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Energy Pyramid

Brian Dinitto
The College at Brockport

Stephen Pudiak
The College at Brockport

David Rogers
The College at Brockport

Final ***integrated*** **project / lesson plan** (teams-Due: Thursday, August 12th)

Submit as hard copy AND electronically through ANGEL

Names: Brian DiNitto, Stephen Pudiak, David Rogers
Grade level(s)/Subject taught: 9, Biology, Math
Objectives: *The students will explore the concept of energy transfer from the sun to plants to animals. Interpreting graphs, reading tables, predicting results when variables in a model are changed will be skills used by the students.* Students will manipulate model of energy from the sun to see how it impacts the energy transferred to autotrophs - plants, primary consumer - herbivore, secondary consumer – carnivore. In other words the energy flow through food chains on the planet Earth. Students will learn modeling; determine the impact of constraints – modifiers to sunlight and energy transfer efficiency as well as learning to interpret plots of energy accumulation over time, to plot log10 versus log 10 graphs in Stella and on the TI84 calculator. The model will be converted to a JAVA application that can be used by all students and teachers via a web browser.

Describe the *integrated* Mathematical - Science Concepts or "key ideas" that modeling will be used to teach: (e.g. Students use mathematical modeling/ multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships and… Organisms maintain a dynamic equilibrium that sustains life).

Mathematical - Science Concepts to be integrated:

The science concept is that all or most energy for life on the planet Earth comes from the Sun. Energy in the food chain is not transferred and utilized at 100% efficiency. There is loss due to heat. Initially autotrophs – plants receive the Sun's energy and through photosynthesis convert energy and raw materials into food – sugar and cellulose that can be digested by primary consumers – herbivores to gain energy. The modeling will demonstrate using tables and graphs that the energy acquired is less than delivered by the Sun, as food moves up the food chain. NYS core curriculum standards and key ideas are detailed in the lesson plan below.

In addition, this lesson involves the following from the New York State Mathematics Standards:

Measurements – Students perform measurements of graphs and tables to see the real-world effects of changes in the data produced from the model.

Modeling – Students use a Stella model to see the effects of cloud cover on energy absorption in the energy cycle.

Number and Numeration – Use number sense, ratios and percentages to show relationships for energy transfer.

Using the Stella Modeling Tool, I plan on having my students…
(software / modeling tool)

Science Component – Lesson Plan

Goal:
Students will demonstrate the understanding of energy flow through a food chain in various ways such as journal entries, oral discussions, written laboratory report.

NYS Standards and Key Ideas:
Standard 4, Key idea # 6: Plants and animals depend on each other and their physical environment. Alternate idea: Human decisions and activities have a profound impact on the physical and living environment.

Objectives:
Students will be able to:

1. Recognize the basic components of a food chain. Name and list the tropic levels from the Sun through at least three levels of consumers.
2. Explain and write the definitions of the following terms correctly:

Tropic level	Food chain	Carnivore
Physical condition	Producer	Predator
Omnivore	Consumer	Prey
Decomposer	Herbivore	Biotic
		Abiotic

3. Label a diagram of the food chain with the producers, consumers, decomposers and calories of energy.
4. Evaluate a graph of energy and food consumption.
5. Explain the significance that green plants make all food and the relationship to their place in the base of the food chain to other organisms – the consumers and decomposers.

Classroom procedure:
Students work individually.

A. Scientific Explanation:

Provide students with reading and other reference material that will allow them to answer the question:

1. What is a food chain?
2. How is a food chain formed?
3. What are the parts of a food chain?
4. What is being moved along the food chain?
5. What / Who is the primary source of energy in the food chain?
6. Name at least one factor that can affect a food chain?
7. Name at least one activity/decision/behavior of humans that can affect the food chain?

B. Focus:

Students use a source within the classroom to define each of the terms listed in objective # 2. Students are to write definitions in the vocabulary section of their notebooks. Students will make a set of flash cards (word with illustration on one side and the student's original definition on the other side.

C. Challenge phase:

Students will form groups of 2-3 people. While observing the computer model, completing several runs of the model ecosystem, the recorder lists the important findings. Entries are to be made in the group journal.

Each student group study data, then select one (1) variable to manipulate and predict the outcome. Make the change (1) and run the simulation. Record the outcome and refer back to the prediction. Describe the outcome. (What happened? Why?) Repeat for all manipulations available on the knobs of the model. (A graphic form may be developed by the teacher or independently by the students)

Each student group devises an explanation/description of how/what human activities could be representative of changes experienced with the manipulations in the simulation/model.

Each student group research and report on sources of inefficiencies of energy transfer found in the ecosystem.

Each student group use materials available in the classroom to construct possible food chains.

Each student group develops at least five vocabulary questions and at least five content questions based on the activity.

D. Assessment:

Each student group prepares a written laboratory report (each students submits an original). The report follows class standard and good English conversions.

Each student group prepares a brief oral presentation (10 minutes) that outline the key results and conclusions of the laboratory report.

All students in the class will tested on:

a. Part a will be vocabulary questions
b. Part b will be student generated content questions
c. Part c will be sample regents exam questions representative of the material in this modeling laboratory.

Also see rubrics below in this document.

Mathematics Component – Lesson Plan

The Last Day of the Sun

Procedure:

Intro: Where does the energy we use come from? Have the class name some forms with energy we use.

Ex: oil, gasoline, food, candy bar, chips, milk, soda, etc.

Teacher elaborates on certain ones and has class brainstorm the source of this energy.

soda -> sugar -> sugar cane -> sun

milk -> cow -> cow feed -> sun

When you burn wood, you are releasing the heat and light stored in the wood when a tree was young.

