ARGUMENT DIRECTED INQUIRY LAB #2

HOW IS THE SIZE OF A PREDATOR POPULATION RELATED TO THE SIZE OF A PREY POPULATION?

Introduction

John Donne wrote, "No man is an island." The same is true for any individual plant or animal. Individuals are always part of a larger group of organisms from the same species, called a *population.* In some respects, populations act like individual organisms. They require space and nutrients. They have daily and seasonal cycles, including when they sleep and eat. They grow and die. The size of any population is in large part determined by a balance between several factors; some of these factors are obvious and some are not. Ultimately the biological success of a population is measured by its size over time. The factors that affect how well organisms grow and survive are the factors that determine population size. These factors are known as *limiting factors.* They will help to determine what the total carrying capacity of an ecosystem is for any given organism in that system. Food, water and shelter are your primary limiting factors.

A population of one kind of organism also interacts with other populations in the same area where it lives. Several populations interacting with each other form a community. Organisms from a different population but from the same community relate in several different ways. Some organisms from a different population help each other survive through providing resources for one another, which is known as *mutualism.* An example of this relationship would be bees and flowering plants. The bees find food when the flowers bloom on the plant, and that food helps the bee population survive. When bees visit multiple flowers, they also carry pollen from one flower to another. This movement of pollen helps the flowering plants to reproduce, so the flower population continues to survive.

Another kind of relationship found between populations is known as *predation.* Predation involves organisms from one population using organisms from another population as food. The organism that is used as food is called *prey*, and the organism that eats the other organism is called the *predator.* There are many examples of predator-prey relationships. When you pick vegetables from a garden, you are a predator and the plant is prey. Seagulls and bears are predators of several kinds of fish that are their prey. Predator-prey relationships are very common in different communities of organisms.

Your Task

In this lab you will use a computer simulation to investigate how a population of a predators (wolves) and a population of its prey (sheep) interact with each other and the local environment over time. The **guiding question** of this investigation is, **How is the size of a predator population related to the size of a prey population?**

Materials

You will use an online simulation called *Wolf Sheep Predation* to conduct your investigation. You can find the simulation in the APPS on your computer. Look for the APP labeled **Net Logo 5.2.1** and open it. Under file, click on **models library**. Click on **Biology**. At the bottom of the column you should find **Wolf Sheep Predation.** Open this program.

Getting Started

The *Wolf Sheep Predation* simulation allows you to explore how a population of predators and prey interact with each other over time. This simulation is designed to follow the rules of nature so you can use it to see what happens to the size of a population when you change different environmental factors, such as size of initial population and availability of food for the prey species.

In the simulation, wolves and sheep wander randomly around the landscape. When a wolf bumps into a sheep, the wolf eats the sheep. Each step costs the wolves energy and they must eat sheep to replenish their energy; when they run out of energy, they die. Each wolf or sheep reproduces at a constant rate. You can also choose to include grass in addition to wolves and sheep in the simulation. If you add the grass, the sheep must eat grass to maintain their energy; when they run out of energy, they die. Once grass is eaten, it will only regrow after a fixed amount of time.

You can change a wide range of factors in the simulation:

- INITIAL – NUMBER – SHEEP: the initial size of the sheep population
- INITIAL – NUMBER – WOLVES: the initial size of the wolf population
- WOLF – GAIN – FROM – FOOD: the amount of energy a wolf gets for every sheep eaten
- SHEEP – GAIN – FROM – FOOD: the amount of energy a sheep gains from eating grass
- SHEEP – REPRODUCE: how often sheep reproduce
- WOLF – REPRODUCE: how often the wolves reproduce
- GRASS – REGROWTH – TIME: how long it takes for the grass to regrow after it's eaten

To answer the guiding question, you must determine what type of data you need to collect, how you will collect it and how you will analyze it. To determine *what type of data you need to collect,* think about the following questions:

- How will you determine if the composition of the sheep and wolf populations changes over time?
- What will serve as your dependent variable?
- What type of measurements or observations will you need to record during your investigation?

To determine *how you will collect your data,* think about the following questions:

- What will serve as a control condition?
- What types of treatment condition will you need to set up and how will you do it?
- How many trials will you need to conduct?
- How long will you need to run the simulation during each trial?
- How often will you collect data and when will you do it?
- How will you keep track of the data you collect and how will you organize it?

