



ECOSYSTEMS

Living organisms and their environments

5th Grade Lesson Plan: Ecosystems

Overview

This series of lessons was designed to meet the needs of gifted children for extension beyond the standard curriculum with the greatest ease of use for the educator. The lessons may be given to the students for individual self-guided work, or they may be taught in a classroom or a home-school setting. This particular lesson plan is primarily effective in a classroom setting. Assessment strategies and rubrics are included. The lessons were developed by Lisa Van Gemert, M.Ed.T., the Mensa Foundation's Gifted Children Specialist.

Introduction

As the environment becomes an ever-increasing matter of national and international importance, students' knowledge of ecosystem dynamics gains in value. In addition to being a core requirement of science standards across the country, the study of ecosystems is interesting to students, creating an arena in which complex ideas become accessible to learners.

Guiding Questions

- What is an ecosystem and what are its parts and functions?
- What can challenge an ecosystem?
- What are the roles of the water and food cycles in an ecosystem?

Learning Objectives

- After completing the lessons in this unit, students will be able to:
- Identify the fundamental structure and function of an ecosystem
 - Evaluate biomes
 - Compare and contrast marine ecosystems
 - Predict the result of parasitism
 - Create a cinquain poem about the water cycle
 - Connect their learning to real-world ecosystem challenges
 - Propose solutions to desertification
 - Categorize the trophic levels of organisms within an ecosystem
 - Create a board game that reflects a significant understanding of essential concepts of the lesson

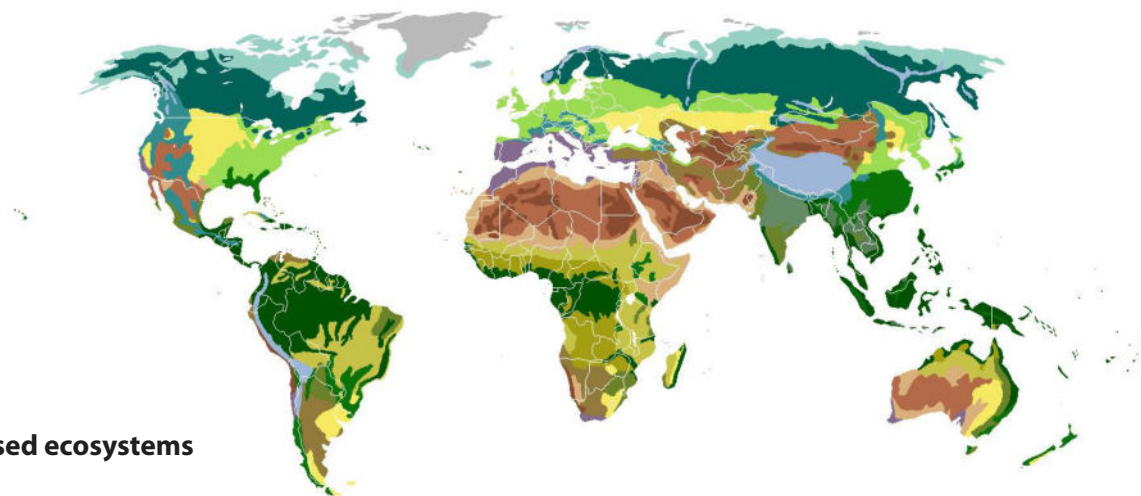
Preparation

- Copy the lesson plan. It is preferable to have a color copy.
- Ensure that students have reliable internet connections.
- Students will need access to typical art supplies for the capstone project.

Lesson 1: The structure and function of an ecosystem

For each section below, read the information in the box on the left, draw a picture to represent the information in the box on the right, and circle the word in the box on the left that you feel is the most important word.

An ecosystem is a group of living organisms interacting with their environment.	
Ecosystems can be very tiny, or they can be as large as the Sahara. For example, a pond in your backyard is an ecosystem.	
Ecosystems that are very large or a series of smaller ecosystems scattered around that have common plants, animals, and qualities are called biomes.	
There are many kinds of biomes; some are terrestrial (on land), and some are marine (water). You may recognize some of them like desert, savannah, tundra, or tropical forest.	
Animals and plants live in the ecosystems and biomes that they do because of their Ranges of Tolerance. A Range of Tolerance is the variation a plant or animal can accept in such things as water or temperature. For example, some plants need a lot of water to survive, while others need very little.	
An ecosystem is like a play, with different animals, plants, and non-living things playing the different roles. The role each thing plays is called its ecological niche. Some of the roles are biotic (or living, like plants and animals), while some are abiotic (non-living, like soil, water, wind, or temperature).	



