Honors Chemistry Summer Assignment for 2010-2011 School Year Mrs. Clifford

Your assignment this summer is to read the following 2 "mini-articles" and then choose 6 additional "mini-articles" from the NewScientist magazine http://www.newscientist.com/issue/current
or similar articles from any of the websites/publications of the American Chemical Society.
http://pubs.acs.org/cen/whatstuff/stuff.html

To start this assignment you must read the two articles from NewScientist which appear below in addition to 6 articles of your own choice. When you are done you'll have a total of 8 articles. For each article you'll be defining chemistry words used in the article. After your definitions you'll be elaborating on the use of the chemistry term by providing diagrams and/or examples.

STEP 1: Read the full text of the two articles Here is the text of the article from the April 25th, 2009 issue and all the words I would consider important to define, explain and give examples of the chemistry involved in their use. The topic of this article is ELECTROCHEMISTRY.

Nanowire network measures cells' electrical signals.

ELECTRICAL signals from different parts of the same cell have been simultaneously recorded for the first time, thanks to a new technique for attaching nanowire probes. This could aid the study of how heart, muscle and brain cells function and communicate.

The method uses a device called a nanowire field effect transistor (NWFET). This consists of a silicon wire just 20 nanometres in diameter attached to metal electrodes on a substrate of silicon dioxide. The nanowire, which sticks out by 30 to 40 nanometres, can be used as a probe to amplify the electrical signals produced by anything it touches.

Many NWFETs can be fabricated on the same substrate, allowing several signals to be measured at the same time. The difficulty had been in growing the cells directly over the nanowire arrays. It was a matter of chance whether cells grew in the right place for the signals to be measured.

Now Charles Lieber at Harvard University and colleagues have created a technique that overcomes this problem. They grow heart cells taken from chicken embryos on transparent polymer substrates and then transfer the cells to the nanowire array. Each cell is then positioned over up to 10 nanowires with the aid of a microscope. "We can do measurements that weren't possible before," says Lieber.

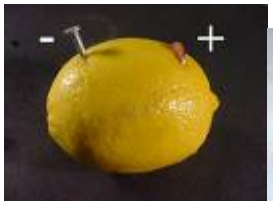
Besides making simultaneous measurements from different parts of the same cell, the wires can record the signals produced by several cells in the same tissue culture at the same time. For example, the team was able to measure the "contractile wave" produced by heart cells to coordinate beating as it passed through the culture (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.0902752106).

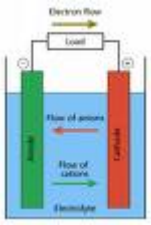
Cell biologists will be able to use the technique to study electroactive cells such as neurons, cardiac cells and muscle cells, as well as the effects of drugs on these cells. As the wires can penetrate the cells, the signals can be studied from the inside. The technique could even be used to improve the interface between the body and medical implants, such as drug delivery devices and artificial limbs, Lieber says.

This technique could improve the interface between the body and artificial limbs
Zhong Lin Wang at the Georgia Institute of Technology in Atlanta says the technique will eventually give new insights into cell function, such as how neurons communicate with one another. "It is very advanced research," he says.

STEP 2: After reading the article and highlighting all the words associated with chemistry you should define them to the best of your ability and give an example of how they are applied in chemistry.

An example of one word from the article is ELECTRODES. Define an electrode in your own words after looking up several definitions in several sources and then discuss an actual chemical example of using an electrode. Such as, electrodes are used in batteries or on the ends of wires to carry the electrons from the anode (where electrons are produced) to the cathode (where electrons are used).



You could insert a picture of an electrode in action and explain the picture to enhance your definition and be more sure of your own understanding of the term. You could say: Notice the negative sign by the nail on the left…since electrons are negative that is the electrode producing them. The penny on the right side of the lemon has a positive sign and would be attracting the electrons IF there were a wire going from the nail to the penny.

Here is the second article you must do from the same issue. The title is: "How to turn a greenhouse gas into a clean fuel." I would place this article under the the ORGANIC CHEMISTRY topic or under the CHEMICAL BONDING topic.

How to turn a greenhouse gas into a clean fuel

CONVERTING a greenhouse gas into a clean-burning fuel offers two benefits for the price of one. That's the thinking behind a novel process for converting carbon dioxide into methanol at room temperature, developed by a team at the Institute of Bioengineering and Nanotechnology in Singapore (*Angewandte Chemie International Edition*, DOI: 10.1002/anie.200806058).

Molecules of CO_2 are very stable, so processes that convert the gas to methanol normally require high temperatures and pressure. They also use catalysts containing toxic metal ions. "Our catalyst isn't toxic, and the reaction happens rapidly at room temperature," says team leader Jackie Ying.

The catalyst used by Ying's team is a type of chemical called an *N*-heterocyclic carbene (NHC). The mechanism by which the NHC speeds up the conversion is uncertain, but it appears to change the shape of the CO_2 molecule, "activating" it in a way that makes it easier for hydrogen to bond with its carbon atom, says team member Yugen Zhang.

The catalyst may also help to release hydrogen from hydrosilane molecules, which are the source of hydrogen in the new process. Hydrosilane is an expensive chemical usually used to make computer chips, so the team wants to find a cheaper source.

"Potentially, it's a means for taking carbon dioxide out of the air and making it into something useful," says Dongke Zhang, director of the Centre for Petroleum, Fuels and Energy at the University of Western Australia in Perth. As well as being a fuel, methanol can be used as a feedstock for the chemical industry.Zhang's team is developing a technique for converting CO_2 into methanol using high-frequency electromagnetic fields or plasmas to activate the gas.

STEP 3: Go over this checklist to be sure you've done all the parts of the assignment.

A. Read and print out the articles you've chosen (the 2 articles given in the assignment plus 6 articles of your own choice)
B. State the area of chemistry under which the article is classified (see list below)
C. Highlight the chemistry terms in all articles
D. Give definitions for the terms and enhance with diagrams and examples of their use in chemistry

Now, use the link at the top of this assignment to go to the current issue of NewScientist or the ACS site and find 6 other "mini-articles you are interested in. Complete the reading/vocab/definitions as you did for the first two I have given you here.

Email your assignment any time during the summer in a single word document to me BY the first day of school Thursday, September 2nd, 2010). I will send you a confirmation that I received it. I do not check my school email daily in the summer so don't expect an instant response.

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So, if you are interested in the chemistry of the environment you could put into the search box the key words "greenhouse gases" or "alternative fuels" or "recycling" etc., and come up with mini-articles. If you were interested in chemistry associated with health you could but in "vitamins" or "nutrients" or "brain function", etc. If you were interested in the chemistry of cars you could put in "internal combustion" or "car fuel" or "automobiles" and see what comes up.

Your articles must be classified as to one of the topics in chemistry listed below. Here are the topics:

1. Classification of Matter (solids, liquids, gases, mixtures, pure substances, etc.) and its Properties (chemical and physical)
2. Measurements and Chemical Calculations
3. Atoms: The Building Blocks of Matter
4. Electron Arrangement in Atoms
5. The Periodic Table
6. Chemical Bonding
7. Chemical Reactions
8. Solution Chemistry
9. Acids and Bases
10. Energy of Reactions (Thermochemistry and Kinetics)
11. Electrochemistry
12. Organic Chemistry
13. Biochemistry
14. Nuclear Chemistry

Have fun and don't worry if you can't define or give examples for every word you think is associated with chemistry that appears in the article. Just do your best with as many words as you can from each article. If you've already defined a term in one "mini-article", like the term electricity from the first article and it appears in other articles you find you don't have to do it again. I don't expect perfection I expect your best effort.

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