

Systems Thinking and Ecosystem in Food Fight

Lesson Plan

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Lesson #1: Introduction of the African Savanna Ecosystem

Learning outcomes:

1. Students will learn about various organisms of the African Savanna.
2. Students will describe various food chain relationships within the ecosystem.
3. Students will use science vocabularies to describe those relationships.

Performance outcomes:

1. Teacher will introduce students to the characteristics of the African Savanna.
2. Teacher will introduce diverse organisms in the African Savanna.
3. Teacher will introduce the complex food web of the African Savanna.

Lesson/Activities

The African Savanna:

Characteristics:

- The African savanna ecosystem is a tropical grassland with warm temperatures year-round and with its highest seasonal rainfall in the summer. The savanna is characterized by grasses and small or dispersed trees that do not form a closed canopy, allowing sunlight to reach the ground. The African savanna contains a diverse community of organisms that interact to form a complex food web.

Food web:

- Healthy, well-balanced ecosystems are made up of multiple, interacting food chains, called food webs. Carnivores (lions, hyenas, leopards) feed on herbivores (impalas, warthogs, cattle) that consume producers (grasses, plant matter). Scavengers (hyenas, vultures) and decomposers/detritivores (bacteria, fungi, termites) break down organic matter, making it available to producers and completing the food cycle (web). Humans are part of the savanna community and often compete with other organisms for food and space.

The following list defines and provides examples of the feeding (trophic) levels that comprise food webs:

- **Producer:** an organism in the food chain that produces its own energy and nutrients. Examples: grasses, trees
- **Primary consumer/herbivore:** an organism that eats mainly plants. Examples: cows, impalas, warthogs, zebras
- **Secondary consumer/carnivore:** an organism that eats meat. Examples: leopard, lion
- **Decomposer/detritivores:** organisms that break down dead plants, animal material and waste and release energy and nutrients in the ecosystem. Examples: bacteria, fungi, termites
- **Scavenger:** an animal that eats dead or rotting animal flesh. Examples: vultures, hyenas

- **Insectivore:** an organism that mostly eats insects. Example: a red-billed oxpecker

Activities:

1. The teacher will have students conduct research about the following organisms who live in the African Savanna and complete the table below.

<http://www.awf.org/wildlife-conservation/all>

Name	Picture	Predators	Prey	Fun facts
Baboon				
Dove				
Elephant				
Giraffe				
Hare				
Hippo				
Rhino				
Vervet monkey				
Zebra				
Driver ant				
Termite				
Ostrich				
Gazelle				

Gnu				
Aardvark				
Chameleon				
Grass owl				
Lion				
Python				
Meerkat				
Crocodile				
Cheetah				
Eagle				
Mongoose				
Mantis				

2. Based on their research, students will complete the food web [graphic organizer](#).
3. The teacher will then lead the whole class discussion of the food web of the African Savanna.
4. The class will discuss what-if scenarios for the ecosystem. For example, students can discuss how a change in the population of mantis (an insect) will affect other organisms. To prompt students to think about how the system will change if it is disturbed some way, the teacher can ask the following questions:
 - a. What would happen if you take away producers?
 - i. If you take all herbivores away from the ecosystem, what would happen?

Resources:

<http://nationalgeographic.org/media/african-savanna-illustration/>

http://media.nationalgeographic.org/assets/file/866_african_savanna_illustration_1.pdf

Lesson #2: The Ecosystem in Food Fight, Part 1

Learning outcomes:

1. Students will identify variables from the game that contribute to the population of two selected organisms.
2. Students will apply their knowledge of the African Savannah to the game.

Performance outcomes:

1. The teacher will scaffold students to engage with the game in a meaningful way.
2. The teacher will organize a learning activity around the game in which students play the game with two pre-selected organisms.

Lesson/Activities

1. The teacher introduces the activity and group students as pairs.
2. Students play a short version [14 turns] of the game with the two organisms pre-selected by the teacher [e.g. Baboon and Owl]
3. When the class finishes playing the game, the teacher facilitates the following discussions:
 - a. How does the **game** work?
 - b. e.g., when can you add a new organism? How can you identify predation relationships based on the organism card?)
 - c. What is the goal of this game?
 - d. What are the rules of this game?
 - e. What happened to the prey card when you added X?
 - f. What happened to X when you added Y?
4. The teacher asks students to play the game again, and students create a table with the variable values from the game [[provide a table worksheet](#)]

5. Students document values for each introduced organism over 14 turns. Students will record in the table the values of the variable for each turn of the game. They do it simultaneously for all the variables.

Lesson #3: The Ecosystem in Food Fight, Part 2

Learning outcomes:

1. Students will create and analyze BOTGs to identify patterns and relationships.
2. Students will create a connection circle that explains connections and relationships between variables.

Performance outcomes:

1. Teacher will facilitate students to create and analyze BOTGs based on variable values recorded in the table during the previous lesson.
2. Teacher will facilitate whole class discussion about identified relationships among the variables.
3. Teacher will lead a whole class discussion to create a connection circle.

Lesson/Activities

1. The teacher will have students draw behavior-over-time-graphs (BOTGs) for each variable using the data collected. See Figure 1 for examples. Click [here](#) for the Template.

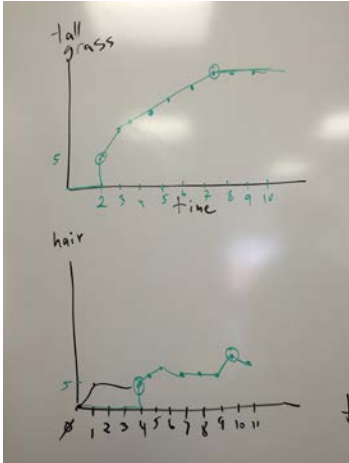


Figure 1: Examples of BOTGs

2. The teacher will help students to describe behaviors that they identified from the graphs. Does the population grow? Does it fluctuate?
3. Based on the discussion, the teacher and class will create a connection circle. See Figure 2 for an example.

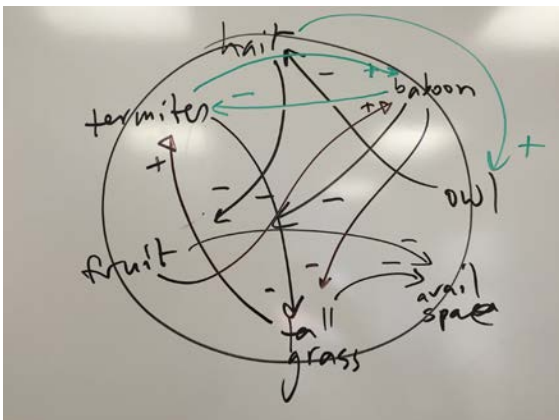


Figure 2: Example of a connection circle

Resources:

- What is Connection circle:

<http://www.watersfoundation.org/webed/mod5/downloads/Connection-instructions.pdf>

- Template:

<https://5thgradewinterhaven.files.wordpress.com/2008/06/connect.pdf>

Lesson #4: The Ecosystem in Food Fight, Part 3

Learning outcomes:

1. Students will understand the systems thinking concepts of the causal loop diagram and the feedback loop (both reinforcing and balancing).
2. Students will draw causal loop diagrams to describe relationships among the organisms within the ecosystem.
3. Students will explain how the game works using the causal loop diagrams and feedback loops.

Performance outcomes:

1. Teacher will explain what a causal diagram is using examples in the game.
2. Teacher will explain what feedback loops are.
3. Teacher will identify reinforcing and balancing feedback loops in the game.
4. Teacher will facilitate the whole class discussion to create causal loop diagrams that explain how the ecosystem in the game behaves.

Lesson/Activity

1. Based on the connection circle, the teacher draws a couple of causal loop diagrams with his students.
2. The teacher explains the feedback within the diagrams.
3. The teacher explains potential benefits of considering an issue or analyzing a system in terms of reinforcing or balancing feedback.
4. Students discuss how they would play the game differently.
5. Students play the game again.
6. Homework: Students will prepare a report to share with the whole class: 1) what they learned about the ecosystem in the game and 2) how playing the game with systems thinking tools helped them to understand how the ecosystem works.

Lesson #5: Putting it all together!

Learning outcomes:

1. Students will explain the African Savanna ecosystem using the systems thinking concepts.

Lesson/Activity

1. Students present:
 - a. Their BOTGs and feedback loop diagrams.
 - b. Explain why they played the game differently based on their understanding of how the system behaves.
2. Students complete the [assessment protocol](#).