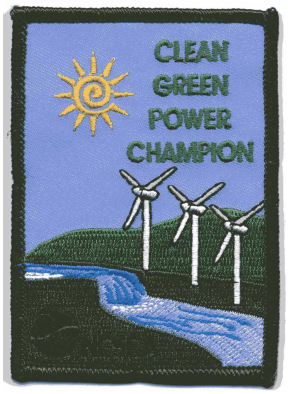
CLEAN GREEN POWER

PROGRAM and RESOURCE GUIDE



All kids can earn a special patch!

DISCOVER CLEAN ENERGY!

An innovative and fun way for educators, families and youth to learn about renewable energy through activities, interviews, projects and field trips in their local community.

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Cover Page Back

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This educational program was developed by the Northeast Sustainable Energy Association in collaboration with the Girl Scouts of Western Massachusetts, and funded by the Massachusetts Technology Collaborative Renewable Energy Trust, and Western Massachusetts Electric Company.

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ACKNOWLEDGEMENTS:
NESEA would like to thank the Massachusetts Technology Collaborative Renewable Energy Trust for their generosity in supporting the development of this educational program. We appreciate the contributions of each member of the advisory board, who brought their expertise from the fields of education, science, engineering, Girl Scouting and administration. Special thanks goes to all the clean energy pioneers who have welcomed interviews and site visits at their homes and businesses, enabling us to empower participants not only to discover and think critically about clean energy and conservation, but also to act on their knowledge, so that generations of people might live in a cleaner, healthier environment. A special acknowledgement is given to Chris Mason, former Education Director and original Project Manager. NESEA would also like to thank the Western Massachusetts Electric Company for their generosity in supporting this 2009 reprint.

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NORTHEAST SUSTAINABLE ENERGY ASSOCIATION:
The Northeast Sustainable Energy Association (NESEA) is the nation's leading regional membership organization focused on promoting the understanding, development, and adoption of energy conservation and non-polluting, renewable energy technologies. NESEA has worked successfully for more than a quarter century in the fields of transportation, building construction, and renewable energy.

LEARN EXPLORE ACT

CLEAN GREEN POWER

Table of Contents

HYPERLINKED FOR USE ON COMPUTERS

For Educators: Unit Outline

This outline offers an overview of the Clean Green Power unit and how it can accommodate a wide range of educational levels.

Grade level
The program is adaptable to all levels, K to 12, and is also a great way for adults and families to gain an introduction to renewable energy technologies, environmental issues, and the related scientific principles.

Rationale & Objectives
The Clean Green Power program offers an introduction to the technology involved in clean, renewable energy and makes a great starting point for in-depth studies in several related areas. It provides a context for teaching scientific principles related to energy transformations, chemical transformations, electricity, and light, which are central to many clean energy technologies. The Clean Green Power program also provides a natural segway to environmental, ecological, social and human health studies in a variety of topics such as: climate change/global warming; acid rain; ground level ozone; air pollution; surface mining; oil spills and mercury poisoning.

Activities & Time Recommended
The basic structure of the Clean Green Power program is simple. There are three basic steps:

1. **Learn:** Short introductory activities are offered to become familiar with clean energy and develop some background knowledge. Educators can print and use the handouts provided or develop their own to suit the learning needs of their students and the direction they wish to take the unit. Allot one or two 40 – 60 minute class periods or more depending on activities.

2. **Explore:** A specific local site where clean energy is currently in use is selected for a field trip, or alternatively, a guest expert is invited to the classroom and students look for renewable energy technologies in their community. Students prepare to interview their host/guest, and then visit the

chosen site with their teachers or mentors. Allot a class period prior to the interview to develop questions and review visit logistics. The time at the destination site will vary based on site, ages, specific interests, etc., but negotiate this with the host ahead of time; about 1 to 1½ hours onsite.

3. **Act:** Students complete an art, science, or communications project that matches their ability level, interest, and the teacher's educational objectives. They present the project to a wider audience, contacting the media with their new knowledge to help spread the word about clean energy.

   Students should receive enough time and instructional support during the project phase to create a polished project that they can present with clarity. Three or more weeks are recommended for both in and out of classroom time.

Certificates of Completion and Patches
Youth that complete all three steps—Learn, Explore, and Act—are eligible to receive a Clean Green Power Champion patch and award certificate from the Northeast Sustainable Energy Association. The certificate is downloadable or can be photocopied from this guide. See page 43 for a Patch Order Form. Patches are free for Massachusetts residents and $5 for non-residents. Requirements for the Girl Scout patch are the same, but a different requirements worksheet and order form are used. See page 45.

Massachusetts State Curriculum Standards
Many Massachusetts Department of Education Curriculum frameworks can be met and exceeded, and a list of some of the potentially relevant Massachusetts Science and Technology/Engineering Curriculum Frameworks can be found in the appendix. (See page 34)

Assessment
Assessment will be based on the specific direction undertaken targeted by the individual educator and selected standards of learning.

Once specific learning objectives and projects are established, a pre- and post test might be designed. A rubric could be created to evaluate the learning evident in the final project and its presentation.
For the best student progress and outcome, continual assessment and adjustment of instruction throughout the unit is also recommended.

Return to Table of Contents

Requirements Worksheet

How to Earn Your Patch and Certificate

To earn the Clean Green Power Patch and Certificate, fully complete the requirements in each of the sections: **Learn**, **Explore**, and **Act**. Record what you did on this worksheet and have your teacher, parent or leader initial each requirement to indicate that you have completed each one with excellent effort and high quality work. The patch order form is on page 43. The Girl Scout patch requirements are the same, but please use the Girl Scout Requirements Sheet and patch order form on page 45.

