

Chicago del Sol:
An Innovative Solar Energy Education Pilot Program
Teacher Workshop

Agenda

- 12:30 Welcome/Lunch/Sunshine Pizza Maps—Hands-On Activity
- 1:00 History of the Nature Museum/Chicago Academy of Sciences
- 1:10 Impetus for the *Chicago del Sol* Project
- 1:15 Nature Museum Education Strategies
- 1:30 Science Content for *Chicago del Sol*: A Brief Introduction to Solar Energy
- 2:00 Resources for You
- 2:10 Working with Online Learning Resources: Webcasting and Online Interactives
- 2:20 Next Steps
- 2:30 Q&A

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History of the Nature Museum/Chicago Academy of Sciences

Founding

- Chicago Academy of Sciences (first Chicago museum)—founded in 1857 by Robert Kennicott and a group of Chicago naturalists



- Original mission similar to that of Smithsonian (also a new institution at the time): the increase and diffusion of knowledge
- Kennicott, in his 20s, was already a nationally famous naturalist and collector of biological specimens—known as one of the great three naturalists: Darwin, Audubon, and Kennicott
- Died at age 30 exploring and collecting specimens in Alaska and is therefore not well known

Fires

- Through the years, fire twice destroyed much of the collections and the museums housing them
- Today, more than 200,000 natural history specimens

Education

- In the 1980s, the Academy's education department became nationally known for its innovative outreach programming in Chicago schools

A New Museum

- For more than 100 years, that Academy was housed in its own building at Clark and Armitage, the Matthew Laflin Memorial Building



- Late 1980s, the Board wanted a new museum. In addition, Zoo was out of office space and Chicago Park District was not allowing new building on park land

- A deal was made: Zoo takes over the Laflin building for office space; the Academy is given land on North Pond site, just across Fullerton Parkway from the Zoo; green space is added to the park
- October 1999—the new Peggy Notebaert Nature Museum was completed and the Academy name was retired



- New Museum offers 77,000 square feet of interactive exhibits: Butterfly Haven, Water Lab, Wilderness Walk, City Science, Children’s Gallery, Outdoor Gardens

A New Mission?

- Traditionally, a mission of scientific literacy for all. Now movement toward a new mission: increasing environmental awareness and linking local environmental issues to global issues and policymaking

Impetus for the *Chicago del Sol* Project

Write Your Own Grant

- Nature Museum educators are encouraged to be entrepreneurial and my background is in environmental law and policy
- Chicago is fairly progressive on environmental issues: brownfields redevelopment, solar panels, rooftop gardens, community greening, open space/parks, migratory flyways
- Nature Museum was the first museum to get solar panels



- We have a history of getting grants from EPA Office of Environmental Education

A Connection With Reilly

- The Nature Museum has a good relationship with Reilly based on successful years of Science on the Go! partnerships
- Reilly was the first CPS school to get solar panels, beating even the Nature Museum



Nature Museum Education Strategies

Strengths and Weaknesses

- Nature Museum Education Department has been nationally recognized for innovative programs: outreach, teens, girl scouts, informal learning at Museum, online
- Strengths include creativity, dedicated and energetic staff, commitment to teachers and students
- Weaknesses flow from grant cycle—primarily, rarely time and money for evaluation and assessment. *I welcome your help and guidance on this during Chicago del Sol!*

Outreach, Museum, and Online Programs

- Outreach programs include Science on the Go! (fee-based)—provides CPS teachers with a 15 lesson science curriculum and all materials needed to teach. Nature Museum educators teach every third lesson to model for teachers diverse teaching strategies
- Museum programs include in-house workshops that support particular exhibits, programming for the pre-school crowd (Knee-High Naturalists), adult lectures, and pre-/post-visit activities
- Online programs include the pioneering CAoS Club, a multi-year program of Internet Webcasting that included live chat; recent project is Nature Museum Online (<http://www.naturemuseum.org/online>)

Bringing It All Together

- Today, a push for hybrid projects that include: outreach lessons in schools, museum visits, and online Webcasts and interactives. Sample projects are the State-funded Museum in the Classroom project, International Public Science Day, and now *Chicago del Sol*

