



THE BALANCE IN NATURE

1. The Food Chain
2. Adapting to the Environment
3. Species Change
4. A Review

TEACHER'S LESSON PLANNER

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INTRODUCTION

The interrelationships among species and among individuals within a species under varying environmental conditions can be the subject of a lifetime of devoted study. Yet, at a simple level, the dynamics of these relationships are critical to the young student's evolving understanding of the process of change in nature. For the teacher challenged with the presentation of these concepts, a readily understandable and interesting introduction is an important first step in meeting that challenge.

"THE BALANCE IN NATURE" is a series of four interactive programs that presents an underwater ecosystem and the imaginary creatures living within it. In "The Food Chain," students are introduced to the creatures and explore some of the implications of competitive and predator-prey relationships. In "Adapting to the Environment," one section of the food chain becomes the focus of a series of environmental changes. In "Species Change," several physical variations occurring naturally in one species are explored in terms of the effect of each variation on the likelihood for survival of the individual and the way in which it may affect the species as a whole within its ecosystem. Finally, "A Review" uses the vocabulary introduced in the first three programs to transfer concepts from the imaginary world of Puffet Pond to easily recognizable real-world relationships.

"THE BALANCE IN NATURE" does not pretend to be a comprehensive study of the mechanisms by which creatures adapt, evolve, or disappear. Rather, it is an introduction to the logic of environmental adaptation and population change. What is emphasized throughout these programs is the logical outcome of a structural or situational change, and the way in which that change limits or defines later possibilities. Both as an exercise in the forming of hypotheses and an introduction to ecological study, "THE BALANCE IN NATURE" will enrich your students' learning experiences in a way that will quickly grow beyond the subject matter of these simple programs.

FOR THE FIRST TIME USER

This section is designed for you if it is your first time using these programs.

HARDWARE REQUIREMENTS

These programs are designed to run on an Apple //, // plus, //e, or //c computer, and on the Commodore 64 computer. Please check to be sure that you have the correct diskette(s) for your computer.

In addition to the computer, the following hardware is necessary:

- * a disk drive
- * a monitor (preferably a color monitor)

START-UP PROCEDURES

TO LOAD ANY PART OF THIS PROGRAM ON AN APPLE SYSTEM:

A. With the machine off, carefully insert the diskette into the disk drive, label up, and close the disk drive door. (If there are two disk drives, use drive 1.)

B. Turn on the computer and monitor.

C. The diskette will now "boot up" (make the program appear on the screen) automatically.

D. If you are using an Apple IIe, make sure the CAPS LOCK key at the lower left of the keyboard is in the down position.

E. Follow the instructions that appear on the screen in order to move through the program.

TO LOAD ANY PART OF THIS PROGRAM ON A COMMODORE 64:

A. Turn on the disk drive, the monitor, and the computer.

B. Insert the diskette in the disk drive, label up.

C. Type: LOAD "F*",8

D. Press the RETURN key.

E. When the cursor is again flashing and the red light is off on the disk drive, type RUN and again press the RETURN key.

F. Follow on-screen instructions to proceed through the program.

CONTENT GUIDE

"THE BALANCE IN NATURE" is a series of three connected programs that explores the relationships among several imaginary creatures. Each of the programs is described below.

1. THE FOOD CHAIN

There are five characters in "The Food Chain:"

A GREEN PLANT;
THE MIRK and THE PUFFET, two plant-eating creatures;
THE PUFFMUNCHER, a creature that eats puffets; and
THE MIRKEATER, a creature that eats mirks.

The plant forms the base for two food chains: it is eaten by the puffet, which is in turn prey for the puffmuncher; and it is eaten by the mirk, which is preyed upon by the mirkeater.

After an animated section in which the creatures and their relationships on the food chain are introduced, the program isolates a specific creature in each section and, by varying that creature's relative scarcity, elicits the result of the change on other creatures in the same environment.

After each question, the computer responds appropriately to correct and incorrect answers, often with animated explanations. The user who answers a question incorrectly is given the explanation for the correct answer, and is then returned to the question, which must be answered correctly in order to advance. Between questions, the user is offered the opportunity to return to the previous question or advance to the next question.

Each series of questions follows:

Series 1:

HOW WILL THE DISAPPEARANCE OF THE MIRKS AFFECT THE FOOD CHAIN?

Question 1: A) The number of plants will probably increase.
B) The number of plants will probably decrease.

Question 2: A) There will be more puffets.
B) There will be fewer puffets.

Question 3: A) The number of mirkeaters will probably increase.
B) The number of mirkeaters will probably decrease.

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Question 4: If the mirks disappear and the puffets increase in number, which should also increase?

