

Life

Notes 6.2

All living things have similar characteristics

You know life when you see it: trees, people, dogs, flowers, fish, birds, mushrooms, and more. It is easy to identify something as being alive. But, how do explain to someone what a living thing is? Is it based on movement? Is it based on some need of the living thing? All living things must have the same common characteristics. This is what makes them a living thing, or organism. In order to be considered an organism, something must:

1. **Be organized.** As strange as this sounds, it is a requirement of all organisms. Some organisms are organized differently than others. For example, you as a human are organized into organelles, which make up your cells, which make your tissues, and so on. Other organisms, like bacteria, do not contain organelles and are only made of one cell. Regardless, organization ensures that the organism stays alive. If any part of the organism stops working, it can impact the rest of it.
2. **Grow and develop.** All organisms grow, and, in most cases, develop (change) over time. Growth is defined as becoming larger. All living things become larger. It is clearly evident in the macroscopic world; is it in the microscopic world? Even though it may not seem like it, bacteria become larger over time! Most living things develop. That is, they become more complex. Imagine the changes a human goes through between infancy and adulthood. Or, imagine how
3. **Respond to the environment.** All organisms must be able to respond to their surroundings. This can include many things such as running from danger, seeking shelter when it begins to rain, etc.
4. **Maintain internal conditions.** Organisms must not only respond to the environment but also respond to their own needs. For example, what do you do if you get cold? You shiver. What happens when you feel hungry? You eat. This is called homeostasis. Homeostasis is maintaining internal condition regardless of changing external conditions.
5. **Reproduce.** Organisms must be able to produce organisms similar to themselves with its own species. There are different forms of reproduction (sexual and asexual) which produce organisms that are either identical or similar to the parent.
6. **Use energy.** All living things must use energy. The chemical processes that occur within organisms require energy. Just like a computer cannot work without electricity, our bodies cannot work with energy.

Scientists also use the terms biotic and abiotic to describe living and non-living things. Biotic is used to describe things that are living or were living at some point in time. Abiotic is used to describe something that is non-living, never was living, or never will be living.

All organisms have needs to survive.

Organisms have needs that must be met in order to survive. Imagine being able to live off sugar. You can't because sugar doesn't contain everything your body needs to grow, repair

and maintain itself. In order to survive, all organisms must have the three general necessities.

1. **Energy.** Remember, all organisms use energy. Therefore, it should be simple to conclude that they need it. Almost all energy used by almost all forms of life on earth comes from the sun. Some organisms, like plants and some bacteria, are able to capture this energy directly. We call these organisms autotrophs. Other organisms must eat, or use food, to obtain energy. We call these organisms heterotrophs. There are other ways to obtain energy which we'll talk about in later units.
2. **Materials.** Materials are nutrients, food, water and anything else the organism needs to grow or maintain itself. Organisms are able to breakdown compounds and molecules into smaller pieces and construct other compounds and molecules from them.
3. **Living Space.** All organisms need a space in which they can live. This space has to be appropriate to them. For example, lions would have a difficult time surviving in Antarctica. All living things have a niche, that is a place where they thrive best.

Organisms must have or obtain energy, materials, and living space. Without any of them, organisms can only survive for a limited time. For example, humans can survive for over a week without food, but only a few days without water.

All living things are made of cells

Cells are the smallest unit of a living thing. This means that the smallest part of an organism that meet the characteristics of life. Beyond that, the parts of a cell do not meet the characteristics.

Some organisms, such as bacteria and some types of protists, are made of one cell. Organisms made of one cell are called unicellular. These organisms tend to be too small to see without a microscope. Organisms that are made of multiple cells are called multicellular.

You may not think a unicellular bacteria and a full grown human have much in common. Yet, they do! The characteristics and needs of a single-celled organism are the same as any other organism. How they meet these needs are very different. Unicellular organisms carry out all their needs within a single cell. In a multicellular organism, different cells carry out different functions (jobs) to keep the entire organism alive.

