Curriculum Toolkit: Intro to Environmental Science

Lesson Plan

Part 1. Lesson Information

A. Lesson Name

Lesson 2: Energy Transfer and Material Cycling

B. Lesson Topic(s):

This lesson will focus on how energy and materials move through ecosystems and on how organisms interact with their environments. The influence of the First and Second laws of thermodynamics on ecosystem structure will also be discussed.

C. Lesson/Course Outcomes Map

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Lesson Outcomes</th>
<th>LO 1</th>
<th>LO 2</th>
<th>LO 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Student will be able to:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Explain how materials cycles for common nutrients (N, C, P, water) provide a</td>
<td>I/T/U</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>continuous supply of these nutrients to ecosystems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Conservation of matter)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Explain how energy enters ecosystems and how it is lost from ecosystems.</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(First and second laws of thermodynamics)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Draw food chains and food webs for familiar ecosystems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Postulate how limited nutrient and energy availability affect ecosystem structure.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*I=Introduce/overview; T=Teach in depth; U=Use/Apply/Practice

D. Instructional Materials

Required (texts/chapters, primary sources, electronic resources, etc.)

TED Talk: Biospere 2  
http://www.ted.com/talks/jane_poynter_life_in_biosphere_2.html

Additional NSC Course and STEM Bridge Material

None for this lesson

Materials, equipment, gear, resources, supplies, etc.

None for this lesson

**Part 2. Lesson Delivery**

**A. Set up/Preparation**

Provide:
- PowerPoint Lecture Notes.
- In-Class Assignments
- Homework Assignment
- Biosphere (optional) : $5-25

**B. Delivery**

**Powerpoint Presentation**

Duration: 45 minutes

In this lecture you will accomplish the following goals:

- Define the Environment (Review from previous class)
- Explain the Ecological Services and the benefits of a clean environment.
- Explain nutrient cycling and energy transfer using the concrete example of a food chain.
- Explain the relationship between the structure of environments/ecosystems and the physical laws of thermodynamics and conservation of matter.

**Starting Point**

Most students will be intuitively familiar with the basic needs of a goldfish or other pet. Therefore it is useful to start this lecture with a discussion of what a goldfish needs in order to survive. (Food, water, oxygen, temperature.) These needs can be classified into **abiotic**, and **biotic** components, and then the class can be led to discuss how these needs are met.
At this point biospheres (entirely self contained ecosystems) can be discussed. Biospheres are useful for talking about **ecosystem services** and **nutrient cycling** because the needs of each organism are provided for by the other organisms in the biosphere. The only input is sunlight.

A demonstration biosphere can be made or a video can be shown. Numerous videos can be found by searching Biosphere 2 and a TED video is listed in the course materials.

The remainder of the powerpoint can be delivered according to the instructions in the powerpoint notes. Manage the material so that sufficient time can be spent on biodiversity and the relationship between the physical laws and ecosystem structure.

**Learning Activities – Sources of Assessment Evidence**

**Lecture**: Powerpoint slides provided.

**In-class discussion questions**: Integrated into Powerpoint, see Powerpoint notes.

**In-Class Assignment**: Provide students with the In-Class worksheet for this lesson. The in-class worksheet may be done in groups of two or individually, but students should be encouraged to ask questions of the instructor and each other. The instructor should move around the classroom helping students as needed.

The intent of this assignment is to allow students to check their understanding of the material from the lecture. It should be graded pass-fail based on whether the student has participated in the activity. Students that do not complete the assignment in the allotted time must complete it for homework.

**Homework Assignment**: (Suggested Time Allowed: 1 week)

Provide students with the homework assignment for lesson 2. Although the focus of the assignment is on identifying, and correctly citing sources students may believe they are being asked to write a paper. Stress to students that they are not required to write a paper and that they should contact you if they have questions while they are doing the assignment.

**Quiz** (To be given the beginning of the subsequent class): The quiz is meant to encourage students to review the material and to assess learning. It should be given in the first 5 minutes of the subsequent class.
Part 3. Evaluation

A. Assessment

Lecture Discussion Questions and In-Class Assignment Evaluation Criteria:

1. Are students actively participating in the class?
   
   Rating Scale- F=Absent or Not Participating; A= Participating

Homework Assignment

Has the student met the requirements of the homework assignment as defined in the rubric? (Attached to Homework Assignment)

Rating Scale- F= 0; D=3; A=5

Quiz

What percentage of the key concepts for the lesson did the student understand as defined by the quiz key. (Key is attached to Quiz)

Rating Scale – F<60%; D=60-65%; C=70-75%; B=80-85%; A=90-100% )

B. Course Log

Evidence of learning (Summarize the extent that the lesson outcome(s) were achieved by the group based on the assessment evidence.)

Sticking Points (Identify the topics that were difficult for students to grasp based on informal observations and formal assessments.)

Coaching Notes (Suggest strategies to address the difficulties identified and other lessons learned from teaching this unit.)