



Natural Resources Education Quarterly

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Mission:
Facilitate programs
and services in
environmental
education for the
people of the San
Luis Valley

Inside this issue:

<i>The Heat is On</i>	2
<i>Renewable Energy in the San Luis Valley</i>	2
<i>Energy and Humans Historical Tidbits</i>	3
<i>Student Reading Living Off the Grid</i>	4-5
<i>Lesson: Comparing Different Energy sources</i>	6
<i>Calendar of Events</i>	7

Check It Out!

Lots Of Field Trip Opportunities in the SLV

www.slv-ecec.org

We All Need A Little Energy

By Mike Blakeman, SLV Public Lands Center

All living things need energy. Living things need energy to grow, move, reproduce, create heat and to think. A lack of energy may make it difficult for your students to think—too much energy may cause your students to act up instead of think. When your students have just the right amount of energy... well, there really aren't any guarantees on how they will use their nog-gins.

The sun is our largest source of energy. It directly provides heat for warmth and is the source of energy that plants use to create the sugars that power the plant. Herbivores

indirectly use the sun's energy by eating the plants, which provides sugars and carbohydrates (created with the sun's energy) that power the animals. Omnivores, such as many humans, eat both plants and animals, thus also indirectly using the sun for energy. And, of course, carnivores and decomposers also indirectly use the energy of the sun to power their bodies. Outline this food web and you can track the energy

flow from producers to decomposers.

Scientists believe that our human-like ancestors (*Homo erectus*) started using fire for warmth and possibly cooking as long as 790,000 years ago. This initial use of fire relied on dead vegetation (biomass), such as sticks and logs, for fuel. Thus, fire is actually the re-

lease of stored energy from the sun. Today, we have developed a variety of systems to use biomass for energy, such as woodstoves, pellet stoves and even converting biomass to ethanol to fuel vehicles.



Coal-fired Power Plant

The sun helped create many other forms of energy that we use today: Coal and other fossil fuels started out as plants. The sun is the biggest factor affecting our weather, thus creating the winds that power our wind turbines. Most of our hydroelectric power is created by tapping gravitational energy produced from water moving from higher elevations to lower elevations. Water reaches higher elevations through evaporation

The Heat Is On

By Andy Zaugg,

We may not know exactly what heat is, but we know it when we feel it. In fact, *heat* is the motion of atoms. If the atoms of your body move a lot, you are hotter than if they move less. When we think about heating our building with solar or another source of heat, we are most often concerned with how heat moves from one object to another.

Heat always moves from hotter objects to cooler ones. This happens in two ways. When atoms are very near one another, the more active atoms bump against the less active, and impart energy, heat, to them. This is called *conduction*. If you put a silver spoon in your hot coffee, the spoon gets hot all the way to the end in due to conduction. In terms of heating a building, a furnace uses conduction to get the heat from the burning gasses of the fuel into the metal heat exchanger that separated the flue gasses from the building air, and from the heat exchanger into the fan-forced building air. The furnace fan helps make sure that the heated metal atoms of the heat exchanger bump against the air atoms. Conduction cannot happen if there is no matter for the heat to conduct through. We receive no heat from the sun by conduction, because there is a large vacuum of empty space between the earth and



the sun.

The other way heat moves from hot objects to cool ones is by *radiation*. When atoms are hot, moving rapidly, they can lose heat by giving off an electromagnetic particle of energy called a photon. These photons may be visible to the human eye, or they may not be. Light bulbs, whose filaments are very hot, give off both visible and invisible energy. The invisible part is *infrared*, which is felt by us as heat. We can feel it with our skin without touching the bulb. This is the form in which wood stoves do much of their heating. And this is the form in which solar energy comes to the earth. We get from the sun a range of photons both visible and invisible, but mostly in the visible (Our eyes are adapted to the light that we

have).

In using solar energy, we start with radiant energy. If our solar “system” consists only of south-facing windows and we stand in the sun, then we get the solar heating directly from the sun to our skin. If it hits our floor and warms the floor, then we are getting the solar energy by conduction and radiation from the floor, both when the sun is shining and later when it is not.

Renewable Energy In The San Luis Valley

Although the San Luis Valley has few, if any, economically recoverable oil and gas reserves, it has attracted a lot of attention lately for its renewable energy potential.

- The SLV has been identified as one of the best areas in the world to produce solar generated electricity.
- Studies are being conducted on BLM land in both the southern and northern parts of the SLV to determine the potential for wind energy.
- SLV farms may some day be major producers of biomass used to make ethanol.
- The Rio Grande National Forest is currently analyzing the potential to provide a sustainable supply of woody biomass for a pellet plant or to heat schools.
- Areas in the SLV continue to be scrutinized for geothermal energy potential.

