Resource Unit

Interdependency

Standards: Product Life Science Grade 12, Standard 3, Benchmark 4, and Indicators 2 & 3.

Grade Range: 10-12

Background Information: This unit is designed to illustrate the link between plants and animals, and the link between biotic and abiotic factors in an ecosystem.

Description: This unit uses discussion, print sheets, games, and research projects to investigate ecosystems.

I. Interdependency in ecosystems.

II. Objectives. The student will investigate interdependency by:
   A. Making food chains and food webs.
   B. Labeling the trophic levels of the organisms in food webs.
   C. Research and reports on a terrestrial biome and an aquatic zone.

III. Materials
   A. Predator Game, Green World Game instructions
   B. Print sheets
   C. Colored pencils, map of world (black and white)

IV. References
   A. For the teacher.
      1. BIOLOGY, by George B. Johnson, 1986
      2. OCEANOGRAPHY, by Dale E. Ingmanson, 1995
      3. LIVING IN THE ENVIRONMENT, by G. Tyler Miller, 1988
      4. Internet site: www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html
      5. Internet site: www.runet.edu/~swoodwar/CLASSES/GEOG235/biomes/intro.html
      6. ECOLOGY AND BEHAVIOR, by Cecie Starr and Ralph Taggart
   B. For the student.

V. Content related words:
   Producers       Consumers       Biomass
<table>
<thead>
<tr>
<th>Decomposers</th>
<th>Gross primary productivity</th>
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<tbody>
<tr>
<td>Trophic Level</td>
<td>Net primary productivity</td>
</tr>
<tr>
<td>Food chain</td>
<td>Energy Transfer</td>
</tr>
<tr>
<td>Biomes</td>
<td>Aphotic zone</td>
</tr>
<tr>
<td>Carnivore</td>
<td>Herbivore</td>
</tr>
<tr>
<td></td>
<td>Omnivore</td>
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</tbody>
</table>

### VI. Projects and activities

A. KWL chart on "Energy Transfer in Food Chains"
B. Green World Game
C. Discussion of "Terrestrial Biomes" and "Aquatic Zones"

### VII. Culminating activities

A. Students will create and label the trophic levels of a food chain.
B. Students will complete a research activity on "Terrestrial Biomes".
   (Using available resources investigate the following research questions for the biome assigned to you.)
   1. Where does your biome exist on Earth? (color the location on the black and white map)
   2. Describe each of the biome characteristics listed as they apply to your biome.
   3. What natural dangers to this biome exist?
   4. What human dangers to this biome exist?
   5. What examples can you find of both natural and human dangers that have impacted this biome?
C. Students will complete a research activity on "Aquatic Zones". (Using available resources investigate the following research questions for the aquatic zone assigned to you.)
   1. Where does this zone exist on Earth? (color the location on the black and white map)
   2. What aquatic life exists in this zone? Give an example of a food web from this zone. Label the trophic levels.
   3. What threats from nature exist?
   4. What threats from humans exist?
   5. What efforts could be undertaken to preserve this zone?

### VIII. Evaluation
(This activity evaluates all three objectives.)
Pick a Kansas ecosystem and using available resources complete the following:
1. Describe in detail the biome/aquatic zone that applies.
2. Chart a food web. Must include at least 8 organisms.
3. Label the trophic levels of each organism. Must have 4 different trophic levels.
4. Label each organism. (producer, carnivore, herbivore, omnivore)
Discovery Center

Subject: Trophic levels in food chains and food webs.

Standards: Product Life Science Grade 12, Standard 3, Benchmark 4, and Indicators 2&3.

Age/Grade Range: 10-12

Objective: The student will identify the trophic levels of organisms in a given food chain.

Materials: Predator games, instructions for Green World version of Predator game, and print sheets.

Procedure: Students will divide into two groups (must have 4 in each). Each group will use 1 deck of Predator cards. Students will read instructions and then play for 15 minutes.

