Quantum Dots in Solar Cell
What does electron got to do with solar cell?

Target Grade Levels:
9-12

Subject Areas:
Chemistry, Environmental Science, and Science & Sustainability

Time Required: 60 minutes

Lesson Objectives:
1. NGSS Practices
   - Asking Questions and Defining a Problem
   - Students will formulate a question and/or define a problem related to solar cell.
   - Developing and Using Models
   - Students will research, formulate procedure and create a solar cell device based on the knowledge and skills they learned and test it.
   - Planning and Carrying Out Investigation
   - Students will create a timetable, procedure, and data sheet of the processes involved in making the solar cell.
2. Common Core State Standard
   - The student will demonstrate that the arrangement and number of electrons and the properties of elements repeat in a periodic manner illustrated by their arrangement in the periodic table.

Lesson Summary

Students are introduced to the basic chemistry behind the operation of a solar cell. They will learn how to develop a solar cell that accepts energy from light and turns it into electricity. Students will be able to answer basic questions about the process of turning light energy into electrical energy and produce a portable solar cell device.

There are countless benefits of solar power, like: minimal environmental impact, minimal physical footprints, does not emit greenhouse gases, no transport cost, renewable, and can be cheaply mass produced.

To make the partnership sustainable, a calendar of curriculum is made and discussed to maintain fluency and effectiveness of the program. The idea is to scaffold production of solar cell device by introducing the concept of a solar cell at the early stage of the course when valence electron is discussed and inject the processes involved in each appropriate topics, like: the periodic table of elements, electron configuration, chemical bonding, law of conservation of energy, etc. Different activities will be formulated in each topic that serve as a prerequisite in making a solar cell, which will be the final project at the end of the semester where they test the current and voltage output using a digital multimeter.

The activities will help students to understand the concepts and learn the skills involved in the different processes of making solar cell. Different methods of instructions from teleconferencing, video presentation, to hand-on activities will be utilized to optimize transfer of knowledge.

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Lesson Plans

Photovoltaics and Fossil Fuel

Show students photos of a Photovoltaic (PV) array and a fuel cell and ask them what they know about the chemistry that makes each technology produce electricity.

Review the chemistry terms: electron, photon, cathode, and anode.

Have the students work in pairs to create the following models: hydrogen, oxygen, water, silicon. Students may use molecular modeling kits if available, pipe cleaners and gum drops or drawings to model the molecules.

Give a short lecture about photovoltaic cell. Students will need to be able to make a general comparison between a PV system and a fossil-fueled one in a discussion at the end of the section. The “PV Presentation FSEC” content may be edited to suit the needs and skills of your students.

Have the students watch the web simulation on fossil fuel. After viewing the simulation on have the students spend a few minutes working in groups to fill out the differences and similarities charts on their student handout.

Discuss the questions on the last slide of the presentation as a class.

Differentiation

Extension Opportunities
Students will develop a plan to interview 3 persons in different organizations that utilize solar energy. Included in their plan is a questionnaire that would address the importance of solar energy, how it benefits the company, its return on investment, maintenance, and future plans. Output could be in a form of booklet, flier, scrapbook, binder, etc.

Concepts

Making the solar cell employ concepts from chemistry (chemical reactions, chemical bonding, lab science), physics (photon energy, photovoltaics, conservation of energy, electricity and circuits), biology (photosynthesis), technology and nano-science (nanochemicals), environmental science (alternative energy) and astronomy (solar energy).