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Analyzing a Biology Textbook for Instructional Purposes Based on the Substandard, Changes in Ecosystems

The textbook analyzed in this assignment is Biology: The Dynamics of Life, published by McGraw Hill: Glencoe Science, copyright 2004. It is a textbook designed for high school biology courses.

The Michigan Ecology Standard, relating to the interdependence on living systems and the environment is addressed in this analysis. This Standard, or learning goal has been unpacked and is available in Appendix 1 and at the following address: https://teacherknowledge.wikispaces.com/Biology+-+Unpacking+Ecological+Energy+Flow

The following table looks at the performance expectations for the Michigan Substandard: Changes in Ecosystems, part of the Ecology Standard. With each performance expectation, the textbook has been evaluated based on three criterion from Project 2061; variety of phenomena, providing vivid experiences, and representing ideas effectively. More information on these criterion can be found at: http://www.project2061.org/publications/textbook/hsbio/report/crit-used.htm#cat3

Performance Expectations	**Variety of Phenomena**	**Vivid Experiences**	**Representing Ideas Effectively**
Ecosystem Stability/ Succession Stages	Fig. 3.4: pg. 69: Photo of wildflowers growing after wildfire. Explicitly linking to secondary succession from the text.	Minilab 3.1: pg. 67. Observing lichens under microscope: example of primary succession species. Not well linked to content and not efficient in terms of teacher's time. Problem-Solving Lab: pg. 68. Distinguish on a graph which lines depict primary and secondary succession, and climax species. Directions difficult to understand, lines not well labeled. Good idea, but not well thought-out. BioLab: pg. 84. Succession in a Jar. Way to investigate succession in a lab experiment. Good use of primary, secondary succession and climax species concepts. Good efficiency in terms of teacher time/effort/resources and amount to be learned.	Fig. 3.3: pg. 68. Drawings depicting succession from exposed rock to climax community. Not well labeled in terms of species. Indicates succession as linear process instead of circular, will add to misconception that climax species is end of cycle and not just one step.

Importance of Biodiversity	Fig. 5.3: pg. 114. Three photos show medicinal plants. Links to text that explains that many cures for disease are found through organisms and having a diverse array to study is important. Supports the ideas presented in text.	Project: pg. 114: Alphabet of Biodiversity. Students choose an organism beginning with each letter of the alphabet and then describe its use. Ex. Apple-food. This activity would not take a lot of resources or time to set up, and it may be valuable for students to come up with 26 different organisms. I would be willing to try it to see if students got the concept better through doing the activity.	
How Biodiversity is Lost	Figur. 5.4: pg. 115. Two pictures show the California condor, a species that was brought back from the brink of extinction through conservation actions, and a sea turtle. This figure links to the text discussing endangered species. Fig. 5.6: pg. 116. A photo of the coral reefs and many species living there. The heading asks the question: How does removal of coral result in a loss of habitat for reef organisms? Supports text on how biodiversity is lost through habitat loss. Fig. 5.7: pg. 117. Photo of farmland breaking up forest. Supports and links to the text on habitat fragmentation.	Problem-Solving Lab 5.1: pg. 115. Interpret Data to decide if species extinction correlates to land area. Is an efficient activity, and helps students interpret data from a table.	
Human Impact: Positive	Fig. 5.11: pg. 123. A habitat corridor is shown for the Florida panther to be able to cross under a highway. This is linked with the text. Fig. 5.12: pg. 123. This photo shows a man sorting brazil nuts and the caption explains that sustainably harvested brazil nuts from the	MiniLab 5.2: pg. 122. Investigation of conservation of soil. This activity is efficient as it would be very helpful for students to see and not too much work for the teacher, as long as he/she planned early. The idea is to show how a tray of soil will wash away easily when water is added compared to a tray of soil with grass growing. This will	Using Prior Knowledge Box: pg. 121. This textbox asks students to link extinction of species by thinking about a ring sliding off their finger and down a drain, never to be found again. This is not a helpful depiction of extinction as sometimes a drain can be taken apart to

	rain forests in the Amazon provides income for people living there. This links to the text that discusses the sustainable use of wildlife areas enables people to protect them. Fig. 5.14: pg. 125. A photo of a ginkgo tree that may have become extinct if they had not been planted at monastaries. This is supposed to link to text on captivity, but it is a bad example. They don't explain why ginkgo would've become extinct if not planted, or why they chose to plant it. Also, it will be confusing for students to think about plants as being in captivity, as they are not freely moving about. Unhelpful phenomena shown here.	help students understand the idea of soil erosion better and know how they can help to stop it in their yard, if they live in a house just recently built and other examples as well. Problem-Solving Lab 5.2: pg. 124. Thinking critically about why conservation efforts are controversial. This is a good, efficient activity that will engage students in discussion and links to text on how humans can impact the environment.	retrieve an item and loss of a species is not comparable to the loss of a material object. This use of prior knowledge is embarrassing. It is in this section as the end of the textbox discusses programs to reintroduce species to areas to help them avoid extinction.
Human Impact: Negative	Fig. 5.8: pg. 118. Photo of dead trees in a forest, caption for picture links it to acid precipitation in text under the heading of habitat degradation. Fig. 5.9: pg. 119. Two pictures linking to water pollution. First picture shows cows on a large feedlot, caption links it to the text on how animal waste can lead to water pollution. The second photo shows the overgrowth of algae in a lake due to fertilizer runoff. This also links to the text on water pollution. Fig. 5.10: pg. 120. Two pictures show exotic species examples, which link to text. However, the two examples the book discusses the most are not pictured; not as	Revealing Misconceptions: pg. 118. This activity has students test the pH of tap water, as it is often slightly acidic and most students will assume it is neutral at pH 7. It may be true that this will address this misconception, but the experience is not linked to the negative impact humans can have on the environment. To do this activity in this section would be disjointed and not link to the concepts being discussed at the time.	

	helpful as it could be.		
Greenhouse Effect and Global Warming		Connection to Earth Science: Global Warming: pg. 128. At the end of the chapter there is a section discussing global warming. It is not in the regular text of the chapter and can easily be skipped by teachers and students. Since it is in the performance expectations for the substandard I would need to make sure to cover it.	Connection to Earth Science: Global Warming: pg. 128. There are two small colored drawings of the greenhouse effect, one in the earth, one in a greenhouse. It is meant to show how light/energy/heat bounce off the earth and are reflected back onto it by greenhouse gases. But the drawings are confusing in that it looks like clouds are bouncing the arrows back to the earth, as glass does in the greenhouse drawing. This would be confusing for students and would need clarification.

Based on this analysis I have a better idea of the experiences I would plan for my students when covering this substandard. For the performance expectation of "succession stages", the textbook is lacking in two criterion; variety of phenomena and representing ideas effectively. The one photo the book has is helpful, but not sufficient to depict the concept, so I would need to bring in other photos of species that are pioneer and secondary succession species. This would also help to fill in the gaps from the forest succession drawing. By showing pictures of labeled species and having students decide what their role in succession is would help them understand the concept. Also, I could set up a forest community with the pictures and have a natural disaster, such as a fire come and ask students to recreate the forest by species after this disaster. That would help them understand that succession is a cyclical, not linear process as the book depicts with the drawing. Also, as far as the criteria covering vivid experiences, I believe the Succession in a Jar experiment is a valuable one for students to participate in.

The second performance expectation is "the importance of biodiversity." The phenomena depicted in the three photos are helpful in understanding why many species of organism are important to have on our earth. Also, as a vivid experience, I would have my students try the Alphabet of Biodiversity activity. I am unsure how difficult this would be for them to come up with 26 different species, each beginning with a different letter of the alphabet and then explaining its usefulness to humans. If they learned about 3 or 4 new species by completing this exercise and learned how they were beneficial, that would be worth it in explaining the concept, I believe. I would need to make sure with

this activity, however, that students understand relevance to humans is not the only reason biodiversity is important.

The third performance expectation is "how biodiversity is lost." I appreciate the variety of phenomena and the vivid experience that the book provides. I like how there are four photos depicting 3 different concepts and one of them involves a question that students can answer. They all link nicely to the text and are clear pictures. The Problem-Solving Lab also provides a way for students to practice reading tables and interpreting data, and it supports this concept as well. I would like to do a simulation game for this section to help illustrate the impact of habitat fragmentation and the importance of habitat corridors, which will be discussed in the next section. It would involve students taking on different animal roles and having the classroom be divided into sections, one part being residential housing area and other parts being forest. Students would need to travel to different sections of forest before they were hit by cars or other things happened to them in the residential areas. This activity could show the importance of habitat corridors for animals. It would work best with middle school students and outside so students could run around. This idea needs to be better flushed out, but it could be a possible experience for students to do to understand the concept of habitat fragmentation better.

The fourth performance expectation is "positive human impacts on ecosystems." I believe the phenomena provided in the book help students understand a few of the important concepts for this section. The prior knowledge textbox would be skipped because it is not helpful in illustrating the permanence of extinction. However, it would be helpful to do the two labs, one looking at how soil erosion can be prevented and the other on the controversy around species reintroduction.

The fifth performance expectation is "negative human impacts on ecosystems." These concepts are depicted visually with 5 different photos that will help students. In terms of exotic species, I would bring in some examples of local exotic species to let students know it is a problem right where they live. Since the vivid experience activity does not relate to the concepts, I would have students do a different inquiry-based activity, such as learn the recycling services offered in their area and learn what is and is not accepted as recyclables so that they could contribute less to land pollution.

The final performance concerns greenhouse gases and global warming. The textbook does not provide very helpful phenomena, representations, or vivid experiences, so it would be important for me to bring in outside curriculum to teach these concepts. I would like to bring in an article from a popular periodical such as Newsweek or Time, describing the debate about global warming. We could have a class discussion on the topic, making sure to cover causes for it and the controversy around it.

Appendix 1: Unpacking of the Michigan Ecology Standard

Learning Goal for Biology: Ecology

National Science Education Standard for Ecology

THE INTERDEPENDENCE OF ORGANISMS

The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.

Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.

Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.

Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.

Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.

- NSES at http://www.nap.edu/readingroom/books/nses/6e.html

Michigan Ecology Standard Relating to the Interdependence of Living Systems and the Environment

STANDARD B3: "Students describe the processes of photosynthesis and cellular respiration and how energy is transferred through food webs. They recognize and analyze the consequences of the dependence of organisms on environmental resources and the interdependence of organisms in ecosystems" (Michigan Biology Content Standards p. 17).

Content, Identifying and Using Performances

- B3.1 Photosynthesis and Respiration

Organisms acquire their energy directly or indirectly from sunlight. Plants capture the Sun’s energy and use it to convert carbon dioxide and water to sugar and oxygen through the process of photosynthesis. Through the process of cellular respiration, animals are able to release the energy stored in the molecules produced by plants and use it for cellular processes, producing carbon dioxide and water.

Performance Expectations:

Essential:
B3.1A Describe how organisms acquire energy directly or indirectly from sunlight.
B3.1B Illustrate and describe the energy conversions that occur during photosynthesis and respiration.
B3.1C Recognize the equations for photosynthesis and respiration and identify the reactants and products for both.
B3.1D Explain how living organisms gain and use mass through the processes of photosynthesis and respiration.
B3.1e Write the chemical equation for photosynthesis and cellular respiration and explain in words what they mean.
B3.1f Summarize the process of photosynthesis.

B3.2 Ecosystems
The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in an ecosystem, some energy is stored in newly made structures, but much is dissipated into the environment as heat. Continual input of energy from sunlight keeps the process going.

Peformance Expectations:

Essential:
B3.2A Identify how energy is stored in an ecosystem.
B3.2B Describe energy transfer through an ecosystem, accounting for energy lost to the environment as heat.
B3.2C Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.

B3.3 Element Recombination
As matter cycles and energy flows through different levels of organization of living

systems—cells, organs, organisms, and communities—and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change.

Peformance Expectations:

Essential:
B3.3A Use a food web to identify and distinguish producers, consumers, and decomposers and explain the transfer of energy through trophic levels.
B3.3b Describe environmental processes (e.g., the carbon and nitrogen cycles) and their role in processing matter crucial for sustaining life.

B3.4 Changes in Ecosystems
Although the interrelationships and interdependence of organisms may generate biological communities in ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution. The impact of the human species has major consequences for other species.

Peformance Expectations:

Essential:
B3.4A Describe ecosystem stability. Understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one.
B3.4B Recognize and describe that a great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment.
B3.4C Examine the negative impact of human activities.

Core:

B3.4x Human Impact

Humans can have tremendous impact on the environment. Sometimes their impact is beneficial, and sometimes it is detrimental.

B3.4d Describe the greenhouse effect and list possible causes.

B3.4e List the possible causes and consequences of global warming.

B3.5 Populations

Populations of living things increase and decrease in size as they interact with other populations and with the environment. The rate of change is dependent upon relative birth and death rates.

Performance Expectations:

Essential:

B3.5A Graph changes in population growth, given a data table.

B3.5B Explain the influences that affect population growth.

B3.5C Predict the consequences of an invading organism on the survival of other organisms.

Core:

B3.5x Environmental Factors

The shape of population growth curves vary with the type of organism and environmental conditions, such as availability of nutrients and space. As the population increases and resources become more scarce, the population usually stabilizes at the carrying capacity of that environment.

B3.5d Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages.

B3.5e Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems.

B3.5f Graph an example of exponential growth. Then show the population leveling off at the carrying capacity of the environment.
B3.r5g Diagram and describe the stages of the life cycle for a human disease-causing organism. (recommended)

Unpacking these statements:

- **What do these statements mean about learning Ecology?**
- Students should be able to:

*Understand that organisms acquire energy directly or indirectly through from sunlight. They will understand that autotrophs use the sun's energy to produce their own compounds, and that heterotrophs then must consume other organisms to produce their nutrients, and that this is an indirect way of obtaining energy from the sun.

*Understand that plants use light energy and convert it into chemical energy through the synthesis of carbohydrates. They will also understand that during cellular respiration that these carbohydrates are broken down, and this chemical energy is used to produce ATP.

*Recognize that during photosynthesis that six carbon dioxide molecules and six water molecules are used to create one molecule of glucose and six molecules of oxygen gas. They will be able to recognize that the carbon dioxide and water molecules are the reactants in photosynthesis, and that the glucose and oxygen gas molecules are the products of photosynthesis.

*Recognize that during cellular respiration one molecule of glucose and six oxygen gas molecules, 38 molecules of ADP, and 38 Phosphorus molecules are converted into six molecules of carbon dioxide, six molecules of water, and 38 molecules of ATP. They must be able to recognize that glucose, and oxygen molecules are the reactants for cellular respiration, and that carbon dioxide, water and ATP are the products.

*Explain how plants are able to take carbon dioxide in the air, and through the part of photosynthesis know as the Calvin Cycle, convert that carbon dioxide into carbohydrates,

thus gaining mass through the process of photosynthesis. They must also understand that organisms then use this mass through the process of cellular respiration in order to make energy for cell function.

*Write out the chemical equations for photosynthesis and cellular respiration, being able to explain in words what each part means. They should be able to note which products result in the generation of energy, and which products result in the generation of mass.

*Summarize that photosynthesis takes place in two parts, light dependent and light independent reactions. They should know that the light dependent reactions chlorophyll molecules use energy from the sun to transfer energy to electrons which then passed from the chlorophyll to an electron transport chain, which are a series of proteins imbedded in the membrane of the chloroplast. They should also know that as the electron is passed down the electron transport chain the electron loses energy, which is used to make ATP molecules, and the electron is eventually added to an electron carrying molecule NADP+, which makes NADPH. Also, they should know that to replace this electron in the chlorophyll a water molecule is split, producing electrons for the chlorophyll, and releasing oxygen molecules into the environment. Students should understand that in the light-independent reactions of photosynthesis, also known as the Calvin Cycle, carbon dioxide, ATP, and NADPH are used to synthesize glucose. Lastly, students should understand that the Calvin Cycle is circular, and that it takes six rounds of the Calvin Cycle to produce one molecule of glucose.

*Identify and distinguish producers, consumers, and decomposers and explain the transfer of energy through trophic levels in food webs they have created. They will understand that energy is recombined and dissipated as heat as one trophic level is consumed by another. They will understand however, that energy and matter are conserved, and that the energy lost to the organisms in higher trophic levels is not lost to the environment, it is simply in another form.

*Describe environmental processes (e.g., the carbon, nitrogen, water and phosphorus cycles) and their role in processing matter crucial for sustaining life.

- Describe ecosystem stability/fragility and understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one. They will recognize that ecosystems are not 100% stable systems, but are subject to change through natural disasters and human influence.
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*Recognize and describe that a great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment. They will understand the positive aspects of biodiversity and be able to provide some examples where biodiversity is being lost, i.e. genetic modification in crops and invasive species issues.

*Understand how human activities are negatively impacting ecosystems, such as air, water, and land pollution, and habitat degradation. Also, they will understand human activities providing positive impacts on ecosystems, such as making habitat corridors, and species protection programs.

*Describe the greenhouse effect and list possible causes as well as consequences of global warming. They will be able to articulate how global warming can be addressed/curbed.

*Understand how they as individuals and as community members can be a positive, responsible influence on ecosystems and the environment.

*Describe different reproductive strategies and explain the advantages and disadvantages of each.

*Describe how the chemical and physical environment may influence rate, extent, and nature of population dynamics within ecosystems.

*Graph exponential growth of a population and how the graph behaves as the carrying capacity of the environment is reached.

*Graph changes in population growth given appropriate data.

*Explain influences that affect population growth.

*Predict the consequences of an invading organism on the survival of other organisms

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What do students need to know to learn Ecology?

Michigan Biology Content Standards provides a list of prerequisites for Standard B3:

L3.p1 Populations, Communities, and Ecosystems (prerequisite)
Organisms of one species form a population. Populations of different organisms interact and form communities. Living communities and the nonliving factors that interact with them form ecosystems. (prerequisite)

L3.p1A Provide examples of a population, community, and ecosystem. (prerequisite)

L3.p2 Relationships Among Organisms (prerequisite)
Two types of organisms may interact with one another in several ways; they may be in a producer/consumer, predator/prey, or parasite/host relationship. Or one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other. (prerequisite)

L3.p2A Describe common relationships among organisms and provide examples of producer/consumer, predator/prey, or parasite/host relationship. (prerequisite)

L3.p2B Describe common ecological relationships between and among species and their environments (competition, territory, carrying capacity, natural balance, population, dependence, survival, and other biotic and abiotic factors). (prerequisite)

L3.p2C Describe the role of decomposers in the transfer of energy in an ecosystem. (prerequisite)

L3.p2D Explain how two organisms can be mutually benefi cial and how that can lead to interdependency. (prerequisite)

L3.p3 Factors Influencing Ecosystems (prerequisite)
The number of organisms and populations an ecosystem can support depends on the biotic resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. (prerequisite)

L3.p3A Identify the factors in an ecosystem that influence fluctuations in population size. (prerequisite)

L3.p3B Distinguish between the living (biotic) and nonliving (abiotic) components of an ecosystem. (prerequisite)

L3.p3C Explain how biotic and abiotic factors cycle in an ecosystem (water, carbon, oxygen, and nitrogen). (prerequisite)

L3.p3D Predict how changes in one population might affect other populations based upon their relationships in a food web. (prerequisite)

L3.p4 Human Impact on Ecosystems (prerequisite)
All organisms cause changes in their environments. Some of these changes are detrimental, whereas others are beneficial. (prerequisite)

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L3.p4A Recognize that, and describe how, human beings are part of Earth’s ecosystems. Note that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. (prerequisite)

(Michigan Biology Content Standards p. 17)

What preconceptions might students have?

