



AZ Science Standards:

Including Ecology Explorers in your science curriculum may help you to fulfill many of the requirements as outlined in the Arizona Department of Education Science Standards. Since ecology is the study of the interactions between living and non-living components in the biosphere, it is one field of scientific study that easily combines the life sciences, physical sciences and earth sciences. The study of urban ecology makes your schoolyard an easily accessible scientific laboratory. Urban ecology also touches on human interactions with the environment and students will be able to see the interplay between science and society as they ask questions about their local environment.

The following are selected standards taken directly from the Arizona Department of Education Science Standards that may be met by incorporating Ecology Explorer into your curriculum. The fulfillment of some of these standards, while not directly addressed by this Ecology Explorer Web site are logical extensions that teachers will make while teaching ecological concepts.



Science as Inquiry:

Participation in Ecology Explorers fulfills many of the requirements for the *Inquiry Process (Strand 1)*, *History and Nature of Science (Strand 2)* and *Science in Personal and Social Perspectives (Strand 3)* because this program is designed to allow students to be active participants in on-going and active research projects at ASU.

Ecology Explorer Project can fulfill:

K-4

- S1C1-K-4: observe, ask questions, and make predictions
- S1C2-K-4: participate in planning and conducting investigations and recording data
- S1C3-K-4: organize and analyze data; compare to predictions
- S1C4-K-4: communicate results of investigations
- S2C2-K-4: understand how science is a process for generating knowledge
- S2C1-K-4: identify individual and cultural contributions to scientific knowledge
- S3C1-K-4: describe the interactions between human populations, natural hazards, and the environment
- S3C2-K-4: understand the impact of technology

5-8

- S1C1-5-8: formulate predictions, questions, or hypotheses based on observations; locate appropriate resources
- S1C2-5-8: design and conduct controlled investigations
- S1C3-5-8: analyze and interpret data to explain correlations and results; formulate new questions
- S1C4-5-8: communicate results of investigations
- S2C2-5-8: understand how science is a process for generating knowledge
- S2C1-5-8: identify individual, cultural, and technological contributions to scientific knowledge
- S3C1-5-8: describe the interactions between human populations, natural hazards and the environment
- S3C2-5-8: develop viable solutions to a need or problem

HS

- S1C1-HS: formulate predictions, questions, or hypotheses based on observations; evaluate appropriate resources
- S1C2-HS: design and conduct controlled investigations
- S1C3-HS: evaluate experimental design, analyze data to explain results and to propose further investigations; design models
- S1C4-HS: communicate results of investigations
- S2C2-HS: understand how scientists evaluate and extend scientific knowledge
- S2C1-HS: identify individual, cultural, and technological contributions to scientific knowledge
- S3C1-HS: describe the interactions between human populations, natural hazards, and the environment
- S3C2-HS: develop viable solutions to a need or problem
- S3C3-HS: analyze factors that affect human populations

Teacher's Guide



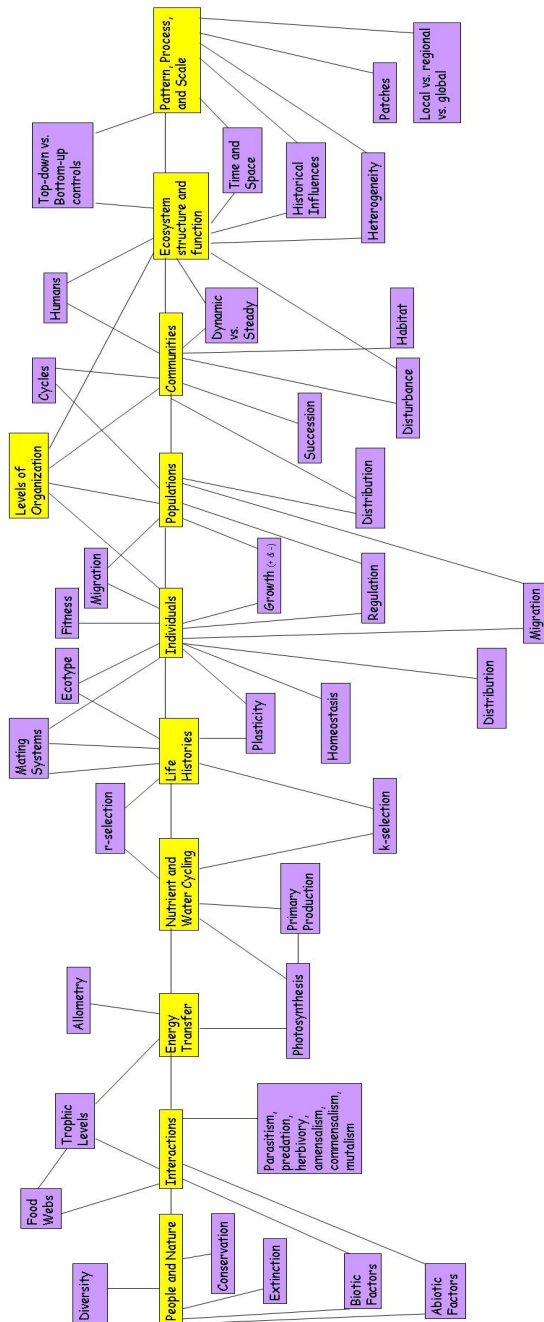
Life Science (Strand 4)