_____ **Learn: Introductory activities to get you familiar with clean green power.**

Grade Level	**Activities** (Circle which activities you completed.)
For all grades	Introductory Reading: *What Do We Mean Clean Green Power*
For grades K - 3	Read and discuss the short story *Breath of Fresh Air* OR Complete a Web Warm Up activity
For grades 4 and up	Complete and discuss two of the following: 1. A Web Warm Up activity 2. True and False Quiz 3. Easy Energy Survey

Explore:

_____**Option A: Visited a clean energy site and interviewed someone who is using or producing clean green energy today.**

_____ **Option B: Identified obvious clean energy sites in my community and interviewed a guest speaker.**

Name(s) of Person(s) Interviewed:	
Address of Site Visited: (Option A)	Number of sites identified (Option B)
Clean energy alternatives and conservation measures you saw:	

Continued on other side.

Requirements Worksheet - cont.

_____ **Act: Completed a project and spread the word about clean green power.**

Project Description:
How I Shared My Project and Got Publicity:
News Media Where I Shared My Project: (Fill in all that apply) Name: Phone: Web Site: Email:

Safety

Parents and youth group leaders must assume responsibility for children and youth in their care and use their own best judgment in each situation. Adult mentors and or parents must accompany and directly supervise youngsters and teenagers during field trips at all times and follow all reasonable safety guidelines. The Northeast Sustainable Energy Association assumes no responsibility for safety. Any photos taken during the project are assumed available for public display unless parent signs otherwise.

Return to Table of Contents

Learn

The "Learn" portion of the project introduces students to the topic of clean green power: renewable energy, energy efficiency, and conservative energy use. You may choose to use your own introductory activity ideas or complete the activities provided below.

If you choose to use the activities provided, begin with the introductory reading, *What Do We Mean Clean Green Power?* and then complete one or two easy tasks—depending on grade level—listed in the following table. You may print out the relevant pages in this guide to use as handouts or download the desired component activities from The Clean Energy for a Clean Environment page at www.nesea.org, K-12 Educators.

Grade Level	Suggested Activities
All Grades	Introductory Reading and/or Discussion: *What Do We Mean Clean Green Power* (page 6)
Kindergarten to grade 3	Read and discuss the short story *Breath of Fresh Air* (page 7) OR Complete a Web Warm Up activity (page 11)
Fourth grade and up	Complete and discuss two of the following: 1. A Web Warm Up activity (page 11) 2. True and False Quiz (page 12) 3. Easy Energy Survey (page 14)

CLEAN GREEN POWER — LEARN

What Do We Mean, Clean Green Power?

Lighting homes, heating water, warming spaces, running machines, driving cars, and flying planes all require energy. The power to do such things is called **Clean Green Power** if the energy comes from (1) sources that produce little or no air, water or land pollution and (2) the energy is used slowly, in ways that don't waste energy.

As a result, using **Clean Green Power** is friendlier and less damaging for the natural environment and for our health than wastefully using other sources of energy. Getting energy directly from the sun, wind, moving water, and plants are some examples of energy sources that are generally considered clean and green. Cars, lights, and appliances that sip—instead of guzzle—energy and turning things off when not in use are examples of using energy slowly and not wasting energy.

The not so good news is that the way we are getting most of our energy at present is not clean. Today, we are still adding pollution to our environment. Even electricity, which seems clean, needs energy to be generated, and right now one of the most common ways is by burning fossil fuels such as coal and oil. We also heat most of our buildings and water with energy that comes from burning fossil fuels and their by-products that include fuel oil, propane, or natural gas. We drive most of our cars by burning gasoline, and we also burn fuels to keep machines in our factories running. Furthermore, we often use far more energy than we need, which adds more unnecessary pollution to our air, water, and land.

When we burn fossil fuels for energy, the pollution that goes into our air changes the environment; in many ways it can harm humans, plants, animals, and other living things. Acid rain, ozone pollution, mercury contamination, and global climate change are some that have been in the news a lot recently. Also, fossil fuels are not renewable, which means you cannot replace what you burned since it took millions of years to form them in nature.

Luckily, some people are beginning to use energy sources that are clean and green and to use energy more slowly. But most people don't realize how possible this is. We need more people to learn about clean, green power, and you can help! More kids and adults need to know that the clean, renewable energy is out there working well, right now! In this program, you find people living near you who use clean energy, meet and interview a person who has made smart energy choices, make a project, spread the good news, and have some fun!

Return to Table of Contents

Short Story

This short story is meant to help children begin to understand some of the issues around energy alternatives and to get them in the frame of mind of the clean green power unit, thinking about what kinds of places they might visit, the interview questions they might ask, and even the project they might carry out.

Feel free to read this story to early readers. More experienced readers may want to read it themselves.

After reading, discuss the story. Where can they find evidence of pollution? Where was it coming from? What are some ways people are saving energy and using cleaner alternatives?

A Breath of Fresh Air
By Susan Reyes

A hazy sun rose as warm as summer on a late winter day. A week of rain and warmth had melted away the deep snow that covered the area only last week. Jasmine was eager to get together with her best friends Samantha and Benito to find something to do, so she called over Sam, and they both headed to Benito's farm.

The threesome seemed to figure how to make the best out of every season, and winter had been an easy favorite. If there was snow, they could sled down the huge hill behind Sam's house; in the early darkness, they could gaze at the constellation Orion and his sparkling dog Sirius from Jasmine's deck, or any day, they could embark on untold adventures, exploring the frozen mysterious maze of swampland or just visiting animals around Benito's farm.

This particular morning, Jasmine noticed that the air felt a bit heavy to breathe, and she felt inside her pocket to be sure her inhaler was there since her asthma had been worse than usual this winter.

