UbD and the Idaho State Science Standards Unit Planner

Grade level: 7th Grade Life Science

Unit topic: Ecosystems

The overarching theme in ecosystem units is to investigate how the interaction of matter and energy support life within an environment. Through the essential question, " Is survival a team sport?" this unit addressed these concepts first with a local sagebrush steppe ecosystem and then with more complex interactions in the Yellowstone National Park ecosystem, before and after the introduction of wolves.

Documents included with this unit planner:

Appendix A - "Cross the River" Game
Ecosystems Card Sort
Ecosystems Oh Deer! - instructions, questions and graphs
Ecosystems Field Work Data Sheets
Ecosystems "Why Care About America's Sagebrush?"
Ecosystems "Why Care About America's Sagebrush?" Questions
Ecosystems Yellowstone National Park - Inquiry Project

1. Idaho State Science Standards (ISSS) and Idaho Core Standards

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<td>ISSS Performance standards:

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
Evaluate competing design solutions for maintaining biodiversity and ecosystem services

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<td>ISSS scientific practices:

Developing and Using Models
Analyzing and Interpreting Data
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

ISSS crosscutting concepts:

Patterns
Cause and effect
Energy and matter
Stability and change
Systems and system models

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<tr>
<td colspan="2">ISSS supporting content:
Interdependent Relationships in Ecosystems

Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently

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constrains their growth and reproduction.
- Growth of organisms and population increases are limited by access to resources.
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

Cycle of Matter and Energy Transfer in Ecosystems
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

Ecosystem Dynamics, Functioning, and Resilience
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

Biodiversity and Humans
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.

Idaho Core Standards:
- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

2. Culminating outcomes:

- Project1: Using an Annenberg Ecology Interactive simulation lab, students design an inquiry to investigate how the size of a predator population is related to the size of a prey population. Results to be presented during a poster session walk about.
- Project 2: Field work in Boise Foothills with research questions and follow-up investigation.
- Project 3 : Model the Yellowstone National Park ecosystem using food chains, food webs, biotic and abiotic interactions. Investigation and argument write up as to whether or not a biotic member of an ecosystem needs a teamwork approach to survive?
- Assessment: Presentation of Yellowstone National Park Ecosystem to 5th grade students in a Visitor Center type experience. Students researched the park ecosystem before and after the introduction of wolves in 1995. They created displays that presented arguments as to whether the Yellowstone ecosystem was healthier before or after the introduction of wolves and how team players affected the ecosystem growth or decline.

3a. Essential question(s):

- Is survival a team sport?

3b. Guiding questions:

- What living and nonliving factors define an ecosystem?
- How is matter exchanged between organisms and their environment?
- How do living things move energy through an ecosystem?
- How do feeding relationships impact an ecosystem?
- How does the amount of energy change as it flows through an ecosystem?
- What impact can an organism have on the interactions between other organisms in a food web?
- What are the ways organisms interact in an ecosystem?
- What patterns do organisms create in an ecosystem?
- How do living and nonliving factors affect the size of populations?

4. Progression of learning:

PART ONE: Introduce the essential question. Explore the parts of an ecosystem. How are the parts of an ecosystem connected?

Frontloading

Day 1

Students began by discussing the characteristics that make individuals, good team players. Students play **"Cross the River Game".** (See Appendix A for the "Cross the River Game.) Strategies and tactics used by students are then discussed and analyzed to list successful team player skills.

Day 2

Students define biotic and abiotic factors for an ecosystem. Students then use a sagebrush card set to sort factors into biotic and abiotic categories. (See Ecosystems Card Sort file). Card sort introduces students to the various organisms in the sagebrush steppe. From their background knowledge and class discussion students begin to think about possible 'players' on a team in the sagebrush ecosystem.

Build Conceptual Knowledge

Day 3

Discuss producers, consumers, food chains and food webs. Students work in small groups using Sagebrush card sort to create combinations of food chains and a food web. Students discuss if organisms are connected as players on a team or competitors from an energy viewpoint. Students research organisms using chromebooks if they are unfamiliar with its relationship to the environment.