Students participating in Ecology Explorers will meet many of the AZ Life Science Standards through learning ecology in cities. Ecology is the branch of biology that studies interactions among living things as well as interactions of living things and their physical environment. We have mapped how the major concepts in ecology relate to the Arizona state science standards and the concepts emphasized in Ecology Explorers are highlighted in the maps. The maps are shown below.

Research Areas within Ecology



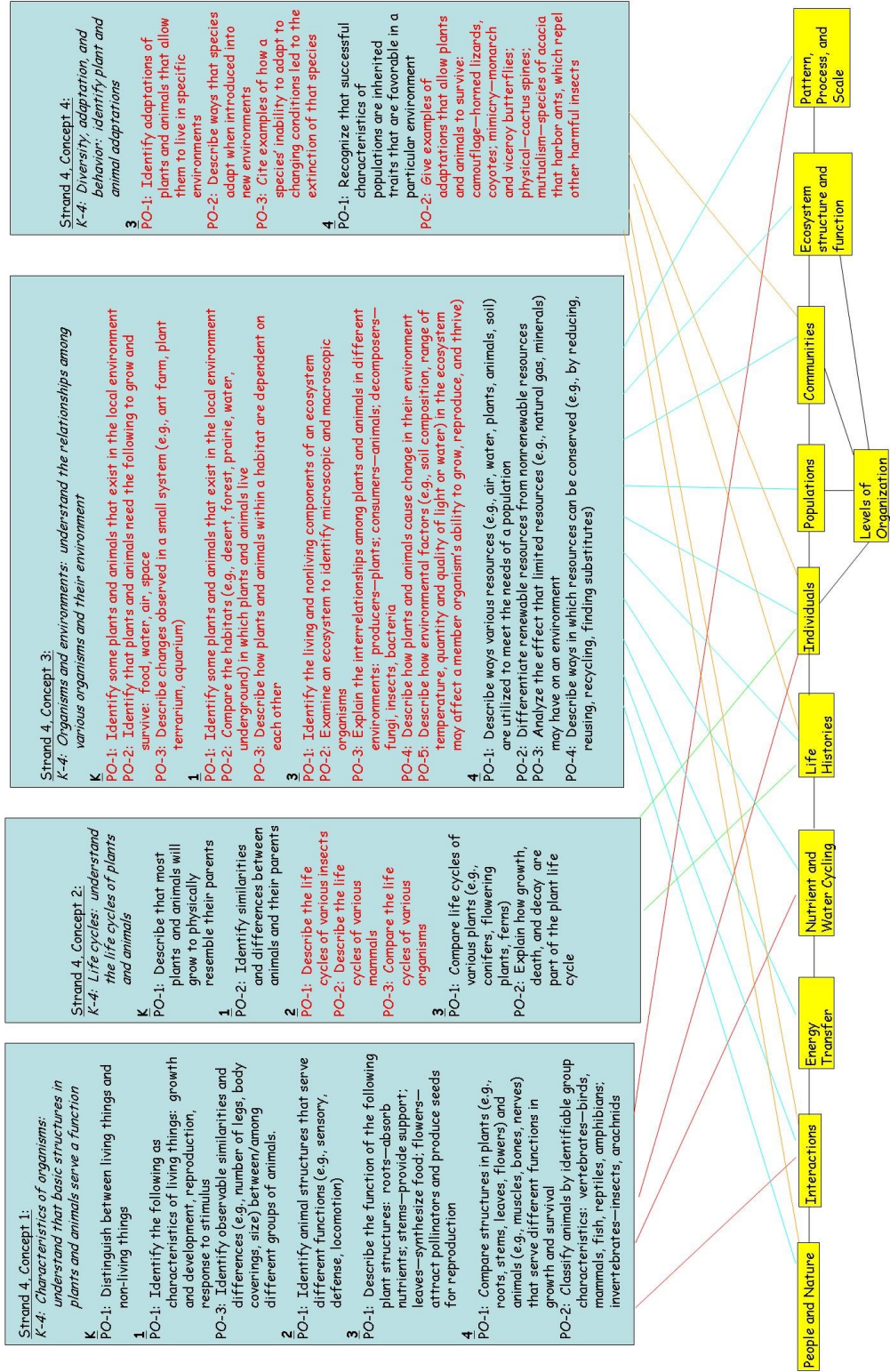
Major Ecological Concepts



Teacher's Guide

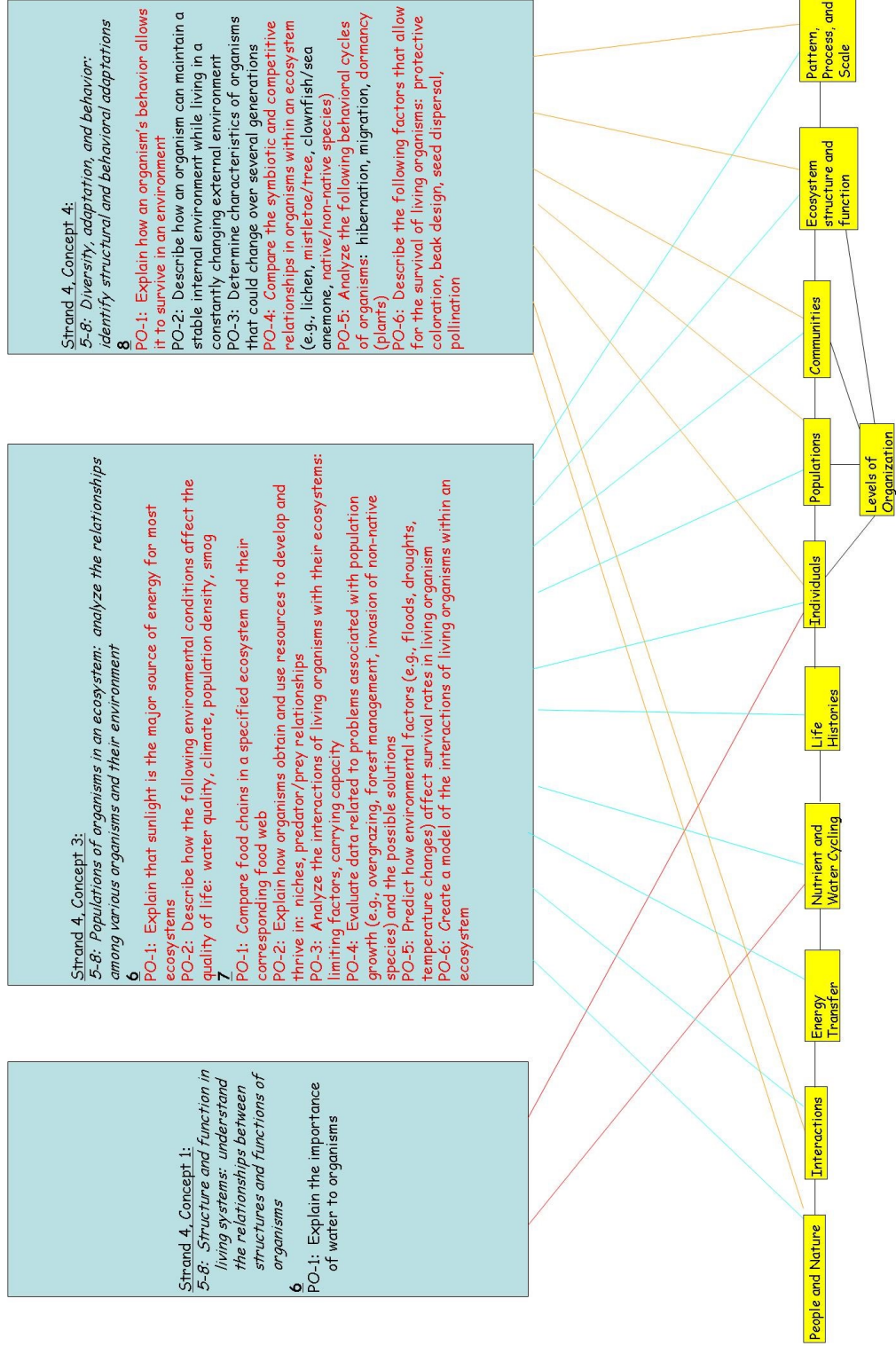


K-4: Life Science Standards



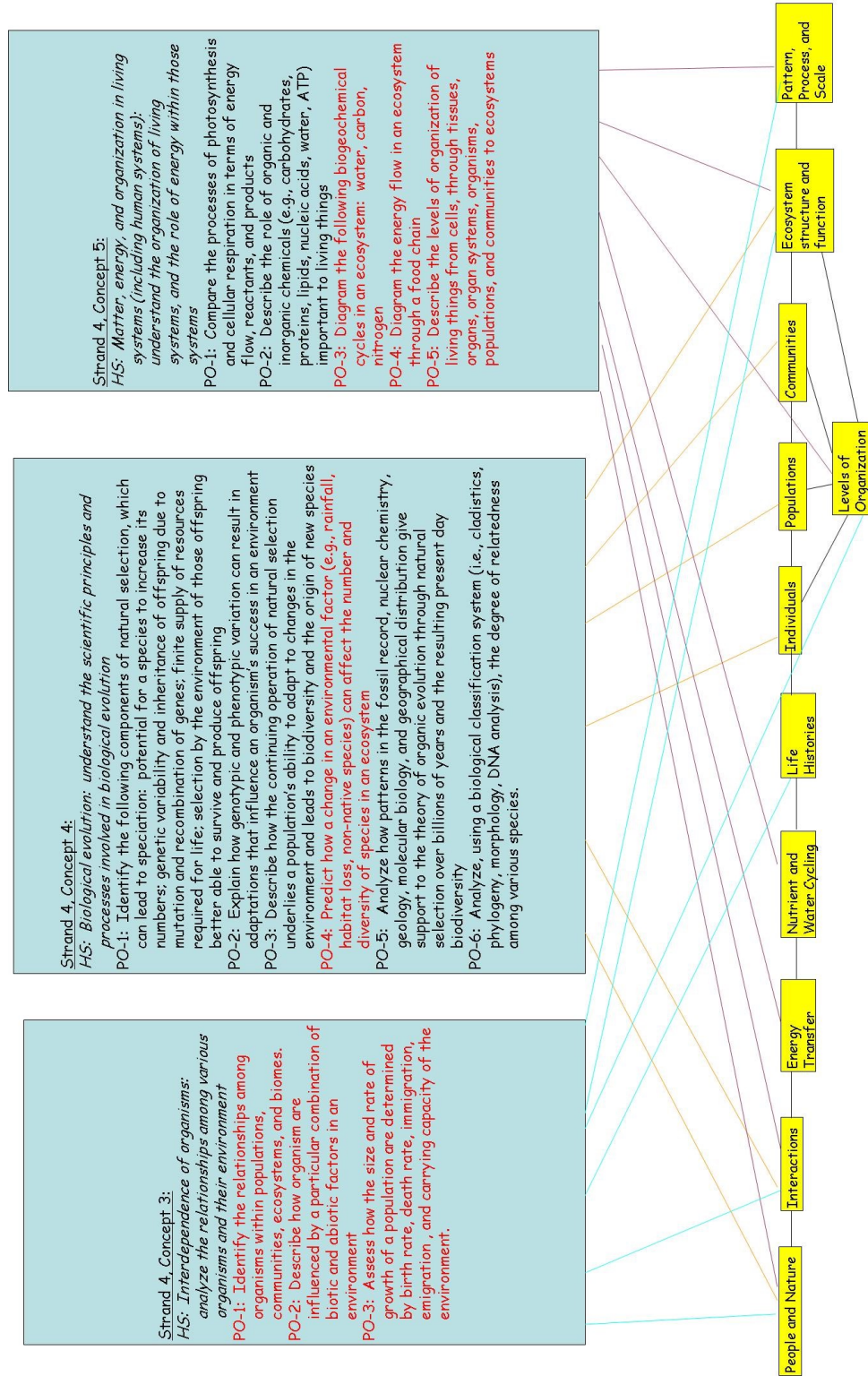


5-8: Life Science Standards





HS: Life Science Standards





Physical Science (Strand 5)

Although the physical sciences are used extensively to understand ecosystems, these standards are specific to understanding the underlying structure of matter. In Ecology Explorers, students need to be comfortable with many of the characteristics of chemical compounds, but they are not part of this curriculum. For example, understanding conservation of energy and matter are key components to understanding ecosystems. Ecology Explorers is a way for students to see how these basic physical concepts are applied in biological systems.

Teacher's Guide



Earth and Space Science (Strand 6)

Since Ecology is the interaction between the living and non-living components, knowing something about the earth is very important. Ecology Explorer project can fulfill:

K-4

- S6.C2.G1.PO1: Identify evidence that the Sun is the natural source of heat and light on the Earth (e.g., warm surfaces, shadows, shade).
- S6.C3.GRK.PO1: Identify the following aspects of weather: temperature, wind, precipitation, storms.
- S6.C3.GR1.PO1: Identify the following characteristics of seasonal weather patterns: temperature, type of precipitation, wind.
- S6.C3.GR1.PO2: Analyze how the weather affects daily activities.
- S6.C3.GR2.PO1: Measure weather conditions (e.g., temperature, precipitation).
- S6.C3.GR2.PO2: Record weather conditions (e.g., temperature, precipitation).
- S6.C3.GR4.PO1: Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers).
- S6.C3.GR4.PO6: Compare weather conditions in various locations (e.g., regions of Arizona, various U.S. cities, coastal vs. interior geographical regions).

5 - 8

- S6.C1.GR7.PO3: Explain the following processes involved in the formation of the Earth's structure: erosion, deposition, plate tectonics, volcanism
- S6.C1.GR7.PO4: Describe how the rock and fossil record show that environmental Conditions have changed over geologic and recent time
- S6.C2. GR4.PO1: Identify the earth processes that cause erosion
- S6.C2. GR4.PO2: Describe how currents and wind cause erosion and land changes.
- S6.C2. GR4.PO4: Compare rapid and slow processes that change the Earth's surface, including: rapid – earthquakes, volcanoes, floods; slow – wind, weathering
- S6.C2. GR4.PO5: Identify the earth events that cause changes in atmospheric conditions (e.g., volcanic eruptions, forest fires).
- S6.C2. GR4.PO6: Analyze evidence that indicates life and environmental conditions have changed (e.g., tree rings, fish fossils in desert regions, ice cores).
- S6.C2. GR6.PO1: Explain how water is cycled in nature.
- S6.C2. GR6.PO-3: Analyze the effects that bodies of water have on the climate of a region.
- S6.C2. GR6.PO 4. Analyze the following factors that affect climate: ocean currents, elevation, location



