Argonne National Lab's
Sustainability Workshop
Activity Lesson Plans
http://teachers.anl.gov/lesson_plans

Argonne National Laboratory's

Mission
Argonne integrates world-class science, engineering, and user facilities to deliver innovative research and technologies. We create new knowledge that addresses the scientific and societal needs of our nation.

Vision
We will lead the world in providing scientific and engineering solutions to the grand challenges of our time: sustainable energy, a healthy environment, and a secure nation.

Sustainability is paramount to the work of the Laboratory. As a natural segway to educational outreach, the Sustainability Workshop for Middle School Teachers was conceived, designed and implemented. The goals of this workshop included knowledge and awareness of alternative energy technologies, their advantages and limitations; the key issues and impacts of technologies related to climate change; to extend the resources of sustainability and encourage energy literacy. The teachers were asked to synthesize their experiences and knowledge gained into a useable lesson plan. The plans presented in this unit are a compilation of those lessons.

I. Solar Panel Tree Activity
Extension Activity (Creative Engineering and Design)

Background information*:* Solar energy is most often used for practical purposes such as home lighting or recharging a car's battery. However, there are artistic uses for solar energy.. One example is GE's Carousolar, a carousel powered by one hundred 80-watt 'thin film' GE solar panels. As solar panels become less expensive to manufacture, more flexible, and lighter weight, we can look forward to seeing even more unusual uses.

Grade Level: Middle School

Goal/Objectives: Students will

• explore their creativity in solving an artistic engineering design challenge
• apply their knowledge of solar panels to an artistic engineering design challenge
• create a model, construct, and test their design

Activity Description:
Students watch a video and read article about a 13-year old student who imagined, designed, and constructed a better use of solar panels, in a tree array. The teacher leads a discussion about the design cycle, then poses her students with their creative engineering design challenge, to build a mobile which moves due to solar energy. Students work in teams to design and build their mobiles. Students then demonstrate their items for the class. Classmates will critique each other's mobiles.

Materials:
GE Website, slide show of *Top 10 Coolest Uses of Photovoltaics*
http://www.ge.com/thegeshow/solar/

Student Resources:
Design cycle description (such as the one here http://schools.dcsdk12.org/education/components/scrapbook/default.php?sectiondetailid=177803&)

Youtube, *video of student talking about his solar panel tree design*
http://www.youtube.com/watch?v=xaOR4nXo9AA

Wall Street Journal, *article about student's new solar panel configuration*
http://online.wsj.com/article/SB10001424052970203550304577138511287470508.html

Several solar panels per group
One small motor per group
electrical wire
wire clipper/strippers
art supplies such as: scissors, colored paper, string, yarn, coat hangers, markers, modeling clay, tag board, magazines, glue, glue guns, foil, sharpies, plastic containers and lids, straws, paper plates, plastic cups, etc.

Time needed: 2-3 class periods

Strategies/methodology:
Whole group discussion, small group discussion, planning, modeling, designing, construction, testing, analysis, comparing, diagramming, communicating, descriptive and scientific writing.

Procedure:
Introduction of Lesson: 20 minutes
1. Walk students through an explanation of the Design Cycle (if they haven't used it in other activities before) such as the one here http://schools.dcsdk12.org/education/components/scrapbook/default.php?sectiondetailid=177803&)

2. Show video of a13-year old who experimented and improved on the way solar panels catch sunlight. (Youtube, *video of student talking about his solar panel tree design* http://www.youtube.com/watch?v=xaOR4nXo9AA)

Discuss this teenager's inspiration for his idea (copying or trying to mimic nature, called biomimicry), and how he went about testing it. You might also want to read the Wall Street Journal *article about student's new solar panel configuration* http://online.wsj.com/article/SB10001424052970203550304577138511287470508.html
with the students for more information as well as an opportunity to use reading for content in science.

3. Ask the students to brainstorm and come up with a list of ideas on how one might use a solar panel. After they have run out of ideas, you can share the following websites, which have photos and descriptions of unusual or creative uses of solar panels.

GE Website, slide show of *Top 10 Coolest Uses of Photovoltaics* (this also has short videos on the sun, and a solar powered carousel) http://www.ge.com/thegeshow/solar/

Steph Hick's (writer and environmental attorney) blog pages, *Creative Uses for Solar Energy* http://stephhicks68.hubpages.com/hub/10-Creative-Solar-Energy-Applications

Design, Build, and Test Mobiles: 1-2 class sessions

4. Introduce the creative engineering design challenge to the students. They are to build a kinetic mobile, which is capable of moving enabled by solar energy. It should be creative illustrate an aspect of solar energy for the viewer. Remind the students of the Design Cycle, and encourage them to refer to it as their team designs their mobile.

5. Require the students to carefully model their design as they create the kinetic mobile. On their diagram page, have the students also describe how their mobile moves, and identify how it illustrates an aspect of solar energy.

6. When teams have finished their mobiles, have each share and demonstrate how they work. Students can critique each other's design, and turn in their own team design document with their model and descriptions.

7. Find a sunny location to best display all of your students' kinetic mobiles!

Assessment:

Use a teacher-created rubric as a summative assessment of the students' design (did it meet the requirement of moving due to solar energy, is it a mobile, is it creative and in some way illustrates an aspect of solar energy for the viewer), involvement in discussions, cooperative teamwork, safety behavior, careful diagram of the mobile,

and explanations for how it works, and how it creatively illustrates some aspect of solar energy. The assessment information can inform teacher instruction for the following school year.

Extensions and outside resources, links:

Youtube, *video of student talking about his solar panel tree design*
http://www.youtube.com/watch?v=xaOR4nXo9AA

Wall Street Journal, *article about student's new solar panel configuration*
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