We All Need A Little Energy

(Continued from page 1)

from lower elevations due to the sun's energy and then precipitating down onto the higher ground in the form of rain or snow.

Humans continue to devise a variety of systems to use the sun's energy for heat and electricity. Passive solar systems use the sun's energy to heat water and space, and solar photovoltaic cells convert the sun's energy into electricity.

Humans have also learned to use other sources of energy, besides those directly or indirectly linked to the sun. Tidal power taps into the gravitational pull of the moon. Geothermal energy is derived from heat produced within the depths of the earth. Batter-

ies provide electricity through chemical reactions, and nuclear power uses energy locked up in atoms.

Presently, fossil fuels provide about 85% of the energy used by humans. This use has created many challenges and concerns, such as air, water and soil pollution, human health problems due to the pollution, landscape fragmentation, political and social unrest, and probably global warming. But, every source of energy, even renewable energy, has social and environmental impacts. Thus, the challenges facing humanity are to improve efficiency of energy production and use, increase the use of energy sources that have the lowest impacts... and maybe even tighten up the belt and reduce our energy consumption.

Energy and Humans Historical Tidbits

1000 B.C. coal was being used in China to smelt copper to make coins. Coal-fired power plants now produce more electricity in the U.S. than any other source.

In many parts of the world, oil would come to the surface in springs. It is believed that the Chinese were the first to refine this oil for use in lamps about 2000 years ago. Whale oil was also used in lamps, but by the 1850s, whale populations crashed and their oil was hard to come by. Petroleum-based fuels now power most motorized vehicles used in the world.

Water power was harnessed through the use of water wheels over 2000 years ago. Both the Romans and the Chinese were known to use water wheels for grinding grains, but the Chinese also used them to run large bellows to smelt metals. The first hydro-electric station was developed in 1882, in Wisconsin. Hydro-electric plants now provide about 15 % of the world's electricity.

The earliest known use of wind power was the development of the sailboat in Egypt over 5000 years ago. The first documented windmills were in Persia about 1500 years ago. The early devices were used to grind grains and pump water. We've come a long way since then with some modern turbines standing over 300 feet tall and generating enough energy to provide electricity for 4500 homes.

The first practical steam engine was invented in 1769 by James Watt. This was important because the raw energy of heat was used to produce mechanical work. Now, steam is used to produce electricity from the heat generated in coal-fired and nuclear power plants.

The first nuclear reactor to generate electricity was developed in the U.S. in 1951. Today, over 100 nuclear power plants produce about 20% of the electricity used by this country.

Student Reading: Living Off the Grid

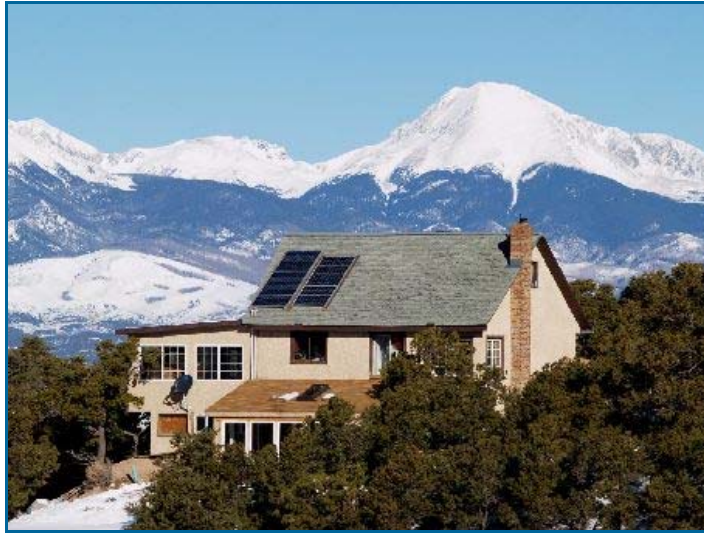
By: Nicole Langley, EarthNest

“So you live off the grid. Are you OK?” The question often comes with a sideways look of concern and a little pity, followed by “So what’s it like to live without electricity?”

No, no, I explain. I have plenty of electricity, just no monthly electric bill. Twelve years ago I bought a mountain cabin on five acres in the foothills of the Sangre de Cristo Ranges, about ten miles southeast of Fort Garland. Back then the place had no electricity of any kind. Once a month a delivery truck brought water and pumped it into my cistern. For more than a year I lived primitively, with thirteen old-fashioned kerosene lamps for light and my wood stove and fireplace for heat. I heated my bath water in a big pot on the stove, fueled by propane. My fridge also ran on propane. It was hard, especially in winter, but I loved the beauty of the place. So I lived simply and saved my money until I could start investing in the alternative energy systems I would need – systems that I knew would give me all the comforts of a modern home, running off the sun and the wind.