Soon the excitement of seeing Benito's older sister Rosa busy at work training a young pony in her indoor rink took the center of her attention. Though it seemed almost unimaginable, soon she and her friends would each get a pony to care for and ride. This all came about because of Rosa who was almost magic in her ability to make everything grow strong and healthy whether it was kids or vegetables or horses. Last summer, Rosa had started a small vegetable stand selling rare, tasty vegetables you couldn't find in the supermarket. She learned how to grow them without chemical fertilizers or pesticides.

Jasmine, Benito and Samantha were eager helpers with growing and selling the organic vegetables, and learned a lot in return. They never even thought of asking

for anything more in return for their help, and never imagined Rosa would arrange for each child to care for and ride one of the farm's young ponies as if it were their own, and that over the years, Rosa planned to work her wonders creating companions of ponies and children. Tonight there would be a neighborhood ceremony where everyone would gather and Rosa would present each child the pony she thought matched their personality the best, and then the pony naming ceremony would follow. Jasmine couldn't wait!

For today, the friends decided they'd mount their bikes, head along the back roads for a five mile ride to the local store, and reward themselves with a treat when they got there. Benito's mom would ride along and carry back a few groceries in her pack as she often did.

As they started off, they felt exuberant as they smelled sun-warmed pine needles and saw the earth born again from winters' grasp. Soon they noticed that their neighbor Jim was tapping some maples and he invited them in to show them his new energy saving machine that required less fuel to be burned. It looked impressive, and the syrup tasted fine, and Jasmine was glad to take the break since her breathing was feeling a little tight, though she didn't say anything. All thanked Jim, thrilled to get an extra treat as they headed along.

Soon, they stopped at a small old graveyard and read some of the interesting epithets on the stones. Benito observed, "The white ones are like, all fuzzy, and you can't read 'em and the thin dark ones, even though they're really old, don't seem as corroded or something." Anita noted that the fuzziness happened because the white marble stones were affected more by the acid in the rain than the dark slate stones.

Coasting down a hill where one could usually catch a view of a distant blue mountain, the haze was so thick they could not see its snow covered ski slopes. Then a panicked hare leaped across their path with the gold flash of a wild cat in hot pursuit. The bikers had come to a stop. An excited Samantha was sure she'd seen a mountain lion, but Benito's mom, a wildlife biologist, settled the matter with a clear identification of the animal as a bobcat.

As they stood still, they could hear the rushing of the river that told them they were not far from their destination. Jasmine noted that they must live in the best place in the world—beautiful and wild and at the same time, not too far away from all the great things that you could do downtown. All nodded and headed onward toward the river's bridge, where they'd make one last stop before a short, hard uphill climb to earn their treat.

"Hey, look at those yellow signs!" shouted Sam, and sure enough, in place of the signs that were up last Fall showing how to tell Atlantic salmon apart from Brook trout, there were warnings not to eat any fish in the river because tests showed they were high in mercury, a poisonous metal. Jasmine said, "That can't be true! The river looks too clean, and we can't possibly have any pollution here."

Stopped at the bridge, they looked down the river, which looked crystal clear. Benito noticed that here and there lay a dead fish. "The mercury is killing the fish!"

"No, its not likely the mercury," said his mom, "it's something called acid rain, and it can come down as snow or just fall out of the sky, and when all the snow melted last week, there was just too much coming into the river all at once for the fish to handle."

"Who's doing this to our river?" they asked in anger and in unison.

"I suppose you could say we all are, though we don't intend to," his mom gently replied, "We all seem stuck in an old way of doing things that is harming the environment and us, too. "

"We'll change that!" said Jasmine, and her friends agreed as they pumped up the hill with renewed energy. Halfway up, Jasmine, the athlete of the threesome, began to slip behind. She got off her bike and it was clear she was having difficulty breathing. Her friends were worried, but she explained that she had her inhaler and would soon be ok, but she had to walk the rest of the way up to the store. Her friends stood at her side and at the first sight of the sun's reflection off the shiny metal panels on the roof, Sam shouted, "We're here!"

Inside, Jasmine was breathing a lot better. While Anita was shopping, the kids enjoyed their treats and began to talk about the pollution. Jasmine wondered if her asthma might have been made worse by air pollution and Benito figured you couldn't see as far with polluted air. Everyone was angry about the fish and wondered what other harm the pollution might be doing. They all wanted to know how air pollution could even exist in a beautiful place like theirs. Ms. Henson, who worked at the store, was impressed with their conversation and invited Anita and the kids to see the solar panels on the roof.

She explained that burning gasoline, coal and other fuels to make electricity, run factories, heat places, and run cars, planes, and so on was what was polluting the air. She explained how the solar panels work and proudly announced that all their electricity came from the sun and was clean, renewable energy. Then she started to list many other people in town who were saving energy and starting to switch over and go clean and green! "The library uses energy from deep inside the warm earth! The Rogers have a wind turbine on their farm. My friend Eva started recording her driving miles 2 months ago and figured out how to cut them in half by sharing rides and walking. We're using photovoltaic cells to get electricity from the sun. Right now, we just need to do two things: get people to think about conserving energy more and get more people learning about clean energy alternatives. It looks like you are just the kids for the job!"

The children were so full of ideas they ended up walking their bikes much of the way home so they could talk. They had seen and felt some of the damage done by burning fossil fuels for themselves, and now they knew that with a little care and a different approach, the earth and air could be clean and healthy as it was meant to be.

At the ceremony, the ponies' names came to mind as if each animal had whispered it to each child: Benito called his Earthfire, and the pony's powerful gold-tipped legs looked as if they brought the earth's energy into his strong black body; Jasmine's spirited golden pony practically spoke the name Sunlight, and the wind rustled the extra long mane of Samantha's dappled mare as she named her Windstreak.

That night, Jasmine fell asleep quickly, dreaming of herself riding on Sunlight holding a lantern at night; she was a messenger with a mission. Suddenly she came to a rich green pasture with her friends and felt at home. The ponies grazed and the air felt light and sweet.

Return to Table of Contents

CLEAN GREEN POWER — LEARN

Web Warm Up Activities

The Internet can be a really helpful place to learn more about clean energy, energy conservation, and pollution from burning fossil fuels. You can get great ideas for your project from the web, too.

Spend about 30 minutes on each activity you choose. If students work on different sites, have them report back to the class on what they learned.

Energy Waste at Home and/or Energy Efficiency

1. www.energyhog.org. There are five games to play geared for elementary age levels and, if you want, there is a home energy survey you can take

2. http://nstar.sawmac.com/ There are games here, too. Teenagers and leaders might be interested in the program guide as it has some games and activities that could lead to project ideas.

In Depth On Solar

3. www.solarenergy.org/resources/kids.html Have students visit this site with a partner and read through the Website's frequently asked questions on solar energy. There is a section for younger kids (ages 6-106) and one for older kids (ages 12-112).

   Have student partners share something about the reading with each other: explain something they learned (e.g., something that surprised them, a new question they have, or an idea they have.)

Choose A Topic

4. Select a few topics of interest from the Clean Energy for a Clean Environment Glossaries and follow the imbedded links to additional web sites. Note the title and web address of at least one good site you might return to for your project or more information.

Return to Table of Contents

CLEAN GREEN POWER — LEARN

True and False Quiz

Take this Quick True and False Quiz and check out the correct answers to start learning about clean (and dirty) energy sources:

1. We need an energy source to make anything work. This means without energy we would not have lights or machines work. Without energy, we could not make a car, plane, train or anything else move. Without energy we couldn't keep a building warm. Without energy, we would not be able to make anything.
   TRUE or FALSE?

2. The only source of energy to do everything is gasoline.
   TRUE or FALSE?

3. Most of the energy we use in our country today comes from burning fossil fuels—ancient remains of sea and plant life buried underground for millions of years.
   TRUE or FALSE?

4. There's so much oil under the ground, we can keep increasing our use of it over time just as we've been doing for at least the next 100 years.
   TRUE or FALSE?

5. Massachusetts has to import all of its fossil fuels used to generate electricity.
   TRUE or FALSE?

6. Coal mining is an almost invisible operation since the mining is usually deep underground.
   TRUE or FALSE?

7. It is possible for an individual or family to make choices that can prevent tons of carbon dioxide (a major contributor to global warming) from going into the air each year.
   TRUE or FALSE?

8. The biggest source of ozone pollution in our country is from the smokestacks of factories.
   TRUE or FALSE?

9. Water vapor in the air can trap heat.
   TRUE or FALSE?

Answer Key—True and False Quiz

1. True. Read on!

2. False. Energy might come from many sources. Some other examples include: moving water, wind, burning coal, burning wood, splitting atoms, the earth's heat, the sun, and your own muscles.

3. True. Coal comes from ancient plants that were around at the time of the dinosaurs, and petroleum which contains natural gas, propane, gasoline, jet fuel, oil and other fuels we use comes from the remains of ancient sea life.

4. False. While we have a lot of coal in the US, and other fossil fuels are available, easily accessible oil could run out if our demand continues to grow and we do not seek alternatives. Fossil fuels are non-renewable energy sources.

5. True. The good new is that Massachusetts can get its own clean energy from a variety of sources, such as solar, biomass and geothermal. We also have wind, and the proposed wind farm off of Cape Cod would be the first offshore ub the whole US.

6. False. It is often surface mined, which may mean mountain top removal and extensive disruption to the local environment. Learn all about it at http://en.wikipedia.org/wiki/Surface_mining, or take a look at this Public Broadcasting Station site for some pictures and an insight into the controversies surrounding surface mining and mountaintop removal. www.pbs.org/independentlens/razingappalachia/mtop.html.

7. True. Today, U.S. individuals put an average of about 22 tons of carbon dioxide into the air per year, while the worldwide average is 6 tons per person per year. A ton is 2000 pounds, about the weight of a car. The good news is that we can help save a lot of carbon dioxide from getting into the air. A car that gets better gas mileage could save tons compared to a gas guzzler. Just carpooling for 2 regular trips a week can save about 1500 lbs per year; recycling can save 850 lbs per year. Planting trees saves 50 lbs per tree since they use carbon dioxide for photosynthesis. Buying things in bulk and reusable containers can save 230 lbs per year. That's just a start! There's a lot more that can be done, and a great project to learn about it. Get more tips from the U.S. Environmental Protection Agency. http://www.epa.gov/climatechange/wycd/actionsteps.html

8. False. Its from the tailpipes of cars, trucks, and SUVs www.nasa.gov/missions/earth/f-ozone.html

9. True. Water vapor is a greenhouse gas as is carbon dioxide. Some scientists have suggested that when we put extra carbon dioxide into the air from burning fuels, not only does it cause warming, but so does the increased water in the air from evaporation. Interactions in nature can be complex! Learn more about climate change from scientists at http://www.realclimate.org/index.php/archives/2007/05/start-here/

QUIZ SCORE: Stellar!
Have fun as you explore the web, interview, make your project and spread the word.