Land-based ecosystems

Here is a map of the terrestrial biomes of the world:

Ice sheet and polar desert	Xeric shrubland
Tundra	Dry steppe
Taiga	Semiarid desert
Temperate broadleaf forest	Grass savanna
Temperate steppe	Tree savanna
Subtropical rainforest	Subtropical dry forest
Mediterranean vegetation	Tropical rainforest
Monsoon forest	Alpine tundra
Arid desert	Montane forest

Find the areas of the world in the arid desert biome. Based on this map and your knowledge of ecosystems and biomes, answer the following questions:

1. Is the arid desert biome found on more than one continent? _____
2. What can you infer about the Range of Tolerance of animals and plants living in the arid desert?

3. Xeric means extremely dry. What do you think the difference between the arid desert and xeric shrubland biomes might be?

4. Find the biome in which you live. What is it? _____
5. Where else in the world can you find it? _____
6. If you could live in any biome, which one would it be and why?

Marine ecosystems

Go to lme.noaa.gov/LMEWeb/downloads/lme64.pdf, the National Oceanographic and Atmospheric Agency's website, and download the map of Large Marine Ecosystems of the World. Make sure that it is big enough to see clearly (You may need to adjust the size at the top of the screen – look for the % sign). Use the map to answer the questions below.

Find Ecosystems 27, 28 and 29 on the west coast of Africa.

These ecosystems abut each other. What do you notice about the land at the edges of the marine ecosystems?

What is the marine ecosystem closest to where you live? _____

Look at Ecosystem 32, the Arabian Sea. How is it different than Ecosystems 27, 28 and 29?

Find Ecosystem 63, Hudson Bay, and Ecosystem 34, the Bay of Bengal. How do you think these ecosystems are different from each other?

Warm water evaporates much more quickly than cold water. Predict which bay evaporates more quickly, Hudson Bay or the Bay of Bengal?

Evaporation creates increased salinity (saltiness). Which bay would you expect to be more salty, Hudson Bay or the Bay of Bengal?

The food chain

Within an ecosystem, plants and animals relate to each other in different ways. Some animals eat other animals in a relationship we call the food chain. It's easy to envision animals competing with each other, but did you know that plants do, too? Plants compete for space, water, nutrients, and light. Plants get their nutrients from air, water, and soil. What do you think a plant could do to increase the amount of nutrients it was getting?

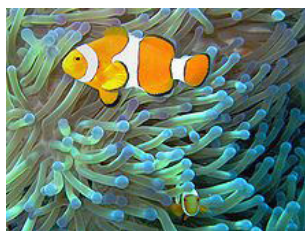
How about light?



Other plants and animals live side-by-side in a relationship we call symbiosis. There are different kinds of symbiosis.

The first is called parasitism. This is where one species (the parasite) feeds off of or is dependent on the other species (the host) in a way that may hurt or even kill the host. An example of parasitism is fleas on a dog. The photo at left shows a flea through an electron microscope.

Another example of parasitism is called brood parasitism. This is when a bird lays its eggs in another bird's nest rather than building its own nest and sitting on the eggs. Cuckoo birds and cowbirds lay their eggs in another bird's nest and have the host bird "babysit" the egg. This doesn't always work out for the host, because the cuckoo sometimes shoves the host's eggs overboard to try to fool the host!



If the host and the parasite benefit from the relationship, we call that mutualism. An example of that would be bacteria in the gut of cows. The cows need the bacteria to help them digest their food; the bacteria need the cow to provide them nutrients. Another example is the relationship between the clown fish and the sea anemone. The anemones protect the fish from predators that would eat the clown fish but don't want to mess with the stinging tentacles of the anemone. The clown fish in turn protects the anemone from a fish called the butterfly fish that eats anemones.

What do you think the biggest problem that brood parasitism could cause would be and why?

The water cycle

Ecosystems rely on delicately balanced cycles in order to function properly. For instance, in the water cycle, called the hydrological cycle, water evaporates and rises into the air, cools and condenses, falls back to the earth as precipitation, and then collects again. The cycle repeats itself over and over. The diagram below shows the water cycle.