Our lesson today will explore what would happen if the sun didn't rise tomorrow, or ever again.

Introduce the model of the energy transfer and the dials for initial sun energy and cloud cover.

Have the students look at the energy graph and table that shows the energy transfer between the sun to plants to herbivores to carnivores. Pose questions that have the students interpret the graph. Questions such as "How long can we survive without the sun according to this model?"

Give the students the following worksheet and have them work in pairs to answer the questions.

Worksheet:

Answer the following questions about the data:

1) What does line 1 in the graph represent? Why does the line 1 go straight down?

2) Why does line 2 start small, increase and then decrease? Where does its energy go?

3) According to the chart, at what day does the highest level consumer (top feeder) run out of energy? What could be done to extend this energy for a longer time?

4) When cloud cover is increased to 0.8, what effects should be seen on the table? Show the data produced from 0% cloud cover and 80% cloud cover in the model. How many days does this lessen the time it takes for carnivores to run out of energy? Which line in the graph is not affected by the clouds? Why?

5) How much energy was "lost" from the transfer of energy from the sun to plants, plants to herbivores, herbivores to carnivores? Express these as a ratio and percent. Which transfer of energy is most efficient?

6) What happens to the energy that was not transferred from the sun to the plants?

Ex: Math rubric

Target	Acceptable	Unacceptable
Students can calculate the area of a rectangle given the width and height.	Students can demonstrate the area of a rectangle given two single digit dimensions with no prompts.	Students can demonstrate the area of a rectangle given two single digit dimensions with one or more prompts.
Students can define the concept of the conservation of area.	Students can give their own example of the concept conservation of area with one prompt.	Students can give their own example of the concept conservation of area with more than one prompt.
A group of two students can successfully find a new rectangular container that just holds all the red particles in the model.	Students can independently find a new container that just holds all the particles and can name its dimensions.	Students need one or more prompts to find a container that can just hold all the red particles. They need prompts to name its dimensions.
The group of two students can state the relationship between the dimensions of the new and the original container; they are factors of the same number.	Students independently derive a relationship between the dimensions that their products are equal.	Student need at least one prompt to state that the dimensions represent pairs of factors of the same number.
Students can state and provide evidence for their rule of the movement of the red particles in the model	With one prompt, the student can clearly state the rule and provide evidence from the running simulation to back up the correctness of his rule.	With more than one prompt, the student can clearly state the rule and provide evidence from the running simulation to back up the correctness of his rule.

Rubrics continued for Science and presentation.

http://www.ncsec.org/team2/eval.htm

Assessment and Evaluation Techniques:

- Students will create lab reports that will be evaluated by the instructor. The reports will be scored using a rubric with which they are familiar.
- Students will produce graphical representations of the motion of the pendulum using a STELLA model. These will be scored using a scoring rubric for STELLA models.

Assessment Rubric for Lab Report

The scoring rubric has four parts: Planning, Data collection, Data analysis, and the Conclusion. Each part is scored on a scale from 0 to 3 as follows:

Planning	3	Defines problem, formulates hypotheses with appropriate variables, designs experimental method
	2	Problem definition is unclear, stated hypothesis or variables not complete, poor experimental method
	1	Any one of the three components is not included
	0	Not Attempted
Data Collection	3	Data collected and recorded, raw data is organized and presented
	2	Data collected and recorded, raw data is poorly organized and presented
	1	Either of the two components is missing
	0	Not Attempted
Data analysis	3	Processes raw data correctly, presents processed data appropriately
	2	Processes raw data correctly, data not presented appropriately
	1	Any one of the three components is not included
	0	Not Attempted
Conclusion	3	Processes raw data correctly, presents processed data appropriately
	2	Processes raw data correctly, data not presented appropriately
	1	Any one of the three components is not included
	0	Not Attempted

SAMPLE STUDENT LAB with RUBRIC

STELLA Model Scoring Rubric

The following rubric is designed to measure these objectives:
6. Use STELLA modeling software to model simple problems.
7. Build and explain a STELLA model of the period of a pendulum.

OUTSTANDING	**4**	The participant, using analysis, has developed a deep understanding of the system being modeled.
		The system diagram and information flows accurately represent the key parameters in the system.
		The equations specifying the relationships between the parts of the system demonstrate a comprehensive integration of the available data and known theory regarding the system.
		The model has been thoroughly tested against a variety of conditions.
GOOD	**3**	The participant, using analysis, has developed a good understanding of the system being modeled.
		The system diagram and information flows accurately represent many of the key parameters in the system.
		The equations specifying the relationships between the parts of the system demonstrate a mostly complete integration of the available data and known theory regarding the system.
		The model has been tested against a variety of conditions.
FAIR	**2**	The participant has developed a basic understanding of the system being modeled.
		The system diagram and information flows accurately represent only part of the key parameters in the system.
		The equations specifying the relationships between the parts of the system demonstrate an incomplete integration of the available data and known theory regarding the system.
		The model has been tested against a few conditions.
POOR	**1**	The participant has exhibited a lack of understanding of the system being modeled.
		The system diagram and information flows are inaccurate representations of the key parameters in the system.
		The equations specifying the relationships between the parts of the system demonstrate a lack of understanding of the available data and known theory regarding the system.
		The model has not been tested.

Bibliography:

1. Food Chains. Kimball's Biology Pages. 22 Jan 2004. http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/F/FoodChains.html
2. Energy and Human Evolution. David Price. March 1995. Population and Environment: A Journal of Interdisciplinary Studies. 16(4): 301-319, March 1995.Human Sciences Press, Inc. <http://dieoff.org/page137.htm>