Applications in Artificial Photosynthesis Group Activity

Working in groups of 2-3, follow the given instructions and complete the assignment. Make sure your research findings answer the provided questions. Once you have completed the assignment, present your findings to the class.

Can Artificial Photosystems Produce Fuel?

In March of 2011, scientists for the Massachusetts Institute of Technology announced the development of the first practical "artificial leaf." The device is about the size of a playing card. When it is placed ins after and exposed to sunlight, it is able to generate electricity using a process that begins by splitting water into hydrogen and oxygen gas (**Figure 1**). The research terms' stated goal is to enable homes to generate their own power.

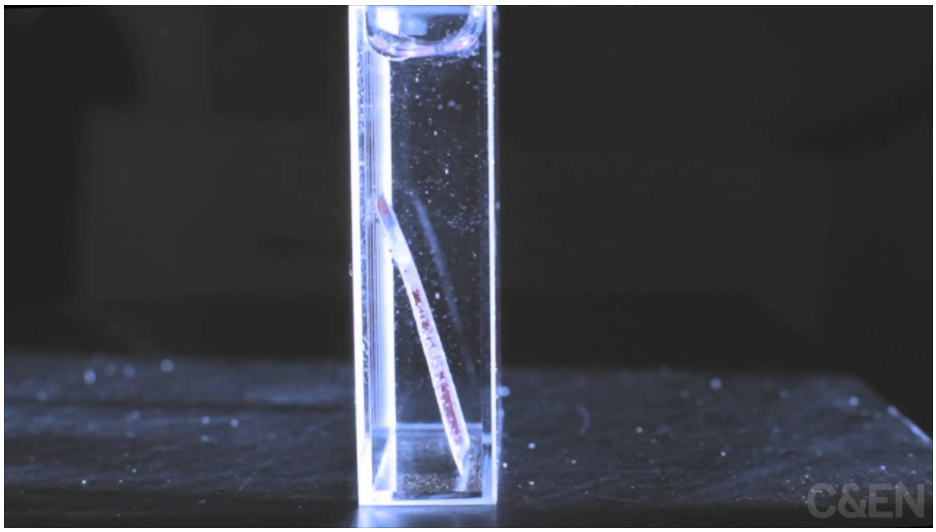

Figure 1

Although plants and other producers convert solar energy into more than enough energy to sustain life on Earth, humans never seem to have enough energy. We harness hydro and nuclear power, mine for coal, drill for oil, process tar sands, and extract natural gas from beneath Earth's surface to meet our energy needs. Each of these methods has significant impacts on the environment and our economy. Disasters such as the meltdowns that occurred at the Fukushima nuclear generating station in Japan in 2011, as well as the growing concern about climate change, highlight the severity of the impact of our methods of energy production. Increasingly, there is a desire to develop technologies that produce "green" energy that can be generated endlessly with minimal harm to the environment.

The Application

In pursuit of this goal, people have begun to question why we do not simply follow the lead of photosynthetic organisms. Although solar panels allow us to collect and transform one light energy into electricity, what if we could transform light energy into fuel? Scientists are working to copy the energy-trapping power of photosynthesis itself. Unlike plants, which use

sunlight to synthesize sugars and other complex organic molecules, scientists are hoping to use the energy-capturing ability of photosystems more directly. As you have learned, photosystem II is able to split water molecules, separating the hydrogen electrons and protons from oxygen atoms. If, for example, the free energized electrons or hydrogen gas could be captured using artificial photosystems, they could be used to generate electricity or to provide a high-energy, clean-burning fuel. In this activity, you will conduct research to learn how scientists are working to develop practical and innovative green energy technologies that mimic the actions of natural photosystems.

Research

Conduct online research about the current scientific work being done to develop artificial photosystems. Use your research findings to answer the following questions:

- How does this technology harness energy through artificial photosynthesis?
- Why does the technology seem to hold so much promise?
- In which ways is this technology considered "green" compared to other ways of producing energy? In what ways is it less "green"?
- How efficient is the process of photosynthesis in plants and other organisms? How efficient is the new technology being developed?
- What are some of the limitations faced by scientists who are working on this new technology?
- Are scientists optimistic about this technology? Are you optimistic after researching it?
- What benefits might this technology provide to society and the environment? What are the risks of this technology?

Summary

As you conduct your research, organize and then summarize your findings under appropriate headings (for example, the science behind the technology, the advantages and potential benefits of the technology, the challenges and potential drawbacks of the technology). This will assist you in preparing your report.

Communicate

Once you have summarized your findings, you are ready to communicate them. You may present your findings in an oral, written, or visual report.