NetLogo Wolf-Sheep Predation Simulation

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Purpose

This activity increases familiarity with NetLogo and the use of computer simulations to model complex topics, in this case the relationship between wolves, sheep and grass within an ecosystem. It reinforces ecology concepts students have recently learned. It reinforces the importance of constants in scientific experiments and the identification of independent and dependent variables.

Overview

In this activity, students will first review some vocabulary and concepts learned about ecology. Then they will familiarize themselves with the NetLogo "Wolf-Sheep Predation" model and identify the independent variables (sliders) of the model, and the dependent variables. They will run the simulation under various settings and analyze the results. They will discover an unstable ecosystem and a stable ecosystem. They will assess the usefulness of computer models to represent real-world situations.

Student Outcomes

Learner objectives:

- Reviews ecology concepts
- Students will be able to identify roles within an ecosystem, and create a food web to represent species roles.
- Students will be able to identify independent and dependent variables in simulations or experiments.
- Students will be able to classify an ecosystem as stable or unstable.
- Students will assess the usefulness of computer models such as this and identify flaws in the models compared to real-world situations.

Illinois State Science Standards:

- 11.A.3c Collect and record data accurately using consistent measuring and recording techniques of the media.
- 11.A.3d Explain the existence of unexpected results in a data set.
- 11.A.3f Interpret and represent results of analysis to produce findings.
- 11.B.3e Evaluate the test results base on established criteria, note sources of error and recommend improvements.
- 12.B.3a Identify and classify biotic and abiotic factors in an environment that affect population density, habitat and placement of organisms in an energy pyramid.

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Time
For 7th graders, 2 60 minute class periods. (Additional class period if you need time to discuss more background –Ecology or NetLogo, or for additional discussions while students work.)

Level
Middle school science

Materials and Tools
NetLogo (Uri Wilenski, Northwestern University) available:
http://ccl.northwestern.edu/netlogo/

Computers (with NetLogo), enough for students to work in pairs or small groups.

Worksheets

Colored pencils or pens

Preparation
If possible, execute this lesson after a classroom ecology unit. Worksheets will need to be copied for each student, and have NetLogo loaded on all computers.

Prerequisites
Familiarity with ecology, or take the time to introduce it, perhaps in an extra period.
Familiarity with NetLogo, or take the time to introduce it.

Background
This NetLogo model simulates the interactions between three species (grass, wolves, and sheep) within an ecosystem. If you're not already familiar with these ecology terms (page 1 of worksheet), use your textbook, along with a partner to come up with a good definition of each word. If you're not sure, that's ok, we will discuss them as a class soon and come up with a class consensus definition. If you are already familiar with these terms from your ecology unit, review them with a partner and be ready to share definitions with the class so we can reach a class consensus definition.

Think about how these three species interact within the ecosystem. Which are predators? What is their prey? How do they fit within foodweb?

Teaching Notes
Before computers are even out, complete Page 1 of worksheet. Have students work in partners to come up with definitions for each vocabulary word. Discuss as a class, and write class consensus definitions on the board for all to copy down. Give students a few minutes to think about and fill in the food web portion of Page 1. Recap in a brief discussion and make sure students understand the flow of energy within an ecosystem.

Working in partners, have students load the Wolf-Sheep Predation Model from the NetLogo models library. Give students about 15 minutes to explore the model, work on identifying the independent and dependent variables, read the info tab and define stable and unstable systems. Remind the students to

think of the model as an experiment – which things can you change? (independent variables), and what changes will result? (dependent variables). Circle the class and see how they are doing. If students have done a similar lesson before, students should follow this pretty well. Review student answers in a small class discussion if necessary.

Tell students they will first run the simulation under the default settings (no grass, only wolves and sheep). Have them look at Page 3, and on the board draw a good sample of a sketched graph (color coded, axes labeled), and remind them what kind of information we are looking to get out of the graph. (Picture is worth a thousand words). Let students begin running the simulation, if there is still time left in the first class period. Continue by allowing them to work on Page 3 and move on to Page 4, running the simulation with grass on. Circle the classroom while students work, answering questions. Try to make sure they are really understanding the difference between stable and unstable systems, and the relationship between the populations (prey population increases result in a slightly delayed predator population increase, which tends to result in prey population decrease, and so on). Finally, let students answer questions on Page 5, still working in partners. If some students are working faster, they may work on the "if you have extra time" section at the bottom of Page 5.

Remember to save at least 15 minutes in the second class period to bring the class back together for an overall discussion. Review the questions of the worksheet – hitting on the most important parts: stable vs unstable system; relationship between predators and prey populations; how useful and how realistic is this model? If time, discuss the difference in the results of running the model under the default settings (bottom of Page 3). Sometimes when the wolf population nears extinction, there are still one or two sheep alive that escape because they never "collide" with the last wolves. Then the sheep reproduce uncontrollably. Ask students, "Is this realistic?". Thinking of what the computer is "told to do" in this model (see Info tab), why does this happen? This may be too complex for students, but is an interesting event with a good computational thinking explanation!

Assessment

- Feedback from class discussions.
- Feedback from one on one discussions while circling the classroom as students work.
- Worksheet responses.