Lesson 3: Populations Dynamics

Delivery Time

This lesson contains approximately three hours of lecture, class discussion, and class activity work.

Course Outcomes Supported

This lesson supports the following course-level learning outcomes. For the complete list, see the NSC Environmental Science Technology Syllabus included in this Teaching Toolkit.

Following successful completion of this course, the student will be able to:

- **Reviewing Scientific Research**
  - Distinguish reliable and unreliable sources.
  - Synthesize a conclusion based on information from multiple sources.
  - Correctly cite sources in written work.

- **Effective Communication**
  - Hold a logical discussions on issues in environmental science.
  - Write fluently in brief, accurate technical style.

- **Human Interaction with Environmental Systems**
  - Identify major local and global environmental issues.
  - Propose solutions to environmental problems.
  - Weigh the needs of various stakeholders when considering environmental issues.

Lesson Learning Outcomes

Following this lesson, the student will be able to:

1. Describe Exponential Population Growth, Carrying Capacity and Limiting Factors.
2. Describe the effects of overpopulation.
3. Describe Population Cycles.
4. Conduct an experiment using a model that simulates population cycles.
Instructional Resources

Recommended Textbook(s)

None

Reference Materials

Resources for writing a scientific paper:

Bates College: http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html

Colorado State University: http://writing.colostate.edu.guides_guide.cfm?guideid=83

Facilities and Equipment

Classroom must have enough room to clear a 12 by 12 foot area.

Materials and Supplies

5-7 reams of different colored paper, 10-sided die or random number generator, object to be used as a marker in population experiment, masking tape, ruler, yard stick.

Health, Safety, and Other Issues

None

Preparation and Setup

- Review PowerPoint presentation.
- Review provided activity on population response to an infectious disease and acquire materials. Clear at least 12 by 12 feet of classroom space.
- Review provided quiz or prepare assessment tool based on course materials.
- Prepare scoring guides, such as a rubric or answer key, for assessment tools.
- Prepare student handouts and resources.
Lesson Delivery

Topics Covered

1. Population Ecology
2. Limiting Factors
3. Implications for Human Society

Lecture/Discussion

- Discuss lesson topics using provided PowerPoint presentation. The PowerPoint is intended to introduce students to the basics of population dynamics. It should be delivered relatively quickly, but you should ask questions, or use think-pair-share activities in order to ensure students understand the concept.
  - Why is the concept of population useful?
  - What controls the rate of population growth?
  - Exponential population growth.
  - Carrying capacity.
  - Population cycles.
- The provided in-class activity is a game that creates a model of population response to an infectious disease. Make sure that you do not begin this activity unless you have at least 70 minutes of time until the end of class.
- Administer the provided quiz.

Handouts/References

- Lesson 3 PowerPoint presentation
- Lesson 3 Population Modeling Paper
- Lesson 3 Quiz

Lab Activities

- The in-class activity works best when it is run as a competitive game, with the winning team being the one that has the most papers in the arena when the game is ended. Teams will develop strategies to win that will add interesting complexity to the experiment, but will not affect populations. After the game/experiment concludes you will be able to talk about
• Some rules are necessary in order to ensure the game is fair and the experiment is effective. These rules should be enforced as necessary.
  1. When an organism (paper) is added to the arena it must be a full sheet of paper and should be crumpled into a ball.
  2. Organisms cannot be moved after they are placed.
  3. If an organism is thrown into the arena and rolls out it has fallen off a cliff and died.
  4. Remind students regularly to keep good notes and to ask for help if they need it.

• When the experiment is completed, prepare a spreadsheet and have the students enter the starting population for each round in their team’s column. When they have done so, do a sum of the total population in each round in a final column. (This spreadsheet should be shared with students after it is completed.) When the total population over time is graphed it should look something like the graph below.

![Graph showing total population over 20 rounds](image)

• A graph of the individual team populations will look something like this.
While looking at the graphs, talk about how well they answer the question of whether disease can cause population cycles and then talk about whether or not other information can be gleaned from the students. Only ask students to analyze the data from the population at the beginning of each round in order to simplify interpretation of the results.

The scientific paper associated with this experiment will be difficult for students to complete, so it may be useful to require students to hand in drafts before handing in the final paper. The instructor may allow students at least 3 weeks to complete this assignment and require drafts each of the sections to be handed in separately. Consider grading these as a class activity, and have students comment on each other’s work and ask questions rather than reading all of them yourself. This reinforces the importance of editing and assures that the students will get comments on their work quickly.

Online Component

- None

Homework

- Data analysis of Lesson 3 class activity.
Assessment

Learning Outcome 1

**Outcome:** Describe Exponential Population Growth, Carrying Capacity and Limiting Factors.

- **Assessment:** Lesson 3 quiz.
- **Evaluation:** Score using prepared scoring guide.
- **Standard:** Minimum score of 70%.

Learning Outcome 2

- **Outcome:** Describe the effects of overpopulation.
- **Assessment:** Lesson 3 quiz.
- **Evaluation:** Score using prepared scoring guide.
- **Standard:** Minimum score of 70%.

Learning Outcome 3

- **Outcome:** Describe Population Cycles.
- **Assessment:** Lesson 3 quiz.
- **Evaluation:** Score using prepared scoring guide.
- **Standard:** Minimum score of 70%.

Learning Outcome 4

- **Outcome:** Conduct an experiment using a model that simulates population cycles.
- **Assessment:** In class activity.
- **Evaluation:** Score using prepared rubric.
- **Standard:** Minimum score of 70%.

About These Materials

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Population Dynamics

Lesson 3

The National STEM (Science, Technology, Engineering, and Mathematics) Consortium (NSC), a collaborative of ten colleges in nine states, was funded by a Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant from the U.S. Department of Labor to develop new workforce training programs in technical fields. For more information about NSC, visit the NSC website: http://www.nationalstem.org.

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