Youngstown City Schools

SCIENCE: BIOLOGY - - Grade 10

Unit #6: ECOSYSTEMS (4 WEEKS)

SYNOPSIS: Students will consider how change mechanisms within an ecosystem (such as population size, species competition, and chemical and physical constraints) can threaten the intricate biological balance and ultimate survival of the ecosystem. Students will study various locations near them (i.e., pond water, school locations, the Mahoning River) to find out if the ecosystem is capable of supporting life. Students will see how fluctuations in biological and geological conditions can alter the flow of energy and the cycle of matter within an ecosystem. By the end of the Unit, students will analyze various scenarios about ecosystems to identify what is occurring and how to remedy disequilibrium; students will also take and defend a position about the disequilibrium theory.

STANDARDS

III. DIVERSITY AND INTERDEPENDENCE OF LIFE

B. Ecosystems

1. Homeostasis is the condition of balance created by various relationships in an environment.
    a. some ecosystems have persisted over hundreds or thousands of years
    b. misconceptions exist about population growth capacity, interspecies and intra-species competition for resources, and what occurs when a species immigrates to or emigrates from ecosystems
    c. physical/chemical constraints have an effect on all biological relationships and systems
    d. mathematical graphing and algebraic knowledge are used to explain carrying capacity and homeostasis within biomes
2. The mechanisms of homeostasis can be expressed with mathematical models; these include - -
    a. the use real-time data to investigate population changes that occur locally and regionally
    b. the exponential growth model and the logistic growth model
    c. the logistic growth model of $dN/dt = rN (K-N/K)$ [the only new variable added to the exponential model is K for carrying capacity]
    d. mathematical graphing and algebraic knowledge must be used to explain concepts of carrying capacity and homeostasis within biomes

    Note 1: Exponential growth equation in simplest form, change in population size *N* per unit time *t* is a product of *r* (the per capita reproductive rate) and *N* (population size).

    Note 2: Carrying capacity is defined as the population equilibrium sized when births and deaths are equal; hence *dN/dt = zero*

    Note 3: Constructing food webs/food chains to show interactions between organisms within ecosystems is not appropriate for this grade. Students may use these diagrams to help explain real-world relationships or events within an ecosystem, but not to identify simple trophic levels, consumers, producers, predator-prey and symbiotic relations.
3. Deviation from the Hardy–Weinberg equilibrium denotes the evolution of a species.
    a. ecosystems tend to have cyclic fluctuations around a state of rough equilibrium
    b. ecosystems always change as geological and biological conditions vary
    c. organisms transform energy (flow of energy) and matter (cycles of matter) as they survive and reproduce. The cycling of matter and flow of energy occurs at all levels of biological organization, from molecules to ecosystems
    d. the concept of energy flow is unidirectional in ecosystems

LITERACY STANDARDS: READING (RST) and WRITING (WHST)

RST.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

21ST CENTURY SKILLS

I. Core Subjects and 21st Century Themes

A. 21st Century Themes

5. Environmental Literacy

a. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as it relates to air, climate, land, food, energy, water, and ecosystems.
b. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
c. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions

II. LEARNING AND INNOVATION SKILLS
B. Critical Thinking and Problem-Solving

2. Use Systems of Thinking
   a. Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

4. Solve Problems
   a. Solve different kinds of non-familiar problems in both conventional and innovative ways
   b. Identify and ask significant questions that clarify various points of view and lead to better solutions

<table>
<tr><th>MOTIVATION</th><th>TEACHER NOTES</th></tr>
<tr><td>
1. The teacher leads students through the "Lynx Eats the Hare" (or another predator-prey) simulation to illustrate balance in the environment as an example of homeostasis.

2. Teacher provides an Anticipation Guide - - pre-assessment - - dealing with Ecological Misconceptions; students complete a table that indicates they agree or disagree with each item, including a rationale. May be done individually or in 2s / 3s. http://ecomisconceptions.binghamton.edu.ecosystem.htm.

3. Teacher pulls together the Anticipation Guide responses to discuss responses, dispel misconceptions.

4. The teacher helps students establish both academic and personal goals for this Unit; the students record these in their Notebooks. e.g.,
<table>
<tr><th>Sample Personal Goals</th><th>Sample Academic Goals</th></tr>
<tr><td>a. Write daily assignments in notebook (planner)
b. Follow classroom rules 3 of 5 days (60%)
c. Come to class prepared (materials, supplies) 80%</td><td>a. Bring to class an example from real-life of something being studied in our Unit
b. Explain learning goals each day to a peer</td></tr>
</table>

5. The teacher previews the Authentic Assessments for the end of the Unit.
</td><td>bold text = featured vocabulary</td></tr>
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<table>
<tr><th>TEACHING-LEARNING</th><th>TEACHER NOTES</th></tr>
<tr><td>
1. Science Vocabulary Strategy
Teacher
a. post words in room on chart paper; allow to hang at least throughout the Unit
b. deal with roots and affixes (if appropriate)
c. use a diagram to illustrate the meaning of a term (e.g. alleles; density)
d. relate each term to a similar word and/or a familiar like-word, and teach the opposite word (e.g., immigration . . . . migration . . . . emigration)
e. in the course of teaching, <u>define</u> the word in context (never in isolation)
f. throughout the Unit, frequently <u>use</u> the word
Students
g. use the words in (1) discussions, notes, diagrams; (2) investigations and write-ups; and (3) 2- and 4-point items
h. use the terms in Rubrics for the Authentic Assessments
</td><td></td></tr>
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TEACHING-LEARNING	TEACHER NOTES

immigration **emigration** **ecosystem** **equilibrium** **disequilibrium** **constraints**	**homeostasis** **carrying capacity** **population** **exponential growth model** **logistic growth model** **intra-species competition** **interspecies competition**	**ecosystem** **[re: biome]** **organism** **energy cycles** **cycles of matter**

2. The teacher directs students to a picture of the deer and the wolf with accompanying graph in text; students attempt to determine how the graph works re: predator-prey. Teacher tells Yellowstone Story (or use PBS Video "In the Valley of the Wolves") and asks thought-provoking what-if questions about **immigration** and **emigration**. **(IIIB1a)**

3. Teacher revisits the cockroach anecdote, inserting a competing species (e.g., a rat); students record how this impacts the **ecosystem**. [**Manfred** getting more info on the anecdote] **(IIIB1b)**

4. The teacher directs students to analyze a text that illustrates ecological abuse; students cite text evidence to support their analysis (i.e., what are the effects of imbalance on the **equilibrium** of the **ecosystem**? And what needs to happen to fix the **disequilibrium**?) **(IIIB3)** (**RST5).**] [Re: Mahoning River article, Directed Reading Guide] [Mahoning River article **included with *Unit Plan***]

5. Teacher demonstrates an oil spill; students will make predictions about physical and chemical **constraints** and draw what they observe. **(IIIB1c** [**hard-copy included with *Unit Plan*]**

6. **Pond-Water LAB.** Teacher explains and models how to collect water samples; students collect water from two (DIFFERENTIATION - - multiple water sites. The teacher models how to examine or observe the samples and record data. Students will make predictions as to which water - - representing an ecosystem - - will support the greatest diversity and maintain its **homeostasis**. Students then compare the two [or more if DIFFERENTIATION] ecosystems to determine the effects of physical and chemical constraints on the organisms living in the water samples. Students determine which water sample is capable of supporting the greatest diversity of **organisms**, using data from the water samples to support their answer. **(IIIB1a,c)** [see also www.science-class.net] ["**Examine an Ecosystem" article included with *Unit Plan***]

7. The teacher uses a PowerPoint to illustrate and give examples of **exponential growth model** using **population** from the beginning of time until now; teacher will ask students questions to check for understanding, including cause-effect and 'what-ifs.' KEY: once the population hits its "**carrying capacity**," then the exponential growth becomes **logistic growth model**. Students take notes, recording key vocabulary and sample graphing problems. **(IIIB2a,b,c,d)**

8. The teacher takes students through a simulation where students manipulate the wolf and moose population in a predator-prey scenario. Students are introduced to **competition** in terms of **Intra-species** and **inter-species competition**. Students complete the enclosed **activity packet** to answer multiple levels of questions. **(IIIB2a,b,c,d)** information for EcoBeaker Lab and Course Pack – simbio.com/products-college/EcoBeaker.
9. Bacteria Lab -The teacher models for students how to use Petri dishes to collect samples. Students make predictions about the various bacteria around school. They then collect bacterial specimens from around the school (e.g., drinking fountains, sink handles), place in Petri dishes, and label each dish as to time and place collected. Students view their samples daily to count the growth of bacteria colonies; they draw, count, and measure, recording the data they observe. As part of completing their lab write-ups, students include their predictions, formulate valid conclusions, and indicate how close their predictions were to being accurate. Depending on the success of data collected, students can graph growth models from the data.

TEACHING-LEARNING	TEACHER NOTES
(IIIB2a,b,c,d) **An alternate activity:** Some similarities exist between the Spread of an Infectious Disease and Population Growth; see hard-copy with Unit Plan. Data are generated from the actual class activity which can be used by students to do growth model calculations and graphing. **(IIIB2a,b,c,d)** 10. The teacher will arrange a field trip (or a video) to the Patriot company in Warren, Ohio **- -** where they recycle brine water. Students will take field notes / draw pictures of what they observe and explain how this process is beneficial to the local environment. **(IIIB1c)** 11. The teacher will show a diagram or chart **- -** preferably, hand-drawn and spontaneous to model constructive teaching ☺ **- -** to summarize Unit and review the **cycles of matter**: the WATER cycle, CARBON cycle, and NITROGEN cycle. Also include the Energy Pyramid. Students record the drawings in their notes, inserting original examples of each **energy cycle** from their own lives. Key points to illustrate and reinforce: **(IIIB3a,b,c,d)** [informational text "Processes of Ecosystems" article included with Unit Plan] a. equilibrium b. conservation of matter c. conservation of energy d. recycling	

TRADITIONAL ASSESSMENT	TEACHER NOTES
1. Unit Test that includes test items for standards **(IIIB1a,b,c,d) (IIIB2a,b,c,d) (IIIB3a,b,c,d)** (a) Multiple Choice items (b) 2- and 4-pointquestions	

TEACHER CLASSROOM ASSESSMENT	TEACHER NOTES
1. 2- and 4-pointquestions 2. Compilation of notes, worksheets, lab write-ups	

AUTHENTIC ASSESSMENT	TEACHER NOTES
All of these are "on-demand" rather than outside the classroom. **Each** student must do #1 and #2 and select between #3 and #4 **- -** 1. Students analyze an "out-of-balance" ecosystem to determine what went wrong, how it could have been prevented, and what steps are needed to rectify the situation. **(IIIB1a,d)** 2. Students work with real data on a given population scenario; graph the populations and offer explanations for the scenario. **(IIIB2a,b,c,d)** 3. Students are given a "what-if" scenario with causes and effects of biological change and they explain how the change impacts the flow of energy and the cycles of matter. **(IIIB3a,b,c,d)** **4.** Students take a position, defend it, and create a visual to illustrate it **- -** related to equilibrium theory **(IIIB3a,b,c,d)**	

BIOLOGY Unit 6: ECOSYSTEMS (4 WEEKS)

MULTIPLE LEVELS OF QUESTIONS

Level I

1. [T-L 1.] What is meant by *morphology*, including an example?
2. [T-L 2.] What is meant by *population growth,* including an example?
3. [T-L 2.] What is meant by *competition,* including an example?
4. [T-L 2.] What is meant by *immigration* and *emigration,* including an example?
5. [T-L 6.] What is meant by *homeostasis*, including an example?
6. [T-L 7.] What is *exponential growth,* including an example?
7. [T-L 7.] What is *logistical growth,* including an example?
8. [T-L 7.] What determines the *carrying capacity* of a population?
9. [T-L 8.] What is *intra-species* competition, including an example?
10. [T-L 8.] In a woodland area with an over-population of rabbits, how would the scenario change if a pack of wolves were introduced?

Level II

11. [T-L 1.] What is the difference between *inter-species* and *intra-species* competition?
12. [T-L 2.] What is the relationship in terms of population growth between a fox and a rabbit?
13. [T-L 5.] What would you predict would happen to a pond-water ecosystem if oil were accidentally introduced?
14. [T-L 7.] What is the difference between an exponential and a logistical growth model, including examples?
15. [T-L 7.] Why is carrying capacity important to living things?
16. [T-L 8.] What is the difference between *inter-species* and *intra-species* competition?
17. [T-L 11.] How would you explain the difference in (a) the cycles of matter and (b) the biodiversity of life in the tropical rainforest and the tundra?

Level III

18. [T-L 6.] If you re-visit the source of your pond water sample. How would you determine if other factors were impacting the growth and survival of the organisms?
19. [T-L 7.] Considering the factors that cause a population to reach carrying capacity - - famine, disease, and war - - how would you rate them in the order of importance? Justify your rating.
20. [T-L 8] In a woodland area with an over-population of rabbits, how would you describe the role of intra-species competition?
21. [T-L 11.] What if an ecosystem undergoes a drastic environmental change (e.g., an increase or decrease in temperature; far more or far less precipitation; etc.)? What would you predict will happen in terms of the equilibrium and disequilibrium of that environment, including evidence to support your answer?