INTRODUCTION TO BIOLOGICAL THEMES

Biology is the study of life. As we progress throughout the school year, we will explore a variety of biological concepts. As you will discover, each of these concepts is part of one or more of the underlying biological themes. In this introductory assignment, you become acquainted with some of the broad, enduring themes in the study of life.

THE CONTINUITY OF LIFE IS BASED ON HERITABLE INFORMATION IN THE FORM OF DNA

Instructions are required to arrange parts or processes in an organized way. These instructions can assist you in the assembly of a toy for your younger sibling or a carpenter in the building of a new house. Biological instructions, unlike a carpenter's blueprint, are encoded in a molecule known as DNA (deoxyribonucleic acid). DNA is the substance of genes, the units of inheritance that transmit information from parents to offspring. These genes will ultimately determine the way you look, think, and behave.

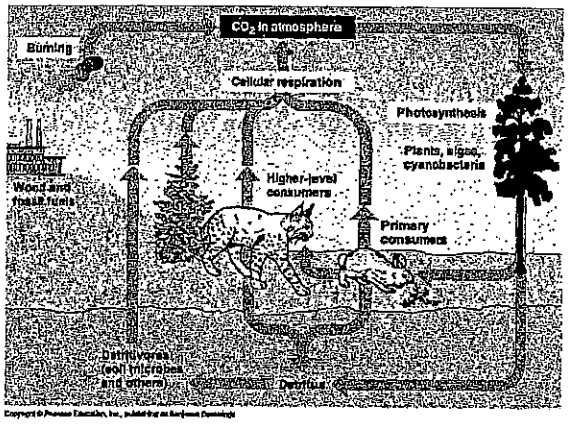
All forms of life from bacteria to you rely on this information coded in the DNA in order to "assemble" the organism. As a result, it is very important that this genetic information is copied and passed on from parent to offspring. In a species that reproduces sexually, offspring inherit copies of DNA from the parents' sperm and egg. Consequently, sexually reproducing organisms are a combination of both of their parents. The continuation of life generation over generation begins and ends with DNA.

STRUCTURE AND FUNCTION ARE CORRELATED AT ALL LEVELS OF BIOLOGICAL ORGANIZATION

Given a choice of tools, you would not loosen a screw with a hammer or pound a nail with a screwdriver. How a device works is related with its structure. In other words, form fits function. Much like a sharp knife looks as if it were made to cut objects, if you were to analyze various biological structures you would begin to have an idea as to what it does based on the way it looks. Conversely, if you know the function of a structure you may have insight as to how the structure may look.

A biological example of this structure/function relationship is evident in the aerodynamics of a bird's wing. The skeleton of the bird also has structural qualities that contribute to flight, with bones that have a strong but light honeycombed internal structure. The structure of the wing is directly related to the function.

ORGANISMS ARE OPEN SYSTEMS THAT INTERACT CONTINUOUSLY WITH THEIR ENVIRONMENT

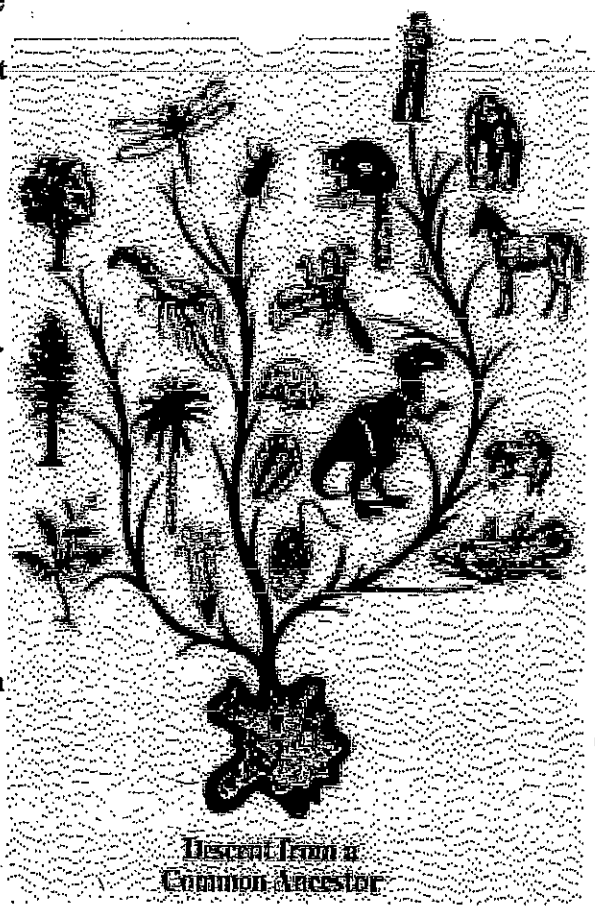


Life does not exist in a vacuum. An organism in an example of what scientists call an open system. As a living thing, we exchange materials and energy with our surroundings. Each organism interacts continuously with its environment, which includes other living organisms as well as nonliving factors. The roots of a tree, for example, absorb water and minerals from the soil, and the leaves take in carbon dioxide from the air. Solar energy absorbed by the chlorophyll, the green pigment in plants, drives photosynthesis, which converts water and carbon dioxide into sugar and oxygen. The tree releases oxygen to the air, and its roots change the soil by breaking up rocks into smaller particles and absorbing minerals. Both organism and environment are affected by the interaction between them. Finally, the tree also interacts with other life, including soil microorganisms associated with the roots and animals that eat its leaves and fruit.

DIVERSITY AND UNITY ARE THE DUAL FACES OF LIFE ON EARTH

A quick glance out the window is evidence of the diversity on the planet. Biologists have identified and named about 1.5 million species. Included in this number are over 260,000 plants, 50,000 vertebrates (animals with backbones), and more than 750,000 insects. Thousands of newly identified species are added to the list each year. Estimates of the total diversity of life range from 5 million to over 100 million different species!

If life is so diverse, how can biology have any unifying themes at all? What, for instance, can mold, a tree, and a human possibly have in common? As it turns out, a great deal! Underlying the diversity of life is unity. This will be evident at the lower levels of organization you will explore this year. For example, there exists a one celled organism called a paramecium. This organism uses a long whip-like tail called the flagella to help it swim through the water. The human sperm cell also relies on this whip like flagella in order to propel it to the waiting egg cell. As you can see, these two extremely different cells (diversity) share a common structure for movement (unity).



Descent from a Common Ancestor

EVOLUTION IS A CORE THEME IN BIOLOGY

Life evolves. Just as an individual has a family history, each species is one twig on a branching tree of life extending back in time through ancestral species more and more remote. Species that are very similar, such as a horse and a zebra share a common ancestor that represents a relatively recent branch point on the evolutionary tree of life. Through an ancestor that lived much farther back in time, horses and zebras are also related to rabbits, humans, and all other mammals. Mammals, reptiles, birds, and all other vertebrates share an even more ancient common ancestor.

All life is connected. Evolution is the process that results in populations changing over time in order to become better adapted and able to survive in their environment. It is the process of evolution that has transformed life on earth from its earliest beginnings to its vast diversity that exists today.