Ants Foraging Simulation
Sample Lesson Plan Day 1 (50 minutes)
Scalable Game Design Summer Institute 2010

Note: *Blue* links provide background information to aid in teaching.

1. **Learning Objectives:**
   **Unit Overview** –
   In this unit, students will use a computer simulation of ants foraging for food to explore artificial intelligence using another application of the collaborative diffusion and hill-climbing algorithms. Computer simulations can help us understand and model natural phenomena. We are able to do experiments within a simulated environment that we never could in the real world, and we can repeat and modify experiments with speed and accuracy that is also not possible in many physical environments.

   Students will first use the ants foraging simulation as is, to begin to understand both ant behavior from the science curriculum and collaborative diffusion from the technology curriculum. Then students will alter the simulation and see what the resulting effects are. For example, students will change the coefficient of the hill-climbing algorithm to see how this affects the rate and accuracy of simulated ants finding food. As a summary evaluation activity, students will be given an incorrect version of the simulation and asked to locate the issues with the simulation and to fix them. They will be using some of the *computational thinking* patterns and skills such as rule based programming, and message sending, which were introduced in previous units. Students will be taking a quiz over these computational thinking patterns on the final day of the unit.

   **Lesson Overview** –
   In this lesson, after being provided some background information about real ant behavior when foraging for food, students will first explore, and then modify a computer simulation of this behavior.

2. **Standards:**

   **Technology**

   The following ISTE (International Society for Technology in Education) NETS (National Educational Technology Standards) will be addressed throughout the unit:
   - #1c use models and simulations to explore complex systems and issues
   - #1d identify trends and forecast possibilities
   - #4b plan and manage activities to develop a solution or complete a project
   - #4d use multiple processes and diverse perspectives to explore alternative solutions
   - #5b exhibit a positive attitude toward using technology that supports collaboration, learning and productivity
   - #6c troubleshoot systems and applications
   - #6d transfer current knowledge to learning of new technologies
ISTE NETS are referred to by CDE Performance Standards for Teachers #7-Technology, which states, “The teacher will have demonstrated the ability to instruct students in basic technology skills. He/She will: … instruct students in basic technology skills by imbedding them in their standards-based, content instruction (7.5.3)”

Science

**Colorado Model Content Standards Grades 6-8 Science Standards**

Standard 3 - Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. *(Focus: Biology--Anatomy, Physiology, Botany, Zoology, Ecology)*

- 3.8 there is a flow of energy and matter in an ecosystem *(for example: as modeled in a food chain, web, pyramid, decomposition)*
- 3.11. changes in environmental conditions can affect the survival of individual organisms, populations, and entire species
- 3.13. individual organisms with certain traits are more likely than others to survive and have offspring

Standard 5: Students understand that the nature of science involves a particular way of building knowledge and making

- 5.4 models can be used to predict change *(for example: computer simulation, video sequence, stream table)*
- 5.5 there are interrelationships among science, technology and human activity that affect the world

Mathematics

**Colorado Model Content Standards Mathematics Standards**
http://www.cde.state.co.us/cdeassess/documents/OSA/standards/math.htm

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

3. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators,
and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

Please check to see if there are different or additional standards at the district or school level and to align this unit with your district’s content standards.

3. **Anticipatory Set / Modeling: 5 minutes**
   Optional: Draw students’ attention to ant farm in front of class.

4. **Teaching: 10-20 minutes**
   **Background information**
   Optional: Invite biology teacher or another guest teacher to discuss the actual process of how ants find food and communicate to other ants in the colony where that food source is.

**Overview of unit and AgentSheets**
Quickly demonstrate the ants foraging simulation – state the objective of the simulation

**Discuss Assessment.** Distribute copy of grading rubric to students (optional). Explain how student’s work will be graded throughout the unit.

If students are not familiar with the software, describe components of AgentSheets:
- Gallery - where agents are
- Worksheet – where game is created
- Behavior – how to tell each agent what to do

And computational thinking patterns used in the simulation:
- **Collision:** Ants “collide” with nest to drop off food.
- Artificial Intelligence using **Collaborative_Diffusion** and the **Hill_Climbing** algorithm

Have students decide what the nouns (the agents) and the verbs (the operations) of ants foraging are.

5. **Guided Practice / Monitoring: 20-30 minutes**
   **Part 1 - Exploration**
   Have students open the ants foraging simulation applet: [http://scalablegamedesign.cs.colorado.edu/sgda/sample/andri/antssimulation/upload/applet/index.html](http://scalablegamedesign.cs.colorado.edu/sgda/sample/andri/antssimulation/upload/applet/index.html). Please note that for Day 1 we are using the applet version so that
students do not have access to the code, but they will still be able to do the modifications outlined in Part 2 below.

Check for student understanding.

Allow time for students to investigate the simulation as is. Whole group discussion: ask students to share their observations of what is taking place

**Part 2 – Modification**

Ask student to modify simulation and note what happens when they do. Choose from the following as time allows.

- Put obstacles in way of ants and food
- Move food to different locations. Is it possible to move it into a location where the ants never find it?
- Vary the number of foragers
- Modify the turning probability
- Vary the life of the pheromone
- Vary the food supply amount (i.e. how long a food source lasts measured by the number of times an ant can take from the source before it disappears, a small number such as 2 represents rapidly diminishing food sources such as an insect, whereas a large number like 100 would represent an almost permanent food source such as tree sap) and see if the optimal time the pheromone lasts (life of the pheromone) correlates with the amount of food available
- Do the “lost ant” experiment in simulation (see extensions for link to explanation of activity in real world setting). Why doesn’t this work unless there is food close by the lost ant? Discuss benefits and limitations of computer modeling of natural phenomena.

6. **Closure: 5 minutes**

   Restate the scope of the project. Tomorrow we will be looking at the code for the agents and seeing what computational thinking patterns are responsible for which behaviors.

7. **Extension/ Remediation**

   Optional activity: To tie this lesson to an activity outside of the classroom, students could try getting a real ant lost. See the following link: