Molecular Models and the Origin of Life

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Target age or ability group: grade 9-14 life science, biology, integrative science or biochemistry course.

Class time: Approximately 100-120 minutes, best spread out over 2-3 days.

Materials and Equipment: (per team of 2 students)
___ 3 page student handout
___ Organic structure set ($29.50 , p. 722 Carolina Biological 1-800-334-5551) or similar set
___ teacher created floppy disk or hardcopy of images using Rasmol software . Allow time to register, download, navigate and edit images of the molecules suggested in this laboratory exercise.
(free plug in available from http://www.umass.edu/microbio/rasmol/index2.htm)

Kits need to include springs so that double and triple bonds can be reflected in some molecules constructed, or can be created using styrofoam balls and pipe cleaners. Need 10 carbons, 2 nitrogen, 6 oxygen, 28 hydrogen.

Summary or Overview of Activity:
Atoms in the universe share a fundamental architecture. Formed in the birth of stars since the Big Bang many billions of years ago, groups of atoms called molecules compose all of matter, including living things. Life's atomic structure is not fundamentally different. By creating 3-dimensional models of organic and inorganic compounds using ball and stick(or spring) kits, students recognize that it is the number, type, and arrangement of atoms that gives each compound its unique set of physical and chemical properties. Life is merely the most splendid of all atomic creations.

Prior knowledge, concepts, or vocabulary necessary to complete assignment:
Students should have a good working knowledge of atomic structure and of the rules that dictate the combining of atoms to form molecules. It is recommended that students have some practice with creating electron shell diagrams and the corresponding ball-and-stick molecular models (as 2-dimensional sketches) of at least a few common molecules like water (H2O), carbon dioxide (CO2) and methane (CH4). After this students can be invited to construct 3-dimensional ball-and-stick representations using common organic structure sets like those recommended above.

Teacher Instructions: After class instruction relating to atomic structure and bonding of atoms to form molecules, assign 2 students to a group, each with its own kit containing at least 10 carbons, 2 nitrogen, 6 oxygen, 28 hydrogen atoms. Set up working stations so that 2 teams of 2 are near each other and able to form a collaborative group of 4 for the larger molecules that come near the end of the laboratory exercise. Provide a disk with images of the molecules to be viewed in Rasmol or create a file and print hardcopy for students to use at their stations. Once all students are dismissed and working at their respective stations, rotate in a particular direction through the lab groups. Maintain this rotation throughout the exercise, pausing to visit at each station to see how each student group is doing in their effort to complete each model. If the group is not ready to have a model checked, the teacher merely moves to the next group. When a group is ready to be checked, look over the completed model carefully and determine if it is correct. If it is, sign each students lab page with your initials on the numbered item on their lab sheet. If the model has not been created correctly, merely say that the model "needs some repair" and that you will return again in a few moments. Do not tell the student group what is wrong with the model. Students will learn a great deal by debating the reasons for the error as they attempt to fix it. Be sure to allow enough time at the end of the period for clean-up. Carefully check each kit for completeness prior to dismissing students from the lab.

Relevant Resources:
(video) The Origin of Life: Research the Possibilities. 50 minutes. $129.00. Films for the Humanities and Sciences. Item # BIM7474. Originally a BBC release called Life is Impossible, this video for advanced high school or introductory college level students profiles seven major hypotheses on the energetic and chemical requirements for the ultimate origin of life. Shows how active the debate is even today.