HS

- S6.C1.HS.PO1: Identify ways materials are cycled within the earth system (i.e., carbon cycle, water cycle, rock cycle).
- S6.C1.HS.PO2: Demonstrate how dynamic processes such as weathering, erosion, sedimentation, metamorphism, and orogenesis relate to redistribution of materials within the earth system.
- S6.C1.HS.PO5: Describe factors that impact current and future water quantity and quality including surface, ground, and local water issues.
- S6.C1.HS.PO6: Analyze methods of reclamation and conservation of water.
- S6.C2.HS.PO3: Distinguish between weather and climate.
- S6.C2.HS.PO9: Explain the effect of heat transfer on climate and weather.
- S6.C2.HS.PO12: Describe the conditions that cause severe weather (e.g., hurricanes, tornadoes, thunderstorms).
- S6.C2.HS.PO14: Analyze how weather is influenced by both natural and artificial earth features (e.g., mountain ranges, bodies of water, cities, air pollution)
- S6.C2.HS.PO15: List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).
- S6.C2.HS.PO16: Explain the causes and/or effects of climate changes over long periods of time (e.g., glaciation, desertification, solar activity, greenhouse effect).
- S6.C2.HS.PO17: Investigate the effects of acid rain, smoke, volcanic dust, urban development, and greenhouse gases, on climate change over various periods of time.
- S6.C3.HS.PO6: Investigate scientific theories of how life originated on Earth (high temperature, low oxygen, clay catalyst model).
- S6.C3.HS.PO7: Describe how life on Earth has influenced the evolution of the Earth's systems.
- S6.C3.HS.PO8: Sequence major events in the Earth's evolution (e.g., mass extinctions, glacial episodes) using relative and absolute dating data.
- S6.C3.HS.PO9: Analyze patterns in the fossil record related to the theory of organic evolution.



Ecology Explorers and the AZ Standards (other than Science)

Reading, Writing, Listening & Speaking: Language Arts Standards & CAP LTER

Arizona Standards stress the interdependency of reading, writing, listening and speaking. Interdisciplinary projects such as CAP LTER protocols and their associated extensions (reading science information, interpreting keys, presenting and sharing data) offer a cross disciplinary method for integration of many language arts skills.

Reading

- Comprehension: identifying cause and effect (R-F3, PO4)
- Structural analysis skills: identify root words, infer meaning from knowledge of prefixes and suffixes, and confirm meaning by context clues (R-E1, PO1,2,3)
- Evaluate an instructional manual: identify components in the manual, incorporate information from illustrations, identify the sequence of activities needed to carry out a procedure (R-E5, PO1,2,4)

Writing

- Gather, organize and accurately, clearly and sequentially report information gained from personal observations and experiences such as science experiments, field trips and classroom visitors: record observations, write an introductory statement, report events sequentially, write a concluding statement (W-F4, PO1 – 4)
- Locate, acknowledge and use several sources to write an informational report in their own words: use resources (W-F5, PO1)
- Write a persuasive essay (W-P2)

Listening and Speaking

- Prepare and deliver an oral report: grades 4 – 8
- Communicate information expressively, informatively, and analytically through a variety of media to audiences inside or outside of the school: grades 9 -12.

Viewing and Presenting

- Plan, develop and produce a visual presentation, using a variety of media such as videos, films, newspapers, magazines and computer images: grades 4 – 8.



Mathematics Standards and CAP LTER

Arizona Mathematics Standards Rationale

“Whenever possible, mathematical learning should be placed in a broader, problem-solving context and evaluated through performance assessments. In this setting, students discover questions involving numbers or equations from a real-world context which lead to answers that have meaning. Ultimately, all problems should be application problems; more ideally, problems should be presented in the broader context of an investigation or project. This way the students use problem solving, reasoning, communication and connections in every mathematical activity. The spirit of these four goals is a mathematical apprenticeship in which the students solve problems on a daily basis, much as mathematics is used in the real world.”

CAP LTER projects offer students real world applications of numerous problem-solving and computational skills required by the Arizona Department of Education.

Strand One: Number Sense and Operations

S1C1 (GR 3-12): Understand and apply numbers, ways of representing numbers, the relationships among numbers and different number systems

S1C2 (GR K-12): Understand and apply numerical operations and their relationships to one another

S1C3 (GR 3-12): Use estimation strategies reasonably and fluently

Strand Two: Data Analysis, Probability, and Discrete Mathematics

S2C1 (GR K-12): Understand and apply data collection, organization and representation to analyze and sort data

Strand Three: Patterns, Algebra and Functions

S3.C2.GR8.PO4: Identify independent and dependent variables for a contextual situation.

