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|  | **Introduction** About twelve years ago, my father constructed a pond in the backyard of our house. Being merely a child, I never gave much thought to it, except for the fact that it made our yard look a little nicer. Every once in while, my father might catch some fish on a fishing trip and bring them back to our house to let them live in our pond. However, it was only a temporary home until he could take the fish to my grandfather�s house to eat. The most curious thing was that when he cleaned out or drained the pond, most of the time he dumped the water onto nearby bushes and plants, as our backyard is a veritable jungle. Every single time that he did this, the plants always seemed to grow a little bit better than they had been growing previously to this different supply of water. The plants always seemed to stand a bit taller, or get a little leafier, or even grow a few more flowers. However, now my father has decided to stock the pond with fish to live year round. This brought up an interesting idea in my mind. As it always seemed that the pond water poured onto the nearby plants made them grow a bit bigger, I wanted to know if it really was because of the pond water, or if it was just a coincidence.  There are many factors that influence or have an effect on plant growth. It can be affected by both its heredity and other environmental factors. A plant�s heredity can determine such characteristics as a flower�s color or size. Hereditary factors are passed on from generation to generation. The more important factor in the growth of a plant are the environmental factors. "All plants need light, a suitable climate, and an ample supply of water and minerals from the soil."1 Plants must have a continuous supply of water in order to carry out many of the processes that take place within a plant. Water is required for nutrient movement into and throughout the roots. And it is the nutrients that a plant takes into its body that provide it with the necessary items to help it grow. "Plants must obtain from the environment the specific raw materials required in the complex biochemical reactions necessary for the maintenance of their cells and for growth."2  Some time around 1800, chemists and plant biologists found that certain chemical elements were absorbed from the environment. They didn�t really know for sure whether the absorbed elements were impurities or constituents required for essential functions of the plants. But by the mid-1800s it was established that somewhere around ten of the chemical elements that were found in the plants were essential for normal growth. When one or more of these elements were lacking, it was found that the plants displayed growth abnormalities or deficiency symptoms. This usually led to the fact that the plant could not reproduce normally. These elements are known as essential inorganic nutrients and there presently are about 16 of them. This list of 16 nutrients are placed into two separate groups: the macronutrients and micronutrients.  Macronutrients are elements that are required in large amounts. The macronutrients are carbon, oxygen, hydrogen, nitrogen, potassium, calcium, phosphorus, magnesium, and sulfur. Carbon is needed as a component for organic compounds. Oxygen will also be a component of organic compounds in plants. Hydrogen will be an organic compound in plants as well. Calcium is used for cell walls of plants. It is also an enzyme cofactor, and has a place in cell permeability. Magnesium is part of the chlorophyll molecule and is the activator of many enzymes in plants. Sulfur is needed in a plant for some amino acids and proteins and for coenzyme A.  Micronutrients are elements that are required only in very small, or trace amounts. The micronutrients are iron, chlorine, copper, manganese, zinc, molybdenum, and boron. Iron is used for chlorophyll synthesis, and needed for cytochromes and nitrogenase. Chlorine is needed for osmosis and ionic balance. Possibly, chlorine is essential in photosynthetic reactions that produce oxygen. Copper, Manganese, and Zinc are all activators of many enzymes in the plants. Molybdenum is necessary for nitrogen fixation in plants and it helps in nitrate reduction. And finally, Boron is needed because it influences the utilization of Calcium in the plants. All of these items will have a significant impact on the plant, but the most important are the Big 3: Nitrogen, Phosphorus, and Potassium.  Nitrogen, Phosphorus, and Potassium are the most important nutrients when dealing with tomato plants, especially. Not surprisingly, they are put into the category of macronutrients because they are needed in such large amounts to ensure the health of the plant. These nutrients are also the main ones that can be found on the outsides of packages of fertilizers. Nitrogen is essential for stem and leaf growth. It is used in amino acids, proteins, nucleotides, nucleic acids, chlorophyll, and coenzymes. "Good sources are well-rotted manure, compost, bloodmeal, fish emulsion and legume cover crops."3 Too much nitrogen produces large leafy plants but few fruits. Stunted growth and yellowing of leaves are signs of nitrogen deficiency. Another important nutrient for plants is Phosphorus. "Agriculture has been designated as the primary source of phosphorus (P) entering inland streams, lakes and water impoundments. Phosphorus, an essential element for all living plant life, is usually the growth limiting factor in inland surface waters for algae and other aquatic vegetation. When phosphorus enters surface waters in substantial amounts, it becomes a pollutant by contributing to excessive growth of algae and other aquatic plants and, thus, to accelerated eutrophication of surface waters."4 Phosphorus promotes strong roots and the formation of flowers, fruits and seeds, and helps plants resist disease. Phosphorus is needed for the formation of "high-energy" phosphate compounds, especially ATP and ADP, which are the sources of energy for the cells of a plant. It is also needed for nucleic acids and the phosphorylation of sugars. Phosphorus is a component of several essential coenzymes and needed for phospholipids. Mined phosphate rock, bonemeal, and poultry manure are good sources for phosphorus. Stunted plants that have thin stems and leaves with a purple caset on their underside are indications of a phosphorus deficiency. And finally, potassium. It is contained in greens, granite meal and wood ashes. It is important to plant vigor, growth, and disease resistance. Potassium is needed for enzymes, amino acids, and