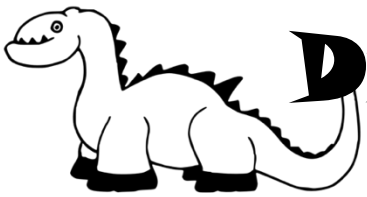
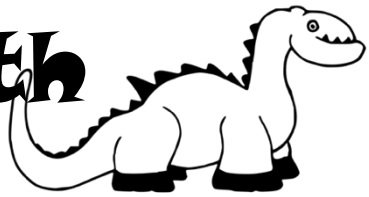


Dinosaur Breath



Student Background Reading: Life of a Carbon Atom

All living organisms are based on the carbon atom. In fact, 18% of our bodies are made of carbon! Carbon atoms continually move through living organisms, the oceans, the atmosphere, and the Earth's interior and crust. This movement is known as the carbon cycle. The paths taken by carbon atoms through this cycle are very complex and may take millions of years to complete a full circle. All animals are part of the carbon cycle. When animals eat food, they gain carbon in the form of sugar. In animal cells, oxygen combines with food to give energy for daily activity. Carbon is waste product of this process, which is known as cellular respiration. As a waste product, carbon combines with oxygen to form carbon dioxide (CO_2) and is released back into the atmosphere when animals breathe and exhale.

Consider the journey of a typical carbon atom that existed in the atmosphere as part of a CO_2 molecule 360 million years ago. This particular CO_2 molecule drifted into the leaf of a large fern. Through photosynthesis, the oxygen (O_2) from the CO_2 molecule was released back into the atmosphere, while the carbon atom (C) was removed from the CO_2 molecule and used to build a molecule of sugar. The sugar molecule could have either been broken down by the plant to release its stored energy, but this particular sugar molecule was transformed into a long-lived structural part of one of the plant cells. Soon after, the fern died and the remains sank into the muck at the bottom of the swamp. Over thousands of years, more plants grew in the swamp and their carbon-containing remains also sank into the swamp, forming a layer of dead plant material many meters thick.

Gradually, the climate changed, becoming drier and less tropical. Sand, dust and other materials slowly covered the ancient swamp and sealed the decaying vegetation under a thick layer of sediment. The sediment hardened, turning into sedimentary rock. The carbon atom stayed trapped in the remains of the long-vanished swamp while the high pressure of the layers slowly turned the material into what we know today as "coal". Today, about 360 million years later, humans mine these ancient coal beds and burn coal in power plants to create electricity to fuel industrial civilization. The process of burning releases the energy stored in the carbon compounds in the coal and reunites the carbon atom with oxygen in the air to form CO_2 again. The CO_2 is released to the atmosphere through the smokestack, and the journey continues.

Now let's consider what would have happened to the carbon molecule if it had been eaten by a dinosaur. Let's say a brontosaurus ate the fern for breakfast, ingesting carbon from the fern in the form of sugar. In the brontosaurus' cells, oxygen combined with the sugar to provide energy for the dinosaur's daily activity. CO_2 was a waste product of this process and was expelled from the dinosaur's body when he took a deep breath and exhaled. So, the carbon contained in the leafy fern was released into the atmosphere in the form of CO_2.

Consider that this CO_2 molecule happened to be floating with other CO_2 molecules over the ocean surface. In a place where the water is warm, it is likely that the water absorbed these molecules. Oceans soak up a tremendous volume of carbon to prevent too much CO_2 from remaining in the atmosphere. Once our CO_2 molecule was dissolved in the ocean water, it could have been captured by a tiny marine organism that used it to make its shell. There are trillions upon trillions of little ocean creatures that capture atmospheric carbon in the form of CO_2 and use it to make calcium carbonate ($CaCO_3$) shells.

By keeping carbon contained within their shells, marine organisms keep it from being re-evaporated into the atmosphere, where it would accumulate as CO_2. When they die, their shells sink to the bottom of the ocean floor to form sediments of limestone and natural chalk. These sediments are raised above sea level by tectonic activity and create large rock formations.

People mine large amounts of natural chalk from these from these rock formations. Through a simple chemical reaction with vinegar, we can release the carbon stored in this chalk into the atmosphere, where it will combine with oxygen to form CO_2. It is possible that this is the same CO_2 that was exhaled by dinosaurs during the Jurassic Period!