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Introductory Lesson:

The Interdependence of Birds and the Great Salt Lake Ecosystem

Abstract:

Students will participate in the “Checks and Balances” game. This game will allow the students to experience, on a classroom level, the interdependence of organisms specific to the Great Salt Lake. Mathematical skills, such as figuring out percentages, will be used throughout this activity. Prior to this lesson, students will have received information about food chains, food webs, trophic levels, various cycles (carbon cycle and water cycle) and habitats (wetlands, prairies, etc.).

Grade Level: 10th

Utah State Core Curriculum Standards:

Standard 8: Students will investigate the interdependence of organisms with each other and with their environment.

Objective 1: Predict how changes in one part of an ecosystem affect the system.

- Describe symbiotic relationships within an ecosystem.
- Identify the factors that limit a population's growth (e.g., temperature, soil type, competition, increased predation, waste accumulation)
- Hypothesize the interrelationship of one variable in an ecosystem to others (e.g., plant and soil characteristics, temperature). Analyze and report results.

AAAS 2061 Benchmark:

The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions, and a great diversity of species increases the chance that at least some living things will survive in the face of large changes in the environment.

NRC National Science Education Standard:

The interdependence of organisms:

- Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.
- Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.
- Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and

other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.

In-class instructional time: 45 minutes

Terminology:

Ecosystem- interactions among populations in a community; the community's physical surroundings, or abiotic factors.

Individual- one organism.

Population- group of organisms of one species that interbreed and live in the same place at the same time.

Species- group of organisms that can interbreed and produce fertile offspring in nature.

Community- collection of several interacting populations that inhabit a common environment.

Intended Learning Outcomes:

Students will:

- Discuss the interdependence of organisms in an ecosystem through the game “Checks and Balances.”
- Students will express, through a short reflective writing activity in a journal, what they understand interdependence to be.

Background:

The community of the Great Salt Lake is one full of interactions between several organisms. Even environmental factors play a role in what happens to each organism. On most any given day, a person can dip their hand into the Great Salt Lake and come out with a hand full of tiny brine shrimp. They can look up to the sky and see a Wilson's phalarope overhead. Whether it's an organism the size of a brine shrimp, or the size of a Wilson's phalarope, they all impact the survival of the Great Salt Lake ecosystem.

According to Ehrlich, Dobkin and Wheye (1988), the marsh wren is one of the birds found in the Great Salt Lake community. The marsh wren nests in reeds one to nine feet in height. These reeds are found in fresh and brackish (salty) water. Where they live helps with their diet of aquatic insects. Their nests are lined with reeds, grass, plant materials and feathers. The male builds the nest, but the female lines it. There are two broods a year, once in the spring and once in the summer. Each time, the female lays four to six eggs.

There are several natural dangers that face the nests of marsh wrens, and surprisingly, most of these are other birds! First of all, the brown headed cow bird does what is called brood parasitism. It lays its eggs in the nest of the marsh wren. These eggs are larger than the eggs of the marsh wren. When hatched, the cow bird babies are much bigger than the marsh wren babies, therefore the cow bird is able to reach the food offered by the mother marsh wren before the little wren can get to it. This eventually leads to the death of the small marsh wrens.

In addition, Red winged black birds and other marsh wrens can destroy the marsh wren's eggs and nestlings. The marsh wren's natural predator is the Cooper's Hawk, which can harvest wren parents or babies for a meal.

Materials Needed:

- Condition, reproduction and management cards
- “Checks and Balances” data sheet
- Calculator
- Dice (one per group)

Instructional Activities:

Prior Knowledge Assessment:

Students will be asked such questions as, “What is an ecosystem?” As the students answer the questions confidently and correctly, the teacher will be able to move through the game quickly without going into too much explanation. If the students seem confused or uncertain, then the teacher will have to spend more time throughout the game explaining concepts.

The Activity:

Checks and Balances Game

1. Each student is asked to be the manager of a Marsh Wren population. The carrying capacity of the habitat is 100 animals. The point of the activity is to end up with a viable population after nine rounds, simulating nine years. If at any time the student’s population reaches less than 10 or more than 200 individual animals, that student no longer has a viable flock and watches the other students until the conclusion of the activity.
2. Each student has a beginning population of 100 animals. The cards are separated into three decks of a total of 36 cards: a condition deck (18 cards), a reproduction deck (9 cards), and a management deck (9 cards). Shuffle the cards within each deck. Explain that cards will be drawn in the following sequence: condition card, reproduction card, condition card, management card. This sequence of draw will be repeated, each repetition representing an annual cycle (the students may think of each draw as representing a different season, e.g., autumn, winter, spring and summer). As each card is drawn, it is read aloud to the entire class. Each student then rolls his or her die and follows the instructions on the card to determine his or her herd population’s new size. Some computations will result in fractions; numbers may be rounded to the nearest whole.

