

Here Comes the Sun: A STUDY OF ENERGY, ELECTRICITY AND *PHOTOVOLTAICS/SOLAR CELLS*

IEEE ARIZONA SCIENCE LAB
www.arizonasciencelab.org

Workshop Focus:

Workshop focuses on energy, renewable energy, electricity, circuits, solar cell operation, solar panel design, and its application in a solar powered model car. It explores how electricity is created from non-renewable and renewable energy sources and how solar panels and solar powered cars operate.

Workshop Synopsis:

The Here Comes the Sun activity explores the concept of how solar energy is gathered by solar panels and adapted to provide power to a variety of machines, from calculators to spacecraft. Students design and build a solar powered model car and explore how the component parts work together. Students work in teams of two to engineer, construct, and race their cars and suggest and test design enhancements to improve the car's performance.

Age Levels:

9 – 15 years (grades 4 – 8).

Objectives:

- Learn the basic principles of electricity, simple series and parallel electrical circuits and how electricity is created.
- Learn about how solar powered cars work and how the product is comprised of a number

of different component parts that work together

- Learn about teamwork and the engineering problem solving / design / build / test / redesign / modify or rebuild / retest process.

Anticipated Learner Outcomes:

As a result of this activity, students should develop an understanding of:

- Electricity, circuits, renewable energy
- Solar power and solar panel engineering
- Solar powered car design and operations
- The design / build / test / modify / retest engineering cycle
- The impact of engineering and technology on society
- Engineering problem solving
- Teamwork

Workshop Activities:

Students learn about how solar energy is gathered and transferred to electrical energy in solar panels. Topics examined include solar panels, simple series and parallel electrical circuits, and the inner workings of a solar powered model car. Students work in teams of two to build a solar powered model car, test the car, evaluate the design and operation of its component parts, recommend changes to improve functionality through redesign and/or material selection, modify and retest the car, and present the results to the class.

Alignment to Curriculum Frameworks:

Note: All Arizona Science Lab workshops are aligned to the National Science Education Standards which were produced by the National Research Council and endorsed by the National Science Teachers Association, and if applicable, also to the International Technology Education Association's Standards for Technological Literacy or the National Council of Teachers of Mathematics' Principals and Standards for School Mathematics. They will also be modified as necessary to be aligned to the Next Generation Science Standards (NGSS) when they are released.

- **National Science Education Standards Grades K-4 (ages 4-9)**

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- Understanding about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of the activities, all students should develop an understanding of

- Properties of objects and materials
- Light, heat, electricity, and magnetism

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- Abilities of technological design
- Understanding about science and technology

• **National Science Education Standards Grades 5-8 (ages 10-14)**

CONTENT STANDARD A: Science as Inquiry As a result of activities, all students should develop

- Understandings about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of their activities, all students should develop an understanding of

- Transfer of energy

CONTENT STANDARD E: Science and Technology

As a result of activities in grades 5-8, all students should develop

- Abilities of technological design
- Understandings about science and technology

• **National Science Education Standards Grades 9-12 (ages 14-18)**

CONTENT STANDARD A: Science as Inquiry As a result of activities, all students should develop

- Understandings about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of their activities, all students should develop understanding of

- Interactions of energy and matter

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- Abilities of technological design
- Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives As a result of activities, all students should develop understanding of

- Science and technology in local, national, and global challenges
- **Standards for Technological Literacy - All Ages**

The Nature of Technology

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.
- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Technology and Society

- Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.
- Standard 5: Students will develop an understanding of the effects of technology on the environment.
- Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

Design

- Standard 8: Students will develop an understanding of the attributes of design.
- Standard 9: Students will develop an understanding of engineering design.
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Abilities for a Technological World

- Standard 13: Students will develop abilities to assess the impact of products and systems.

The Designed World

- Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.

Internet Connections:

- TryEngineering (www.tryengineering.org)
- U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (www.eere.energy.gov)
- National Renewable Energy Laboratory (www.nrel.gov)
- NREL Video: "Photovoltaics: Turning Sunlight Into Electricity" (www1.eere.energy.gov/solar/video/pv4.mov)

- IEEE Virtual Museum - Solar Power Satellites (www.ieee-virtualmuseum.org/collection/tech.php?taid=&id=2345888&lid=1)
- History of Solar Energy (www1.eere.energy.gov/solar/pdfs/solar_timeline.pdf)
- McREL Compendium of Standards and Benchmarks (www.mcrel.org/standards-benchmarks). A compilation of content standards for K12 curriculum in both searchable and browsable formats.
- National Science Education Standards (www.nsta.org/standards.)

Recommended Reading:

- “Got Sun? Go Solar” by Rex A. Ewing (ISBN: 0965809870)
- 21st Century Complete Guide to Solar Energy and Photovoltaics CD-ROM by the National Renewable Energy Laboratory (ISBN: 1592482694)

Materials and Tools:

All materials and tools required for this workshop are provided by the Arizona Science Lab

Time Needed:

One four hour workshop (inclusive of lunch and restroom breaks).

ASL Staff Responsibilities:

The ASL staff is responsible for the conduct of the workshop:

- Setting up the workshop
- Presenting the lecture and teaching the science
- Performing the demonstrations
- Provisioning the materials and equipment to the student teams
- Supervising the construction project
- Supporting the students during the construction project
- Supervising the project testing
- Answering student questions about the science, the workshop, or any other related topic
- Cleaning up the workshop after the students have left

School Teacher Responsibilities:

- **Managing the students during the class and the lunch and restroom breaks, and imposing discipline as necessary**

- The ASL staff is NOT responsible for the class management or for student discipline!
- **The restroom breaks will require at least one male and one female teacher be present from the school**
- Assisting the ASL staff in the teaching of the science
 - This could comprise asking the students questions about what had just been explained, presenting what had just been explained in another fashion, and so on
 - The ASL staff are not necessarily trained teachers and the school teachers know their students very well, so they can provide valuable insights and help to the ASL staff
- Assisting the ASL staff during the project construction and testing