Return to Table of Contents

CLEAN GREEN POWER — LEARN

Easy Energy Survey

This quick survey is meant to get you thinking a bit about your own energy use. Be honest, its good to know where you are at right now. As you work through the Clean Green Power Program, see how many no's can become yes's:

Do you almost always turn off lights when you leave a room?
YES NO

Do you ride or drive only when necessary, choosing buses, trains, carpooling, biking, walking etc when you can?
YES NO

Do you know about how many miles you rode in a car last week?
YES NO

Do you usually consider fixing broken items or buy used one before buying new?
YES NO

Do you grow some of your own food or buy it through a local farmer?
YES NO

Do you know what temperature your home's thermostat is set to when no one is home?
YES NO

Do you separate recyclables?
YES NO

Do you know the average kilowatt-hours (kWh—a measure of electric power usage) used over the last year in your home or apartment? (Utilities measure how much electric energy you use in kilowatt-hours. One kilowatt-hour would power ten 100-watt light bulbs for one hour.)
YES NO

If your family has cars, trucks, or other vehicles, do you know how many miles each one can travel per gallon of gasoline in the tank?
YES NO

Do you know what heating system(s) your house or apartment uses?
YES NO

Do you know the energy source(s) for the heating system(s)? YES NO

Have you ever tested TVs, DVDS, computers or other electrical appliances to see how much power they use when they are supposed to be turned off?

YES NO

Do you use compact fluorescent light bulbs wherever lights are on the most?
YES NO

Do you know the expected yearly kWh usage of any of your home's major appliances, such as water heater, refrigerator, wash machine, drier, freezer, or air conditioner?

In the last several years, large electrical appliances are sold with yellow "Energy Guide" labels that give you this information. www.eere.energy.gov/consumer/tips/energyguide.html.

YES NO

Do you know what an Energy Star rating on an appliance means?
YES NO

Do you know how much insulation is in your attic and walls?
YES NO

Did you ever make the connection between energy use and pollution?
YES NO

Have you ever changed a habit to save energy?
YES NO

Clean Energy Tidbit

Each year, Americans spend more money to power home audio and DVD products when turned off than when actually in use.
Alliance to Save Energy,
www.ase.org/uploaded_files/powersmart/

Return to Table of Contents

With the "Explore" portion of the project, students discover people living near them who use clean energy and meet and interview a person who has made smart energy choices.

Choose one of the following clean energy explorations to complete.

A. Arrange for students to visit a clean energy site near you and interview the site host or hostess about their clean energy choices. See page 17

   Over 100 families and businesses in Massachusetts that use or produce clean and green energy have offered to host youth groups and be interviewed by kids and teenagers. You can find a site near you by visiting the Destination Sites pages on *Clean Energy for a Clean Environment* web site: Visit http://www.nesea.org/k-12/cleanenergyforacleanenvironment/destinationsites/

B. Invite a clean energy site host or hostess to visit the classroom and, as a homework assignment, have students conduct a windshield-survey scavenger hunt of clean energy sites in their neighborhood. See page 20

Return to Table of Contents

CLEAN GREEN POWER — EXPLORE

Clean Energy Site Visit and Interview

To complete this option of the "Explore" section, the teacher arranges for students to visit one or more Clean Energy Destination sites. The students create lists of questions to ask and then interview the host(s) or hostess(es).

1: Find a site to visit.

You may already know of a site to visit in your neighborhood. This could be a local "green" school building or someone you know with a home or business that includes renewable energy or energy efficiency features—perhaps even your own! But if not, you can find a site near you by visiting the Destination Sites pages on *Clean Energy for a Clean Environment* web site: http://www.nesea.org/k-12/cleanenergyforacleanenvironment/destinationsites/

The sites are organized by county and then listed alphabetically by town. Start by clicking on your county or a county you wish to visit.

Site Finding & Arrangement Tips:

- Check sites in the nearby counties in addition to your own.
- If you are willing to travel, feel free to choose any site in the state.
- Browse sites all over the state to get a sense of the diversity of clean energy alternatives in use.
- If you know someone who has a clean energy site you'd like to visit that is not on our list, feel free to go and interview that person and let us know if they are open to others interviewing them as well. (Email mailto:sreyes@nesea.org)
- Consider including a fun side visit while you are on the road. Pair up the clean energy site visit with an ice cream stand stop, some other refreshments and some other local fun opportunity. Our host sites have offered suggestions.
- Arrange a schedule for the visit, or at least a time estimate-it helps to be clear about time expectations.
- Contact your local news media and you might fulfill the publicity requirement for the certification by having them join you or write about your visit.

2: Prepare Students for the Interview:
Before you go to the site, you should work with students to prepare some interview questions and write them down. Here are some tips:

- One very helpful first question is to ask why the host/ess decided to use alternative sources of energy and how they learned to use clean power. Here's how the question might be framed: Could you tell me the story of how you got involved in using clean power?

- Equip students with personal energy information. Before you go, figure out how families heat their homes, heat water, light the house, and try to identify everywhere energy is needed, and where it is coming from with as much detail as possible. If you have an electric bill, it will show you how much electricity was consumed over the last year. You could have students compare how their uses and needs are similar and different to the hosts. Energy conservation measures can be shared both ways.

- The interview is a good opportunity to ask what some unfamiliar terms mean. Encourage students to ask and ask again if needed.

- Especially for older students, explore the "Glossaries" on the Clean Energy for a Clean Environment website http://www.nesea.org/uploads/textWidget/912.00008/documents/Clean_Green__Glossary.pdf and http://www.nesea.org/uploads/textWidget/912.00008/documents/Clean_Green_Links.pdf
to research the clean energy topic(s) students can expect to encounter during the site visit. This will help your group come up with smart questions ahead of time.

- Here are a few more general sample questions; be sure to check out the site you are going to and create questions that fit:
    - What makes your power source "clean?"
    - Why is it renewable?
    - How does it work?
      How long have you been using this system?
    - Were there any people, books, organizations, websites, people, stores, etc. that influenced your decisions, or that you recommend?

Site Visit Tips

- Have students bring notebooks or clipboards to the interview and be prepared to jot down new questions to ask, or possibly to follow-up on later.

- Consider bringing a tape recorder, camera, or video camera to the interview as a way to record of your visit. Just be sure to ask the host or hostess ahead of time if its OK to record images or voices and let them know how the information will be used.

3: The Interview and Visit

Meet a clean energy pioneer! See clean power technology up close. Enjoy the interview, learn a lot and help get students inspired to carry out their projects.

Needless to say but important enough to include: parents and adult mentors must accompany youngsters during all parts of site visits and take responsibility for all safety considerations.

On Site and After Site Tips for Adult Mentors:

- Many sites are homes and host/esses may be unfamiliar with the age and academic levels of children so adult mentors may need to help the site host/ess in this regard—for instance, ask for simpler words or more concrete descriptions.

- It is helpful to remind kids to be respectful of someone else's home and the different cultures we have—such as taking off shoes or not.

- Write individual or group thank you notes. Site hosts would be thrilled with specific notes about what was meaningful as well as drawings or photocopies of artwork.

Clean Energy Tidbit

If every household in the U.S. replaced **just one** bulb or fixture with an Energy Star qualified model, we could save more than 8-billion kWh—equivalent to removing 1 million cars from the road—per year!

Alliance to save Energy
www.ase.org/uploaded_files/powersmart/

Return to Table of Contents

Clean Energy Scavenger Hunt and Guest Visit

To complete this option of the "Explore" section, assign students the task of identifying as many obvious clean energy sites in your area as they can over a minimum of one week's time. The most obvious clean energy technologies that they will find will be solar hot water panels, solar-electric panels, and, in some areas, wind turbines.

Have students report back each day on their success. You may want students to identify where they sighted each clean energy system either by creating a class list of sites or by putting pins in a map identifying clean energy sites.

You will need to help students identify whether they spotted a solar-electric or solar hot water system. See the table on the following page for written descriptions of the differences.

Return to Table of Contents

CLEAN GREEN POWER — EXPLORE

How Can I Tell a Hot Water Panel from a Solar-Electric Panel?

Solar-electric panels have a trimmer look and you usually cannot see the connected wire cables.

In general, solar hot water panels are bulkier and you can often see insulated pipes attached.

House with solar hot water panels (top) and solar-electric panels (on porch).

Characteristic	Solar Hot Water	Solar-Electric
Where you will find them	Often on a roof but sometimes on the ground. They will always be tilted to face the southern sky.	Often on a roof but sometimes at the top of a pole.
Shape	Large flat boxes, bulky in appearance. OR Many long glass tubes.	Thin flat panels, trim in appearance.
Number of panels	Two to six is typical. More then that is an unusually large system.	Any number, although eight to ten is typical if mounted on a residence.
Connections	Usually, you can see one or two fat pipes connected.	Usually, no connections can be seen.

Caution: From the outside, some skylights may look like a solar hot water or solar electric panel but skylights generally stand up higher off the roof than solar-electric panels and they won't have pipes running to or from them, as do solar hot water panels.

Return to Table of Contents

During the "Act" part of the project, students create a project and spread the word about clean green power to others in their community.

Student Projects: Students can choose a science, language art or art project in the spirit of clean, green energy. The finished product should be of a quality high enough that the students would be proud to display it in a public setting of their choosing, such as their local library, environmental center, kid's museum, youth hall, house of faith, or other public setting.

The opportunities are open to imagination, although examples of project ideas are provided in this section to get your creative ideas flowing.

For project ideas for a variety of ages, see page 23

For project ideas for ages 11 and up, see page 27

Spread the Word: Students publicizing their experience with clean energy is an important aspect of the project. Publicizing the project can be done in many ways and students should be encouraged to think up their own ideas.

To help students along, example ideas are provided starting on page 30.

Return to Table of Contents

Create a Project

Examples of project ideas adaptable to a variety of ages

A Breath of Fresh Air
Illustrate the story, *A Breath of Fresh Air* (page 7). It could be broken up into parts with each student getting a frame to illustrate and then mount on a story mural.

The next chapter or a sequel could be written to this story and also illustrated. How do the children accomplish their mission? What adventures do they embark on in the process? What surprises do they encounter?

Tell Your Site Visit Story
Tell the story of the place you visited and the person you interviewed in some form of presentation. Be sure it is ok with your host or hostess before you proceed with this project! As you do this, make sure that your story comes out so that you would be proud about the way someone else told your story, double check for accurate details. Most hosts will be happy to answer questions. Be sure to send them a copy of your final product or photographs if applicable!

A Few Tips:
- Expect to make a few drafts before your presentation draft.
- Include credits and thank you notices as appropriate.

Here are a few suggested ways to produce your story.

- **Comic Strips**: Start with a page of mini-sketches (thumbnails) telling the whole story before starting in one section. Make several copies of blank comic strips to work in with neat boundaries -use rulers and shapes.

- **Books**: Use interesting borders. Make borders around photos and drawings. Laminate the front and back. Bind your book for a quality presentation.

- **Power Point or Video**: Think about the most interesting pictures and messages then set out the order and plan your frames. Be sure to open and close well.

CLEAN GREEN POWER — ACT

Clean Energy is Here Now Display
One way to spread the message is through a set of dioramas, tiles or a mural showing many examples of uses of clean and renewable energy technology such as wind turbines, solar panels, solar hot water on a roof, earth sheltered homes, or others you have learned about.

Each student can find out why an energy source or way of using energy is clean and green, imagine a picture to represent it, and then construct a 3-D model in a diorama. With the help of a carpenter, older girls can design a mural they paint on a board and hang it on a wall. Box dioramas can also be stacked to create a wall art piece. Short descriptions of each clean energy example should be available to interested viewers.

Re-Use It Gifts
Re-using saves energy because it takes energy to make anything, not to mention the land space used up by trash and pollution from the materials. With this in mind, identify commonly discarded items that you could use to make reusable gifts with pictures or slogans that remind people to recycle. Paper towels, napkins, plastic dishware, and lunch containers are common, and cloth alternatives with stenciled suns, trees, or other clean and green images. Some craft places offer time and space to paint ones own tiles and dishes at a cost.