Students might think:

- Animals get their energy from the outside environment, and plants get their energy from the soil by using their roots.
- Organsims at the top of the food chain eat all of the organisms below them in the food chain.
- Students believe there is a starting and ending point in the food chain.
- The top of the food chain has the most energy becuase it is the "top" of the food chain.
- The numbers of organisms at the top of the food chain are higher becuase they eat the organims lower in the food chain.
- There are more herbivores soley because people keep and breed them.
- Decomposers release some energy that is cycled back to plants.
- Diagrams of energy pyramids that indicate decreases in energy (without indicating that the energy is given off as heat) can reinforce students' misconception that energy is not conserved.
- The number of producers is high to satisfy consumers.
- Students believe energy can be recycled through an ecosystem many times.
- Plants do not live in water.
- Often students will only address the components of a food chain that they can see. This is often reinforced by teachers using those components that are observable in their particular local.
- Plants are dependent on humans, not vice versa.
- Carbon dioxide is a source of energy for plants.
- Energy is not lost in trophic transfer.

- Energy comes from fuel (like gasoline) which makes power. Students may not think of a plant or animal as a source of power/energy.
- Students may only think of energy in association with humans. (i.e. Energy is like bouncing around.)
- Students may get stuck in thinking about individual organisms that do not fit the food web pattern.
- Students may not see the overall flow of energy in an ecosystem.
- Students may visualize flow only in terms of water and not grasp the concept that it means something starts in one place and gradually moves to another (In our case, energy flows through the food web slowly).
- Varying the population of an organism will only affect the others that are directly connected through a food chain.
- Varying the population of an organism may not affect an ecosystem, because some organisms are not important.
- Varying the population of an organism will affect all other organisms to the same degree.
- The top of the food chain has the most energybecause it accumulates up the chain.
- Populations higher on a food web increase in number because they deplete those lower in the web.
- Ecosystems are not an organized whole, but a collection of organisms.
- Communities change little over time.
- Decomposers release some energy that is cycled back to plants.
- The number of producers is high to satisfy consumers.
- An organism cannot change trophic levels.
- Humans provide food for other organisms.
- The climax community is usually the final stage, long-lasting, and self-perpetuating.
- Succession involves separate stages leading ultimately to deterministic climax.
- Species coexist in an ecological system because of their compatible needs and behaviors: they
  “get along.”
- The needs and roles of a species are general and typical of species.
- Traits are passed on by the bigger, stronger organisms that replace the smaller, weaker ones.
- Species coexist in an ecological system because of their compatible needs and behaviors: they “get along.”

- Varying the population of an organism will only affect the others that are directly connected through a food chain.
- Green plants are only producers of carbohydrates in ecosystems.
- Plants take in food from the outside environment, and/or plants get their food from the soil via roots.
- Food webs are interpreted as simple food chains.
- The top of the food chain has the most energy because it accumulates up the chain.
- The relative sizes of prey and predator populations have no bearing on the size of other.
- In a food web, a change in one population will only affect another population if the two populations are directly related as predator and prey
- Humans provide food for other organisms.
- Food chains involve predator and prey, no producers.
- Carnivores are big or ferocious. Herbivores are passive or smaller.
- Carnivores have more energy or power than herbivores do.
- Traits are developed by individuals in response to the needs of the individual.
- Traits develop because they are part of a predetermined plan.
- Traits are properties of populations.
- Traits are passed on by the bigger, stronger organisms that replace the smaller, weaker ones.
- Adaptation equals evolution.
- All factors are limiting except the most abundant one.
- The most limiting factor is the least abundant one.
- Populations exist in states of either constant growth or decline depending upon their position in a food chain.
- Some ecosystems are limitless resources and provide an opportunity for limitless growth of a population.
- The relative sizes of prey and predator populations have no bearing on the size of the other.
- Density-dependent factors are biotic, and density-idependent factors are abiotic.
- Populations increase until limits are reached, then they crash and go extinct.
- In a food web, a change in one population will only affect another population if the two populations are directly related as predator and prey.
- Plants are weak and cannot defend themselves.
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- Resources:** <http://ecomisconceptions.binghamton.edu/energyflow.htm>,
- <http://departments.weber.edu/sciencecenter/biology misconceptions.htm>