Educational Strategies

- Personally, no graduate training in Education. Experience includes one summer teaching high school students English, history, and photojournalism and one semester team-teaching an undergraduate course in environmental law as a first law course at Boston College. Since joining the Academy, I have taught at most K-12 levels



- Nature Museum education strategies include:
 - Constructivism
 - Journaling
 - Cooperative Learning
 - Hands-On Inquiry
 - Learning Standards (of course)
- National, State, and Chicago Standards for 4th Graders as related to *Chicago del Sol* (see Resources for You)
- Teaching to the tests: Nature Museum can offer supplemental and diverse (and, hopefully, unique) resources. We remain mindful of alignment issues, but don't "teach to the test" so to speak

Science Content for *Chicago del Sol*

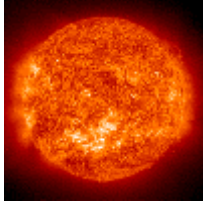
Adapted from *The Energy of Nature*, E.C. Pielou (Univ. of Chicago, 2001) and *The Sun: Voyage Through the Universe* (Time-Life Books, 1990).

Energy

- Everything in the Universe is matter (things) or energy (actions, movements, events—think of “ing” words: running, pushing, dancing, lifting, eating)
- Energy is “the capacity to perform work,” work being “the application of force through distance”
- The basic unit of energy (and work) is the Joule (J)
- Forms of energy include: electrical, electromagnetic, chemical, heat, nuclear, and others
- Energy can be converted among these many forms, but not necessarily in one step
- Ultimately, all energy becomes heat energy
- In any system, some energy is dissipated as unavailable heat, called useless energy or entropy; all energy will someday become disordered entropy energy

The Sun

- The sun is a medium-sized star of hydrogen and helium gases. The north star (Polaris) is 6,000 times brighter
- The sun has a diameter of 865,000 miles and contains 99 percent of all matter in our solar system. A million Earths could fit inside the sun
- The sun's fusion reactions started about 4.6 billion years ago and should continue for another 5 billion years, making the sun middle aged



- Each second, the sun transforms 700 million tons of hydrogen gas into 695 million tons of helium gas—the remaining 5 million tons of matter escape as pure energy
- The sun emits light and heat in the form of electromagnetic radiation
- It takes 8 minutes for light to travel from the sun to the Earth
- The sun drives wind and ocean currents to help distribute heat more evenly across the planet
- 30 percent of sun's energy reflected back into space by clouds. 19 percent of the remaining 70 percent is absorbed by clouds, chiefly by water vapor. So 51 percent is received by land and ocean. Most of this 51 percent bounces back into the atmosphere and space

How Solar Energy Works

- The earth receives less than 1/2 of one billionth of the sun's energy output
- All energy, even "human-made," comes from natural sources and, ultimately, the sun
- Coal, oil, and natural gas are "fossilized" solar energy, thus "fossil fuels"
- All of the fossil fuels on Earth represent the heat content of just 10 days of solar energy received by the Earth

In Plants

- Only plants can convert solar energy into chemical energy. Plants receive radiant energy and convert it into chemical energy (carbohydrates) via photosynthesis (carbon dioxide + water vapor + solar energy = glucose (simple carbohydrate) + oxygen). We eat plants and convert the carbohydrates into sugars, which fuel our bodies

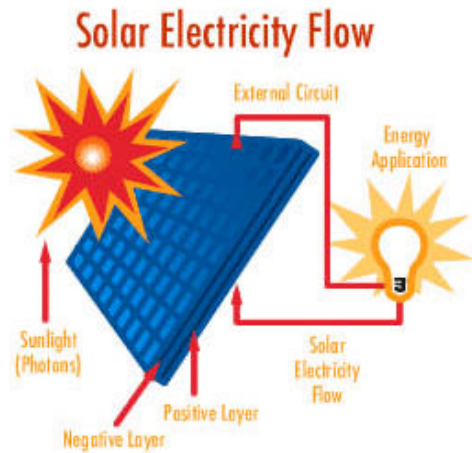


- Photosynthetic efficiency is 1-3 percent
- Trophic levels: 1=vegetation, 2=plants and animals that get their energy from level 1 (herbivores), 3=plants and animals that get their energy from level 2; efficiency up each trophic level is around 10 percent

- Well-trained athletes can perform not much higher than 30 percent
- Most all vegetation is NOT eaten—all the energy in this matter is released by either decay or burning

In Solar Cells (Photovoltaic Cells)

- Electromagnetic (EM) waves carry the sun's radiant energy to Earth
- Y-rays and X-rays (and even lower-power light waves) carry so much energy that their photons can dislodge electrons from atoms
- Electrons in metal are shifted by the photons—this is called the photoelectric effect—creating an electric current. An inverter converts the direct current (DC) power to alternating current (AC) power for use in the school or home



- The discovery that EM waves consist of “grains” of energy (i.e., photons) won Einstein his Nobel Prize—not the Theory of Relativity
- “When high-energy EM waves strike any matter, or when waves with a lower energy strike ‘susceptible’ metals, they dislodge electrons; the energy of each photon of radiation is converted to the kinetic energy of an electron” (*Energy of Nature*, p.206)

Resources for You

Activities

- *Experimenting with Energy* (Alan Ward, Chelsea Juniors, 1991)
- *Astronomy for Every Kid*, Sun Activities (Janice VanCleave, John Wiley & Sons, 1991)

Articles

From *Eyewitness Science: Energy* (DK, 1993)

- Assorted

From *The Sun: Voyage Through the Universe* (Time-Life Books, 1990)

- Gifts of the Sun
- Drawing Current from a Star

From the Microsoft Encarta Online Encyclopedia 2001 (<http://encarta.msn.com>)

- Energy
- Sun
- Solar Energy
- Photoelectric Effect
- Photoelectric Cell

From Solar Matters (Florida Solar Energy Center— <http://www.fsec.ucf.edu/ed/SM/Index.htm>)

- What is Solar Energy?
- Solar Energy Timeline
- Performance Assessment Ideas

From the Solar Electric Power Association

- Photovoltaic Fact Sheets

From Spire Solar Chicago (<http://www.spiresolarchicago.net/solar/PVbasics.html>)

- PV Basics: Solar Electric Power—How It Works

Books/Videos

- Challoner, Jack, *Energy*. Dorling Kindersley, New York, NY, 2000
- Tomecek, Steve, *Sun*. National Geographic Society, Washington, DC, 2001

Learning Standards

- National Science Education Standards (<http://books.nap.edu/html/nses/html/index.html>)
- Illinois Learning Standards (<http://www.isbe.state.il.us/ils/default0.html>)

Web Links

- See the *Chicago del Sol* Website at <http://www.naturemuseum.org/online/chicagodelsol>

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Working with Online Learning Resources: Webcasting and Online Interactives

Webcasting

- Webcasting is an Internet TV show with live chat. Picture and sound quality vary, but are still fairly poor compared with TV



- Webcasts are accessed via a Web site and a software program; we will be using Windows Media Player. Teachers and students can ask questions via live chat
- Students can watch the show in pairs in your computer lab (to whom would I speak at Reilly to start the process of ensuring the computer lab will be able to receive transmissions?)
- We'll try to have an expert speaker—I would be happy to take suggestions for topics to be covered
- Webcasting dates may shift due to new Harcourt Teacher Leadership Center, a resource you're all invited to make use of
- Before the Webcasts, we can have your students prep questions

Online Interactives

- Still figuring out form and content of "online activities"
- Nature Museum does not support kids being alone on computers; we encourage teacher/parent guidance

Next Steps

Teaching Visit

- I will E-mail you the lesson for next week (11/6 visit) by Monday a.m.
- I know it's short notice, but all feedback is welcome
- Plan for pre-evaluation: ask students to draw or write sentences about the sun and the solar panels on the roof (or discuss the same)

Museum Visit

- Buses are reserved: Alltown Bus Service (773-248-0090). Pickup at 9:30, return to school by 1:00 p.m.
- I will try to arrange for workshops; if not, I will create "Sun Guide" for use during the visit

Documentation

- Your classroom Web pages are up, so document anything you do. I can scan in student drawings and writing, as well as classroom photos you take (recyclable cameras)

Q&A

Questions, answers, remaining issues?