* This game was adapted from the Checks and Balances game by Project Wild.

Assessment:

Students will express, through a short reflective writing activity in a journal, what they understand interdependence to be. The journal should include:

- The characteristics of the Great Salt Lake ecosystem
- Their understanding of interdependence
- How they feel about what happened to their flock of Marsh Wrens.
- What they can do to help an ecosystem

Resources:

Biggs, A. alt. (2000). *Biology: The Dynamics of Life*. McGraw-Hill.

Ehrlich, P.R., Dobkin, D.S. & Wheye, D. (1988). *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*. New York : Simon & Schuster Inc.

<p style="text-align: center;">Weather Card</p> <p>A late frost in the spring forces individuals to look elsewhere for habitat. Decrease your flock by the percentage equal to five times your roll.</p>	<p style="text-align: center;">Weather Card</p> <p>A mild winter with little snow has had a dramatic positive impact on the survival of the flock. Increase your herd by the percentage equal to five times your roll.</p>
<p style="text-align: center;">Weather Card</p> <p>A prolonged drought has had a serious negative impact on the survival of the herd. Decrease your population by the percentage equal to five times your roll.</p>	<p style="text-align: center;">Breeding Card</p> <p>An increase in European Starlings and Brown Headed Cow Birds causes competition in nesting sites. Decrease your population by the number equal to two times your roll.</p>
<p style="text-align: center;">Habitat Improvement Card</p> <p>A group of naturalists plant some cattails, improving nesting ground. Increase your flock by the number equal to your roll.</p>	<p style="text-align: center;">Poaching Card</p> <p>Poaching- illegal killing of animals- has reduced the size of the flock. Decrease your population by the number equal to two times your roll.</p>
<p style="text-align: center;">Habitat Destruction Card</p> <p>A large area of wetland has been destroyed. Decrease your population by the number equal to two times your roll.</p>	<p style="text-align: center;">Habitat Loss Card</p> <p>Urban development has resulted in a loss of critical habitat for the flock. Decrease your population by the number equal to three times your roll.</p>
<p style="text-align: center;">Reproduction Card- Average Year</p> <p>This has been an average reproduction year. If your current population is over 50 individuals, increase your flock by the percentage equal to three times your roll. If your population is between 50 and 10, increase your population by the number equal to your roll. If your population is under 10, do not reproduce.</p>	<p style="text-align: center;">Reproduction Card- Average Year</p> <p>This has been an average reproduction year. If your current population is over 50 individuals, increase your flock by the percentage equal to tree times your roll. If your population is between 50 and 10, increase your population by the number equal to your roll. If your population is under 10, do not reproduce.</p>

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<p style="text-align: center;">Habitat Degradation Card</p> <p>A large range fire has occurred, damaging critical habitat. Decrease your population by the number equal to three times your roll.</p>	<p style="text-align: center;">Habitat Destruction Card</p> <p>A dam has been built, flooding wetland areas and destroying critical habitat. Decrease your population by the number equal to five times your roll.</p>
<p style="text-align: center;">Habitat Degradation Card</p> <p>A riparian area has been severely damaged by cattle. Decrease your population by the number equal to two times your roll.</p>	<p style="text-align: center;">Habitat Loss Card</p> <p>Increased summer recreational use (boating, fishing, etc.) has resulted in a loss of critical habitat for the flock. Decrease your population by the number equal to your roll.</p>
<p style="text-align: center;">Habitat Loss Card</p> <p>The building of more summer homes has resulted in a loss of critical habitat for the flock. Decrease your population by the number equal to three times your roll.</p>	<p style="text-align: center;">Habitat Loss Card</p> <p>An increase in road building has occurred, resulting in the loss of critical habitat for the flock. Decrease your population by the number equal to three times your roll.</p>
<p style="text-align: center;">Habitat Loss Card</p> <p>Over population of bison has resulted in a loss of critical habitat for the flock. Decrease your population by the number equal to five times your roll.</p>	<p style="text-align: center;">Disease Card</p> <p>An outbreak of the West Nile Virus has struck the flock. Decrease your population by the percentage equal to your roll.</p>

Inquiry-based Lesson:

Water Levels and the American White Pelican

Abstract:

Students will view data received on the American White Pelican counts from the Great Salt Lake. They will hypothesize how water levels will affect the pelican. Students will graph the water level of the Great Salt Lake and the corresponding count of pelicans, after which, they will analyze their data and compare with their hypothesis.

