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To the teacher ...

The purpose of this book

This book is part of a series of five designed to convey a holistic understanding of ecological principles and contemporary environmental problems. Such a holistic understanding can provide us with the tools for solving environmental problems — on both a local and global level — thus allowing us to move toward a healthier future.

Conveying a holistic understanding of the world

The theme for all five books of this series is provided by a simple notion: environmental problems — such as pollution, resource depletion, extinction of organisms, and over-population — exist because the human world does not model the conditions that generate **balance** (equilibrium or stability) in nature. If this notion is valid, it follows that environmental problems may be solved, or avoided, if the human world were to model those conditions.

Two questions arise from these statements: (1) What are the conditions for balance in nature? and (2) What characteristics of the modern human world differ from, or oppose, those conditions? Answers to these questions must deal with the following characteristics or principles governing the biosphere, *including* its human element:

1. Everything — living and nonliving — is in a constant state of change.
2. There is a constant exchange of materials between living things, and between living things and the physical environment.
3. Matter and energy cannot be created or destroyed, but may be transformed; as energy is used, it is ultimately transformed into heat, which largely dissipates into the atmosphere.
4. Populations of organisms tend to grow exponentially — that is, by doubling — a pattern characterized by staggering leaps in numbers following a gradual initial buildup.
5. Living things are interdependent with one another, and with the physical environment.
6. Living things are the product of their heredity and environment.

Whether or not these six characteristics result in a state of balance is conditional. For example, if change is *gradual*, *minor*, or *occurring periodically* (such as seasonal change), an ecosystem can absorb the change, or become part of a gradual, nondisruptive turnover of species and surroundings — as in natural succession. In such cases, a state of dynamic equilibrium — or balance — may exist at any point in time. If change is *abrupt and drastic*, on the other hand, as in the eruption of a volcano or the excavation of a pit mine, balance may not exist (at least in the region surrounding the event,

although it may be maintained on a larger scale).

Nature tends to maintain itself in a state of balance because of six conditions which are generally true of the characteristics outlined above. These conditions are presented schematically on the following page.

In contrast, the human world is characterized by:

1. **abrupt and drastic changes** — as in mining activity, excavation for homesites, deforestation, etc.
2. **cycles which are open in terms of human (as opposed to geologic) time spans** — as when raw materials are "locked up" in landfills rather than recycled.
3. **use of short-term (i.e. non-renewable) energy resources** — as illustrated by a continuing dependence on fossil fuels.
4. **unchecked growth of the human population.**

These departures from the first four conditions for balance have resulted in disruption of nature and a deterioration of ourselves. The remaining two conditions fostering balance in nature are modelled in some significant ways within the human world, but not in ways related to our treatment of the natural world around us.

5. **Webs of interdependence are simplified** — through monoculture farming, clear-felling of forests, etc.
6. **Adaptation of organisms to their environment is frequently destroyed** through alteration of their natural habitat or through alteration of their physiology by radiation or chemicals in the environment.

Modelling the conditions that generate balance in nature may alleviate environmental deterioration and promote harmony between the modern human world and the world of nature. The means to this end are feasible and do not require a discarding of technology. For example, organic wastes could be recycled as fertilizer, renewable energy resources could be put into large-scale use, the number of children born to a family could be voluntarily limited, and agricultural systems could be diversified. This concept of modelling the conditions for balance in nature appears in all five books of this series as the foundation for a holistic understanding of the world and its environmental problems.

*The degree of stability created by the other 5 conditions may determine how rapid or great a change can be absorbed without balance being destroyed.

To the student...

Hello, I'm Benjamin Franklin, the Black-footed Ferret from America. I am in Australia visiting my good friend Meryl, the Mountain Pygmy-possum. Your body is made up of atoms that come from foods you eat. Those atoms came from the soils and waters of the earth. And before that — billions of years ago, when the earth was forming — they came from the same clouds of atoms out of which the sun and other stars formed ... You are made of stardust!

All other living things are made up of those same atoms. You will see, furthermore, how atoms are constantly cycling through nature as living things grow, use materials from their environment, and die. So at one time, the atoms in your breakfast foods may also have been part of a brontosaurus or a butterfly. They may even have been part of an ancient mountain range that eroded away to help form the soil that grew the grain for your breakfast toast. And the water in your orange juice may have been part of a mighty river in some distant land.

So you are part of many cycles. And those cycles are all part of a great circle of creation in which — as in all circles — each part is connected to every other part, either directly or indirectly.

In this book, you will look at some of the connections — or **relationships** — among living things, including yourself, and between living things and their surroundings. You will also see how the effects of human activities, such as pollution, are interfering with the connections and cycles of life. And you will learn some ways we can stop that interference and live in harmony with nature.

You must first know that you are a part of nature, not apart from it. To preserve its connections and cycles is to preserve yourself.