Conclusion: Day 1, Assignment A- After allotted time for Green World Game each group will chart out 2 food chains that include 4 different trophic levels using the game cards. The food chains then need to be copied by each student on a sheet of paper. Each student will then label the four trophic levels and identify the organisms of each food chain as producers, herbivores, omnivores, detritivores, or carnivores.

Evaluation: Individual students will identify the trophic levels of indicated organisms in a food chain/web to be evaluated in the concluding activity for unit.

Background: The background necessary for this center was provided through a KWL chart and the attached print sheets.

Extension: Day 1, Assignment B- Using organisms from the cards try to connect the two food chains together into a food web.
**Day 1: Trophic Levels in Food Chains/Webs**

Assignment A: After allotted time for Green World Game each group will chart out 2 food chains that include 4 different trophic levels using the game cards. The food chains then need to be copied by each student on a sheet of paper. Each student will then label the 4 trophic levels and identify the organisms of each food chain as producers, herbivores, omnivores, detritivores, or carnivores.

Assignment B: Using organisms from the cards try to connect the two food chains together into a food web.

**Day 2: Biomes**

Assignment: Using available resources investigate the following research questions for the biome assigned to you.

1. Where does your biome exist on Earth? (color the location on the black and white map)
2. Describe each of the biome characteristics listed as they apply to your biome.
3. What natural dangers to this biome exist?
4. What human dangers to this biome exist?
5. What examples can you find of both natural and human dangers that have impacted this biome?

**Day 3: Aquatic Zones**

Assignment: Using available resources investigate the following research questions for the biome assigned to you.

1. Where does this zone exist on Earth? (color the location on the black and white map)
2. What aquatic life exists in this zone? Give an example of a food web from this zone. Label the trophic levels.
3. What threats from nature exist?
4. What threats from humans exist?

What efforts could be undertaken to preserve this zone?
Interdependency Unit by Brenda Beecher

Day 1: KWL on Energy Transfer
   Discussion of energy transfer with handouts
   Greenworld Game (instructions)
   Day 1 assignment

Day 2: Review of Day 1
   Discussion of terrestrial biomes with handout
   Day 2 assignment
   Map

Day 3: Quiz
   Discussion of aquatic zones
   Day 3 assignment
   Map
   Final Activity assignment

Other activities/handouts that could be added:
   Biome Summary
   Middle latitude food chain
   How much energy do you need to keep a wolf happy?

RESOURCE UNIT FIELD TRIAL

This unit is intended to illustrate the link between plants and animals, and the link between biotic and abiotic factors in an ecosystem. My intent was to show the importance of how plants and animals are linked using the following topics: food chains, food webs, trophic levels, and energy transfer. By also including terrestrial biomes and aquatic zones in this unit I can emphasize how abiotic factors influence the makeup of an ecosystem. Food chains, food webs, and trophic levels can vary by ecosystem, while energy transfer occurs in all ecosystems. I used discussions, print sheets, games, and research projects to cover the information in this unit.

The field trial took place in an Advanced Biology class. This class was within the intended 10-12 grade range for this unit. The class consisted of mainly Juniors. The field trial was completed over a three-day period. The unit started with a KWL chart on "Energy Transfer". The teacher uses KWL charts on a regular basis so the students were familiar with the process, but had not completed the reading assignment that I had expected so I did not have the responses I would have liked, but I guess I really did find out what they knew. They had a good understanding of the concept, but were not as familiar with the
correct vocabulary. The discussion of "Energy Transfer" and "Trophic Levels" using print sheets was next. The discussion continued until there were 20 minutes left in the class period. The discovery center used the remaining time.

The second day a few minutes were given to questions and answers from the day before. The topic for the second day's discussion was the 7 terrestrial biomes and the characteristics of each. With 15 minutes remaining in class the assignment for Day 2 was given to the students. Each student was given a different terrestrial biome. The students worked on the assignment using the resource materials placed in the room. I circulated throughout the classroom answering questions and directing students to the appropriate resource for their particular biome.

