Pedagogy 3: Ocean Lesson Plan

It's All Connected: Trophic Tag

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(I have seen many variations of this lesson and made very few modifications. I substituted the marine organisms for the prairie organisms that I usually use)

Parameters:

This lesson plan would be appropriate for middle school students learning about the concept of energy flows in ecosystems. In Kansas this addresses:

Standard 3: Life Science
Benchmark 4: The student will identify and relate interactions of populations of organisms within an ecosystem.
Indicator 3: The student races the energy flow from the sun (source of radiant energy) to producers (via photosynthesis – chemical energy) to consumers and decomposers in food webs.

Depending on discussions this activity would take one or two 50-minute class periods.

Description:

In looking through our current district and state curriculum, there are not indicators that explicitly include the Ocean Literacy Principles. I found this lesson plan that is a game where students learn about the ecological balance, interdependence and tropic energy in marine food webs. We do have indicators around the flow of energy through an ecosystem (see above) so why not use a marine ecosystem to teach this concept! The goal of this game is to achieve a balanced marine ecosystem, and I believe that the learnings can be applied to any ecosystem. This lesson/games supports the Ocean Literacy Principle 5d (the ocean supports a great diversity of life and ecosystems).

http://teachoceanscience.net/teaching_resources/ocean_science_curriculum/ocean_primary_production/marine_food_web/it_s_all_connected_trophic_tag/

The objectives for this lesson plan/game are:

- Students will illustrate the concepts of ecological balance and interdependence through role playing
- Students will understand where energy comes from in an ecosystem
- Students will simulate the various roles in a marine ecosystem and transfer that knowledge to a local ecosystem

Procedures:

- Begin by asking the following question:
  Where does energy in any ecosystem come from?
- Review food chains by giving groups of student's food chain cards (organisms) and have them line up in the order of a food chain. (Formative assessment: check each groups 'line up' and ask questions about why they choose to line up in the order they did. Make any corrections). This is a time to review the concepts of energy flow through an ecosystem. Using organisms that students will be familiar with will support them as they begin this activity. Since this activity is going to use ocean organisms review the various organisms that will be used in this simulation. These include phytoplankton, copepods, bay anchovies, striped bass, bacteria, and fishermen.
- Provide students with organism ID cards (make these by typing the names and a description of the organisms to be used in this simulation on cards)
- Identify the boundaries of your ocean ecosystem (maybe your classroom or an area in a pod out other open area).
- Use ping-pong balls to represent plankton and place these randomly around the playing area, reserving some for use in Round 3.

Rules

Everyone has to stay within the boundary.
Everyone has to stop "feeding" promptly when instructor indicates.
No running: copepods can only hop because this is how copepods move in the water; fish can power walk.

There will be 5 rounds

Round 1: Primary consumers (15-30 copepods)

- Distribute a copepod ID tag to each student.
- Hand students a stomach (gallon size plastic bag). Students can place ID cards in their plastic bags. Have them start "swimming"/hopping around the ecosystem.
- When you say go, students will try to fill their stomachs with as many "phytoplankton" as they can.
- Start the round, continuing until all phytoplankton are consumed.
- Give a signal to stop feeding. (Formative assessment: Ask students which copepods survived, what happened to all the food).
- Introduce concept of carrying capacity: that resources in a system can only support certain number of organisms indefinitely. (Formative assessment: Ask students to write what will happen in the bay now that all the food is gone? How could we balance the Bay?).
- Have students return plankton to the playing area.

Round 2: Secondary consumers (switch out 4-6 copepods with bay anchovies, depending on class size)

- Place 2 hula-hoops in the ecosystem as hiding places for copepods. Only one person at a time can hide in a hula-hoop for only 5 sec at a time, and students must take 5 steps away from the hula-hoop before reentering.
- Add secondary consumers to the ecosystem. Tell students that bay anchovies eat zooplankton, like copepods. The anchovies are now "it" and need to tag copepods. If a copepod is tagged, he/she is eaten and has to empty the contents of his/her stomach into the anchovy's bag, then sit out on the side. Meanwhile, copepods are still hungry—they still need to eat while trying to avoid the predators.
- Begin feeding, continuing until most of the plankton have been eaten. How many copepods have plankton in their stomachs? Those copepods survived. How about the anchovies?
- (Formative assessment: Ask students to write what will happen in the bay now that all the food is gone? How could we balance the Bay? What would happen to the food if we kept playing? Is there anything missing?).
- Have students return plankton to the playing area.

Round 3: Decomposers (switch out 1-4 copepods with bacteria—there are actually more bacteria than this in the real world, but this number works for the game)

- Now when copepods are tagged, they hand over half of their "phytoplankton" to the anchovy, then go to the side and pair up with a bacterium to start the decomposition process: bacteria decompose dead things and organic matter (like waste, food particles from sloppy feeding, etc.), releasing nutrients. Since nutrients fuel phytoplankton growth; the pair can throw the copepods left over ping-pong balls back into the ecosystem. These phytoplankton provide new food for the copepods.
- Start this round of feeding. If things are going well, you can add some copepods back into the game to illustrate reproduction. Stop until most phytoplankton are consumed or after the ecosystem persists for a few minutes.
- (Formative assessment: Ask students to write how many copepods survived? Anchovies? How did the bacteria impact the system? Is the system balanced? Is anything else missing?)
- Have students return plankton to the ecosystem.

Round 4: Apex predator (switch out 1-3 copepods with rockfish/striped bass)

- Replace a copepod with a rockfish. You can have some copepods switch out with anchovies/bacteria as well so that everyone gets a chance to be "it."
- Rockfish eat anchovies. Anchovies still eat copepods, copepods still eat phytoplankton, and bacteria are still decomposers. Again, if a student is tagged, he/she hands over half of his/her phytoplankton to the predator, then sits on the

side to share the rest of the phytoplankton with bacteria, throwing the phytoplankton back into the game. Hula hoop rules still apply (one critter at a time, no hovering near the hula-hoop).

- How many of each species survived? Is the ecosystem in balance? If not, how could you adjust the number of each organism to achieve balance?

Round 5: Humans as apex predators (switch out 1-2 copepods with fisherman/woman)

- Discuss how people are part of an ecosystem and how they might impact it.
- Select a copepod to be a fisherman. Fishermen need to first find bait—by tagging and linking arms with an anchovy—before they can fish. The linked anchovy and fisherman try to catch a rockfish. The fisherman takes any caught rockfish and his/her food to the edge of the lake. At the end of the round, ask what happens to the energy from the rockfish caught by the fisherman.
- Determine who survived and whether the system is in balance (there should be more copepods than anchovies, more anchovies than rockfish, etc. (Formative assessment: Ask students to write what would happen if there were too many rockfish? What would happen if fishermen caught too many rockfish?)
- If there's time, try to balance the system by adjusting numbers of each species.

After completing the 5 rounds, review the major concepts of the activity/game (energy flow, primary consumers, secondary consumers, tertiary consumers and apex predators, and food webs). Follow with the big picture of how everything in an ecosystem is connected and the sun is the energy source.

Assessment:

The most appropriate way to assess this activity/game is through formative assessment. I listed those throughout this activity. I would have students write answers to questions and then have a brief discussion with classmates if there is any disagreement. I would listen to these discussions and supply correct answers if necessary. The following rubric could be used to assess participation in the activity as well as asking student to diagram on paper the energy flow in a prairie ecosystem (familiar) and another marine ecosystem.

	5	3	1/0
Participation in simulation	Actively participates in simulation	Participates in simulation	Does not participate in simulation
Energy flows in familiar ecosystem	Correctly identifies energy flows in familiar ecosystem	Partially identifies energy flows in familiar ecosystem	Incorrectly identifies energy flows in familiar ecosystem
Energy flows in the marine ecosystem	Correctly identifies energy flows in the marine ecosystem	Partially identifies energy flows in the marine ecosystem	Incorrectly identifies energy flows in the marine ecosystem