Go to ga.water.usgs.gov/edu/followadrip.html and follow a drop of water through the hydrologic cycle.

In an ecosystem, the cycle of water is critically important. Do you remember what a Range of Tolerance is? Many plants and animals have a strict Range of Tolerance when it comes to water and are very susceptible to drought or flooding.

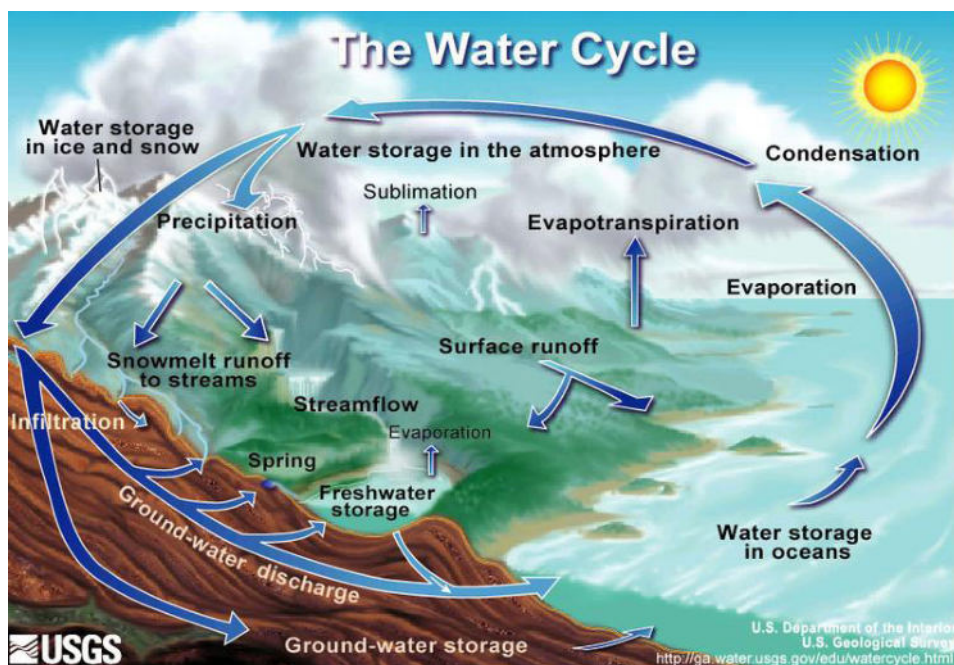


Image: ga.water.usgs.gov/edu/watercycle.html

After studying the diagram and reading about the drop of water, you are ready to write a cinquain poem about water. A cinquain (pronounced "sin cane") is a five-lined poem that follows a pattern of syllables.

Here is the pattern: **Line 1:** topic – either a two-syllable word or two single syllable words

Line 2: four syllables of adjectives or words describing the topic

Line 3: six syllables of verbs that show what the topic does.

Line 4: eight syllables that express something about the subject. It can be a sentence.

Line 5: two syllables that wrap the whole poem up. It can be a synonym of the topic.

Here's an example:

*Desert
Sandy and dry
Waiting for welcome rain
To make the flowers bloom again
Arid*

Now you try it. The first line is done for you. Make sure you check the number of syllables!

Water

Lesson 2: Challenges to ecosystems

An ecosystem is a delicately balanced system that can be thrown off kilter through both man-made and natural causes. Go to ted.com/talks/rob_dunbar.html and watch Dr. Rob Dunbar's talk about the ancient climates his team is discovering in Antarctic ice. Before you watch, glance through the questions below so you have an idea of what you're looking for. After watching, come back and answer the questions.

1. What are some of the challenges, both man-made and natural, that Dr. Dunbar and his team have found to the ecosystems in the Antarctic and the Galapagos Islands?

2. Dr. Dunbar discusses El Niño events. An El Niño is when the normally cold waters on the western coast of South America heat up. This causes everything from flooding in Peru to drought in Australia. What are some of the effects of this natural event?

3. What did you think was the most interesting thing Dr. Dunbar talked about?

Watch this video on deserts at youtube.com/watch?v=1ONWt83KD7g.
(This video is also available on the United Nations website at unep.org/newscentre/multimedia.)

Suppose you could do one thing to help the desert ecosystem. What would it be?

How would you tell if your idea was successful? _____

Can you propose an alternative to the use of rivers like the Rio Grande for agricultural irrigation?

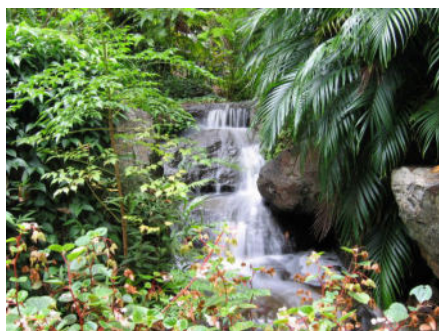
What could be done to minimize the effects of population growth on an area?

Lesson 3: Food webs

You have learned that animals and plants in an ecosystem have a niche, or a role, in the ecosystem. One aspect of an organism's niche is its place in the food web or food chain. The term "food web" is the most preferred term because it is not a simple chain; all the organisms are interconnected like a spider's web.

There are three kinds of ways animals interact with food. They can be producers, consumers or decomposers.

- Plants and algae are usually the producers in an ecosystem. Producers don't eat anything else; they get their energy from another source, often the sun, which is that foundation of the food web just like it is at the foundation of the water cycle. Plants get their nutrients from soil, water, and air, so they don't need to eat things. There are plants that eat insects, though!
- Consumers eat the producers and/or other consumers.
- Decomposers eat the dead plant and animal material in the ecosystem, turning it into nutrients that can be used by the producers. Fungi, like these mushrooms growing on a tree, bacteria, and worms are the most common decomposers.



In the picture to the left, do you see producers or consumers?

Plants and animals are assigned what is called a "trophic level." Trophic is a word with Greek origins meaning "food," so a trophic level is a fancy way of saying where an animal or plant is in the food chain. Trophic levels are a pyramid, meaning that as you go up the levels, there are fewer organisms there.

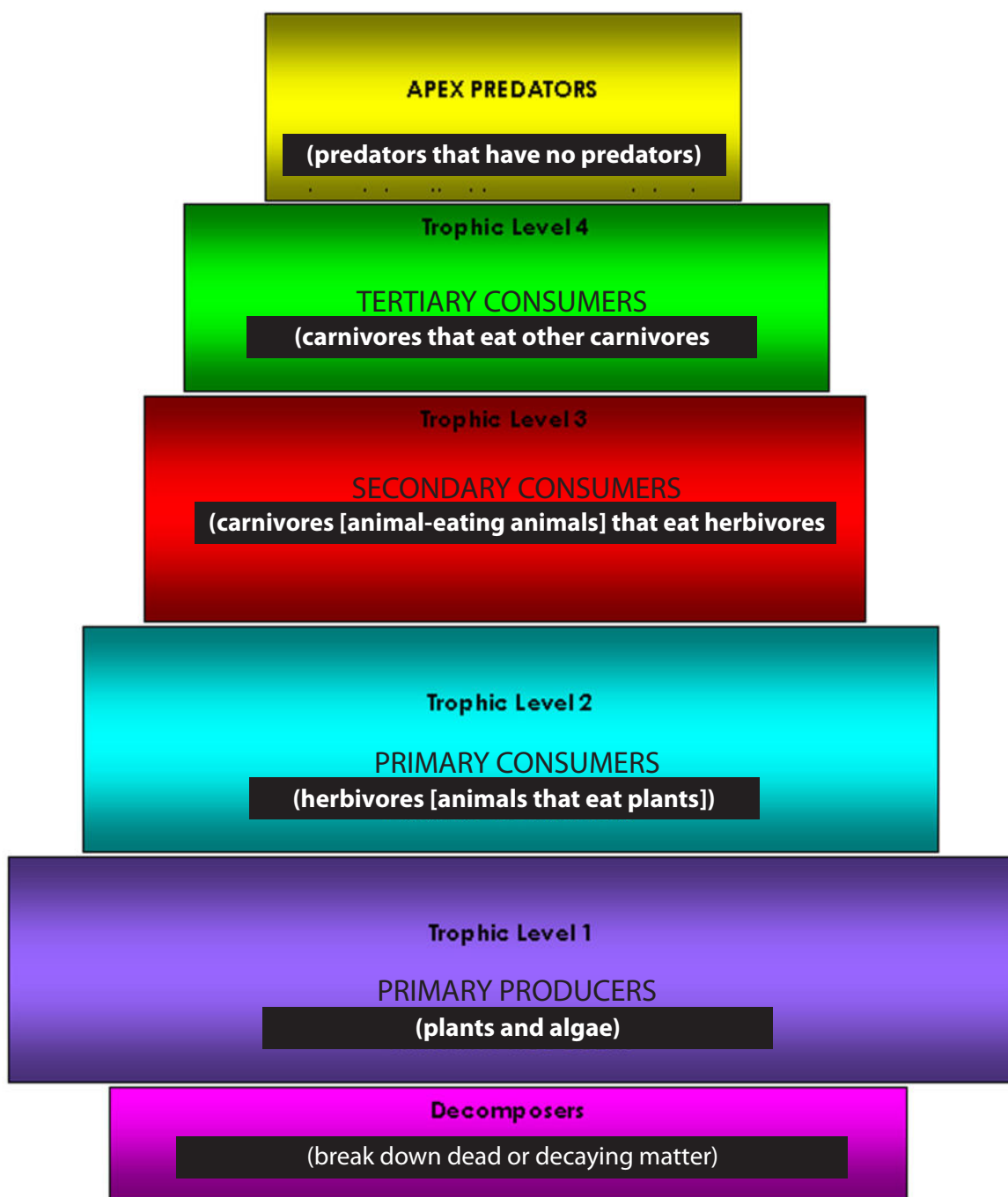
So, one important thing to remember about trophic levels is that it takes a lot of organisms at the lower levels to create food for organisms at the higher levels. When you eat an animal from a high trophic level, you are essentially eating everything that animal ate below it on the chain.