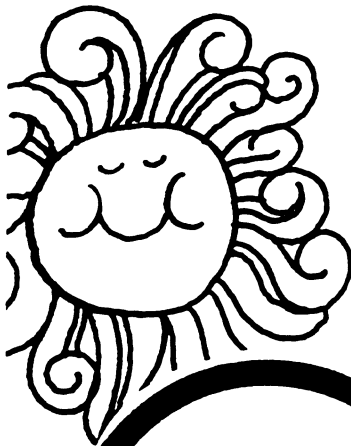
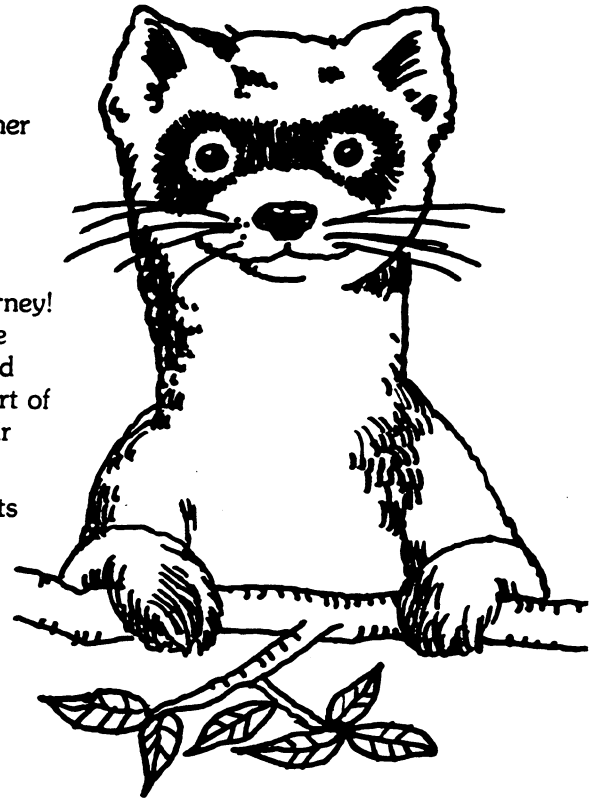
Living things depend on each other.

To Eat or Be Eaten

1. Living things depend on each other for food. As one animal eats another, atoms and energy in the body of one become part of the body of the other. What a basic connection!

Atoms are on a wonderful endless journey! They are constantly recycling from one living thing to another through this food connection. They may also become part of the surroundings of living things in their journey.

Let's follow a carbon atom on part of its journey.



CO₂

Suppose we meet the atom first in a molecule of carbon dioxide, CO₂, in the air.

That gas may be taken in by a plant and combined with water to form a starch molecule that becomes part of the plant's body.

That plant may be eaten by a plant-eating animal.



A series of plants and animals who have a food connection like this is called a **food chain**. In a food chain, each living thing is the source of food for the next organism in the series.

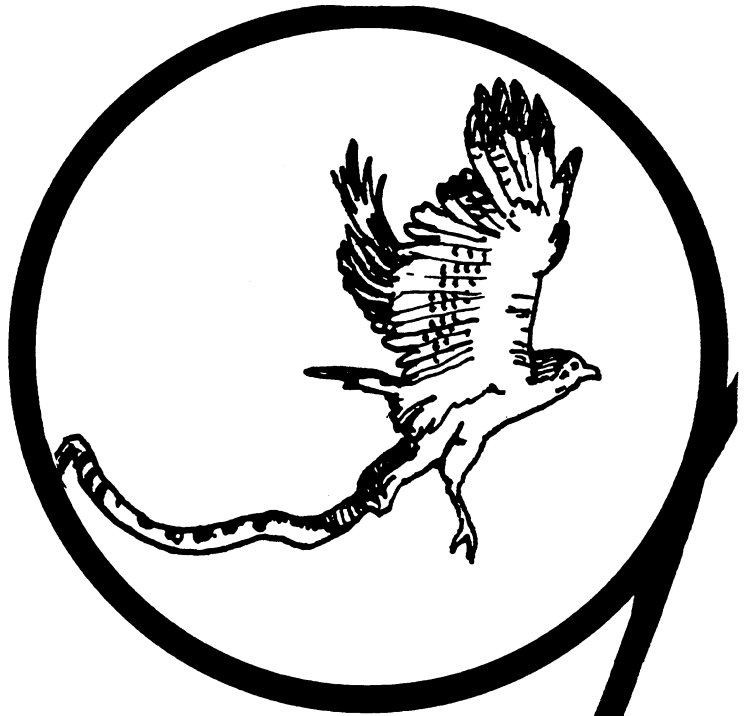
Organisms in a food chain which can produce their own food from materials in their surroundings are called **producers**. Label the producers in this food chain.

Organisms which must *eat* their food are called **consumers**. Consumers which get their atoms and energy from eating plants are called **herbivores**. Label the herbivores.

Consumers which in turn eat the plant eaters or other meat eaters are called **carnivores**. Label the carnivores.

Consumers which eat *both* plants and animals are called **omnivores**.

Are you a herbivore, a carnivore, or an omnivore?



The meat eater may be eaten by another meat eater.



The plant eater may be eaten by a meat eater.

Life cannot exist without energy. Like atoms, energy is passed along through food chains. What is the original source of that energy?

Unlike atoms, energy is not recycled. When animals and plants use it, it is changed into a scattered kind of heat energy that goes off into the air and cannot be used again.

Draw red arrows to show how energy "flows" from its source through a food chain. Draw smaller arrows to show energy being "lost" to the air as each organism uses it.