- A) the mirkeaters
- B) the puffmunchers

Series 2:

SUPPOSE THE MIRKEATERS INCREASE IN NUMBER. WHAT WILL BE THE EFFECT ON EACH OF THE FOLLOWING: (ANSWER INCREASE OR DECREASE.)

- A: the plants
- B: the mirks
- C: the puffmunchers

Series 3:

Question 1: If the plants decrease in number, how will the puffets be affected?

- A) They will increase in number.
- B) They will decrease in number.

Question 2: If the puffets decrease in number, how will the mirks be affected?

- A) They will increase in number.
- B) They will decrease in number.

When the user has completed "The Food Chain," he/she may either return to the main menu or press a key to continue to part 2, "Adapting to the Environment." The user who returns to the main menu may then want to choose option 4, "Review." Within that option, the user can choose to answer questions on "The Food Chain" or on any of the programs that make up "THE BALANCE IN NATURE."

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2. ADAPTING TO THE ENVIRONMENT

This program focuses on one of the two chains introduced in "The Food Chain," the one containing the plant, the puffet, and the puffmuncher. After a series of introductory screens reestablishing the relationships among the creatures in this chain, the idea of variation within a species and its possible effect on individual survival is introduced.

Questions are posed and incorrect answers are handled in the same manner as described in "The Food Chain." Each series of questions is shown below.

Series 1:

FOR EACH DIFFERENCE THAT APPEARS ON THE SCREEN, TYPE 'Y' IF IT PROBABLY WOULD AFFECT A PUFFET'S CHANCES FOR SURVIVAL, AND 'N' IF IT PROBABLY WOULD NOT.

- A) size
- B) shape
- C) speed
- D) coloration

Series 2:

FOR THE DIFFERENCE THAT FOLLOWS, TYPE 'Y' IF YOU THINK THE UNUSUAL PUFFET WILL HAVE A BETTER CHANCE TO SURVIVE AND 'N' IF YOU THINK IT WILL NOT.