For example, this cow has eaten the grass around it. If that cow becomes a steak, the person eating the steak also used up the resource that was the grass, too, not just the cow. The higher you go, the more resources you use.



Now, go to this site and organize the food webs: harcourtschool.com/activity/food/food_menu.html

Look carefully at the trophic level pyramid here. Read the descriptions of the organisms listed in the chart below the pyramid and decide what trophic level they belong to.



Organism	Description	Trophic Level
1. Killer whale (orca) 	No natural predators	
2. Phytoplankton 	Tiny organisms that receive energy from the sun	
3. Rabbit 	Rabbits are herbivores	
4. Wolf 	Wolves are omnivores that will eat plants, as well as other animals. Some animals they eat are carnivores, like foxes. Others are herbivores, like rabbits. So, the wolf will be at different trophic levels depending on what it is eating.	When eating foxes: When eating vegetation: When eating mice:
5. Eagle 	Eagles can eat foxes	
6. Mushrooms 	Gain nutrients from decaying matter	

Lesson 4: Capstone project – construct an ecosystem board game

Imagine that you are a board game designer. Your company has been approached by a government agency to design a board game to teach kids about ecosystems. Because of your vast knowledge of this subject, the company has asked you to spearhead this project. You will need to design and create a board game that can be used to teach children the key ideas about ecosystems that you have learned. Hasbro, the manufacturer of Monopoly, has told you that they want these things from a game: They want it to be fun, challenging, not frustrating, have a reward, and give a fresh experience each time you play. You have decided to make sure your game fits those criteria.



To do this, you will need to ask yourself some questions.

1. What are your favorite games? It will be easiest and most rewarding to design a game that incorporates some of the things you enjoy about games. Do you like games that require strategy? Do you like traditional boards, or do you prefer more innovative ones? Do you like characters or just markers? Do you like drawing cards, rolling dice, or a combination of both?
2. Some things you should keep in mind are:
 - a. How do you win?
 - b. How many people can play? Think about how well the game would run with very few and/or very many players.
 - c. Game boards should have a combination of positive (move forward), negative (move backward), and challenge spaces. Challenge spaces are when you have to perform a task or answer a question to move forward, gain something, or not go backward.
 - d. You can find rules for dozens of existing games at boardgamecapital.com/board-game-rules.htm. You may want to read through a few of them to get an idea of how you want your rules to be structured.
3. Your game should have the following components:
 - a. A board (you can find templates at people.uncw.edu/ertzbergerj/word_games.html — scroll down to where it says “printable board games” or “Want even more boards?”)
 - b. Pieces — these can be simple or complex
 - c. Cards (you may use the template on the next page)
 - d. Rules booklet (be sure to create a picture of your game or design a logo of it for your booklet cover)
4. Follow the guidelines in the rubric in the Assessment section to make sure your game fulfills (or exceeds) the standards.





