Solar Energy Basics

Thermal and PV

KidWind Project
www.kidwind.org
Solar Energy – A Bright Idea!

“I’d put my money on the sun and solar energy. What a source of power! I hope we don’t have to wait ‘til oil and coal run out before we tackle that.”

- Thomas Edison
People have been harnessing solar energy for a long time!

A home in California in 1906

Solar collector for heating water
Two Main Categories:

Solar Thermal
- Water heating and cooking

Solar Photovoltaic (PV)
- Electricity production
Solar Thermal Energy

Cooking

Water Heating
Solar Water Heating
How Does it Work?

Solar Panel to Heat Water

Sun Rays (Heat Energy)

Cool Water In

Inlet

Transparent Top

Box

Water Pipe

Outlet

Warm Water Out
Solar Hot Water Classroom Experiments

• Design your own SHW collector

• Variables:
  – Color of collector
  – Tubing length, pattern, material
  – Light intensity
  – Insulation
  – Use of reflective materials
  – Rate of water pumping
  – Etc…
Solar Cooking
Benefits of Solar Cooking

• Consumes no fuels/wood
  – No loss of trees & habitat
  – Trees sequester carbon
• Generates no air pollution
• Generates no greenhouse gases
• Produces no smoke
  – Cooking smoke kills over 1.6 million people each year, mostly women & children, according to a recent report
• Eliminates fire dangers
Solar Cooking
How Long Does it Take?

- Vegetables: 1.5 hrs
- Rice/wheat: 1.5-2 hrs
- Beans: 2-3 hrs
- Meats: 1-3 hrs
- Bread: 1-1.5 hrs
Fun Student Projects!
Solar Electric (Photovoltaic)
Solar Electric Systems

- Photovoltaic (PV) systems convert light energy directly into electricity.
- Commonly known as "solar cells."
- The simplest systems power the small calculators we use every day. More complicated systems will provide a large portion of the electricity in the near future.
- PV represents one of the most promising means of maintaining our energy intensive standard of living while not contributing to global warming and pollution.
How Does it Work?

• Sunlight is composed of photons, or bundles of radiant energy. When photons strike a PV cell, they may be reflected or absorbed (transmitted through the cell). Only the absorbed photons generate electricity. When the photons are absorbed, the energy of the photons is transferred to electrons in the atoms of the solar cell.
How Does it Work?
Centralized Wind-Solar Hybrid System

- In hybrid energy systems more than a single source of energy supplies the electricity.
- Wind and Solar compliment one another
Solar Concentrators

• These 20-kW Solar Systems dishes dwarf visitors in Alice Springs, Australia.
• The concentrators use an array of mirrors to focus sunlight onto high-efficiency solar cells.
• Four supports hold the cells in front of the mirrors.
• The supports also supply cooling water and electrical connections.
How Does the Color/Wavelength of Light Affect PV Efficiency?

- Test 5-8 colors using different backgrounds on PowerPoint Slides
  - Purple
  - Blue
  - Green
  - Yellow
  - Orange
  - Red
  - White
Approximate Wavelength:
390-455 nanometers
Approximate Wavelength: 455-492 nanometers
Approximate Wavelength:
492-577 nanometers
Approximate Wavelength: 577-597 nanometers
Approximate Wavelength:
597-622 nanometers
Approximate Wavelength:
622-780 nanometers