such as a key or guide.
b. Generalize criteria used for classification of organisms (e.g., dichotomous keys, structure, broad to specific).
c. Explain how evolutionary relationships are related to classification systems.
d. Place taxa in phylogenetic (evolutionary) context and provide data to support hypotheses of relationships.
e. Construct a graphical representation of animal evolution (cladogram)
f. Recognize characteristics that are shared and derived, uniting taxa
g. Interpret graphical representations of animal evolution (cladograms)
h. Describe how technological advances have resulted in reclassification of organisms. (eg, DNA , RNA analysis)

Language science students should use: evolution, fossil record, geologic record, molecular, homologous, vestigial structures, mutation, recombination, hierarchy, classification scheme, theory, natural selection, adaptation, evidence, inference, speciation, biodiversity, taxonomy, kingdom, dichotomy

**Standard II. Students will understand that animal groups differ from one another because of variations in the structure and function of organs and organ systems.**

**Objective 1:** Students will compare function and form relationships within animal groups (Clades) and across key taxa.

a. Explain the similarities and differences among major body plans (e.g., asymmetry, radial, and bilateral symmetry).
b. Compare and contrast taxa based on morphological and genetic characters.
c. Relate important structural changes to key functional transitions.
d. Dissect representative taxa and describe their internal anatomy and the function of major organ systems and organs and relate to cell specializations.
e. Assess the diversity, form, and function of Acoelomates and Coelomates; Pseudocoelomate

Objective 2: Describe the relationship between structure and function of diverse organisms.

a. Examine the relationships of organ systems within an organism and describe the relationships of structure to function in the relationship.
b. Relate the tissues that make up organs to the structure and function of the organ.
c. Compare the structure and function of organ systems in one organism to the structure and function in another organism.

Objective 3: Animal body planes can be categorized according to how cells are organized into tissues and how body parts are distributed within and around an animal.

a. Identify the body planes of organisms.
b. Relate the concepts of symmetry and apply them to patterns of animal structural organization
c. Locate and describe relative position of various structures of organs within organisms.

Objective 4: Compare the evolutionary advancements of organ systems and life cycles in various animal phyla.

a. Identify and understand differences in Respiratory, Nervous, and Reproductive processes of invertebrates and vertebrates.
b. Compare and contrast organ systems between lower level organisms to higher level organisms. (e.g., annelids vs. arthropods, Monotremes vs. Placental)
c. Examine the evolutionary advancement of various life cycles among taxa.
d.

Science language students should use: organ, organ system, organism, Acoelomates, Coelomates, Psueocoelomates, Symmetry, Radial, Bilateral, Asymmetry, Protostomes, Medial, Distal, Proximal, Caudal, Posterior