- A) speed
- B) size

At this point, the program challenges the user with the following question:

```
*****
*
*           Try to think of some other changes,
*   or adaptations, that might occur in the
*   larger puffet that would make it less in-
*   teresting to the puffmuncher. When you're
*   ready to compare answers, press the RETURN
*   key.
*
*****
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Suggestions given by the computer when the RETURN key is pressed are:

bad taste;
bad odor;
spiny skin.

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The computer then returns to complete the series of questions begun before this question was posed:

- C) able to eat a wider variety of plants
- D) brighter color

Series 3:

After a discussion of the desirability of speed as a puffet trait, the following question is posed:

As more newborn puffets are able to swim faster in each generation, fewer slow-moving puffmunchers will survive. Answer T or F.

3. SPECIES CHANGE

Questions in this program are posed and processed in the same manner as described for the first program, "The Food Chain."

After an introductory section reviewing structural variety within the puffet population, a variation is introduced. Specifically, some of the puffets are able to subsist on a wider variety of plants, and some of the plants in question live at or near the water's edge.

The questions follow.

Series 1:

These related questions explore the implications of the development of puffets able to eat a wider variety of plants. They are posed as True/False questions.

Question 1: Puffets that can eat these plants are more likely to live near the water's edge than puffets that cannot.

Question 2: In times of food scarcity, all puffets will move into deeper water.

Question 3: The puffmunchers are less likely to chase puffets at the water's edge than they are in deeper water.

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There follows a series of screens speculating on the implications for change in habits that is afforded by increased feeding flexibility, including the possibility that puffets at the water's edge may sometimes find themselves on land. This leads to the next series of questions:

Series 2:

Question 1: Why would puffets that are able to leave the water sometimes do so?

- A) to work on a tan
- B) to escape from the puffmuncher
- C) to find food
- D) to get a breath of fresh air

Question 2: Of the variations listed below, which do you think would be the most important for a puffet trying to adapt to life at the water's edge or on land?

- A) slightly different coloration
- B) slightly different fin shape
- C) slightly different ear shape

Question 3: Which of the following conditions may cause the difference between deep-water and shallow-water puffets to become greater generation after generation:

- A) Puffmunchers in deeper water are feasting on slower moving puffets.
- B) There is food to be found in shallow water for those puffets who can use it.

The program concludes with an exploration of some possible long-range effects of this single variation within the puffet population.

4. REVIEW

The "Review" program is divided into three parts, each of which has a title corresponding to the title of one of the other three programs on the diskette.

All review sections are arranged in a similar manner. Each question is posed twice. Credit is given only if the correct response is given on the first attempt. (An exception to this rule is indicated below.) If the question is answered incorrectly on the second attempt, the correct answer is given. A screen indicating the number answered correctly and the percent correct may be accessed after each question or not at all.

There are three types of review questions included in the "Review" program. They are: multiple-choice questions (each of which has four choices), true/false and increase/decrease questions, and a series of food chains that must be correctly ordered. (It is on this series that the user receives full credit for a correct response on the second attempt.)

The review section deliberately and systematically integrates new and relevant vocabulary from each program in the questions as well as in the answer choices. Questions do not refer to the imaginary creatures of the programs, but rather use the concepts presented in real-world situations.

OBJECTIVES

Students will be able to:

1. distinguish among prey, predators, and competitors;
2. recognize and identify a food chain;
3. explore the relationships among creatures in an ecosystem;
4. predict the implications of simple changes within an ecosystem;
5. recognize relationships among creatures in the natural world;
6. recognize naturally-occurring, observable variations within a homogeneous population;
7. form hypotheses regarding the outcome of natural ecological processes;
8. sharpen inductive and deductive thought processes.

HOW THESE PROGRAMS CAN BE USED

These programs can be incorporated into the study of any of the following topics:

- the food chain;
- predator-prey relationships;
- competition in nature;
- ecological balance;
- adaptive mechanisms;
- adaptation to the environment;
- local effects of environmental changes;
- species change;
- population variation.

The teacher using these programs in conjunction with a unit of study in environmental or species change may integrate them in many ways. The suggestions below propose one possible course of study only, and in no way are intended to limit the creative thinking that necessarily forms the basis for the development of a successful unit.

1. Introduce the concept of the food chain by presenting for consideration a plant-eating creature that your students will readily recognize. (The animal chosen may vary, as animals indigenous to one area may be totally unfamiliar in another.) Proceed as follows:

A. First, move to the base of the chain. What does the creature eat to survive? What would happen to the creature if its food supply disappeared?

B. Next, move to the predator or predators that rely on the creature. Identify them and discuss the implications for them of an increase in food supply or a decrease in the food supply at the base of the chain.

C. Which creatures rely on the predator in (B) for food?

Having constructed a food chain based on the student's life experience, the imaginary world of the first program in this series, "The Food Chain" can be used to explore the implications of the train of environmental logic begun. Students should now be led further down the road of ecological reasoning.

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2. How does the food chain affect the creatures connected by it? Develop the understanding that in some cases the link in the chain must die to satisfy the next link (cattle may fall into this category if humans, wolves, or mountain lions are the predators), while in other cases, the link is renewable (as in the case of grass for sheep). Explore the implications of this observation for each species along the chain in terms of the sensitivity of a given creature to environmental change.

Use the second program in this series, "Adapting to the Environment," to reinforce and elaborate the effects of environmental change on individuals within a species and upon the species as a whole.

3. Introduce the concept of population variation as follows:

A. List the ways that people are different. Depending upon the level of work that your students are capable of understanding, you may want to emphasize such obvious differences as foot size, height, and speed, or more subtle differences, such as thumb shape, nail texture, and blood type. (Note: In many areas, it may be possible to study this subject without reference to humans. A fish tank with a number of fish of the same species, a pasture with many cows, or even an ant farm may provide a basis for this discussion. Humans are used in this example because the differences are easier to observe and elicit and because they are readily available for study in every classroom.)

B. Construct a chart with three columns summarizing the significance of the variations elicited as follows:

OBSERVED DIFFERENCES	POSSIBLE RANGE	POSSIBLE ADVANTAGES
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Note that the issue of possible advantages (or disadvantages) has been added to the discussion for students to consider. As an example, if height were to be considered as a variation for, say, humans, an entry 'tall' in the middle column might occasion the comment 'better range of vision' in the final column, while the entry 'short' in the middle column might elicit the entry 'better chance for concealment' in the final column.

Introduce the concept of selective advantage by using the third program, "Species Change" to elaborate the advantages and disadvantages of certain traits.

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4. Divide the class into committees and assign each committee a local species to observe for structural or behavioral variations within the local population. When the study period is over, have students present their findings. These findings should, with class discussion, highlight possible advantages and/or disadvantages of variations in observed traits.

Use the "Review" program in the series to reinforce understanding of the real-world implications of newly-learned concepts.

5. Complete the unit with a discussion of why species change. The process of mutation, which is not mentioned in "THE BALANCE IN NATURE," must be introduced and explained. The extent to which mutations alone or gradual environmental pressures alone cause species to change is an as yet unresolved issue. However, the broad outlines of change may be discussed in terms of the logic of this program regardless of which mechanism is at work.

Student Worksheet: Puffet Pond

This worksheet should be used by students before viewing program 1, "The Food Chain." Teachers are hereby given blanket permission to reproduce this student worksheet in whole or in part for use in conjunction with the series "THE BALANCE IN NATURE."

Name: _____ Date: _____

Teacher: _____ Class: _____

The creatures in this program are:

GREEN PLANTS:

The green plants live underwater. They are eaten by puffets and mirks.

PUFFETS AND MIRKS:

Puffets and mirks live underwater. They eat the same green plants.

Puffets are the food of puffmunchers.

Mirks are the food of mirkeaters.

PUFFMUNCHERS and MIRKEATERS:

Puffmunchers are fish. They eat only puffets.

Mirkeaters are fish. They eat only mirks.

QUESTIONS:

1. Name two creatures in Puffet Pond that eat green plants.
2. Name a creature that eats only puffets.
3. What does the mirkeater eat?
4. Do puffets eat mirks?
5. Do mirkeaters eat puffets?
6. Do the green plants, the puffets, the mirks, the puffmunchers, and the mirkeaters live in the water or out of the water?

PROGRAM GLOSSARIES

Each program of "THE BALANCE IN NATURE" has a separate glossary which may be accessed by pressing the "G" key at any time that the prompt to do so is on the screen. (This prompt is on most screens.)

Listed below are the words and definitions included in each program glossary. We suggest that you copy the glossary and distribute it to students using the programs.

PROGRAM 1: THE FOOD CHAIN

- 1) affected: changed.
Our plans may be affected by the weather.
- 2) compete: to be a rival for something.
The eagle and the hawk compete for the same food supply.
- 3) competitor: rival.
The two fastest runners are competitors for the first place medal.
- 4) contribute: to have a part in bringing about.
We each contribute to the neatness of our classroom.
- 5) food chain: a chain of living things in which each creature eats the one below it and is eaten by the one above it.
Grass, cows, and humans form a food chain in which grass is eaten at the primary (lowest) level.
- 6) interaction: having an affect on one another.
The interaction of children and puppy dogs often makes both very happy.
- 7) predator: a creature that lives by killing and eating other creatures.
The fox is a predator of small animals and birds.
- 8) prey: an animal hunted for food by another animal.
The rabbit is the prey of the hungry eagle.
- 9) relationship: connection.
There is a relationship between the amount of food and the number of creatures that live in an area.
- 0) survive: continue to exist.
Creatures can only survive if there is enough food for them to eat.

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PROGRAM 2: ADAPTING TO THE ENVIRONMENT

- 1) adaptation: a change in an animal, plant, or person that helps it to fit in with its surroundings.
One adaptation that helps a duck to swim is its webbed feet.
- 2) advantage: something about a person, animal, or plant that can help it to survive better.
The faster antelope has an advantage over the slower antelope when the herd is chased by a hungry lion.
- 3) competition: rivalry.
Sheep and cattle are in competition for food when they graze in the same pasture.
- 4) environment: the surroundings in which an animal, plant, or person lives.
The polar bear lives in a cold environment.
- 5) individual: a single animal, plant, or person.
Some individuals within a group behave strangely.
- 6) population: the number of persons, animals, or plants that lives in a place.
The population of kangaroos in Australia is getting smaller and smaller.
- 7) species: a group of animals or plants that share common characteristics.
Lions and tigers are different species of cat.
- 8) survival: staying alive, or not dying out.
The survival of wild animals in Africa is difficult because people are using more and more of the land on which they live.
- 9) trait: a characteristic of a person, animal, or plant.
The dog's fur color is a trait that it inherited from its parents.
- 0) variation: a different form of, or a change in something.
There is great variation in the kinds of birds that live in the United States.

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PROGRAM 3: SPECIES CHANGE

- 1) adaptation: a change that makes it easier to exist.
The white coat of the polar bear is an adaptation that helps it to blend into its snowy background.
- 2) generation: a group of people, animals, plants, or things born or developed around the same time.
Each generation of computers is easier to use than the one before.
- 3) offspring: the young, or children, of a person, plant, or animal.
Mother robins feed worms to their offspring in the spring.
- 4) population: the number of people, animals, or plants living in a certain place.
The population of New York City is greater than the population of Los Angeles.
- 5) relationship: connection.
There is a relationship between the number of lions and the number of herd animals that they feed on.
- 6) scarcity: a lack, or shortage, of something.
Scarcity of rain may cause fruits or vegetables to grow poorly.
- 7) species: a group of animals or plants that have certain things in common.
There are many species of cats: lions, tigers, house cats, etc.
- 8) structure: the way in which the parts of something are put together.
The bone structure of a horse makes it possible for it to hold a rider.
- 9) survive: to continue to exist.
In order to survive, people must eat food.
- 0) variety: a difference or a change.
There are many varieties of apple that have different colors and shapes.