Grow Organic or
Compare Locally Organic Grown vs. Supermarket Food
Students who have visited an organic farm can make a set of posters showing clean green benefits of buying local organic food: energy saved in transportation and the health of the soil and water as well. You could also research how to grow organic plants and plan an organic vegetable garden or an organic family lawn this summer.

Compost or Vermicompost
Get some red wriggler worms and have fun as you learn to transform nutrients from your food scraps into great fertilizer for your plants, and help keep your food local. Make a booklet describing how someone else can do the same thing and the energy benefits of eating locally grown food.

Composting Toilets
Sewer treatment requires energy, even septic systems in rural back yards, as sewage may need to be pumped up hill or taken away in trucks. Composting toilets are an interesting topic to explore and they keep lots of good nutrients local. Visit someone with a composting toilet, learn how it works, make a model or diagram, research a good site for a composting toilet and campaign for the toilets.

Recyclables Art and Programs
Start or rejuvenate a recycling program in your community, school, town or even in your home. Collect interesting recyclables, visit a re-use or recyclables store and construct sculptures with your finds. Beautiful new designs can be created in mosaic tiles from broken pottery pieces set in mortar.

Meaningful Message Postcards
Write helpful reminders and tips on pollution prevention and send them out printed on postcard size copies of your artwork- pen line with color, watercolor, or pastel all work well. Illustrate the beauty of the nature we are protecting. Save photographs of your postcards as proof of your certificate work. As a tip, a digital photograph is easier to share with the media.

Cozy Nature Saving Quilt
The squares could each be made by a different child and symbolize the things we love and are protecting as we conserve energy and protect our environment from acid rain and ozone pollution: a brook trout, a white pine, clear blue sky, a mountain view, etc. An information sheet or booklet could explain the squares.

Green Buildings
Make a model of a green building technology, either one you saw during your site visit or one you are interested in. Some examples include a straw bale house (straw bales make the sides of these homes) or an earth-sheltered house where some of the sides of the structure are partly underground. Write up the benefits and display these with your creation, or a photograph of it, in a public place.

Make the NO a YES
Take fresh look at the Easy Energy Survey (page 14). Turn some of those NOs on the quick energy survey into YESes and make a system of rewards for doing so. Expand on this survey and create an energy survey for your community. Provide rewards for people

who record a change. You could even calculate the pollution avoided.

Minimize the Miles
Figure out how many miles families in the class are currently driving and then brainstorm ways to trim the weekly average. Be supportive of one another and agree on no criticism, only praise. Invite parents' input. Graph your progress in minimizing the miles your class members drive.

Conduct a Poetry Slam, Contest or a Tea
Write poetry about environmental conservation, environmental stewardship, damage of mining, air pollution, clean energy, or related topics. Plan the event with food and a microphone. Get others involved through advertising and invitations.

Weigh the Waste
A great class activity, where kids get to choose what they eat and how much is left, is to weigh the food waste at the end of the meal (not counting inedible, fatty parts), and to graph it. Food takes a lot of energy to produce and transport (and don't forget the energy in getting the fuel itself). Mapping out all the sources of energy that go into getting a meal for a class of students on the table makes a great project.

More Ideas
Many of the web sites linked to in the Clean Energy Glossary (page 45) can be very useful in coming up with more project ideas.

Return to Table of Contents

Create a Project

Examples of projects suitable for middle school and older

Build a Model Solar Electric Car
Or for the oldest teenagers, mentor a team of builders. There's a whole program called Junior Solar Sprint for kids up through 8th grade—teams can enter their car in race and design events. Adults or even older teenagers could serve as mentors and organizers for a team of middle school age youth. The Northeast Sustainable Energy Association provides fun workshops for anyone interested in helping middle school age teens take on this project. See http://www.nesea.org/k-12/juniorsolarsprint/

OZONE: Good Up High, Bad Near By
Learn about ozone pollution at ground level and how it harms plants and animals including people. A totally different problem is that some of our human made pollutants are thinning our ozone layer high in the atmosphere, where we need it to protect us from dangerous radiation. Create a public project to help people get clear about this common confusion and help correct the human caused ozone problems. Here are some helpful web sites:

For a quick picture:
www.nationalgeographic.com/eye/ozone/science.html

For learning about the importance of the good ozone layer:
www.epa.gov/sunwise/kids/kids_ozone.html

For everything you wanted to know about ozone:
http://science.howstuffworks.com/ozone-pollution.htm

To explore NASA's ozone mapping, navigate the site of the Total Ozone Mapping Spectrometer (TOMS):
http://toms.gsfc.nasa.gov/

Or check out some amazing work that New Hampshire scientists are doing with students, where they study the pine needles of white pines all over (including Massachusetts) for evidence of ozone damage that you can see using sophisticated equipment. Visit: www.forestwatch.sr.unh.edu

You can do science experiments testing for ozone pollution in areas around where you live by using ozone-sensitive papers.

You can make your own test strips and experiment: http://www.ucar.edu/learn/1_7_2_29t.htm

Test for Carbon Dioxide
With plastic bags, big syringes, and a liquid acid indicator (red cabbage juice works fine), you can go around collecting samples from different locations such as car exhaust, breath, air near a bus terminal, or even straight carbon dioxide made by mixing vinegar and baking soda in a bag or an alka-seltzer in water. Bubble these gases with the syringe through the acid indicator and check for acid levels. The more carbon dioxide in the gas, the higher the acid reading will be in an acid indicator.

