Webs, Sorts & Survival

A workshop in Life Sciences

1. Web of Life and Owl Pellets

2. Classification with Harry Potter & Bertie Bott’s Any Flavored Beans

3. Antibiotic Resistance:

A Presentation at the Southern Nevada Regional Professional Development Program. Las Vegas, Nevada March 11-12, 2005

Presented by

David T. Crowther
Associate Professor Sci. Ed.
College of Education / 280
University of Nevada, Reno
Reno, NV 89557
(775) 784-4961 ex 2004 Work
(775) 327-5345 Fax
E-mail: crowther@unr.edu

John R. Cannon
Associate Professor Sci. Ed.
College of Education / 280
University of Nevada, Reno
Reno, NV 89557
(775) 784-4967 ex2001 Work
E-mail: jcannon@unr.edu

Brooke Hodges
Doctoral Student
College of Education M/S 280
University of Nevada, Reno
Reno, NV. 89557
(775) 784-4961 ex2133 Work
E-mail: hodgesb@unr.edu
The recently released National Science Education Standards (NRC, 1996) propose that science content should include both process skills of science as well as the traditional areas of content science. Specifically, the National Science Education Standards list eight areas to consider when developing science curriculum: 1. Unifying concepts and processes in science, 2. Science as inquiry, 3. Physical science, 4. Life Science, 5. Earth and space science, 6. Science and Technology, 7. Science in personal and social perspectives, 8. History and nature of science. (NRC 1996, p.6).

The National Research Council (NRC) and the National Science Foundation (NSF) have explained that only 4 major publishers of kit science do indeed conform and adhere to the National Science Education Standards as they are now written. However, with the incredibly huge task of developing quality hands-on lessons in all of the different areas of science, along with the task of incorporating process skills and the nature of science into an integrated curriculum, many of the current versions of elementary "kit" science still need supplemental engaging activities for elementary school children. Additionally, elementary school teachers are required to be specialists in all academic fields. Many teachers follow the "kit" curriculum very well, but still find their content knowledge and "extension" or "elaboration" activities lacking. It is for this purpose that programs like GEMS, AIMS, Project Wild, etc. are kept alive. Elementary teachers don't have the time, and in many cases are not prepared well enough in science content, to develop additional activities from scratch which relate to developing thematic units and integration of subject matter into a holistic curriculum.

In a study done by In 1978 Weiss found that only 28% of elementary teachers felt qualified to teach science and that on the average 90 minutes per day were spent on reading instruction versus an average of 17 minutes on science instruction. These results have been corroborated by Stefanich and Kelsey (1989) who found that less time is spent on science instruction in elementary schools than any other subject. Of the time spent on science instruction, an earlier study found that 90% of the teachers relied on textbooks for about 90% of their science instruction (Stake & Easley, 1978). Yager and Lutz (1994) found similar results and further explained that science instruction was comprised of students listening to lectures, reading from textbooks, and memorizing, repeating and confirming scientific facts. More importantly, a study done by Roychoudhury, Tippins, & Scantlebury (1995) found that science instruction was generally not connected to students' prior knowledge nor was it relevant to students' everyday lives.

It is for this reason that we are proposing a life science source book for CESI to accompany the other source books. Many teachers are comfortable with life science, as it pertains to nature and the world around us (e.g. rain forests, recycling, plants, animals, and
oceans). However, single comprehensive sources of current engaging hands-on activities are not as readily available as in other physical sciences.

The purpose of this article and activity is to set a format for which lessons can be developed and then submitted for consideration in the CESI Life Science Sourcebook.

This activity focuses on food chains, food webs and the food pyramid. As is true with most activities, the following activity is not original. I have found similar activities in Project Wild, Global Science, and in Science Is. However, it is how these activities have been changed to fit the National Science Education Standards (NRC, 1996) and the 5E model of the Learning Cycle as described in the Biological Sciences Curriculum Study (BSCS) by Bybee and Landes (1990) as well as how they can be adapted to fit into an existing curriculum, that makes them original.

**The Web of Life Activity**

**Purpose and Objective:**

The purpose of this lesson is to help children understand that there are many living creatures that make up the delicate balance of an ecosystem. Children will also learn the different levels of producers and consumers that exist in an ecosystem and identify them both by level and by carnivore, herbivore, omnivore.

**National Science Education Standards Connection:**

- K-4 Science as Inquiry, Content Standard A, Abilities necessary to do scientific inquiry.
- 5–8 Science as Inquiry, Content Standard A, Abilities necessary to do scientific inquiry.
- 5-8 Life Science, Content Standard C, Populations and ecosystems.

