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HOW DOES WOOD ROT?

By Steve Smith

The life forms on this planet may be generally divided into two basic groups, animal and vegetable. The vegetable (plants, broadly speaking) forms are characterized by the ability to absorb from sunlight the energy they need to live, grow and multiply.

The animal life forms are characterized by their inability to absorb light energy from sunlight, although these definitions are simplified. Vegetable life forms are generally rooted in one place, whereas animal life forms are generally capable of movement. A mushroom is rooted in one place although it does not absorb sunlight for energy, relying instead on the energy content of its food. In recent years the scientists who classify things have decided that fungi are different enough from plants that they should get a third, separate category. Life forms now are "animal" and "vegetable" life forms, some of which are called "plants" and some called "fungi". We are not going to get any more complicated than that.

There is a "food chain", wherein some life forms eat others. Each life form is seeking to survive, and all life survives by exchanging energy with other life. In some cases the exchange may be rather one-sided, in that not everyone who comes to dinner goes home.

The ultimate source of life energy is sunlight. Each of thousands of life forms takes that energy, stores most of it in their physical and chemical structure, and uses up the remainder. Those life forms are plants, and they are eaten (while alive) by animals, and sometimes by fungi. Some of those animals are eaten by other animals. Some of the plants and animals, who were lucky to not be eaten entirely by others, eventually die. Various fungi and plants and animals feed on the corpses. Various other fungi and plants and animals feed on them. Generally speaking, the ones that move the fastest and/or grow the fastest and /or multiply the fastest tend to survive. For example, fast growing plants that scatter many seeds flourish in the Amazon rain forest, even though they cannot run quickly. For example, humans move quickly, even though they neither grow the fastest nor multiply the fastest. The life span of an individual life form is also obviously a factor. Every life form has some factors that combine to favor its survival.

Each time one life form eats another, some of the stored energy is used up by that life form in maintaining its own life, and the remainder is either excreted as waste (for that organism, perhaps, but for another perhaps as fertilizer) or stored as chemical energy within the tissues of that life form itself.

We love sugar for the fast energy rush it gives (not to mention it tastes good) and so it is easy to see that there is usually something in one life form which another life form craves as its sugar. This is why some life forms prefer to eat certain other life forms. As a defense, some life forms survive best when they taste bad to whoever is trying to eat them at that moment. This is why some kinds of wood are more resistant to fungal attack and rot than others; those trees taste the worst and they were the ones that survived. Different trees taste bad to different predators or parasites. Life is diverse.

Fungi are one of the oldest and most primitive life forms on this planet. Fungi feed on just about anything, whether dead or alive. Fungi move by growing more fungal cells that spread further by growth; they don't have legs or wings or swimming fins as some other life forms do. When a cell of fungus is in contact with something, and it is hungry, the cell secretes digestive enzymes onto what it touches. The enzymes break down the surface and dissolve it, and the cell absorbs the digested material as food. The stomach of a fungal cell is its outside surface; if a human body worked that way, our stomach would be on the soles of our feet, and if we wore shoes all the time we'd either starve to death or learn to eat our shoes.

Plants reproduce either by scattering seeds, which are a kind of egg, or by sending out shoots, runners, buds or branches (some kind of extension of the main body which is capable of taking root and becoming independent). Fungi reproduce in two ways. First, they just grow, forming new cells at the tips of old ones, spreading in branching strands everywhere they can find something edible. Second, they reproduce by

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creating seeds, called spores. The spores are smaller than can be seen with the human eye. They are so small and light that they drift on the wind. There are many varieties of fungal spores drifting in the air all the time. When it rains, the spores are picked up by rain water and carried everywhere rain water leaks into. As the rain water evaporates, the humidity of that surface drops from 100% down past moist to damp to maybe-damp to sort-of-dry to completely-dry.

Fungi need both water and air. As the surface (or piece of wood) slowly dries out and gets into the moist-to-damp zone the fungal spores hatch and become very fast-growing baby fungal cells. These rapidly grow up into adult fungal cells and begin to spread over and into whatever surface they are on, and the life cycle continues. When the surface dries up and cannot support fungal life, the adult fungal cells make many spores and leave them scattered around where they were. Eventually someone comes along and kicks that piece of rotten wood and zillions of fungal spores drift invisibly away on the wind.