The third day I gave the students an unannounced quiz on trophic levels and food webs. I gave them a food web and asked them to identify the trophic levels of the different organisms. No student missed more than one question. After going over the answers to the quiz I went ahead with the aquatic zones and the characteristics of each. With 15 minutes remaining in class the assignment for Day 3 and The Final Activity assignment were explained and handed out. I again circulated through the room helping the students with their assignments. The Final Activity was an evaluation of all three objectives stated in the outline.

The students kept a regular notebook with all their assignments for a unit to be turned in at the time of the test. The teacher I worked with wanted the students to continue with this arrangement, so all work (KWL chart, notes, quiz, and the written assignment) was turned in at the end of the teacher's unit. The work was graded by the teacher and was described as fine, really neatly done, and well thought out. He also said the students scored similar to what they normally do on a typical test.

The main strengths of this resource unit were the interest level of the topic and the Final Activity. The topic was one that the students really seemed to enjoy learning about. They did not ask the often-heard question, "Why do we need to learn about this?" It is a topic that can be connected to so many students' own lives. I feel the other strength to this unit is the Final Activity research project. For a greater level of understanding the student must expand on the information that is given to them, and by completing this Final Activity I feel the students went through an expansion phase of the learning cycle. This Final Activity also brought together all parts of this unit.

The weaknesses in this unit were that I did not allot myself enough time for the information I set out to cover, and that the major concept was too broad for this type of planning. I also relied too heavily on whole class discussions.

I would correct this by narrowing the major concept and dividing it into two units instead of one. This would eliminate the need for as much whole class
discussion and open up the opportunity for individual discovery or invention by the students.

After working on this resource unit and actually going through the field trial I realized that the learning cycle lesson plan fits very well with science instruction. It does require extra time and effort to do it correctly, but the benefits can be great. It was somewhat difficult to fit into a high school classroom that was lecture based.

I think the students did learn from my unit. By completing the Final Activity assignment they were able to pull together what they had learned from me. This information was then ready to apply to the regular teacher's unit test.

**Discovery Center Field Trail**

My discovery center was designed for students in grade 10-12 with two purposes in mind. The first corresponds to the objective stated. The student will identify the trophic levels of organisms in a food chain. The second purpose for this center was to illustrate how important the producers are in an ecosystem. By modifying the Predator game into the Green World game it shifts the focus away from the top predators such as fox, bear, and bobcat to the producers (plants) that an ecosystem is truly based upon. The object of the Green World game is to collect as many energy points as possible. Energy points are assigned to each organism. Energy points are assigned according to the organism's trophic level. Producers have the highest energy levels while primary consumers have the next highest level. Predators, or upper level consumers, have the lowest level of energy points assigned to them.

The field trial took place in an Advanced Biology class. The class consisted of mainly Juniors. The discovery center field trial was completed the last 20 minutes of a class period. The class started with a KWL chart on "Energy Transfer". I followed with a discussion of the print sheets. The print sheets include a diagram to illustrate energy flow through an ecosystem, a real life example of energy transfer in a food chain, a pyramid diagram to illustrate energy transfer and energy loss, and a chart to show examples of trophic levels and their energy sources.

The 8 students were divided and given the Predator game cards and the Green World instructions. The students were then instructed that they had 15 minutes to play and would be given an assignment to complete. The students proceeded to play the game with only a few questions regarding the rules of play. While observing play I noticed that many were trying to obtain the top predator cards and not even trying to obtain any of the plant (producer) cards. At that point I stopped the games briefly and asked the students to read the object of the game again. Play then continued with more attention to obtaining plant cards. At the
end of 15 minutes the games were stopped and the energy points were totaled. I then handed out Day 1: Assignment A and B. Assignment A was to be completed by the end of class and Assignment B was to be completed at home. The students worked on their assignment the remaining time. Some of the students were able to complete Assignment A by the end of class.