**Materials List:**

- A huge ball of yarn (The extra large Afghan ball of yarn at Wal Mart works great)
- 3 x 5 cards (100 pack)
- a copy of "There once was a Daisy" rap song by the National Wildlife Federation (1989)
- several different nature magazines (National Geographic World, Ranger Rick, National Geographic, etc.)
- Scissors
- glue
- paper
- An imagination.

**Preparation:**

Before class prepare the huge ball of yarn so that it can be thrown easily. Next figure out how many people will be involved in the activity and prepare enough 3x5 cards so that there is a proportionate representation of grass, grasshoppers, field mice, snakes, one red tailed hawk, and a vulture. Note that in the trophic pyramid there are far more producers (grass) than other consumers. Therefore for a class of 28 students I would make about 12 grass cards, 8 grasshopper cards, 4 mice cards, 2 snake cards, 1 red tailed hawk, and 1 vulture card.

Run off a copy of the *There once was a Daisy* (NWF, 1989) rap song for each child.
Engagement:
Put the students into groups of four. Explain that they are going to sing a song that deals with food chains. Hand out a copy of There Once was a Daisy (NWF, 1989) song to each person. Have each group of students take a verse to sing. The entire class will sing the chorus section together. Model what an appropriate rap beat is by singing the first line, then sing the song as a class.

After the song go to the Chalk board and have the students tell you what the food chain was in the song. Draw the simple food chain on the board with arrows connecting who eats who.

Fox
↓
Snake
↓
Wren
↓
Bugs
↓
Daisy

Exploration:
Hand each child one of the pre-made 3X5 cards with an animal assignment on it. (See preparation section). Have all the children with grass on their cards stand and present themselves. Repeat this process with each of the categories of Grasshoppers, Field Mice, Snakes, and Red Tailed Hawks. Do not introduce the Vulture at this time.

Beginning with a student who is designated as a grass, have them hold the end of the yarn and toss it to someone who would eat grass (the Grasshopper). The person who is designated as a Grasshopper then holds on to the yarn and throws it to the person who would eat the Grasshopper (the Field Mouse). The Field Mouse then holds onto the string and then tosses the ball to the Snake. The Snake then tosses the ball to the Red Tailed Hawk. Since the Red Tailed Hawk is the Tertiary or Top consumer in the chain the ball then gets thrown back to a person who is a grass and the process starts all over again. You will soon see how a single chain becomes a complex Web of Life!!

Once everyone has a chance to hold a piece of the yarn, play some nature music (any kind will do) and have the students move to the beat so they can get a feel of the interdependency of the web.

When the music is off introduce the following scenario:
I have just been informed that a developer has just received permission to build a new housing track in this wonderful ecosystem that we have created. The developer has hired a bulldozer to clear the grass and plants from the field. If you were grass or a plant you are now dead and must let go of the yarn. Allow the other children to feel the string go slack. Next, if you were the consumer of grass your food source is now gone and you are dead. The Grasshoppers let go of the string. Do the same for the Field Mice and the Snakes. The Red Tailed Hawk no longer has food here and is able to travel to a new ecosystem to find a food source. Now all that is left is a bunch of dead and dying parts to a once healthy ecosystem. There is only one person who benefits from this travesty and that is the Vulture. The Vulture
flies in and cleans up the mess.

**Explanation: (Including Teacher Background Knowledge)**

As you debrief the previous two activities, put each step of the food chain on the board, discuss with the class what part each organism played in the food chain. (E.g., The daisy / grass were the producers - it is called a producer because it makes its own food through a process called photosynthesis (Be sure to add the sun to the board as the main source of energy for producers). The rest of the organisms in the food web are consumers - they are consumers because they can’t make their own food, but must rely on eating other things to survive. The bug and Grasshopper are a special type of consumer (1st. Order or primary consumers) that only eat plants, we call them herbivores. The Wren and Field Mice are also consumers (2nd level), but because they eat both bugs (meat) and seeds (plants) they are called omnivores. The Snake, Red Tailed Hawk, and Fox are also consumers (Tertiary or 3rd level), but once again they are special types of consumers that primarily eat meat, they are called carnivores and are at the top of the food chain!! An animal that has no predators in a food chain is the top consumer. Additionally, the role of the decomposers must be discussed as they complete the life cycle in the food web by breaking down the organisms into the basic elements that are required of plants and animals to grow (e.g., fertilizer - See carbon cycle, nitrogen cycle etc.)

