Science Objectives

- Students will develop a method of graphing a population cycling model.
- Students will demonstrate an understanding of population dynamics.
- Students will describe several factors affecting animal populations.

Vocabulary

- predator
- prey
- population cycling
- population dynamics

About the Lesson

- This lesson provides an opportunity for students to:
  - Graph a population cycling model.
  - Analyze the data and investigate the predator/prey relationship between the lynx and the snowshoe hare.

TI-Nspire™ Navigator™

- Send out the *Hare_Today_Gone_Tomorrow.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Hare_Today_Gone_Tomorrow_Student.pdf
- Hare_Today_Gone_Tomorrow_Student.doc

TI-Nspire document

- Hare_Today_Gone_Tomorrow.tns

Discussion Points and Possible Answers

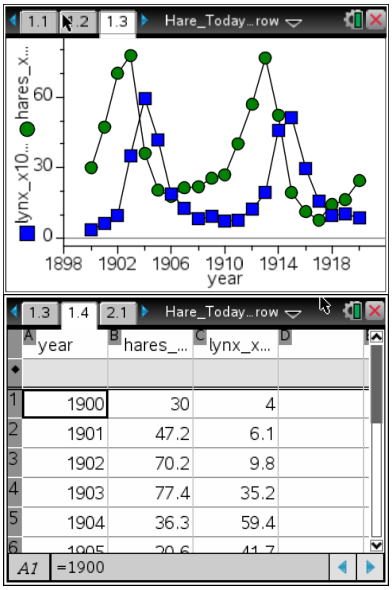
In this activity, students will determine how to graph the relationship between populations of lynx and snowshoe hare, and then analyze the data about the populations. They begin by reading about predators and prey on the student activity sheet.

Move to page 1.3.

1. Students will review the data on the graph. The populations of lynx and snowshoe hare are given for a period of 20 years.

Move to page 1.4.

2. Students then analyze the spreadsheet data to observe how the population numbers fluctuate over this time period. They should notice that the population numbers are never negative.



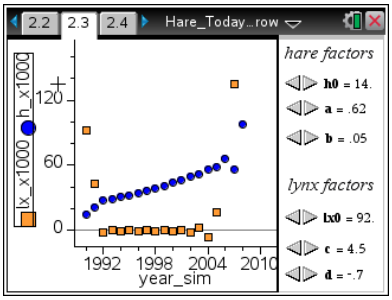
Move to pages 2.1–2.3.

3. Students read about using **iterative** equations to model the populations of the lynx and the snowshoe hare. The model uses two formulas:

   hare: b2=b1+0.1*(a*b1+b*b1*c1)

   lynx: c2=c1+0.1*(c*c1+d*b1*c1)

   In the spreadsheet, **Menu > Data > Fill** was used to copy the formulas down the columns. The values of cells b1 and c1 were set to the starting populations (the variables h0 and lx0). Then b2 and c2 were calculated from the values of cells b1 and c1, and so on. Students will use the left and right arrows to experiment with changing the values of h0, lx0, a, b, c, and d.



Techear Tip: You may want to have students brainstorm the type of variables that could affect a population. The variables are not defined so the students can hypothesize. This is an inquiry lesson

Move to page 2.3.

4. Students review the graph produced by the spreadsheet model. They decide how they might improve the model by adjusting the variables or formulas. Students are then challenged to make a graph that shows fluctuating populations.

Tech Tip: To zoom in on an area of the graph, select **Menu > Window Zoom > Zoom - In**. Then, have students select the region that they want to zoom in on. To zoom out on an area, select **Menu > Window Zoom > Zoom – Out.** Then, have students select the region that they want to zoom out of.

Tech Tip: To zoom in on an area of the graph, students can press two fingers to the screen and then move them apart from each other. To zoom out of an area, press two fingers to the screen and move them in towards one another.

Have students answer the questions on the activity sheet.

Q1. How did you determine how to produce a fluctuating graph? Describe the method used. Sketch the graph of the lynx and hare population cycling that you have produced.

Answer: Student graphs and method descriptions will vary. Look for trends, such as a steady increase in the hare population, followed by an increase in the lynx population about two years later. As the hare population declines, the lynx population should also decline after a similar lag. The students may wish to try starting with a hare population that is twice the lynx population.

Q2. As the hare population increases, why does the lynx population increase?

Answer: The lynx population increases as the hare population increases because there are more prey for the lynx to eat.

Q3. Hares are herbivores (plant eaters) and tend to stay in the same general location throughout their lives. At the peak of their population cycle, hares can reach a population density of up to 1500 per square kilometer. Besides predation, describe another factor that might affect the hare population.

Answer: Other factors that affect the hare population include availability of food, weather, birthrate, and so on.

Q4. How does your answer to question 2 affect the lynx population?

Answer: When there are more hares, more lynx can live in that area.

Q5. In the arctic, there is a chicken-sized bird called a ptarmigan (pronounced TAR-muh-gun) that is also a food source for the lynx. Describe how the fluctuations in the snowshoe hare population numbers might affect the population of ptarmigan.

Answer: When the hare population is low, the lynx may eat more ptarmigan, thereby reducing its population. When the hare population is high, the ptarmigan population may be high as well, since lynx prefer hares. Look for interrelatedness of populations.

Q6. Why do the crashes in lynx numbers lag behind the crashes in hare numbers?

Answer: It takes a while for the lynx to suffer the effects of a reduced food supply. They may find other food sources, but, if not adequate, they will begin to die. Their birthrate will also decline sometime after their food source declines.

Q7. When female lynxes are in poor condition, fewer will breed, and those that do, may not have kittens. Why might this occur? How would this affect the lynx population? How would this affect the hare population? When might the females start producing kittens again?

Answer: The female lynxes are struggling to survive, so their fertility declines. When a female is malnourished, she probably will not support kittens. As the lynx population declines, the hare population can start to rebound. With a renewed food source of hares, the female lynxes will start to produce kittens again.

Q8. Choose ecosystems from two other biomes and describe a predator/prey interaction that might occur there.

Answer: Answers will vary.

TI-Nspire Navigator Opportunities

Use TI-Nspire Navigator to capture screen shots of student progress and to retrieve the file from each student at the end of the class period. The student questions can be electronically graded and added to the student portfolio.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved by TI-Nspire Navigator. The TI-Nspire Navigator Slide Show can be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test, inquiry project, performance assessment, or an application/elaborate activity.