Even though unicellular and multicellular organisms have the same needs, they meet them in different ways. In unicellular organisms, organelles and other cell parts help them meet their needs. For example, in an euglena, a type of single celled protist, chloroplasts help it obtain energy, its flagellum allows it to move, and its nucleus controls everything.

In a multicellular organism, such as a bird, there are different types of cells that help it meet its needs. For example, muscle cells help the organism move. Nerve cells help transmit signals throughout its body. Skin cells help protect it from infection. As you can see, many cells work together to keep the organism alive.

The microscope led to the discovery of the cell

Most cells are microscopic, which means they are too small to be seen without the aid of a microscope. The discovery of the cell was done by Robert Hooke. However, Hooke was unaware that the cell is the smallest unit of a living thing. He believed that it was used by organisms but was unsure of its function. Hooke published a book in 1665 detailing his observations made with a microscope. The cell got its name after he viewed cork under the microscope. The dead cells reminded him of a monk's chamber, also called a cell. Most of his work was actually smaller organisms such as fleas, gnats, and louses.

Anton von Leeuwenhoek, a Dutch business man, spent his free time refining lenses in microscopes. With his microscopes, Leeuwenhoek was the first person to observe microscopic life (1670s). He observed protists in pond water and bacteria from his mouth; quite the accomplishment for his day!

Before the important findings of Hooke and Leeuwenhoek, biologists were unaware of what organisms were made of. They believe it was some standard unit but they didn't it was the cell.

Cells come from cells

After the work of Hooke, Leeuwenhoek, and others, scientists began asking if all organisms were made of cells. Scientists began observing samples taken from all sorts of matter. They discovered that all organisms had cells, but the cells looked different from one another. This was a major accomplishment. Scientists finally had an answer to what made all living things. And, as is the way in science, a new question was posed: where did cells come from?

At the time, most people believed in what was called spontaneous generation. This idea states that living things came from non-living things. For example, people believe that frogs came from mud, mice came from piles of hay, and flies came from rotting meat. This idea remained popular until the 19th century!

In the 17th century, scientist Francesco Redi carried out experiments observing the the development of insects. In addition to observing the metamorphosis of maggots into flies, he also disproved spontaneous generation. In his experiment, Redi placed a piece of meat into a jar left open and into a sealed jar. Redi observed that the sealed jar did not produce any flies but the exposed jar had maggots in it. Redi concluded that the maggots came from the eggs of a fly. His future experiments confirmed this observation. Even though he had disproved spontaneous generation, many people did not accept it until the works of Louis Pasteur in the 19th century confirmed and expanded Redi's work.

With spontaneous generation disproved, scientists had to find out where cells came from. Observations made in the 1850s revealed the answer. German scientists Matthais Schlydun and Thedor Schwann concluded that plants and animals are made of cells. A German doctor, Rudolf Virchow, proposed that cells come from other cells. Scientists studying all types of living cells observed the same thing: cells divide. That is, one cell would split into two cells. This verified Virchow's hypothesis. Finally, the question was answered. Scientists discovered that cells come from other cells; that life comes from other life.

Over a long period of time, this and other observations formed what is now today called cell theory. Cell theory has three fundamental statements:

1. All organisms are made of one or more cells.
2. Cells carry out the functions needed to support life.
3. Cells only come from other living cells.

Just to refresh your memory, these ideas are referred to as a theory and not a law because of the definition of theory. A theory is a widely accepted explanation of things observed in our environment. Cell theory is easily supported by our observations and other evidence.

Practice Questions

Answer the following questions for review.

1. What are the characteristics of life?
2. What does it mean if something is biotic? Abiotic?
3. What are the needs of living things?
4. What are the differences between unicellular and multicellular organisms?
5. Who discovered the cell?
6. What are the contributions of Hooke and Leeuwenhoek to science?
7. Describe the experiment Redi designed to challenge spontaneous generation.
8. What is cell theory?