### Lesson 4: Up and Down in the Wild: Predator and Prey

#### Overview
This lesson allows students to explore the interactions of two animal populations (wolves and moose) within an ecosystem. One animal in the simulation is a predator. The other animal is its prey. Their populations rise and fall (oscillate) over time as they interact and impact one another.

**Learning Goals:**
- Match predators with corresponding prey animals.
- Explore a population simulation with two interacting populations.
- Represent and interpret data on a line graph.
- Tell the story of how and why two populations go up and down (oscillate) over time.
- Identify predator/prey animals in ecosystems.

**Materials:**
- One computer for every 2-3 students
- Simulation online at http://www.clexchange.org/curriculum/complexsystems/oscillation/Oscillation_Pred-preyA.asp
- Handouts (See page 4-9)

**Curricular Connections:**
- Science: Populations, ecosystems, scientific method
- Math: Representing and interpreting data*
- Reading: Describing connections among ideas*

* Common Core Standards

### Student Challenge
What settings for the moose and wolves create the most stable populations, i.e., with the minimum fluctuation?

### Key system dynamics concepts and insights:
- Populations do not exist in isolation; other factors (e.g., number of prey, amount of food supply) affect their growth and decline.
- Predators and their prey form a type of complex system that can exhibit oscillatory behavior.
### Lesson Details

**Preparation:**
1. Create groups of two to three students each.
2. Copy included handouts for each student or student group. Make multiple copies of the simulation record sheet, depending on how many runs you'd like students to complete.
3. Cut or have students cut out animal predators and prey cards (Handout 1).
4. Check computers to make sure you can access the simulation.

**Session 1:**
1. Introduce vocabulary terms (predator, prey, ecosystem, etc.) as needed.
2. Distribute card sets to student groups and have them find matches for the different predator/prey animals. Students can use the T-chart on page 5 (Handout 2) to classify their cards. Optional: Provide some blank cards for students who would like to draw additional animals. Students may come up with varying answers. This is one set of answers, based on the initial data used.

<table>
<thead>
<tr>
<th>Predator</th>
<th>Prey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolf</td>
<td>Moose</td>
</tr>
<tr>
<td>Bear</td>
<td>Salmon</td>
</tr>
<tr>
<td>Coyote</td>
<td>Rabbit</td>
</tr>
<tr>
<td>Owl</td>
<td>Mouse</td>
</tr>
<tr>
<td>Polar Bear</td>
<td>Seal</td>
</tr>
<tr>
<td>Roadrunner</td>
<td>Lizard</td>
</tr>
<tr>
<td>Praying Mantis</td>
<td>Cricket</td>
</tr>
<tr>
<td>Lion</td>
<td>Deer</td>
</tr>
</tbody>
</table>

3. Briefly compare and discuss the different matches. You may want to note that some predators may have multiple food sources, e.g., a coyote may eat rodents, rabbits, cats, and other small mammals.
Lesson Details

4. Show students the simulation in the classroom and read the introduction together (Figures 2 and 3).
5. Have students work in their small groups to “Make Decisions” (Figure 4). The simulation is initially set, based on data for wolves and moose on a small island. The moose is the main source of food for the wolves.
6. Have students continue to “See What Happens” (Figure 5), recording their data on Handout 3 on page 6. After completing the initial run, students can continue to explore, asking “What if?” questions relating to the wolves and moose while using additional copies of Handout 4 on page 7.
7. Students can also run the simulation for different animals they have researched and record their data on the simulation record sheet for each one. Note that the simulation results may vary, including some unrealistic results, if they input data that would not make sense. An example would be an insect with a long lifespan and lots of babies.

Session 2 and beyond:
1. If needed, have students complete the simulation within their small groups.
2. After running the simulation multiple times, students continue to the “Think About It” section (Figure 6).
3. Debrief the simulation experience using ideas for bringing the lesson home and assessment (Handouts 5 and 6).

Bringing the Lesson Home:
- Explore the “Think About It” section of the simulation within small groups or as a class.
- Consider and discuss why the animal populations went up and down over time (oscillated).
- Discuss what settings would minimize the oscillations. Test these back in the classroom using a computer/projection system.

Assessment Ideas:
- Have students complete the assessment handouts to tell the story of the loop, to identify other predator and prey animals, and to share what they learned. You may prefer to have students orally tell the story of the loop. The assessment questions can also be part of a class discussion.

Figure 6: Think About It
<table>
<thead>
<tr>
<th>Deer</th>
<th>Rabbit</th>
<th>Salmon</th>
<th>Mouse</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Deer" /></td>
<td><img src="image2" alt="Rabbit" /></td>
<td><img src="image3" alt="Salmon" /></td>
<td><img src="image4" alt="Mouse" /></td>
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</table>

<table>
<thead>
<tr>
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<th>Coyote</th>
<th>Bear</th>
<th>Owl</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Lion" /></td>
<td><img src="image6" alt="Coyote" /></td>
<td><img src="image7" alt="Bear" /></td>
<td><img src="image8" alt="Owl" /></td>
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</table>

<table>
<thead>
<tr>
<th>Moose</th>
<th>Lizard</th>
<th>Seal</th>
<th>Cricket</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image9" alt="Moose" /></td>
<td><img src="image10" alt="Lizard" /></td>
<td><img src="image11" alt="Seal" /></td>
<td><img src="image12" alt="Cricket" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wolf</th>
<th>Roadrunner</th>
<th>Polar Bear</th>
<th>Praying Mantis</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image13" alt="Wolf" /></td>
<td><img src="image14" alt="Roadrunner" /></td>
<td><img src="image15" alt="Polar Bear" /></td>
<td><img src="image16" alt="Praying Mantis" /></td>
</tr>
<tr>
<td>Predators</td>
<td>Prey</td>
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Predator/Prey Simulation Record Sheet

Predator: __________________________
Number: _____ Babies: _____ Lifespan: _____

Prey: ______________________________
Number: _____ Babies: _____ Lifespan: _____
How much space? ______________________

Draw and label the graphs for both animals.
Predator/Prey Simulation Questions
Try ideas one at a time and then record what happens on a new sheet.

Question 1: What might happen if the animals had less space to live?

Question 2: What might happen if the animals had more space to live?

Question 3: What might happen if the island had more wolves to start?

Question 4: How could you change the settings so the ups and downs were not so big?

Question 5: What are some other questions you could explore? Write a question below and then try your idea.
Assessment
Tell the story of the predator/prey loop.
If the owl population goes up, then ...

Other Predators:

Other Prey:
Assessment

What have you learned about predators and their prey?

Why do populations go up and down?

What did you change to keep the populations from going up and down as much?
Acknowledgements:
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This model with accompanying lesson is one in a series that explore the characteristics of complex systems.

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