UNIT: H15 TITLE: Tallgrass Prairie Communities

TYPE: Lesson Plan

This activity is based on the US Forest Service's "FireWorks Northern Rocky Mountains & Northern Cascades" Curriculum

Overview

Burning the tallgrass prairie has many impacts on the community ecology. Perhaps one of the most important roles is the suppression of the Eastern Red Cedar, a species which can have dramatic impact on the flow of energy and nutrients among the producers and consumers in the tallgrass prairie community.

Subjects: Life Sciences

Duration: 2-3 Class Periods

Group Size: Whole Group or Small Groups

Setting: Indoor with potential field experience

Vocabulary: Biomass, Trophic Levels

Lesson Goals:

Students will be able to quantitatively and qualitatively describe the impact of red cedar suppression on the tallgrass prairie community and energy transfer between trophic levels.

Objectives:

1. List at least three examples of tallgrass prairie species for producer, primary consumers, secondary consumers, tertiary consumers and decomposers
2. Using the at least one example of species from each of the trophic levels, construct a food chain to demonstrate the flow of energy and nutrients.
3. Given tallgrass biomass (lb/acre), estimate the biomass at each trophic level on a given example (energy pyramid).
4. Given the red cedar calculator, recalculate the biomass at each trophic level for a given example (energy pyramid).

Anchoring Phenomena:

Compare a prairie burning that has large eastern red cedar: https://youtu.be/gFPKQlEzB2g

To prairie that does not: https://youtu.be/aabIQd0jLis

Academic Standards:

Standards		High School (9-12)
NGSS – Disciplinary Core Ideas	**HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.**	
	Cross Cutting Concepts	Energy and Matter
	Disciplinary Core Ideas	LS2.A, LS2.B, LS2.C
	Science and Engineering Practices	Analyzing and interpreting data, Obtaining, evaluating, and communicating information
NGSS – Performance Expectations	**Speaking and Listening**	SL.9-10.4, SL.11-12.4
	Reading	
	Writing	

Teacher Background:

The following articles provide good background on the Easter Red Cedar, which is an invasive species, energy in biomass and strategies of controlling for Eastern Red Cedar with fire.

Eastern Red Cedar Expansion, Effects and Control

Biomass vs. Energy Pyramids:

Ecological Consequences of Shifting the Timing of Burning Tallgrass Prairie

Materials and Preparation:

Laptops

Student Materials

Procedure:

1. **Engage:**
   Compare a prairie burning that has large eastern red cedar: https://youtu.be/gFPKQlEzB2g to prairie that does not: https://youtu.be/aabIQd0jLis, take notes as you watch the videos.

   What are your observations? What is similar, what is different? How might you account for the similarities or differences? Recalling the fire triangle activities, what inferences can you make related to the fuel levels? How do you think each scenario might impact species within the tallgrass prairie community? How might it impact humans?

2. **Explore:**

Direct student groups to the student handout entitled *Prairie Community Ecology*.

Now let's explore some of the species and their roles within the tallgrass prairie ecosystem. Scientists often use the transfer of energy to describe these relationships and identify species as producers, consumers (primary, secondary, tertiary) and decomposers. This environment in which these energy transfers take place both influences and is influenced by these interactions. The following is the information and direction provided to students on the Prairie Community Ecology student page:

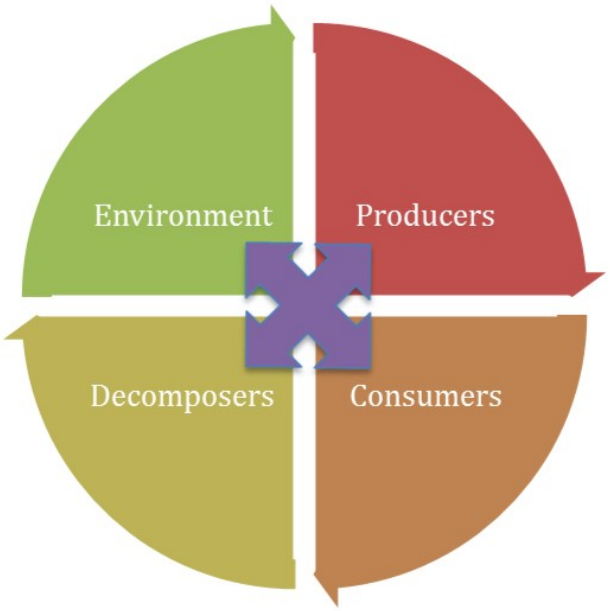
First, conduct a bit of research and identify at least 5 producers, 4 primary consumers, 3 secondary consumers, 2 tertiary consumers and 2 decomposers.

Examples for student research

Tallgrass Prairie Community Ecology	
Producers	Examples include all prairie plants including grasses and forbs or wildflowers

Consumers-Primary	Primary consumers get their energy from producers like bison, cattle, deer, rabbits, mice, butterflies, bees, grasshoppers, etc.
Consumers-Secondary	Secondary consumers get their energy from primary consumers like meadowlarks, red-tailed hawks, owls, racoons
Consumers-Tertiary	Tertiary consumers get their energy from secondary consumers like coyotes, bobcats, hawks and owls. Note that as organisms move up the consumer chain they can occupy more than one level.
Decomposers	Worms, mushrooms, dung beetles, carrion

Next, using the diagram below, describe the relationship between specific examples of producers, consumers, decomposers. You may write, draw/create a visualization or combine the two to describe the relationships.



3. **<u>Explain:</u>**

Teacher Background: Rule of 10%--The energy available for transfer to the next level decreases as you ascend up levels of consumers. Plants as producers have all their energy available for primary consumers, primary consumers have 10% of their energy available, secondary consumers have 1% and tertiary (at the top of the food chain(have 1/10 of 1%.

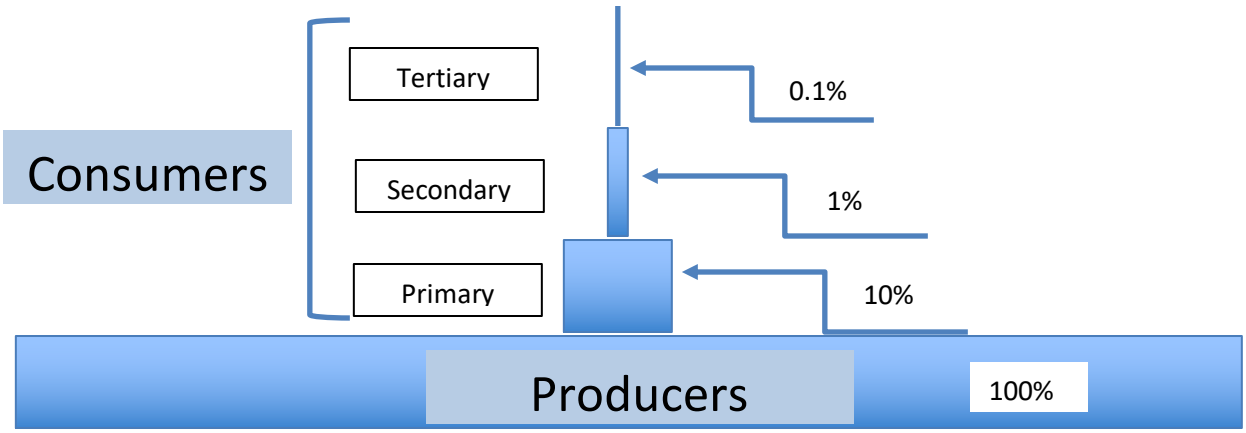
(From https://socratic.org/questions/what-is-the-10-rule-used-in-an-energy-pyramid) When energy moves between trophic levels , 10% of the energy is made available for the next level. (The exception is the transition from the sun to producers, in which case only 1% of the energy is retained.)

Have student groups present their research and descriptions/visualizations of the interrelationships between environment, producers, consumers and decomposers. Following presentations, discuss with students:

1. What observations did you have as your team completed this work? As your classmates presented?
2. What environmental factors might impact producers? Consumers? Decomposers?
3. How would you describe the relationship between trophic levels (e.g. producers, consumers, decomposers) and energy? What might generalizations you could make about energy transfer in an ecosystem?

Explain to students that when a consumer eats a plant, it gains energy from the plant. That energy is used for growth, reproduction, and other biological processes. Some of that energy is also lost through heat loss. Thus, when a predator eats that consumer, all of the energy the consumer gained from the plant is not available to the predator, so energy transfer is not complete from one level to the next.

As we move up an energy pyramid or a trophic level, we can see that less and less of the original energy from the sun is available. Roughly ten percent of the previous trophic level's energy is available to the level immediately higher up. This is called the 10% Rule. (Share this slide found in the slide deck).



Keeping in mind that multiple species occupy a given space, what do you think might happen if an invasive species like the Eastern Red Cedar began overtaking native species in an ecosystem?

4. Elaborate:

(Using Student Page, *Quantifying the Impact of Eastern Red Cedar*) Thinking back to the beginning of the lesson and your observations, the prairie with established Eastern Red Cedar produced larger flames and the conversion of energy as fuel in the fire was larger. The Eastern Red Cedars also interfere with the growth of grasses and forbs, which can have ripple impacts throughout the ecosystem. This is also an important factor for cattle ranchers, as the invasion of Eastern Red Cedar impacts the biomass that can be consumed by cattle. Understanding and quantifying the impact of Eastern Red Cedar is important to the health of the prairie and to ranchers. The Using the *Red Cedar Forage Calculator* (found in Teacher Resources on this page) explore the impact Eastern Red Cedars on available producer biomass by using different scenarios. Give yourself a hypothetical 1000 acres. How much biomass would be available on a well-managed section of prairie which is regularly burned? What about in moderately well managed section of prairie? What about in an unmanaged section of prairie? For each scenario, identify the benefits and tradeoffs of each management strategy.

Evaluate:

Evaluate on group.

Evaluation Rubric:

Tallgrass Prairie Community Ecology Rubric

Team Members:

0-5 Points	6-10 Points	11-15 Points	Points Awarded
Team correctly identified less than 50% of at least 5 producers, 4 primary consumers, 3 secondary consumers, 2 tertiary consumers and 2 decomposers	Team correctly identified 70% of at least 5 producers, 4 primary consumers, 3 secondary consumers, 2 tertiary consumers and 2 decomposers	Team correctly identified at least 5 producers, 4 primary consumers, 3 secondary consumers, 2 tertiary consumers and 2 decomposers	
Group presentation involves only one or two team members and team does not accurately describe most interactions and interrelationships	Group presentation involves most team members and team accurately describes most interactions and interrelationships between environment,	Group presentation involves all team members and team accurately and thoroughly describes the interactions and interrelationships	

between environment, producers and consumers.	producers and consumers.	between environment, producers and consumers.	
		TOTAL OUT OF 30 POINTS	

References/Resources:

Eastern Red Cedar Expansion Effects and Control