Today my house is wonderfully comfortable, well lit, warm, and connected to all the information and entertainment I need. The sun and the wind power my computer and my laptop, keeping me connected to the world by high speed satellite, and even on cloudy days I enjoy my good music system. Although I’m considering getting the latest HD TV, I’ve chosen not to have TV, using an old set for movies and DVDs and for my grandkids’ video games when they come to visit.

Although my off-the-grid home is similar to a home connected to the grid, there are some big differences. After a few winter storms we have to sweep the snow off the ten photovoltaic solar panels on the roof, and for some things, like doing the laundry or ironing, I run the noisy gasoline generator out in the well house. Normally the only other sound outside is the steady whisper of a small wind propeller on the hill. It whirls and hums to the Valley’s constant breezes and sometimes howls when the winds are strong, delivering a steady charge to the bank of batteries in the basement. An inverter takes the sun and wind energy and charges the batteries, then “inverts” that stored power into regular household electricity, delivered to ordinary 110-volt outlets throughout the house, to which I can plug in the microwave, the sewing machine, or any sort of power tool. Last summer I needed to dig out a foundation, so we were able to run a heavy jack-hammer for many hours off the house current, powered by the sun and the wind!



Off the Grid - Nicole's House

Life off the grid requires us to change some of our energy-wasting habits. In a grid-connected home your family can be working on the computer, watching TV, playing video games, and having a hot shower while you zap a pizza in the microwave and your sister dries her hair in the bathroom – all at once! This could never happen in my home. To keep the house from shutting down we all need to be conscious users of energy. Good load management means ALWAYS turning off a light that’s not being used, checking to see what else is “on” before running the vacuum cleaner, and never

(Continued on page 5)

Living Off the Grid (Continued)

(Continued from page 4)

using a hair dryer while the microwave is running - especially not if it's been cloudy for a few days.

All these are examples of "active" solar energy, converting photons into electricity, but the loveliest places in my home use "passive" solar energy, or direct heat from the sun. Last summer I built a south-facing sunroom to passively "collect" the warm rays of the sun in the day and release that warmth into my downstairs apartment at night. This winter my downstairs has been nice and warm without requiring any kind of stove, fire, or heater. Many houses have big windows facing a good view, with no regard to efficient use of sunlight. That only causes cold air and high heating bills. A passive solar house has lots of glass, floor to ceiling, on the south side, making best use of the warmth of the sun. My sunroom is a wise and beautiful space, making the SUN a year-round honored guest in my house!

I still use petroleum-based propane and gasoline, old solar power refined from yesterday's ancient sunlight, but I am constantly working to reduce my need for it. I replaced the old water heater with a tankless on-demand heater, which uses propane only when the hot water tap is on, so we never run out of hot water. And I've installed the pipes for next year's roof-top solar hot-water collector. My refrigerator and stove use propane, freezing my ice cream and baking my muffins at low cost. My

great wood-burning stove is backed up by a Toyo heating system which ignites tiny droplets of diesel and vents all burned fuel to the outside, so our inside air is always fresh. Eventually I hope to convert it, and my car, to biodiesel. I seldom iron, because that's the most wasteful use of solar electricity, and I don't like ironing with gasoline!

So, it all started from nothing. For more than a year I got up and went to bed with the sun, read by candle light, bundled up a lot in winter, and traveled to San Luis to go to work. Although I've never been rich, I decided back then that every spare penny would go to creating this new way of life, so instead of buying expensive "stuff" I put my money into insulation, plastered the house with stucco, put in sunny south-facing windows, used only compact fluorescent bulbs, laid stone and concrete as heat sinks in the sun room, and used permaculture and xeriscaping methods for my garden. At every step I've had great satisfaction from reducing my ecological footprint - but that's another story. The best part is that along the way, this great grandmother just seems to keep growing younger and happier. Anybody can do these things. It's just a matter of choosing your priorities. Now, after many years, it's mostly done and I'm free. I'll never have to worry about the rising costs of electricity, because for every sunny day, I get plenty of juice from *el sol*, and with every little breeze I get a few more volts from *el viento*. Yes, I'm OK. Living off the grid means that I really do have everything I need.



Try This!

Select any simple human-made object or piece of food and track the energy that went into producing it and getting it to you. Chart the type of energy input in a diagram showing each step from production to delivery. This means including, for example, the fossil fuels that went into producing the chemical fertilizers used to grow the corn fed to the cow to produce a steak. And then there's the packaging.... Kinda complex, eh?

Lesson: Comparing Different Energy Sources

Audience: Grades 6-8

Days needed: 2 to 3

Colorado Science Standards: 1, 2.2, 5, 6

Lesson Objectives:

Students will observe different types of energy sources, learn more about energy and where it comes from, and conduct their own research reports on energy sources.

Materials:

Picture of the sun; fruit or vegetable; piece of firewood; piece of charcoal; container of motor oil; gas lighter; cup of water and an empty cup; child's pinwheel; picture of nuclear power plant; piece of discarded trash; and a battery.

Method:

1. Using the information provided at the end of this activity, demonstrate the different energy sources with the materials listed. Write the names of the energy source types on the board.
2. After the introduction to the energy sources, inform the students that they will be conducting research reports to find out more about their energy sources. Break the class into groups of two or three students and assign each group a different energy source. Instruct each group to complete a two to three page report about the energy source. This is designed to be a collaborative effort, so encourage the students to divide the work.
3. After the reports are completed, have each group give a five minute presentation about the energy source they studied.
4. After all the presentations have been given, initiate a discussion with your class about what they learned. Ask your class to choose the safest energy source, the most efficient, the cheapest, and the source least destructive to the environment. Then, write a list of the energy sources on the board, and have the class vote for the "best" source. You may have them vote for the best two or three.

Teacher Information:

Sunlight: The light that comes to the earth is pure energy. The sun is the original energy source. Many other sources of energy originally got their energy from the sun.

Food: Food is what the body processes to create energy.

Wood: When trees are cut down and used as firewood, they release their energy in the form of heat.

Fossil Fuels: The following three energy sources come from prehistoric fossils.

Coal: Coal is burned to heat homes and produce electricity. About 20% of the energy we use comes from coal.

Oil: Petroleum products produced from oil are burned to fuel motor vehicles and heat homes. About 45% of energy used comes from oil.

Natural Gas: Natural gas is used to heat homes and generate electricity. About 20% of the energy we use comes from natural gas.

Water: Pour water from one cup to another. Water is not an energy source, but water is used to generate electricity. This is called hydroelectric power. About 5% of the world's power is now produced by hydroelectric dams.

Wind: Blow on the pinwheel. Winds that blow can be used to turn windmills, which generate electricity.

Nuclear Power: Nuclear power comes from the radioactive ore uranium. About 6% of the energy used in the world comes from nuclear power.

Refuse-Derived Fuel: Now, we are able to extract energy from garbage. Garbage is burned in a waste-to-energy facility. This is a small but growing source of energy.

Chemical Energy: Batteries create energy through chemical reactions. When different chemicals react with one another, energy is released.

Calendar of Events

- Feb 15 & 16 Regional Science Fair, Alamosa

- March 9-11 SLV Crane Festival, Monte Vista. Check out:
www.cranefest.com

- April 5-7 State Science Fair, Fort Collins

- April 27-29 Teaching Outside the Box, Snow Mountain
Ranch, Granby, CO. Over 50 sessions on a variety
of environmental topics for K-12th grade
educators.
Credit: 1 semester hour with paid tuition.
Contact: Colorado Alliance for Environmental
Education at: www.caee.org or 303-273-9527.

- May 13-19 International Science and Engineering Fair,
Albuquerque, NM. Contact Lucy Adams at BOCS
if you want to help judge: 589-5851, ext. 112.

EE Contacts

Geology, Ecosystems, Cultures & Archaeology	Great Sand Dunes National Park and Preserve. . . Melanie Rawlins. . . 719-378-6344 Melanie_Rawlins@nps.gov
Wetland Ecosystems and Wildlife	Alamosa, Baca, Monte Vista National Wildlife Refuges . . . 589-4021
Water and Soil Conservation	SLV Conservation Districts & NRCS . . . Judy Lopez. . . 589-3907 X117 judy.lopez@rcdnet.net
Service Learning	ASC Community Partnerships. . . . 719-587-7230. . . nancy_molina@adams.edu
Sustainable Development and Culture	EarthNest Institute. . . . Nicole V. Langley. . . 719-206-2222 nlangley@fone.net
Natural Resource Conservation Camp at Beaver Creek	Colorado State University Extension Service. . . Robert Mathis. . .852-7381 rmathis@coop.ext.colostate.edu
Forest, Range, River and Wetland Ecosystems	Rio Grande National Forest/SLV Bureau of Land Management . . . Mike Blakeman . . .852-6212. . . mblakeman@fs.fed.us
Other Resources	SLV Resource Conservation and Development. . . Jim Mietz. . . 589-3907 X123 james.mietz@co.usda.gov