M O D U L E - 1

The Bacteria and Fungi

Bacteria: they are everywhere!

This may seem like an odd statement, but it's true! Wherever you find life on this planet, there will always be bacteria. In fact, there are many places where the only living thing you will find is bacteria, such as:

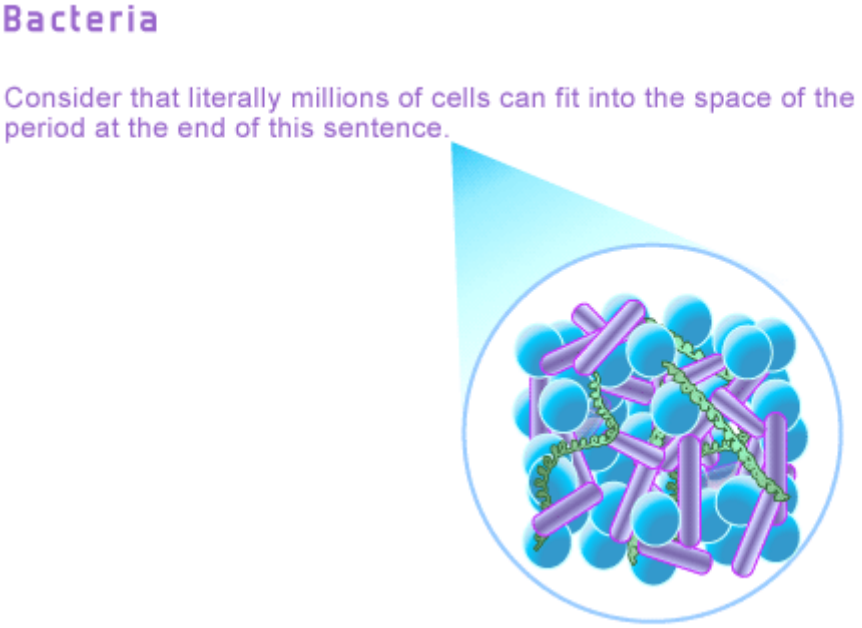
- Deep ocean hydrothermal vents
- Hot sulfur springs
- The furthest frozen reaches of the tundra

Remember that bacteria are usually extremely small single-celled organisms. Bacteria are quite simple in structure; they do not have cellular organelles and their means of reproduction (binary fission) is relatively simple. Each individual cell is capable of producing millions of copies of itself!

Consider that literally millions of cells can fit into the space of the period at the end of this sentence – you'll never look at punctuation the same way again!

As one of this week's assignments, you'll begin a lab activity that monitors food decomposition. During the progression of this exercise, you will undoubtedly encounter bacterial colonies. The round, dome-shaped pasty colonies are millions upon millions of cells, derived from a single cell that happened to land on your experiment!

Why are the bacteria so successful in invading every aspect of the environment? We turn to the next topic for the answer.



Bacteria and the environment

Bacteria have adopted every means of meeting nutritional requirements imaginable! Some bacteria obtain energy via photosynthesis. The mechanisms and basic chemistry are quite similar to those of plants. This has led to certain researchers suggesting that the chloroplasts of plants are actually modified bacteria – they've been able to form a very intimate relationship with the plant cells in which they live!

On the other hand, some types of bacteria must meet their nutritional needs in the total absence of light. How do they do this? Recall the process of photosynthesis. The main function of photosynthesis is to convert radiant energy (light) into chemical bond energy (food for the cell).

Some bacteria (the **chemoautotrophs**) take inorganic chemicals and convert them into organic molecules – the bond energy that can be used by living things. Of course, other bacteria depend on organic molecules produced by other organisms (the **heterotrophs**). Take note: human beings fall into this category!

As you can see, bacteria are able to obtain nutrition in many different ways. This is one explanation why they are found everywhere. Another factor is that bacteria are capable of withstanding extreme temperatures. You may live in an area where boil water advisories or boil water orders have been issued in the past – usually due to a water main break and repair.