Draw a pyramid (like below) as the discussion proceeds.

```
    Fox
   /    |
  Consumer/Carnivore
   |
 Snakes
   /    |
Consumer/Carnivores
   |
Wrens
   /    |
Consumers/Omnivores
   |
Bugs = Consumers/Herbivores
   /    |
Plants = Producers - they make their own food
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Microbes & Bacteria = Decomposers

As you proceed make a list of terms on the trophic pyramid that you have identified through this activity. The list should include: producers, consumers, herbivores, omnivores, carnivores, 1st order consumers or primary consumers, 2nd order consumers, tertiary consumers, top consumers, ecosystem, decomposers, and energy.

**Elaboration:**

This part of the activity allows for the children to construct their own food webs from pictures cut from nature magazines. Explain to the students that they must create several food chains which represent each level of the trophic pyramid by cutting pictures out of magazines and gluing them onto a large sheet of paper. Each of the levels should be attached by gluing a piece of yarn that goes from the consumer to the consumer!! Then use different colors of yarn to show the interrelationship between the chains. In other words, a chain will interact with another chain and become a web.

Once the children have completed the construction of their webs they can then share them with the rest of the class.
Evaluation:

The evaluation to this project is fairly simple. I would use the product oriented approach that says that if they completed the Elaboration correctly and were able to communicate the different trophic levels to the rest of the class, then they would get full credit and have a product to put in their science portfolio. Also, a journal entry about their final product would be a nice writing connection to this science activity. However, evaluation is subjective and may be best left to the individual teacher to fit her needs.

References


There Once Was a Daisy

There once was a daisy that grew on a plain,
Where the sun helped it grow, and so did the rain—
Links in a food chain.

There once was a bug who nibbled on flowers,
Nibbled on flowers for hours and hours!
The bug ate the daisy that grew on the plain,
Where the sun helped it grow, and so did the rain—
Links in a food chain.

There once was a wren who gobbled up bugs,
And creepies and crawlies and slimies and slugs.
The wren ate the bug, who nibbled on flowers,
Nibbled on flowers for hours and hours!
The bug ate the daisy that grew on the plain,
Where the sun helped it grow, and so did the rain—
Links in a food chain.

There once was a snake who often grabbed birds,
And swallowed them whole, or so I have heard.
The snake ate the wren, who gobbled up bugs,
And creepies and crawlies and slimies and slugs.
The wren ate the bug, who nibbled on flowers,
Nibbled on flowers for hours and hours!
The bug ate the daisy that grew on the plain,
Where the sun helped it grow, and so did the rain—
Links in a food chain.

There once was a fox, and I'll make a bet:
He'd eat anything he could possibly get.
The fox ate the snake, who often grabbed birds,
And swallowed them whole, or so I have heard.
The snake ate the wren, who gobbled up bugs,
And creepies and crawlies and slimies and slugs.
The wren ate the bug, who nibbled on flowers,
Nibbled on flowers for hours and hours!
The bug ate the daisy that grew on the plain,
Where the sun helped it grow, and so did the rain—
Links in a food chain.

The fox, he grew older and died one spring day,
But he made the soil rich when he rotted away.
A new daisy grew where he died on the plain.
The sun helped it grow, and so did the rain—
Links in a food chain.
Popcorn Pyramid

Kay Berglund-Newhouse

Why are there more plants than animals?
Why are there so few carnivores, such as hawks and cougars?
How is energy transferred through the food chain?

Food chains, a basic concept in any ecology unit, help students to explore the idea of the roles of different organisms as food producers and consumers in an ecosystem. After gaining a basic understanding of these concepts by studying food chains, students can develop these ideas further by participating in this “Popcorn Pyramid.” Through this activity, students construct for themselves an understanding of energy transfer through the chain, and why there must be more producers than primary consumers, fewer secondary consumers, and even fewer tertiary consumers in any sustainable ecosystem.

This lesson is consistent with the National Science Education Standards K-4 Content Standard C: The Characteristics of Organisms, and Organisms and their Environments, and 5-8 Content Standard C: Populations and Ecosystems. This activity was developed with second grade students, but is easily adaptable for a wide variety of ages.

Every food chain begins with the sun, the source of energy for all living things on Earth. Food producers, plants such as clover, make their food directly from the sun’s energy by photosynthesis. Primary consumers, such as caterpillars, get their energy by eating the plants. Secondary consumers, robins in this game, eat primary consumers for energy. Tertiary consumers, such as snakes and hawks, get their energy from the secondary consumers. The transfer of energy from level to level is not efficient, because each animal uses much of the energy in the food it eats for its own life processes. A caterpillar eats a lot of plants to get its energy, but one caterpillar will not sustain a robin.

