Chemosynthesis essay

Introduction Synthesis is the process of producing a chemical compound usually by the union of simpler chemical compounds.

For example, photosynthesis, the word photo means putting together with light. Photosynthesis is the process of converting sunlight into food for organic organisms such as plants. Photosynthesis is the basis of life for planet earth and without it; not only would we not be able to produce the fruits and vegetables that we consume, but the food to feed the animals that we eat. Plants absorb this sunlight which in turn makes oxygen in a process called respiration.

This delicate cycle is what allows us to thrive on this planet. Although much of the life on this planet relies on photosynthesis in one way or another, there is another form of synthesis that is equally as important, chemosynthesis. The deep sea is considered the largest, yet, least-known habitat on earth and covers about two-thirds of the earth. Every year, and every dive down to the mysterious depths of the deep-sea bring scientist closer and closer to unraveling the secrets of the unimaginable deep.

This is where chemosynthesis takes place because there is no sunlight available in order for photosynthesis to take place.

How hydrothermal vents work In 1977, in the Galapagos Islands, the first hydrothermal vents were found. Using a submersible called the Alvin, scientist were able to explore this alien world never known to have existed for the first time. Hydrothermal vents are chimney like structures on the ocean floor that release extremely hot, mineral rich water. This process is called Hydrothermal Circulation. Ocean water seeps into the earth, becoming

increasingly hotter as it descends downward. As the water passes through the cracks of the earth, it is becoming enriched with metals and minerals until finally turning to a very acidic fluid.

When the super heated water reaches about 700˚F (400˚C), the fluid rises and bursts through cracks in the sea floor. The super heated water mixing with the cold sea water causes a chemical reaction and forms particles of metal sulfide to cloud the water. The pieces of metal settle around the area of the crack, and over time, collect to form the chimneys of black smokers.

One would assume that at the very bottom of the ocean, in 700˚F waters, that nothing could possibly exist here. Surprisingly, over 300 strange and unique species thrive only in these conditions.

What lives near hydrothermal vents? Although hydrothermal vent habitats would be considered a harsh habitat for life to thrive, oddly, a collection of animals live near hydrothermal vents. Animals living here have to deal with the high pressure, steep temperature gradients, and the extremely high concentrations of toxic elements such as sulfides and metals (Minic & Herve, 2003). Clams, mussels, crabs, and worms are found near hydrothermal vent locations (Grassle, 1985). Normally, deep sea soft bottoms are characterized by low population densities, high species diversity and low biomass.

But, in the case of chemosynthetic hydrothermal vent communities, this is not true. Since there isn’t anything on the sea floor, other than hydrothermal vents, the area surrounding a vent exhibit high densities and biomass, low species diversity, rapid growth, and high metabolic rates (Corselli ; Basso,

1995). How hydrothermal vent creatures survive Earlier, photosynthesis; the production of food using light, was discussed.

How do creatures who live in hydrothermal vent communities and other areas devoid of sunlight make food? They use a process called chemosynthesis.

Chemo- means chemical, and as previously stated, synthesis means the process of producing a chemical compound usually by the union of simpler chemical compounds, thus, Chemosynthesis must mean the process of converting chemicals into food. In order for one to understand the chemosynthesis, you must know the why, where and how of it.

Why: Animals found near hydrothermal vents have very few options for food. They either have the chemosynthetic bacteria to perform chemosynthesis, or they wait for some type of carcass to slowly drift to the bottom of the ocean. Without chemosynthesis, most animals near hydrothermal vents would not be able to live. Where: Chemosynthesis can only occur where there is lack of sunlight with the proper bacteria and chemicals needed to perform chemosynthesis.

How: Chemosynthesis does not occur in the water near hydrothermal vents, it occurs within the actual animal itself. Hydrothermal vent dwellers carry chemosynthetic bacteria usually located in their tissue or in their gills.

These bacteria are known as Chemosynthesis Autotrophs. This partnership between bacteria and animals is called symbiosis. Symbiosis is the living

together of two organisms of different species. When involving chemosynthesis, the bacteria become chemoautotrophic.

The chemosynthetic bacteria use chemical energy to change CO2 into something edible; carbohydrates. How is CO2 changed into carbohydrates? Using Hydrogen-sulfide gas (H 2 S) that escapes from the earth. The exact equation is: CO2 + H2O + H2S + O2 CH2O + H2SO4. Where CO2 is Carbon dioxide, H2O is water, H2S is hydrogen sulfide, and O2 is Oxygen. The result of this equation is CH2O + H2SO4, which is a combination of carbohydrates and sulfuric acids.

The carbohydrates (CH2O) are kept as food and the sulfuric acid (H2SO4) is released. Examples of Animals and their means of Chemosynthesis One of the more studied animals of the hydrothermal vent community is the Giant Tube Worm, Riftia pachyptila. Riftia satisfies its large appetite by using chemolitautotrophic sulfideoxidizing bacteria located in its cells in an organ called the Trophosome.

The tube worm must take in sulfide, ammonia, oxygen, and carbon-dioxide in order to produce the food necessary for survival (Minic ; Herve, 2003). Another one of the more researched hydrothermal vent dwellers is the polychaete annelid, the Pompeii Worm, or, Alvinella pompejana.

The Pompeii Worm is found near the hydrothermal vents along the East Pacific Rise. (Cottrell ; Cary, 1998). The worm is found in colonies on the sides of hydrothermal vents. The Pompeii worms dorsal integument is covered in a diverse community of chemoautotrophic bacteria for chemosynthesis. Some of these bacteria have specialized jobs.

For example, some are sulfur oxidizers, sulfate reducers, nitrifiers, and nitrogen fixers (Cottrell ; Cary, 1998). Conclusion Chemosynthesis is the method by which creature that lurk at the very bottom of the ocean are able to survive and thrive and continue doing their job in the ecosystem, whatever it may be. This goes to show that even in the most unbearable of living circumstances, there is a way for life to exist in these areas. Chemosynthesis and photosynthesis are two very different processes by nature, but they have one common feature, keeping the ecosystem ticking. Without these processes, the earth would not be able to support life.

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