Years ago, most people thought that boiling water for five minutes would be enough to take care of any "critters" found in the water. The time was then extended to ten minutes, fifteen minutes, twenty minutes – at last count in some towns, thirty minutes.

Why do you think this number keeps rising? As it turns out, many bacteria produce specialized structures called **endospores** (internal spores). These structures are capable of withstanding extreme temperatures and quickly grow into new bacterial cells. In other cases, the capsule of the bacteria is such that it can live in extremely caustic conditions (such as the hot sulfur springs).

Click the links below to learn more about boil water advisories or boil water orders.
http://www.hc-sc.gc.ca
http://www.dnr.state.mo.us

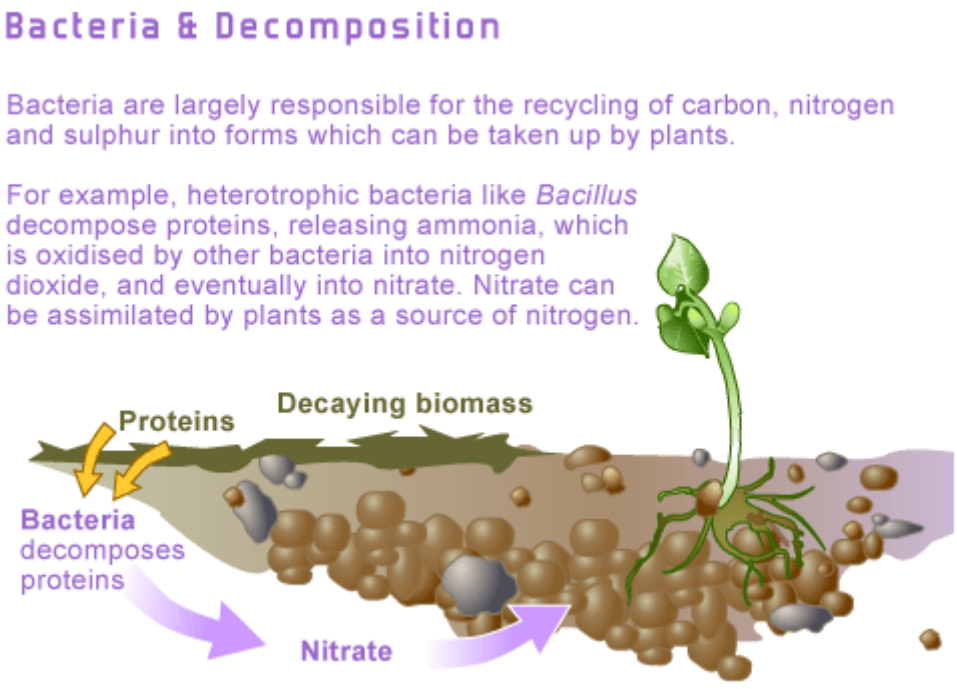
Bacteria: the vital roles it plays in life

Why do bacteria exist in this world? There must be a reason! It's like wondering why the sky is blue. (For your information, the sky is blue because of the light refraction in the upper atmosphere.) Bacteria are everywhere because they are capable of serving several distinct roles in the environment.

One of the most important roles of bacteria is **decomposition**. We just mentioned that if it weren't for bacteria and fungi, we'd be swimming in our own waste. Bacteria are a vital part of our sewage treatment facilities. Consider the concept of a "settling pond" – this settling allows the bacteria to do their work. They break down our waste products into useful and harmless chemical components. The next time you flush the toilet, remember the bacteria!

You should think about bacteria the next time you sit down to your favorite meal, too. Primary digestion is a function of the stomach and small intestine. Secondary digestion and water reabsorption take place in the large intestine, thanks to bacteria such as *E. coli*.