Example

What was the name of Mom's
first dog?

(Ralph)

Extension: There's so much more to learn!

Build a terrarium!

- stormthecastle.com/terrarium/index.htm
- *The New Terrarium: Creating Beautiful Displays for Plants and Nature* by Tovah Martin and Kindra Clineff
- *A Kid's Guide to Making a Terrarium (Gardening for Kid's)* (Robbie Readers) by Stephanie Bearce
- *Terrarium Animals from A to Z* (Compass Guides) by Oliver Drewes (Paperback - Apr 18, 2005)

Buy an Ecosphere!

- eco-sphere.com

Play the Water Cycle Game!

- [response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY\(entry_subtopic_topic\)=entry_id,subtopic_id,topic_id&entry_id\(entry_subtopic_topic\)=447&subtopic_id\(entry_subtopic_topic\)=27&topic_id\(entry_subtopic_topic\)=3](http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY(entry_subtopic_topic)=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=447&subtopic_id(entry_subtopic_topic)=27&topic_id(entry_subtopic_topic)=3)

Research El Niño!

- elnino.noaa.gov
- kids.earth.nasa.gov/archive/nino/intro.html

Assessment

Answers to the questions found throughout the packet will often vary due to the open-ended nature of the questions. Teachers should decide how much they would like the entire plan worth (for example, 100 points) and allocate points per question accordingly. Not including the cinquain or the board game, there are 42 possible answers (the table in Lesson 1 has 12 — six for the pictures and six for circling the words; the trophic table has an extra two because of three answers for wolves).

One possible assessment strategy would be to award two points each for each possible answer, and giving some answers three possible points to bring the total to fifty. Some answers require considerably higher levels of thinking than others and that could justify a higher point total. The cinquain could be worth 10 points, and then the game is worth 90, for a total lesson value of 200 points. A teacher could take it as two separate grades, one for the questions and another for the game.

The game rubric is included on the following page. The cinquain should meet the requirements of a cinquain and also reflect an acceptable level of understanding of the poem's subject.

Credits: Game card template from

www.microsoft.com/canada/home/memories-and-crafts/articles/all-a-board-create-a-personalized-board-game.aspx

BOARD GAME RUBRIC					
	Below expectations (1)	Developing (2)	Meets expectation (4)	Exemplary (6)	
Board	The board is lacking severely lacking in positive, negative, and challenge spaces keep play interesting.	The board is lacking sufficient positive, negative, and challenge spaces keep play interesting.	The board includes positive, negative, and challenge spaces in a sufficient balance to keep play interesting.	The board includes positive, negative, and challenge spaces. It also has visually appealing graphics.	
Rules development	Rules are unclear, too long, incomplete, and/or contain rules that add complexity without improving play.	Rules are lacking in one of the following areas: ● reasonably brief ● clear ● complete ● in a booklet with a design on the front	Rules are: ● reasonably brief ● clear ● complete ● in a booklet with a design on the front	Rules are: ● reasonably brief ● clear ● complete ● in a booklet with a design on the front ● innovative or creative in some way	
Effectiveness	There are significant portions of the game that bear no relation to the content. One could play the game well without knowing about ecosystems.	There is a lack of alignment between success in the game and knowledge of ecosystems.	There is alignment between success in the game and knowledge of ecosystems, although it may not be complete.	There is complete alignment between success in the game and knowledge of ecosystems. Players who demonstrate superior knowledge will perform better.	
Cards	The game cards are sloppily done. The questions are poor, lacking in sophistication and understanding of the content.	The game cards are not particularly attractive or neat. The questions require less than comprehensive knowledge of the content.	The game cards are reasonably attractive and neat. The questions require fairly comprehensive knowledge of the content.	Game cards are attractively and neatly done. The questions require comprehensive knowledge of the content.	
Playability	The game lacks challenge, is not flexible, has an unclear path to victory, and/or is predictable from playing time to playing time.	The game is lacking in more than one of the "Hasbro Rules," and does not offer a very satisfying playing experience.	The game is lacking in one of the "Hasbro Rules," but offers an overall satisfactory playing experience.	The game meets the "Hasbro Rules" completely – fun, challenging, has a clear way to win, and offers a different playing experience each time.	
Comments					
					/30 x 3