The strengths of this discovery center were that the game was age appropriate and that the students enjoyed playing the game. The weaknesses were that I did not allow enough time for the game and that the students did not have experience playing the game. I think that if I were in my own classroom I would have had the students learn how to play the Predator game in an earlier unit. The emphasis on producers instead of predators would have been more noticeable if the students had been able to play both versions of the game.

The students did well with the concluding activity even though some of them had to complete it at home. The students made appropriate food chains and they were labeled correctly. The extension activity was also completed and the students were able to use the food chains they had made and turn them into food webs by adding organisms. The concluding activity for the unit provided the evaluation for the discovery unit.
### Members of Trophic Levels

<table>
<thead>
<tr>
<th>Trophic Level</th>
<th>Energy Source</th>
<th>Representative Organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Producers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photoautotrophs</td>
<td>Sunlight energy</td>
<td>Grasses, diatoms</td>
</tr>
<tr>
<td>Chemoautotrophs</td>
<td>Inorganic substances</td>
<td>Nitrifying bacteria</td>
</tr>
<tr>
<td><strong>Primary consumers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbivores</td>
<td>Primary producers</td>
<td>Grasshoppers, deer, krill</td>
</tr>
<tr>
<td><strong>Secondary consumers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary carnivores</td>
<td>Herbivores</td>
<td>Spiders, foxes, small squid</td>
</tr>
<tr>
<td><strong>Tertiary consumers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary carnivores</td>
<td>Primary carnivores</td>
<td>Penguins, bears</td>
</tr>
</tbody>
</table>
## Tuna Energy Transfer

<table>
<thead>
<tr>
<th>Producer</th>
<th>Primary Herbivore</th>
<th>Secondary Consumer</th>
<th>Tertiary Consumer</th>
<th>Consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diatoms</td>
<td>&gt;&gt;&gt;&gt; copepods</td>
<td>&gt;&gt;&gt;&gt; herring</td>
<td>&gt;&gt;&gt;&gt; mackerel</td>
<td>tuna</td>
</tr>
<tr>
<td>60,000kg</td>
<td>6,000kg</td>
<td>600kg</td>
<td>60kg</td>
<td>6kg</td>
</tr>
</tbody>
</table>

To gain 6kg of weight, a tuna would need to eat about 60kg of mackerel. (The energy in about 54 of the 60kg would be lost, either as heat immediately after feeding or as heat later in the tuna's life as it swims, metabolizes, and reproduces.)

In order for the mackerels to produce the 60kg needed by the tuna, they would have to eat some 600kg of herring. (The energy in about 540kg would also be lost.)

The herring, in turn, would have to eat some 6,000kg of copepods.

The copepods would need to eat some 60,000kg of diatoms.

An average tuna would weigh approximately 60kg.
GREEN WORLD GAME

Object:
To collect as many energy points as possible.

To Start:
Deal out all the cards. The player to the left of dealer starts with a SHOWDOWN.

To Play:
Players may ask for either a SHOWDOWN or a CHALLENGE.

In a SHOWDOWN a player starts by asking any other player for a SHOWDOWN. At a given signal, each of the two players lays down a card. If one card "eats" another, that player takes the "eaten" card. If neither eats the other, it is a STAND-OFF, and each returns the card to his or her hand and play goes on to the next person. If both cards "eat" each other, it is also a STAND-OFF. Cards are always returned to the hand.

In a CHALLENGE the player demands a certain card and shows the card with which he can take it. (John, I want your Grass card and I'm taking it with my Deer card.) He then wins the card and is entitled to another turn. (Note this is not so in a SHOWDOWN, even if someone wins. If the challenger was wrong, and the person he challenged did not have that card, he must give up his challenging card (the Deer card) to the person wrongly challenged and his turn is over.

When a challenger no longer knows where the cards are that he can take, he should ask someone for a SHOWDOWN, and this ends his turn.

Sometimes two kinds of animals can eat each other. For instance, preying insects eat spiders, and spiders eat preying insects. In a SHOWDOWN, neither takes the other. But in a CHALLENGE, the challenger does take the other card.