S3.C2.HS: Describe and model functions and their relationships

Strand Four: Geometry and Measurement

S4C1.HS.PO14: Solve contextual situations using angles and side length relationships

S4C4 (GR 3-12): Understand and apply appropriate units of measure, measurement techniques, and formulas to determine measurements

Strand Five: Structure and Logic

S5C1 (GR 1-12): Use reasoning to solve mathematical problems in contextual situations



Social Studies Standards & CAP LTER

Human interactions play a large role in Urban Ecology and are an integral component of the research being done as part of CAP LTER. Studying Urban Ecology with your students not only addresses science standards, but social studies as well. The following are selected standards taken directly from the Arizona Social Studies Standards that may be met by incorporating Ecology Explorer into your curriculum.

Standard 1: History

“Students analyze the human experience through time, recognize the relationship of events and people, and interpret significant patterns, themes, ideas, beliefs, and turning points in Arizona, America, and world history.”

Essentials

1SS-E1: Understand and apply basic tools of historical research, including chronology and how

to collect, interpret, and employ information from historical materials.

1SS-E8: Demonstrate and apply the basic tools of historical research, including how to construct timelines, frame questions that can be answered by historical study and research, and analyze and evaluate historical materials offering varied perspectives, with emphasis on:

PO 1. constructing and interpreting graphs and charts using historical data

PO 3. framing questions that can be answered by historical study and

research

PO 8. recognize the difference between cause and effect and a mere

sequence

of historical events

Proficiency

1SS-P1: Apply chronological and spatial thinking to understand the meaning, implications, and

import of historical and current events.

1SS-P2: Demonstrate knowledge of research sources and apply appropriate research methods,

including framing open-ended questions, gathering pertinent information, and evaluating the evidence and point of view contained with primary and secondary sources.

1SS-P3: Develop historical interpretations in terms of the complexity of cause and effect and

in the context in which ideas and past events unfold.

1SS-P12: Analyze the development of the American West and specifically Arizona, with emphasis on:



PO 2. the development of resources and the resulting population and economic patterns, including mining, ranching, and agriculture.

Standard 3: Geography

“Students analyze locations, regions, and spatial connections, recognizing the natural and cultural processes that impact the way in which people and societies live and interact with each other and their environment.”

Essentials

3SS-E1: Demonstrate understanding of the physical and human features that define places and

regions in Arizona, including the geographic tools to collect, analyze, and interpret data...

3SS-E2: Describe the impact of interactions between people and the natural environment on the

development of places and regions in Arizona, including how people have adapted to and modified the environment....

3SS-E4: Demonstrate understanding of the characteristics, purposes, and use of geographic

tools to locate and analyze information about people, places and environments....

3SS-E6: Describe the economic, political, cultural, and social processes that interact to shape

patterns of human populations, interdependence, and cooperation and conflict....

3SS-E7: Explain the effects of interactions between human and natural systems, including the

changes in meaning, use, and distribution of natural resources....

3SS-E8: Use geographic knowledge, skills, and perspectives to explain past, present, and future

issues...

Proficiency

3SS-P1: Acquire, process, and analyze geographic information about people, places, and environments by constructing, interpreting, and using geographic tools...

3SS-P2: Analyze natural and human characteristics of places in the world studied to define

regions, their relationships, and their patterns of change...

3SS-P3: Analyze how economic, political, cultural, and social processes interact to shape patterns and characteristics of human populations, interdependence, and cooperation and conflict...



Technology Standards & CAP LTER

The technology standards are designed to “help students live, learn and work successfully and responsibly in an increasingly complex, technology-driven society.”

Technology Standard 3: Productivity Tools

“Students use technology tools to enhance learning, to increase productivity and creativity, and to collaboratively construct technology-enhanced models, prepare publications, and produce other creative works”

Using technology tools for data collection and analysis including spreadsheets and data probes (3T-F2, 3T-E2, 3T-P2)

Technology Standard 4: Communication Tools

“Building on productivity tools, students will collaborate, publish, and interact with peers, experts and other audiences using telecommunications and media”

Using technology to access remote information and online resources and collaborate with peers, and experts (4T-E1, 4T-E3, 4T-P1, 4T-P3)

Technology Standard 6: Tool for Problem Solving and Decision Making

“Students use technology to make and support decision in the process of solving real-world problems”

Determine when technology is useful and select and use the appropriate tools and technology resources to solve problems (6T-E1, 6T-P2)