Bacteria are pivotal in the lives of plants as well. Plants can't process nitrogen as it exists in the environment so they turn to bacteria. Bacteria have the natural ability to convert nitrogen into compounds that are usable by plants. This planet would not have its lush vegetation if bacteria didn't carry out this important procedure. Instead, plants would be forced to rely on lighting and volcanic reactions.



As you can see, the bacteria serve many vital roles in the world around us. The next time you hear the word "bacteria" mentioned with distaste, recall that most are beneficial; very few cause disease. In fact, bacteria don't set out to cause disease! Rather, it is caused by proteins in the capsule wall of the bacteria, or by the waste products of the bacteria.

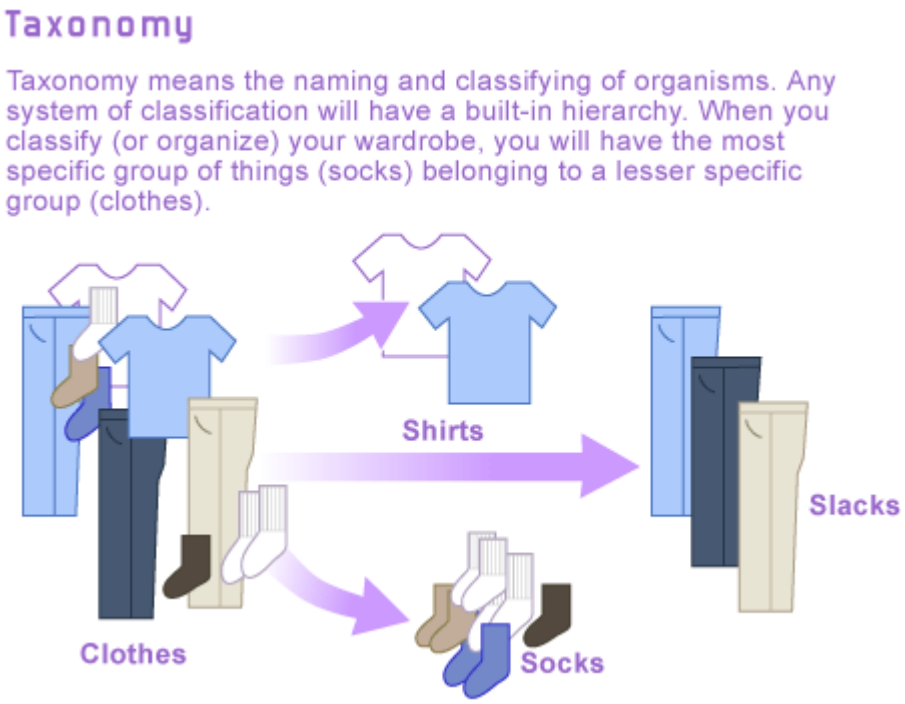
Next, we'll step into the realm of the eukaryotes and learn about the science of taxonomy!

Concept of organismal taxonomy

Taxonomy is an important concept used in science. It means the naming and classifying of organisms. Why name and classify? Think about this for a moment. Do you just toss all of your clothes and shoes into one big box and pick through them when you need a pair of socks? Or do you have a system with drawers and hangers (and possibly a closet) to organize your stuff?

We may not always use our system – our clothes could be scattered about the house, for example. But chances are that we have a system in place. This is an example of taxonomy at work. Humans have an inherent need to "pigeon hole" everything in life. So it stands to reason that scientists would want a way to classify all of life.

Any system of classification will have a built-in hierarchy. In other words, you will have the most specific group of things (socks) belonging to a lesser specific group (clothes).



The same is true for the world of biology. Organismal classification starts with the most inclusive group and then moves increasingly specific categories. Here's the system biologists have devised, the organismal taxonomy:

- Domain
- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

The most "specific" category is the species. An organism must meet a precise set of criteria to be a species. For example, ***Homo sapiens*** is the species of humans. Humans belong to the phylum Animalia, just as with all of the other animals.

Classifying the protists

What is a protist? Simply put, if we don't know what it is, we group it in the phylum Protista!

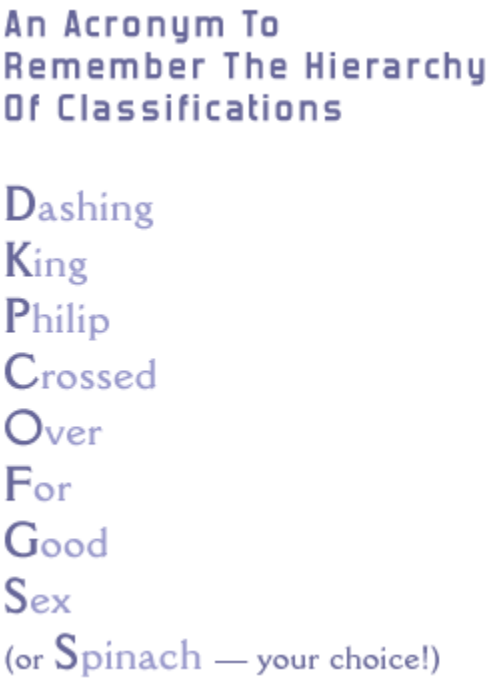
To give you a few facts about protists, they are:

- Eukaryotic
- Unicellular (at least for part of their lifecycle)
- Most exhibit motile cells at some point in their lifecycle

In addition, protists can be:

- Fungus-like (slime molds, for example)
- Plant-like (the algae)
- Animal-like (the good old paramecium that most of you have heard of)

Remembering the hierarchy of classification



As we mentioned, the hierarchy of classification for living things is:

Domain, Kingdom, Phylum, Class, Order, Family, Genus and Species.

Whew! That's going to be a challenge to memorize! However, we're willing to bet this acronym will help you to keep the order straight:

Dashing **K**ing **P**hilip **C**rossed **O**ver **F**or **G**ood **S**ex (or **S**pinach – your choice!)

You may have noticed that the species name for humans – *Homo sapiens* – appears to be written in some odd foreign language! In fact, it is Latin for "wise one" (a cruel joke, perhaps?)

Why have biologists chosen to use Latin instead of using simple names like "dog" or "oatmeal"? The reason is two-fold:

- First, all organisms have one – and only one – scientific name.
- Second, regardless of the country we're in, if we say *Homo sapiens* to a scientist of that country, they will know exactly what we're talking about!

Latin was chosen because it's a "dead" language – no culture truly uses it in modern times. Thus, we kill two birds with one stone by using a single language that transcends all cultures. We have only to assign a single name and everyone will know what organism we are talking about.

Binomial naming of species

The science of taxonomy dates back to the ancient Greeks. Aristotle was one of the first people to attempt a classification of living things. His system was simple: if they moved, they were animals; if they didn't move, they were plants!

Scientists consider Carl Linnaeus to be the "father of taxonomy" as we know it today. Linnaeus is famous for being the first scientist to use **binomial** (two-part) names for species. One example of a binomial name is *Homo sapiens;* the genus is *Homo* and the specific epithet is *sapiens*. This particular example suggests that we may not be the only member of the genus *Homo*!

Linnaeus was the first scientist to use only binomial names in his writings. Others used binomials interspersed with "phrase names". These people might have called us *Homo sapiensis north americanius inhabitus houseous in the yardious all dayious*.

Of course, this is a joke. But you do get the idea –using phrase names for species could have been very confusing!

Binomial Nomenclature

One example of a binomial name is *Homo sapiens*; the genus is Homo and the specific epithet is sapiens.

Before Linnaeus, binomials had been interspersed with "phrase names". Thus, humans could have been called *Homo sapiensis north americanius inhabitus houseous in the yardious all dayious.*

The garden variety American *(Homo sapiensis north americanius inhabitus houseous in the yardious all dayious)* in his natural habitat.