The two Death and Decay cards are very powerful. Thus there are restrictions on their use: (1) Death and Decay may be used as a challenging card only once in a person's turn. (It may be used in unlimited fashion in defending oneself in a SHOWDOWN, however.) (2) There are organisms that take Death and Decay cards: anything that consumes decaying or decayed material. In a SHOWDOWN, they provide a STAND-OFF with Death and Decay. In a CHALLENGE, the challenger wins. However, a person may capture only one Death and Decay card by CHALLENGE in any one turn.

Scoring: At the end of the allotted time, count the energy points to determine the winner. Energy points for each organism are given on the cards, with plants producing the most energy points. (The figures do not approximate real values.)
Final Activity

Assignment: Pick a Kansas ecosystem and using available resources complete the following.

1. Describe in detail the biome/aquatic zone that applies.
2. Chart a food web. Must include at least 8 organisms.
3. Label the trophic levels of each organism. Must have 4 different trophic levels.
4. Label each organism. (producer, carnivore, herbivore, omnivore)

Reflection

The wealth of information presented during the week's activities was tremendous. The teaching methods, the resource materials, the presentation of units and centers, and the lectures by Cami Liggett were put together to make a very interesting class. I feel this class was useful to me as an educator preparing to reenter the classroom.

I was impressed with the KWL chart. I had not seen this method used before, but I immediately wanted to use it in a classroom. I think the KWL chart will be useful to me as a high school teacher. I plan to use it to check for misconceptions and what prior knowledge my students are bringing to the class. I also can see its use in determining what the students want to know about what I am teaching.

The presentation of the Learning Cycle Lesson Plan was a little harder for me to grasp, but once we started working in small groups, and I was with someone that was used to writing lesson plans this way, I was able to understand how it fit together. I needed to look at the Exploration, Invention, and Expansion phases as 3 parts of a larger lesson. The Exploration phase is used to find out what the students know about a subject. The Invention phase is used to allow students to gain the information about the subject. The final phase, Expansion, requires the students to apply the information so it is actually able to soak in. So even though each phase might involve one or two separate lessons one needs to be able to see the larger picture to understand the concept. I also saw a correlation to the KWL chart. (What do they know, what information do they want to gain, and what did they learn)

The resource material provided by Roland Stein was fabulous. I can't believe I graduated with a degree in education from a Kansas college and did not know about the resources available through the Wildlife and Parks Department. I imagine I will refer to those resources often once I start teaching again. I also learned some things about Kansas's wildlife that I did not know.
The trip to the OWLS site was enjoyable. I can see how this could be a great resource for an inquiry based classroom. I think the decision to try for an OWLS site would be dependant on your location and the people around you and how much help could be provided.

The different Units and Centers presented during the class were interesting and well designed. I thought the 'Wheat' unit and the "Microbes" unit were especially interesting. The "Microbe" and "Crystal" units seemed closest to the level that I will be teaching. All the unit presentations generated ideas and gave me a look at the "bigger picture" for designing my own unit.

The visit to the Discovery Room and the tour of the museum were fabulous. The Discovery Room provided many ideas for centers in a science classroom. The tour of the museum was a learning experience for me as a teacher. I think that before a teacher takes a class to a museum they should know what is there and what the students will be seeing. The behind the scenes part of the tour gave me a much clearer idea of what a museum really is and what a fabulous resource it can be.

The information provided by Cami Liggett through lecture, handouts, Internet listings, and personal help will be very useful. I think all teachers, elementary or secondary should broaden their knowledge about their state. Cami provided extensive information about Kansas geology. She also provided information about Kansas minerals, Kansas' reptiles, and about keeping live animals in the classroom. She shared a wealth of information and has access to so much more. Cami must be a great resource for the teachers in that area.

This class was a learning experience on a number of levels. I learned a different teaching method for science. I learned about a number of natural science resources that are available to teachers. I was also exposed to a number of different teachers and the units they developed using the method presented in class. All of these learning experiences will benefit my teaching.