Grade Level: 10th

Utah State Core Curriculum Standards:

Standard 8: Students will investigate the interdependence of organisms with each other and with their environment.

Objective 1: Predict how changes in one part of an ecosystem affect the system.

- Describe symbiotic relationships within an ecosystem.
- Identify the factors that limit a populations growth (e.g., temperature, soil type, competition, increased predation, waste accumulation)
- Hypothesize the interrelationship of one variable in an ecosystem to others (e.g., plant and soil characteristics, temperature). Analyze and report results.
- Design and conduct an experiment to measure the interrelationship of ecosystem components. Analyze, graph, and report results.

AAAS 2061 Benchmark:

The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions, and a great diversity of species increases the chance that at least some living things will survive in the face of large changes in the environment.

NRC National Science Education Standards:

The interdependence of organisms:

- Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.
- Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.

Lab Time: 2 days

Intended Learning Outcomes:

Students will:

- Analyze the data received on the American White Pelican counts from the Great Salt Lake.

- Hypothesize how water levels will affect the pelican.
- Graph the water level of the Great Salt Lake and the corresponding count of pelicans.
- Analyze data and compare with hypothesis.

Background:

According to Paul, Manning and Dewey (1999-2002), the American White Pelican is one of several birds who migrate through the wetlands of Great Salt Lake. Ehrlich, Dobkins and Wheye (1988) tell us that its nests are rimmed with dirt or rubbish, and are made of stems, wood bits, and fine material. They brood once a year, with the second chick usually dying from starvation or harassment from the other chicks. One can find this pelican on islands in inland rivers and bays free from mammalian predation. Their diet consists of mostly fish. Their young are fed through regurgitation. The pelican swims at the surface and dips its head into the water to scoop up the fish. It averages about three pounds of food a day.

In Utah, the Great Salt Lake ecosystem contains the only known historic breeding colonies of American White Pelicans. The largest population of nests can be found on Gunnison Island. They are known to arrive during the last week in March. Here they stay for the next three months. Since one-quarter of the pelican's life is spent near Great Salt Lake, the condition of the lake may impact the bird's population. What happens as water levels rise and fall?

Materials Needed:

- American White Pelican estimates (1963-2000) on Gunnison Island, Utah
- The USGS graph of the Great Salt Lake water elevations
- Paper
- Pencils
- Binoculars
- Text of North American birds
- Computers

Instructional Activities:

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The Lab:

Water Levels and the American White Pelican

Day 1:

The class will take a field trip to the Great Salt Lake. There they will observe and identify whatever birds they can see through their binoculars. Students and teacher will interact with questions, answers and thoughts.

Day 2:

This day will be an in-class lab. Students will hypothesize on what they think will happen to the pelicans as the water levels increase and decrease in elevation. All work will be recorded in a lab journal. Students will then be given the table of the American White Pelican estimates on Gunnison Island and the USGS graph of the Great Salt Lake water elevations. They will compare the levels of the lake to the count of the birds by charting the numbers on a graph drawn by them. They will conclude the lab with an analysis of their findings and their original hypothesis.

Assessment:

The students will be assessed by their completion and content of a lab journal which will include:

- Observations made at the Great Salt Lake
- Notes on the Great Salt Lake and the American White Pelican
- Hypothesis on what will happen to the count of the pelicans as the level of the lake changes
- Graph of the water levels and the bird counts
- Analysis of data and conclusions, and an explanation of how their hypothesis may have changed.

Resources:

Ehrlich, P.R., Dobkin, D.S. & Wheye, D. (1988). *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*. New York: Simon & Schuster Inc.

<http://www.ugs.state.ut.us/utahgeo/gsl/index.htm>

Paul, D.S., Manning, A.E. & Dewey, L.H. (1999-2000). Gunnison Island American White Pelican Report. Utah Department of Natural Resources, Division of Wildlife Resources & the Great Salt Lake Ecosystem Project.