G8 Organic Chemistry

Sugars, Starches, Proteins, Fats

In this unit the student studies the chemistry of sugars, starches, proteins and fats in relation to their function in the body, their function in plants and their function in the food industry. Some modern-day Waldorf teachers also include alcohol in this unit as it has become a modern-day issue for children in this age group and older.

Waldorf Approach

In a chemistry workshop in Larna, Sweden the importance of the Waldorf approach in teaching chemistry was discussed in great detail. A teacher at the conference summed the message up as this, "It is quite different whether one is involved with chemistry as a science or technology or else as a pedagogical tool for life. As technology chemistry is a tool for controlling and utilizing the world for our purposes. But this "objective" approach contains a danger: acting separately from nature, our lack of intimate knowledge or appreciation has already resulted in serious damage to the natural world. For the developmental aims of Waldorf pedagogy, the goal is to live into a wonderful world of spiritual, soul experiences (a German word for this is *"schliessen*," making connections), to get "caught up" in nature and put yourself experientially right into the process."

So when we educate, as teachers, the goal is not to have our students memorize formulas and definitions. It is more about teaching students to understand our relationship with nature and nature's relationships within different systems. We equip our students with the facts and then teach them to be able to make connections from there. The emphasis should be not on "substantial thinking but in "process thinking"

There is also another way of looking at chemistry that the "strict formulas and definition" approach misses. In the Middle Ages, Renaissance and Elizabethan Eras that we studied/will study this year a child would learn skills as an apprentice either from their parent or a neighbor. This child would learn, slowly, the tools of the trade and how to take pride in their work. All learning was done by experience. At the same time these people would directly share their skills with society around them, thus strengthening the educational bond. And throughout this process the child would naturally learn the "mysteries and meaning" behind their craft. There were only a few in the Elizabethan Era (that we study this year) and before who chose to become "scholars". And these scholars often focused on our relationship as humans to nature or to the complex issues of free will, destiny and existence.

Today, that process and that way of thinking is almost gone. We have machines to create most of the things we need and very few craft-people. Anyone who can read can

learn a bit about any technique or philosophy without having the learning or life experience behind it.

Historically, the process of learning naturally connected a person to nature, the process and the world and community around them. Today this does not happen naturally. Teaching in the Waldorf method can bring this important missing part of education back into existence. It can also help create an enthusiasm and passion for learning in your student(s).

Your job as a teacher is to awaken the wonder and reverence in your students for the beauty of the world. This was obvious in the playrooms of the preschool and KG students that were filled with natural toys, fairies, silk scarves and nature tables. But it is not as obvious in the older grades. Gone are the fairies and silk scarves. But this does not mean that wonder and reverence are gone too. A student in the older grades holds the tools of his lessons in the same reverence. Remember the first time a science teacher let you do an experiment with a beaker? Or the first time your wore safety goggles? Or viewed a powdery substance and wondered what it was going to do during your lesson? Teach your students to care for their materials, put them away carefully and purchase them with thought. Create a place in your classroom where science tools have a beautiful home.

You will also want to consider adding "surprises". In today's world there are experiments being done on TV, on educational DVDs and even at the local science center. Probably every child has seen an experiment done somewhere. Is there a child alive that has not seen a baking soda volcano? So many of these experiments, then, have lost their charm and the student(s) may come into class imagining they know everything already and they don't really need to know more about whatever experiment you have planned. Thus, it is good to be creative. Find ways to 'change up' things by adding essential oils, pinecones, bits of moss, fruits, or other things from around the home to an "ordinary" experiment and see what happens. Or find a way to make the experiment applicable to your student. I have provided some experiments below but you are free to modify them to fit your own needs and surroundings.

Another way to encourage reverence is to remind students that the devotion given to a project is the way to yield something that is truly revolutionary. You can even tie in the example of Shakespeare. He didn't just "write plays" for money or for method. He devoted his time to really doing what he was inspired to do and in return he took the English language, which millions of people had access to and managed to revolutionize plays and language by "living" in the process. Of course we don't have the time he did to focus on one thing all the time but we can teach that focus on a daily basis. This is something that today's society has lost the ability to do – focus. Steer students to focus and become completely involved in the process of what is happening in the lesson/experiment. It is not about finishing the work, it is not about lunch time coming up, and it is not about the cute boy or girl who is a lab partner or the gossip of the day –

it is about focusing on experiencing and trying to understand the wonder of what is happening in the lesson.

Always remember – just as in other Waldorf lessons – showing the relationship to humans (the student), history and nature is key. In chemistry the temptation is to switch to "logical" mode and talk in abstracts about substances we are not familiar with on a daily basis. Instead, the Waldorf teacher can get their students familiar with these substances first.

With each lesson start out by talking about what children are already familiar with. Ask them where does fire exist in nature? Where does light exist? What about wind? This conversation will bring you to discussions of the sun, starts, reflections in metals, glowing sea creatures, volcanoes, the "fire" or warmth within the human body, and even the sparkle in a person's eyes. Or, as one poet, Frances Thompson described (a poppy) : "Like a yawn of fire from the grass it came, And the fanning wind puffed it to flapping flame."