Materials:
A big bowl of plain popcorn, labeled “Sun”
One small cup for each child
16 tags labeled “clover”
8 tags labeled “caterpillar”
4 tags labeled “robin”
2 tags labeled “snake”
1 tag labeled “hawk”

(One tag for each child. Adjust numbers as necessary for your group, keeping the pyramid shape. The top level, “hawk,” may be omitted for a small group.)

Exploration:
First, review the concept of food chains, using the names of the organisms in this game as an example of a food chain. In this game, popcorn represents energy from the sun. The big bowl, the sun, is the source of all the energy in this game. Only plants can get their energy straight from the sun.

Select sixteen children to be “clover,” pass out their tags, and have them come
sit in the front row, facing the sun. These students should each receive a cupful of popcorn from the sun.

Select eight children to be "caterpillars." Ask them to sit in a row behind the clover. Caterpillars cannot get their energy straight from the sun, but they can get energy from clover. Each clover should pass half their energy (half the popcorn in their cups) to a caterpillar. The clover can then eat the half-cup of popcorn they have left.

Select four children to be "robins." The birds in our game get their energy from eating caterpillars, so the caterpillars should pass half the energy in each of their cups back to the birds. After passing half, they may consume the other half of their energy. Set up the "snake" and "hawk" rows in the same way. The two snakes receive half of the popcorn from the birds and the birds give half of their popcorn to the hawk. Because hawks are the top of this food chain, they can eat all the energy (popcorn) they get, and do not have to pass any on.

Once that first round of popcorn has been passed back and consumed, continue filling up the clover’s cups and letting them pass back half their energy, and eat the other half. (To keep the game reliable, remind them to give away half their energy before they eat the other half.) Continue until all the popcorn is gone.

Use reflective discussion to explore these ideas with students and probe their understanding of this activity. Why were the numbers of clover, robins, etc. set up in a pyramid shape? It’s likely that many students would like to be a hawk or snake next time-- but what would happen if we had 20 hawks? Would they get enough energy? How does this game relate to the numbers of producers, primary consumers, etc. in the natural world?

It is also important to discuss how this model is different from real life. For example, the bowl of popcorn may run out, but the sun will not run out of energy for at least four billion more years; caterpillars must be eaten to give their energy to the robins, whereas in our game they could just keep passing on energy; and so on.

Using different food chains, such as one local to your area, or one that occurs in the ocean can extend this activity. Students may also be able to identify a chain that does not begin with the sun, if they have heard of chemosynthesis near ocean vents.

Pollution Extension

The “Popcorn Pyramid” can also be used to explore the impact of pollutants such as: DDT (dichlorodiphenyltrichloroethane) on a food chain. Add one foreign object, such as a bean, to each clover’s cup. (Be sure it is either edible, or large enough to be easily avoided.) DDT is a pesticide that started to cause alarm in the US in the 1960’s. It is stored in body tissue, so as the predator eats the prey with the bad tissue, the poison builds up in the predator. Everyone should pass the bean on to the consumer above them. Watch this pollutant pass up the food chain. The effect on hawks is most dramatic, as they receive 16 beans eventually.
DDT's effects showed up primarily in predators like hawks and eagles, because of large concentrations of DDT they ended up consuming; this poison caused eggshells to become so thin they broke when the parent birds tried to sit on them to warm them. The use of DDT has been banned in the United States since 1972, but many other pollutants still in use show similar concentrations in fatty tissues.

With older students, discuss the relevance of this pyramid to people's eating choices. We are omnivores with lots of nutritional knowledge, who can eat wherever we choose to on this pyramid. Why do some people who want to minimize their environmental impact and land use choose to "eat lower on the food chain?" What kind of diet do these people eat?

Tips for the Teacher:

To do this game as a calmer demonstration, use day-old, plain unsalted popcorn which students are less likely to want to eat. If you decide to let them eat the popcorn, be sure to explain directions carefully before starting, because things can get loud and fun while the game is in progress. It usually works best for the teacher be the "Sun" and fill the clover's cups, because students will spill much of the popcorn in their eagerness to fill their small cups. Try to tailor the food chain to producers and consumers found in your area, or try a pond food chain, or one involving ocean plants and animals.

References:
For more information on the ecology of food webs (and a nifty environmental site!) try:

ThinkQuest ® Organization at: http://library.thinkquest.org/11353/

The New York Coalition for Alternatives to Pesticides has much more information on the impact of pesticides on the environment. Visit their web site at http://www.crisny.org/not-for-profit/nycap/