Grass, Rabbits, and Wolves – Oh My! Understanding Food Chains and Ecosystem Interactions

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Engineering Challenge:

Use a model to understand and predict species function and interactions, and energy transfer through an ecosystem.

Activity List for Lesson

Activity 1 (Engage):

- Predator-Prey Tag
  - Assign about 3/4 of your class to be rabbits and the remaining to be wolves.
  - Spread construction paper squares around your room, as grass for the rabbits to eat.
  - Tell rabbits to go out and eat grass, collecting green squares (energy) and placing them in their plastic cup.
  - About a minute later, tell wolves to go out and eat rabbits by tagging them. Rabbits should pour their construction squares (energy) into the cup of the wolf that caught them.
  - Materials
    - ~100 1”x1” squares light green construction paper (can be other size if easier)
    - ~30 clear plastic cups (enough for each student)

Activity 2 (Engage):

- Wolf and Rabbit Masks or Other Crafts
  - Use the following materials to make masks of predators and prey
    - Paper plates
    - Markers
    - Construction paper (optional)
    - Pipe Cleaners (optional)
    - Glue (optional)
  - Links to examples are in Additional Resources

Activity 3 (Explore and onward):

- Use computer model of grass, rabbits, and wolves from Shodor
  - http://www.shodor.org/interactivate/activities/RabbitsAndWolves/
- Use or modify the supplementary Model Handout file.

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Key Words/ Concepts:

food chain: series of events in which one organism eats another for energy

food web: the pattern of combined food chains in an ecosystem

ecosystem: the network of species in a geographic area, and all of their interactions with each other and non-living components of their environment (soil, climate, sun, etc.)

producer: an organism that makes its own food from light or chemical energy, also known as an autotroph

consumer: an organism that eats other organisms as food to obtain energy, also known as a heterotroph

predator: an animal that kills and eats other animals to survive

prey: an animal that is hunted or killed by another animal for food

population: the number of a certain species that lives in a certain geographic area

carrying capacity: the maximum population of a certain species an environment can support

trophic level: a hierarchy in a food web where all organisms in a single level are the same number of steps removed from primary producers

resilience: in ecology, the ability of a system to maintain its integrity or return to an initial state when disturbed

stability: in ecology, the ability of a system to avoid large or numerous disturbances

sustainability: in ecology, the capacity of an ecosystem to endure over time, to meet the needs of the present generation without hindering future generations

5E Lesson Plan:

Engage:

- Complete activities 1 and/or 2. Debrief the activity with questions.
    - What do students know about rabbits, wolves, and the relationships between them? What do they look like? What do they eat?
    - For activity 1, ask students to explain what happened when wolves came in and what pouring the cup of grass pieces from the rabbit to the wolf means. Is it still grass when the wolf is eating it?
- Introduce the concepts of predators, prey, food chains, and food webs in an ecosystem.

Explore, Explain, and Elaborate with a Single Activity

- Use Activity 3, the model, to understand how energy flows through an ecosystem. Refer to the Predator-Prey presentation and modeling handout for content and sample activity workflow.
- You can begin with wolves on or off in the model depending on your grade level.

- Introduce several more key words to students through questioning and discussion. What patterns do students notice? What causes a species population to increase or decrease?
- Build up to the challenge of creating a resilient ecosystem where species populations may change but no species goes extinct. This may require resizing the ecosystem grid, increasing and decreasing populations, and lots of trial and error!
- Adjust parameters in the model besides population, like metabolism and reproduction rate, to elaborate on understanding of species interactions and ecosystem dynamics.
- Predict what happens in the ecosystem when a disturbance like drought occurs by adjusting grass regrowth rate.

Additional Elaborations with Other Activities

- *How Stable is your Food Web?* By California Academy of Sciences
  - Use your skills in ecosystem modeling in a new setting: a marine food web. This activity includes both natural and man-made disturbances.
  - http://www.calacademy.org/educators/lesson-plans/how-stable-is-your-food-web

- *Sustainable Grazing* by California Academy of Sciences
  - Apply your knowledge on carrying capacity, sustainable populations, and food chains to explore land use and food consumption for humans.
  - http://www.calacademy.org/educators/lesson-plans/sustainable-grazing

Additional Resources:

- Wolf Hunting from *Life of Mammals* by BBC Earth
  - https://www.youtube.com/watch?v=_UH-6r5jrGI

- *How Wolves Change Rivers* by Sustainable Human
  - https://www.youtube.com/watch?v=ysa5OBhXz-Q

- *Did wolves help restore trees in Yellowstone?* by Kate Tobin, PBS
  - http://www.pbs.org/newshour/rundown/wolves-greenthumbs-yellowstone/

- Ripple, W.J., Beschta, R.L., 2012. Trophic cascades in Yellowstone: The first 15 years after wolf reintroduction. *Biological Conservation, 145*, 205–213.

- Crafts for Wolves and Rabbits
  - Cotton Ball Bunnies: http://www.busybeekidscrafts.com/Mini-Bunnies.html
  - Bunny Mask: https://www.youtube.com/watch?v=7pTxYKNMmTM
  - Paper Plate Wolf 1: http://www.dltk-kids.com/animals/m-plate-wolf.htm
  - Paper Plate Wolf 2: https://www.pinterest.com/pin/566679565589259009/

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Supports National Next Generation Science Standards:

Disciplinary Core Ideas

- LS1.C: Organization for Matter and Energy Flow in Organisms
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- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS4.D: Biodiversity and Humans
- ESS2.E: Biogeology
- ETS1.B: Developing Possible Solutions
- PS3.D: Energy in Chemical Processes and Everyday Life

Science & Engineering Practices:

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions

Crosscutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter
- Stability and Change