There are also bacteria, a different kind of life than fungi, but still a microscopic single-cell life form. They are more like an animal than a plant, and more like a fish than an air-breathing animal. There are thousands of different kinds of bacteria, and many of those will also make spores when the region dries out. Bacteria tend to prefer the wood more damp than do fungi, but there is a humidity range where both can live. Many bacteria can survive drifting through the air until they contact a wet surface. Some bacteria live completely immersed in water. Most bacteria can move about. Some wiggle, others have many small legs they use to crawl about with, or to swim through the water in search of food or company.

When you look at a stump or a piece of wood you can see on the cut surface a series of concentric rings, usually a darker brown and a light tan for common wood such as Fir, Pine or Spruce. The darker rings are the growth of the diameter of the tree in the winter and the lighter rings are the (much greater) growth of the diameter of the tree in the summer, as seen by the greater width of the summer growth rings. Certain kinds of bacteria or fungi will feed enthusiastically on the harder parts of wood (the winter growth rings) where other kinds of fungi prefer only to eat into and dissolve the softer, more porous parts of wood (the summer growth rings). Wood, before deterioration has started, has only a little porosity, but is about fifty percent empty space inside. If you put a piece of wood in water, it floats about half-above the water and half-below. This shows that wood is less dense than water. As wood deteriorates, it becomes "waterlogged". In this condition water has gotten into most of the empty space inside the wood, and it floats with less of its volume above the water, or may even sink when there is no air space left inside the wood. You may have seen waterlogged wood on the bottom of a pond, or you may have handled waterlogged or damp wood and noticed how much heavier it was than ordinary dry wood.

Wood is said to breathe because the natural humidity of wood, perhaps five to fifteen percent (once it has sat around in your garage for six months) can go up and down a bit as the humidity of air varies. The air humidity ranges from maybe ten percent in a dry summer to perhaps ninety-five percent in a humid summer. Humidity (of air) means how much water vapor is dissolved in the air. Ten percent humidity means the air is holding ten percent of its maximum capacity. Ninety percent atmospheric humidity means that the air has, dissolved in it, ninety percent of its capacity. At one hundred percent humidity it is raining. The humidity of wood is usually expressed as a percent (say, ten percent). What this means is the percentage by weight of the wood that is water. In the case of air the humidity is not the percentage by weight of air that is water, but rather the percent of capacity. The capacity of air is about one percent water by weight, and it varies a lot with air temperature. A cubic foot of wood weighs maybe 35 pounds. A cubic foot of air weighs .07 pounds (a cubic foot of water, for comparison, weighs 62.4 pounds).

Wood holds a little water very strongly and more water with less strength and even more water rather casually. When there is less humidity in the air, wood loses some of its water to the air by evaporation. When atmospheric humidity is high, damp wood may lose some of its water but really dry wood will actually capture some water from the air. You may have noticed that small branches of plants are very flexible. That is because the wood is full of water. As wood dries out it becomes stiffer. Old wood found in the desert is not only hard but brittle. You may have noticed how brittle is a dead branch of wood in the summer.

Wood can actually be placed in a box and exposed to the hot steam from boiling water. After a few hours the wood becomes flexible and can be bent into a new shape. If the wood is held in that shape as it cools down and dries back to its natural humidity at room temperature, it holds its new shape. The curved ribs for many small boats are made by this "steam-bending" process.

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Wood, microscopically, consists of bundles of large hollow tubes with doors across the tubes every so often. These tubes are the walls of living cells, long since dead with only the skeleton remaining. The hollow tubes, the cell walls, are the skeletons of those cells. As the fungi eat away those cell walls, they open up the spaces between those tubes, and as the fungi dissolve the doors between one wood cell and the next, the wood porosity is opened up more and more. This allows more rainwater to be more rapidly absorbed in the wood, thus providing more humid wood which is more favorable to rapid fungal growth, thus accelerating the decay of the wood. As the wood becomes more porous it holds enough water to favor growth of not only fungi but bacteria, and between them they eat first the porous summer growth rings and then the harder winter growth rings, and finally there is nothing left.

And that is how wood rots.