

Science 9, Unit on Modeling
 Topic: Population Dynamics using Stella for Modeling

Joann Bell
 Bruce Mellen

Aim / Goals & Objectives:
 (Cognitive skills / Affective /
 concepts / new terms /
 applications)

To...Introduce students to Stella modeling software by having students develop a simple population model and have students experiment with parameters on a more complicated food chain model.

Students will be able to...

- Build a basic Stella model of a population incorporating birth and mortality rates.
- Use a pre-built Stella model to represent relationships, make conjectures, and model the dynamics of a food chain.

Re: The Mathematics Core Curriculum for grades 7-8, as published by the New York State Education Department, 1999 version, building upon the 1996 New York State Mathematics Learning Standard 3 for Intermediate Students - Key Ideas & Performance Indicators:

Key Idea 1: Students use mathematical reasoning to analyze mathematical situations, make conjectures, gather evidence, and construct an argument.

1B: Make and evaluate conjectures and arguments, using appropriate language.

Key Idea 4: Students use mathematical modeling/multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.

4E. Use variables to represent relationships.

4F. Use concrete materials and diagrams to describe the operation of real-world processes and systems.

4G. Develop and explore models that do and do not rely on chance.

Interdisciplinary Connections:

Mathematics (8), Technology Software (Stella)

Prerequisite Competencies:

- Operation of PC/Windows software.
- Practice with basic logic.

Teacher must be knowledgeable in the building and operation of Stella models

Special Resources:

PC Lab with Stella, and teacher PC overhead projection.
 Legos with instructions
 Pre-built Stella models of Owls population and food chain
 Area on network, floppies, removable drive... - to save student models

Agenda:

- Do-Now
- Introduction
- Instruction
- Practice
- Summary & Challenge
- Assign Homework
- Ticket-out-the-door
- Dismissal

Do-Now warm-up:

Order/Construction is important: Legos with 3 ways to construct operational model. Student needs to find the correct method to reinforce the fact that order and construction is important when using Stella.

Essential Question:

What relationships exist within the populations of a food chain?

*Motivation /
Review /
Anticipatory Set:
Lesson Details:
(Procedures /
Instructional Formats /
Approaches / Methods /
Modeling / Activities /
Anticipated Difficulties
/ Connections...)*

Have computer? Follow directions using computer? Know Stella? Why are the letters in your name in a certain order?

Overview:

- Discuss basic population dynamics.
- Demonstrate the building of a simple population on Stella.
- Walk through the user interface that will be needed for students to build a simple population model.
- Walk students through the building of a simple population model.
- Have student pairs build their own model of a population.
- Discuss dynamics of interaction between two populations where one depends upon the other (food chain) – such as Owls, Snakes, Rodents, where owls eat snakes and rodents, and snakes eat rodents.
- Introduce a pre-built model of those population dynamics and guide students through use of the model interface
- Have students explore model parameters and answer questions

Details:

Open Discussion (Teacher guided) on population dynamics

- Discuss population of Owls – birth, mortality/death rates, effects of food supply and population density.

Teacher Centered demonstration building population model (see instructions below for building Snake population if there is some question on how to build/model/demonstrate an Owl population model) (see also electronic version of Owl population model that should be included with lesson plan)

- Model building of Stella model of Owl population using typical lifespan and birth rates somewhat affected by population density and randomness. Include population graph. Demonstrate how you want students to save their models.
- Demonstrate how model runs and how/what happens when starting parameters change.

Guided use of Stella graphic user interface (GUI) and construction of similar model of Snake population – step by step

- Bring Stella up on PC
- Handout of Icons/meaning
- Review meaning/purpose of icons in Stella
- Hover over icons to see names (don't click)
- Place stock icon in worksheet, name it, put in value & delete it. Do also with converter (student drill to associate names with icons & practice placement)
- Place stock & name it Snake, and put in a starting value of 10.
- Place converter and name it Snake Birth Rate, value of
- Select flow and hold pointer (flow icon) to the left of the Snake stock and press/drag on top of the stock until it turns grey and release – thus placing the flow. (narrate as students model)
-add arrows feeding flow
- Double click on flow to enter formula
-do separate flow for birth and death
- build graph pad....

- Run and expect results:.....
 - Save model.
- Independent Pairs – construction/exploration of Rodent population model**
- Have student pairs build, save, and explore model of identically structured rodent population, only using, perhaps, different death, birth, density, food rates/factors.
 - Have students answer questions relating to model.
- Open Discussion (Teacher guided)**
- Discuss population interactions within food chain.
- Teacher Centered**
- Introduce pre-built food chain model (electronic version should be included with this lesson) and demonstrate interaction with different factors/rates/parameters
- Student Exploration**
- Students are given a few parameters to change and note the results.
 - Students are then asked to vary parameters of their choosing and describe effects.

Practice Activities:

Challenge & Closure:

Homework Assignment:

Ticket-out-the-door

Assessment: