ACTIVITY 9

Constructing Predictive Models

PRESENTATION

Historical data, such as where coyotes have been observed over time, inform predictive models.

9: CONSTRUCTING PREDICTIVE MODELS

GUIDING QUESTION

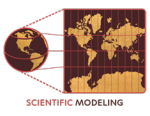
How can a model be used to predict changes to the distribution of a population?

INTRODUCTION

A weather forecast relies on models that incorporate how different factors—including temperature, precipitation, and wind—interact and then predict, or forecast, what conditions will look like hours or days in the future. Accurate forecasting is helpful in all kinds of decision-making. With changing global conditions, ecologists are increasingly using models, based on large datasets of observations, to predict future changes in ecosystems. Known as *ecological forecasting*, this is a growing field that requires skills in data analysis, ecological modeling, quantitative reasoning, and computing. In this activity, you will begin to explore aspects of this process.

People often check weather forecasts before participating in outdoor activities.

CONCEPTUAL TOOLS



MATERIALS LIST

FOR EACH STUDENT

- STUDENT SHEET 9.1 "Developing Model Components"
- STUDENT SHEET 9.2 "Developing Fermi Estimates"

PROCEDURE

1 In this activity you will begin to develop a model to explore the future distribution of a species in your community. Work with your partner to choose a species (excluding humans) that you observed on your field trip or that is common in your community and record it at the top of Student Sheet 9.1, "Developing Model Components."

2 Work with your partner to develop a scientific question that you have about the species and its future distribution in your community. Record your question on Student Sheet 9.1.

HINT: You may want to consider the possible effects of a single likely change in your community on your species (such as an increase in human structures or a changing climate pattern).

3 Work with your partner and use your knowledge and observations of your community to brainstorm a list of five factors that could most affect the distribution of your local species in the future. Record those factors in the first column of the table on the student sheet. Consider how these factors are likely to change over time. For example, traffic may be a factor that affects the population size of some species, and traffic may be predicted to continue to increase.

4 Decide which factors to include in your model by completing the following columns of the table on the student sheet.

Column 2: For each factor you listed in the first column, describe its present and likely future effects on the population distribution of the local species and if that effect is likely to change over time.

Column 3: Based on your scientific question, identify the orders of understanding. Rate the factors affecting the population in the model with 1 having the greatest impact and 3 having the least impact.

NOTE: You may choose to use the same rating for factors that appear to have similar impacts (for example, labeling two factors as 3) or not use some rating numbers.

Column 4: Decide which three factors you will incorporate in your model and mark them with an "X" or a check mark.

5 You will use the following model (Figure 9.1), which you first saw in Activity 2, to help you construct your model. Begin by discussing with your partner what you can conclude from this model. Note that arrows show relationships between related factors: a "+" indicates a positive effect or an increase, and a "–" indicates a negative effect or a decrease.

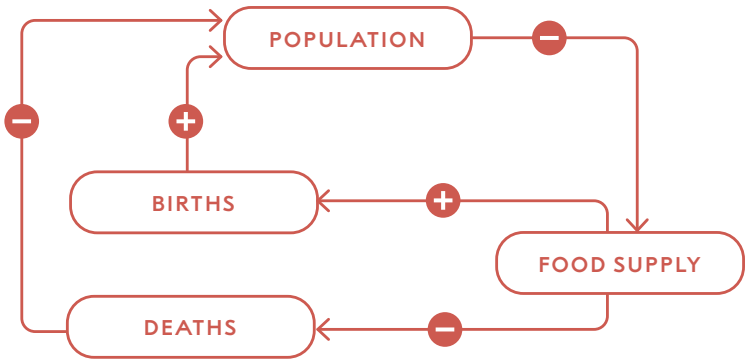


FIGURE 9.1
Sample Model

6 On the reverse side of Student Sheet 9.1, construct a model that reflects your scientific question by:

- centering the main factor you are investigating (for example, population size)
- adding the three factors that you identified that you will incorporate in your model.
- drawing arrows to show relationships between related factors.
- adding + or — signs along each arrow to indicate predicted changes in your species.
- writing at least three sentences describing the relationships shown in your model.

7 Explain your model to the other half of your group. Respond to any questions, comments, or suggestions they have and modify your model as needed.

8 On Student Sheet 9.2, "Developing Fermi Estimates," work with your partner to make two Fermi estimates of the population size of the local species—one in the present and the other 50 years in the future. Be sure to identify any assumptions that you are making and show your calculations.

- Based on your food web model from Activity 3, make a Fermi estimate of the population size of this species **today**.
- Consider how each factor in your model would likely be affected under future conditions.
- Make a Fermi estimate of the population size of this species **50 years in the future**.

9 Discuss the following questions with your group:

- What data would you want to collect to test your model?
- If the data did not support your model, how would you revise it?
- How could this type of data help make your Fermi estimates more accurate?

10 Present your model to the class and explain how you can use your model to make a prediction of the future population size of your species. Discuss any similarities and/or differences you notice among the models presented by others who chose the same species.

BUILD UNDERSTANDING

① A local group wants to use your model to help determine land use, such as the location of housing vs. open space.

a What would you tell them about sources of uncertainty in your model?

b How could you test your model to evaluate its accuracy?

② Imagine that a new species is accidentally introduced into your community. It can successfully outcompete your local species in wooded areas but not in other spaces. Explain how you would modify your model (in words or in a drawing) to account for this new species.

A model can be used to determine the probability of everyday events.

CONNECTIONS TO EVERYDAY LIFE

③ A high school soccer coach wants to create a simple predictive model to guess the probability of winning the next game.

Model 1: This model uses the team's number of game wins over the last five seasons.

Model 2: This model uses the number of goals scored per game, plus three other factors: the number of rained-out games, the number of games played on the weekend, and the number of injuries in the previous season.

Which model would you use and why?

EXTENSION

On the Internet, you can find student-friendly computer programs to model complex systems that explore cause-and-effect relationships and test ideas. Find one of these tools to construct your population model and explore how the factors in your model interact.