Day 4 & 5

Students explore producer / consumer relationships using the online Ecology simulation from

Annenberg Learner. Use the link below.
(https://www.learner.org/courses/envsci/interactives/ecology/)
The simulation allows students to explore the relationships by manipulating initial quantities of producers and consumers. Students collect data in tables and analyze data from charts and graphs. Students design an inquiry and present results in a poster format. Students share results with classmates by presenting during a walkabout poster session.

Day 6
Close reading of interactions between organisms (predator, prey, symbiosis, mutualism, commensalism, parasitism) using the life science textbook. Students work independently to complete Cornell notes and then continue to build sagebrush ecosystem knowledge by working in small groups to make connections of various interactions between sagebrush organisms. **Card sort** can be used for the interactions. Gallery stroll between groups to see connections all groups developed.

PART TWO: Continue to build deeper knowledge of ecosystems through study of population dynamics and dependence on biotic and abiotic factors. Begin to build procedural knowledge needed for Boise Foothills field inquiry.

Day 7
Discussion and Cornell note taking (from textbook) for concepts such as

- Populations
- Habitats
- niches
- trophic levels
- Carrying capacity
- limiting factors

Day 8

Play the Oh Deer! Game from Project Wild. Students simulate population variations due to limiting factors in an ecosystem. Follow up to the activity includes students answering questions, graphing outcomes and whole class discussion of results. See the " **Ecosystems Oh Deer!"** document for instructions, questions and graphs.

Day 9
Coordination with student's math instructor to calculate organism populations using a Mark-Recapture Lab Activity. This activity exposes students to a process used by wildlife biologists to estimate populations. Limitations of the process are discussed especially attrition of the population due to disease or natural disasters.

Day 10

Using various parts of the school grounds, students investigated the micro ecosystems present in various locations of the school yard. The purpose of this work was for students to become familiar with the techniques that they were going to use in their field inquiry in the foothills. Students practiced making general site descriptions, marking a meter square investigation area with locations markers, working with soil and air temperature probes, identifying plants and insects using field manuals, relative humidity, soil moisture, soil type, slope, wind speed and performing an organism count. For follow up, students were asked to make conclusions about their particular micro ecosystem and support their argument with evidence that they collected from their data. Students also discussed patterns between locations. Questions were formulated for their field work day in the Boise Foothills ecosystem. See **Ecosystems Field work Data Sheets.**

Day 11
Read "**Why Care About America's Sagebrush?" from U.S. Fish & Wildlife Service**, February 2014. (https://www.fws.gov/mountain-prairie/factsheets/Sage-steppe_022814.pdf). (Also included as a document). Use Socratic Seminar to discuss current conditions of the sagebrush ecosystem, stressors to the sagebrush environment (fire, drought and invasive species), and human impact to the ecosystem. Some students modified their inquiry questions for the field work day based on their knowledge gained from this discussion.

PART THREE: Field work and Yellowstone National Park Inquiry

Day 12
Students were divided into four groups and performed inquiry field work at the Boise Foothills Learning Center. They were able to investigate conditions at two different locations and make comparisons. Students created posters and presented their conclusions based on the data evidence they collected. Factors that influenced the data they collected were considered and how methods might be revised in the future to increase accuracy.

Day(s) 13 - 22
The final project in this ecosystem unit was for students to independently research the more complex Yellowstone National Park (YNP) ecosystem. Students deepened their understanding of ecosystems components by using transfer to relate the patterns and interactions of organisms in the sagebrush steppe to the larger and more complex Yellowstone ecosystem. Using a KWL chart, students recorded their initial knowledge and ideas on what they wanted to learn about Yellowstone in their science notebooks.

Frontloading knowledge included a discussion about the YNP ecosystem before 1995 and after 1995 - the year wolves were reintroduced to the park. Human influences on ecosystems were also considered. Without much further knowledge, students were given the assignment described in the **Ecosystems Yellowstone National Park** document. See the document for complete description, guidelines, questions to consider, and rubric.

The following is an excerpt from the document describing the scenario given to students:

"The superintendent of Yellowstone National Park has asked you, a wildlife biologist working in Yellowstone, to create a display for the Old Faithful visitor center, titled "Is survival a team sport?" Your display must include detail information about the Yellowstone ecosystem before wolves were introduced in 1995 and how the ecosystem was affected by their introduction from years 1995 till present. In addition to wolves, you need to consider the interaction of elk and beavers. **At least** three additional animals/plants of your choice should also be included. (Grizzly Bears, cougars, coyotes, bison,...)"

Some examples of guiding questions were:

- "Did introducing wolves make the Yellowstone ecosystem healthier? Or did introducing wolves into the ecosystem weaken it? Your argument should be strongly supported with scientific evidence from your research. "
- What biotic or abiotic stressors can interfere with a species survival?
- What role do scientists play in the Yellowstone ecosystem?

Students worked in groups (max size 3 students) to research their project. They considered the stability of the YNP ecosystem with and without wolves and assessed the change to the ecosystem that wolves brought. They were asked to consider the essential question of the unit, "Is survival a teamsport?".

Their end product was a presentation given to our 5th grade class as if they were in the Visitor Center of Yellowstone National Park. Presentations included tri fold displays, posters and dioramas, Google slides presentations, and websites.

5. Ongoing formative assessment:

- Opening Moments
- Closing Moments
- Science notebook
- Small group and individual check-ins

6. Unit Reflection

Student engagement was very high in this unit. They had many personal connections to investigating the local sagebrush ecosystem and the Yellowstone National Park ecosystem. I would consider expanding the foothills inquiry day into a larger project. I would also like to bring in a local wildlife biologist so students would get a direct perspective with issues facing the foothills. Also, next year I would like to tap the resources offered by Yellowstone National Park by taking advantage of a visit from a Yellowstone park ranger through their school

program. I think that would make a direct impression on the students and their projects.

The culminating project of considering the wolf reintroduction to Yellowstone was very enlightening for most students. They were intrigued with the trophic cascade that was created by putting the keystone species back into the ecosystem. Although their definition of teamwork was redefined they could see that wolves were an important member of the Yellowstone ecosystem team.

Appendix A

CROSS THE RIVER

Materials

- 1' x 1' squares of cardboard
- 2 pieces of rope or masking tape to make river banks

Set Up

Create a river by marking two river banks with the rope or tape. Make the river wide enough to be a challenge for the group to get from one side to the other (look at about 15 – 25 ft.). Distribute the cardboard squares – 1 piece for every 2 people.

Directions

The object of the activity is to get all members of the group safely across the river. They must go as one big group, not multiple smaller ones. Everyone must be on the river before anyone can get off the river, forcing the entire group to be engaged at once. Participants cannot touch the water (floor/grass) and therefore must use rafts (cardboard squares) to cross. The water is filled with crocodiles. Therefore if someone loses their balance and touches a hand in the water it gets eaten (put behind the back). Same goes for a foot. If a person completely comes off the raft they are gone and since this is a team exercise everyone must start over. Rafts must be in contact with a human at all times or they will be swept away with the current.

Once the group has started the process, your role is to take cardboard squares that are "swept away by the current" and to watch for safety issues. Use this to your advantage as well. The participants will invariably slip up and leave some rafts here or there with no one contacting them, those you should steal. When the first group members get to the other side immediately start to encourage them to hurry and get off the river. Nearly every time the first few people will rush off the rafts leaving them unattended for you to steal and stranding some of their team-mates. Work this into your debrief, when working with a team you can't forget about your teammates.

Variations

- Participants must stay in constant contact
- Each raft represents a symbol named by participants
- The tiles can only go forward. They cannot move backwards
- No one can finish until everyone has left the "bank" of the river
- Choose to add challenges like muting individuals, using only 1 arm, eyes closed/blindfolded, no one can talk, others can be "gators" in the river and try to impede those crossing the river, stand in front of the group with arms outstretched to simulate tree they must go around.
- Give group an object that they need to carry with them to safety and discuss what that might represent

- Create situations for them to draw from that are connected directly to their group

Discussion

- What happened during the process? What worked? What didn't or what hindered the process?
- What leadership was demonstrated during the process? How so? What did you observe?
- What were the individual roles people played?
- Who knew what the process for crossing was? Who didn't? How did you communicate the plans to group members?
- When the first people rushed off the river and stranded some of you how did that feel?
- What were some of the characteristics of a team player?