From discussion move to demonstration. For example, after discussing fire you would simply burn a branch or other materials and sit and observe the process. Have the student(s) talk about the process. Talk about the burning in terms of all the senses. What do you see? What was the process? How did it start and finish? What did you smell? Taste? Feel? Hear? What was the crackling you heard? What is that taste on your tongue when you got to close to the smoke? What is that smell coming from the log (or other item)? Burning different substances will then cause additional questions to arise – why did that one burn a different color? Why did that one smell differently?

You can make other observations like the fact that when we burn something a process happens where matter is no longer solid. However, when we do other experiments we are creating solid from non-solids. Have students think about how these processes are different and how they can apply to different experiments. Have them keep in their minds – are we creating or destroying with this scientific experiment? And is this creation a creation or a transformation? And is this destruction also a transformation? Is there a "good" or a "bad" in this process?

And never forget to include the connection with nature. We have lost this sense of connection today but we need to reconnect our students in realizing that all these processes were originally inspired by nature – and that we are still being inspired by nature. Share with students that humans first learned to create substances by watching nature at work – by watching a spider spinning, a plant growing or transforming or bat using echolocation. Just as Marcus Aurelius wrote, "O Nature, from thee are all things, In thee are all things, To thee all things return." It may also be good to find modern articles, like the following one, about how man is still inspired by nature:

Smithsonian Science Magazine
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If you've ever had a violent encounter with a porcupine, it probably didn't end well. The large rodents are most well-known for the coat of some 30,000 barbed quills that cover their backs, an evolutionary adaptation to protect against predators. Although they appear thin—even flimsy—once quills lodge in your flesh, they're remarkably difficult and painful to get out. Recently, a group of scientists led by Jeffrey Karp of Harvard decided to closely investigate just what makes these quills so effective. As they report in an article published today in the Proceedings of the National Academy of Sciences, their analysis revealed a specialized microscopic barbed structure that enables the quills to slide into tissue extremely easily but cling to it stubbornly once it's in place.

Each cylindrical quill, it turns out, is coated with backwards-facing barbs interspersed with smooth, scale-like structures. When a porcupine brushes up against an adversary (or against anything else), it sheds its quills; the barbs around the circumference of the quill act like the teeth on a slicing serrated knife, providing a cleaner cut into tissue and making penetration easier. Once the quill has dug into the other animal, these same barbs have the opposite effect, lifting up and preventing the needle from sliding out easily.The researchers took a rather interesting approach to arrive at these findings: They measured how much force it took to push in and pull out porcupine quills into pig-skin and raw chicken meat. They then performed the same experiment with other quills, which they'd rendered smooth by carefully sanding off all the barbs.

All this research had a greater purpose than merely satisfying the authors' curiosity about porcupines. Like Velcro (inspired by plants' burrs that get stuck on your clothing) and tape-based adhesives (inspired by the sticky coating on geckos' hands and feet), the scientists studied the characteristics that made the barbs so effective in hopes of developing next-generation hypodermic needles.

If one could be designed that would require less force to penetrate human tissue, it might mean less pain with your next flu shot. The quills' staying power could be useful for needles that need to stay in place for a longer period of time, like an I.V. drip.

As a proof-of-principle, the team made replica porcupine quills made out of plastic and put them through the same battery of tests on tissue and skin. The plastic quills worked like a charm. The researchers speculate that such technology could someday be incorporated into a range of medical applications beyond hypodermic needles, such as staples that hold wounds together during healing and adhesives used to hold drug delivery systems in place.

With all these principles in mind we can now embark on the lessons for 8th grade chemistry.

The Four Basic Biomolecules

There are four basic biomolecules and of those, three basic macronutrients. During the eighth grade year your students will be given the tools to understand the three basic macronutrients. The four major classes of biomolecules are – carbohydrates, proteins, lipids and nucleotides.

Carbohydrates (also called saccharides) are the most abundant of the four. The molecules contained in a carbohydrate are mostly carbon, hydrogen and oxygen atoms. Their role in nature is to transport energy, and provide the structure for plants and anthropods. They are also involved in fertilization, immune systems of plants, animals and humans, the development of disease and blood clotting.

Lipids are also molecules formed from carbon, hydrogen and oxygen atoms and are the main constituent of all membranes in cell walls.

Proteins are molecules that, once again contain carbon, hydrogen and oxygen but unlike the other two they also contain nitrogen. Proteins usually act as biological catalysts and as a source of fuel.

Nucleic Acids or nucleotides are DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) and will be studied later in High School. These molecules are involved in genetic formation as well as forming structures within cells. They are involved in all inherited material in the body as well as the conversion of all this data into proteins.

Start your class out with the awareness that this fourth category exists so they know where it belongs in the “organizational structure” later. They will not be studying it in detail but it will be helpful to know that it is part of the group they are studying now.