5. Ecology (Life Sciences)

Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:

a. Students know energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.

b. Students know matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.

c. Students know populations of organisms can be categorized by the functions they serve in an ecosystem.

d. Students know different kinds of organisms may play similar ecological roles in similar biomes.

e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

My dear Future Scientists in California,

In my previous four letters I talked about how Earth is shaped and how energy is constantly moving about. This fifth letter will look at life, how everything in life is interdependent, and how a single change in a system can produce drastic changes for the whole system.

Do you remember my little experiment with the mint plant? How it didn't die when shut in the bottle but rather continued to grow? And how it even replenished the oxygen inside its bottle? Back in 1775, I got so involved with everything else that I didn't follow up much on that discovery. But one of the great surprises of my afterlife was seeing how that experiment contributed to a revolution in our thinking about life.

In the decades after my death we learned that all animal life consumes oxygen which is taken from the air or from water that contains dissolved oxygen. In the animal body the carbon based food is “burned” in the oxygen to release the energy the animal needs to think, and move, digest food, and keep warm. The by-product of this burning is carbon dioxide which the animal breathes out and the plants absorb. The plant has the ability to use the energy of sunlight to once again separate the carbon from the oxygen. It then uses the carbon to create the fibers and sugars that it needs to grow, and it releases the oxygen back into the atmosphere—or the water if it is seaweed—to be taken up again by other animals. This is the basic cycle of life on earth.

But oh my, how many many different kinds of systems can be supported by this cycle! And how easily these systems can be upset.

Consider Australia, the world's smallest continent. It broke away from the land mass that would form Africa and India at a very early date and remained separated by water. That's why it evolved many life forms not found on other continents. Kangaroos and Koalas are prominent examples. There were no rabbits before Europeans colonized the country. Now they are an incredibly expensive pest. The infestation originated with the

release of 12 wild rabbits by an English colonist who wanted to hunt them. He stated, "The introduction of a few rabbits could do little harm and might provide a touch of home, in addition to a spot of hunting."

How wrong he was!

Breeding quickly, they spread rapidly across much of the country. Conditions were perfect for a population explosion. And they had virtually no enemies to catch them, eat them, and keep their number under control. Their effect on the ecology has been catastrophic. They are thought to be the prime factor in many native species going extinct. And rabbits are also responsible for serious erosion as they strip away native plants, leaving the topsoil exposed and vulnerable to sheet, gully, and wind erosion. The removal of this topsoil is devastating, as it takes many hundreds of years to regenerate.

All this because one amateur hunter wanted to pursue an English sport in a far country.

Another example of good intentions leading to bad outcomes is from much closer to home. A hundred years ago, after some disastrous forest fires in the Northwest the Forest Service vowed that they would put out every wildfire as quickly as they possibly could to save human lives, and property, and natural resources like timber. They didn't distinguish between fires started by man and those by natural causes like lightning. They didn't take into account that many landscapes, including most of California, evolved with predictable wildfires every few years. Early white settlers to your region often remarked how much the land looked like a park with space between the oak trees and a welcoming appearance. They never thought that this beauty was dependent on periodic fires clearing out the undergrowth and many of the young trees that otherwise would make the forests very crowded.

After a few decades of putting out every fire, they found that the fuel load on the land had increased dangerously and that the number of really big fires was increasing. More resources were destroyed than when fires burned themselves out. Many species require frequent open spaces between the thick forests. But these spaces were being overgrown by Manzanita and small trees. Plants that grow best at the edges of thick woodland were diminishing. Some forest scientists had discovered what the Indians had known forever that a lot of small fires create a healthy environment. Finally the policy was reversed to employ burning for a healthier wildland. But it is taking many decades to address the damage done.

These are just two of thousands of examples of human intervention leading to unexpected and unfortunate consequences. The lesson I hope you will bear in mind as you study more ecology is that **the web of nature is very complex and the less you understand how everything relates to everything else, the more catastrophic mistakes you will make.**

Your friend from the other side,

Joseph Priestley