To determine *how you will analyze your data,* think about the following questions:

- How will you determine if there is a difference between the different treatment condition and the control condition?
- What type of calculation will you need to make?
- What type of graph could you create to help make sense of your data?

Connections to Crosscutting Concepts, the Nature of Science, and the Nature of Scientific Inquiry

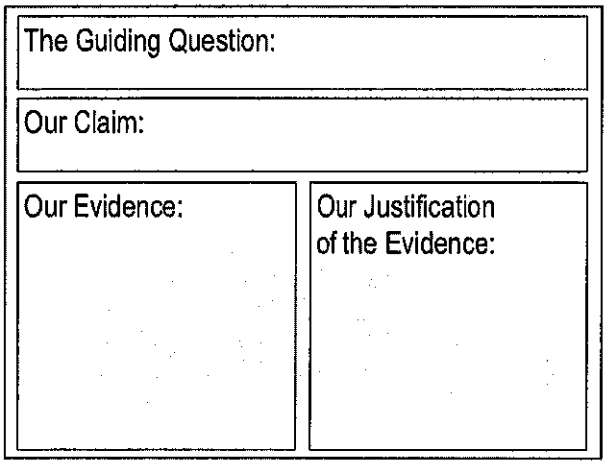
As you work through your investigation, be sure to think about:

- the importance of understanding cause and effect relationships for natural phenomena,
- the use of models to study systems,
- the way scientific knowledge can change over time, and
- the different types of methods that scientists use to answer questions.

Initial Argument

Once your group has finished collecting and analyzing your data, you will need to develop an initial argument. Your argument must include a claim, evidence to support your claim, and a justification of the evidence. The claim is your group's answer to the guiding question. The evidence is an analysis and interpretation of the data. Finally, the justification of the evidence is why your group thinks the evidence matters. The justification of the evidence is important because scientists can use different kinds of evidence to support their claims. Your group will create your initial argument on a whiteboard. Your whiteboard should include all of the information shown in Figure 1.

Figure 1



Argumentation Session

The argumentation session allows all of the group to share their arguments. One member of the group will stay at the lab station to share that group's argument, while the other members of the group go to the other lab stations one at a time to listen and critique the arguments developed by their classmates. This is similar to how scientists present their arguments to other scientists at conferences.

If you are responsible for critiquing your classmates' arguments, your goal is to look for mistakes so these mistakes can be fixed and they can make their argument better. The argumentation session is also a good time to think about ways you can make your initial argument better. Scientists must share and critique arguments like this to develop new ideas.

To critique an argument, you might need more information than what is included on the whiteboard. You will therefore need to ask the presenter lots of questions. Here are some good questions to ask:

- What did your group do to collect the data? Why do you think that way is the best way to do it?
- What did your group do to analyze the data? Why did your group decide to analyze it that way?
- What other ways of analyzing and interpreting the data did your group talk about?
- Why did your group decide to present your evidence in that way?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those other ideas?
- How sure are you that your group's claim is accurate? What could you do to be more certain?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the guiding question.

Report

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why? What was the goal? Is there enough background information provided?
2. What did you do during your investigation and why did you conduct your investigation in that way? How did you analyze the data? Are you using the correct terms to describe the investigation?
3. What is your argument? Is it clear? Is it supported by evidence? Do you reference your data, graphs, or models? Is the science behind your argument used to justify your claim? Are you using correct scientific terms?

Your report should answer these question in two pages or less. The report must be typed, and any diagrams, figures or tables embedded into the document. Be sure to write in a persuasive style, you are trying to convince others that your claim is acceptable or valid! Do not use personal pronouns (I, we, our, my, etc.) in the report. Refer to **the** experiment, **the** data, **and the** claim. This is a report, not a personal narrative.

Peer Review

Your first draft will undergo a peer review. Scientists present their results to other scientist to review and critique before they publish the results. In this process, your group will review reports submitted by other students to be sure they have followed the report format and answered the necessary questions in their report, other groups will do the same with your paper. There is to be no name associated with the report. You will use the code given to you by the teacher. You will be given a peer review sheet to fill out and complete. Be thorough and honest in your review. You are trying to help someone get better at this process.