protein synthesis. Also, it can be an activator of many enzymes. It also has a part in the opening and closing of stomata. Stunted plants, poor yields and yellow-splotched foliage indicate too little potassium. This is why it is important to make sure that all of your plants get all the nutrients that they need to survive. The availability of all of these nutrients does have a serious impact on the plant itself. If the plant cannot get to these nutrients, especially the macronutrients and the Big Three, then it is a good bet that the plant will not grow to its full potential, or it could even die. While most of these nutrients will be obtained directly from the soil, the nutrients have to get to the soil from somewhere. "Both macronutrients and micronutrients are recycled constantly through plant and animal bodies, returned to the soil, broken down, and taken up into plants again."5 For example, the nitrogen cycle exhibits just this idea. Much of the nitrogen in soils is derived from dead organic materials in the form of complex organic compounds such as proteins, amino acids, nucleic acids, and nucleotides. These compounds are usually rapidly decomposed into simple compounds by bacteria and various fungi, which incorporate the nitrogen into amino acids and proteins and release excess nitrogen. This excess nitrogen is converted into a few other forms but is eventually dissolved in water where it can be utilized by plants. This sort of cycle is endless as animals can provide the materials to be broken down and plants can use it.  Another important nutrient cycle is the phosphorus cycle. "Phosphorus circulates from plants to animals and is returned to the soil in organic forms in residues and wastes; these organic forms of phosphorus are converted to inorganic phosphate and thus again become available to plants."6 This is very similar to the nitrogen cycle in the fact that it circulates between plants and animals. It is different from the nitrogen cycle though, in that it is much simpler and requires fewer steps than that of the nitrogen cycle. And compared to nitrogen, the amount of phosphorus required by plants is relatively small.  Ponds are a very interesting habitat. They can house all sorts of different organisms. Some especially constant visitors are green algae. "Some smooth algae growth on the pool and pot sides is considered a sign of good health in a pond. Fish feed on algae."7 With an abundance of fish, and considering that fish waste products are used in fish emulsion, a form of fertilizer, it would be easy to think that using the water that fish reside in would also contain the necessary nutrients that fish provide for their autotrophic counterpart. But with all of the nutrients that the fish provide, an abundance of algae can also appear. If there are a lot of algae, they can use up most of the nutrients provided in the water by the fish. "The underlying cause of algae blooms or excess string algae is too much nutrient."8 With all of the organisms that live in a pond, it is easy to think that there must be an abundance of nutrients in the water. This pond water would then be a good choice to water plants with because it should be able to grow plants and provide them with nutrients that they don�t usually get. It is pretty obvious that ponds that are left alone to thrive on their own will also develop bacteria, fungi, or protists. "The soil animals and microorganisms break down the organic matter, releasing its inorganic nutrients, which can then be reutilized by the plants."9 This is why I decided to test this theory by growing some plants of my own using my pond water. I wanted to see if different types of water really could affect a change in the growth rate of plants. If they could, then this could be a great, very inexpensive form of growing plants bigger, faster, and better.  My pond is full of fish, which led me to believe that there would be an abundance of nutrients in the water. However, the pond is also full of algae, which apparently use up much of the nutrients that are presently given off because of the fish that live in the environment. With both of these forces acting against each other, I wanted to know if the pond water would still be a good medium to feed the plants with because of the residing fish. I also wanted to see if the presence and overabundance of algae in the water would be able to use up all those nutrients, which would make using pond water a moot point.  I thought that it might be very interesting to see how this pond water would compare to the more commonly used waters for growing plants, especially tap water. Most people think water is just water and that it must all be the same. However, when water is taken from a different environment or from somewhere that it has been treated to be pure and free of all impurities, like minerals, then it will not be the same as it should have different qualities specialized for its role in life. I decided that growing a tomato plant would be good because not only are tomatoes delicious, but the tomato�s taste can be affected by the medium in which it was grown in, especially pH levels. "It should be noted, however, that tomatoes grown in an acid soil just do not taste as good as those grown at a neutral pH of about 7."10  Now I want to find out if type of water really does have an impact on the rate of growth of tomato plants. To make sure that the waters are different, I will use distilled water, tap water, and my pond water. Because distilled water comes from a process known as distillation, in which water is evaporated and then the vapor is collected and condensed, it is free of impurities and should be free of nutrients. Tap water is treated to be safe for drinking and safe for flow through pipes, so it will have different qualities than the distilled water. And finally, the pond water should be very different from both the distilled water and the tap water. Because there are living organisms in the pond, including fish and algae, there should be many nutrients available to be put to use in a plant that is given the pond water. To see how each type of water affects the plants, I will set a certain number of plants to be watered with only one of the three types of water. I will observe their rate of growth to see if one of them grows at a faster rate. If I find that the plants thrive more on one type of water when all other environmental conditions are the same for each plant, it must be that there are more nutrients available for the plant to utilize in that type of water. | |
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