Build and Cook Meals on a Solar Oven
To help you get started, here's a great site to learn about cooking with solar ovens and a lot of global culture around the topic. The Solar Cooking Archive, Solar Cookers International. www.solarcooking.org

Solar and Wind Kinetic Sculpture
Once you know how electric circuits, solar panels, and motors work, you can play around and create some sculptures with parts that move from the power of the sun. Solar fountains are fun and you can start with a kit and work from there.

Create a Model Wind Turbine
The web site www.KidWind.org has many great instructions on how to build model wind turbines that actually produce power when placed in a strong breeze or in front of a large fan. Write up the benefits of wind power and display these with your creation, or a photograph of it, in a public place.

Home Energy Audit
Learn about energy conservation and save your family money while you are at it by helping your family investigate your home's energy use with the Home Energy Audit calculator at this Lawrence Berkeley National Laboratory site: http://hes.lbl.gov/hes/vh.shtml.

To get answers to frequently asked questions, check out: http://hes.lbl.gov/hes/answerdesk.html

Create a Web Site on an Energy Issue
You and your class can become experts on a specific topic and help make all the important connections for other kids. For instance, if you chose global warming you might include information on the carbon

cycle, how burning fossil fuels creates carbon dioxide, and how carbon dioxide traps the sun's energy in the atmosphere. You could review other web sites that talk about how global warming may affect our planet's ecosystems, make links, and recommend the best.

Start, Moderate or Join an Energy Issues Discussion Forum
Organize an energy issues forum in your town or participate and support an existing one by taking an active role in discussions, raising questions, agenda items, and logistics.

Energy Information Exhibits
You've been to fairs and you know what attracts people to a booth. Can you make a booth fun, interactive, and informative? Develop some demonstrations and models, interactive if possible, and make handouts for visitors. Join an earth day event, or have each individual become an expert on their own topic and run a section of booths or your own fair. Make it a traveling exhibit for classrooms, school assemblies, or other groups.

Model Fuel Cell Car
Learn about the exciting technology of hydrogen fuel cells.
Kits are available to make and conduct experiments and races with model cars. To get started, visit www.fuelcellstore.com.

Public Access TV
Get show time. Many adults would likely be eager to help you create an energy panel discussing important issues on air.

A Cause and Effect Map or "1+1=2"
Many, perhaps most, voting adults don't understand important connections between our current energy use and its effects on our society and planet, as well as the effects of making wiser energy choices. Try to list each problem and each effect on a piece of paper. Write "causes" or "may cause" or "can lead to" on several little strips of paper and attach them to several separate strings. Use the strings to connect the problems and effects in every way that makes sense based on your research. Use a large area. A large wall poster can be created when you feel satisfied you have identified many problems, effects and what may cause what.

Return to Table of Contents

Spread the Word!

Publicizing the experience with clean energy is an important aspect of the project. It can be done in many ways and here are some examples, but feel free to let students think up their own ideas as well.

- Create press releases for your site visit and interview, or for the project(s) if it is an event or if it will be displayed at an event. Do be sure it is OK with the site owner to have the press involved prior to inviting them. For press release tips, see, "Make Yourself a Star" (page 32).

- Make the focus of your project spreading the word about clean energy. Teach other people about what you have learned by displaying your project at your local school, library, city or town hall, or other commonly visited places. Have an opening reception just prior to a meeting—such as a PTO meeting—and advertise with good-looking photocopied fliers in advance.

  If your project is geared toward teaching kids of a certain age group, you might get permission from the teacher to make a special class visit or from the principal to offer a special assembly. The school library is also a great place to spread the word.

- Prepare a 10 to 15 minute presentation with your project and get yourself on the agenda at a local adult meeting of the Rotary Club, or another group. Here's a simple outline. Tell:

  a. About the program and what clean green power means.

  b. Where you went, why, and what you learned.

  c. What project you created and describe or show it.

  d. About the most important things you learned, changes you hope for, and what you think are most important things adults can do.

- Write a letter to the editor of your newspaper describing a position on clean energy, energy alternatives, energy conservation, or problems associated with energy use. You may also respond to an energy related article you find in the newspaper.

  Tip: Look at the length of the letters they publish. Usually it is about two or three paragraphs. That's the space you have to get

across your point. Respectfully share your point of view and give reasons for it.

- Look for a small newspaper, e-zine or newsletter where you can write about your project and include some photographs. You could even create your own publication and have each class member's project set up in article form.

  For an example, check out *The Green Schools Gazette* www.ase.org/section/program/greenschl/gazette/

  At this site you can look through previous editions of this newsletter for students and by students. You could get ideas for a project and maybe publicity. Articles wanted!

- Here are additional ideas for places to share projects and experiences

  Earth Day Events
  Environmental Centers
  Energy Committees in Towns
  Energy Study Groups
  Green Car Clubs
  County or Agricultural (you can win awards, too!)
  Conferences
  National Honor Society
  Nature & Hiking Clubs
  After School Clubs
  After School Care for Younger Kids
  Historical Societies
  Science Fairs & Expos
  Open Mikes
  Key Club
  Public Access Television
  Interfaith Councils
  Other Girl Scout Troops
  Rotary Club

  Asking around among parents, checking with your Chamber of Commerce, can leads to some good ideas for places where you can share your project and spread the word.

CLEAN GREEN POWER — ACT

MAKE YOURSELF A STAR!

Alerting the local press about your activities and achievements associated with the Clean Green Power program is an important way to spread the word about clean renewable energy! In the process, you get a sparkling image of yourself out in your community as well. Follow these steps and make the news!

1. Find media outlets to cover your event or project. Besides the well-read area newspapers, try getting an article in the elementary, middle, high school, and college papers. Also consider publicity on the local television and radio stations.

2. Call your local media or check websites to find a contact person in education or local interest reporting. Be sure to get a full name, phone, and fax numbers.

3. Prepare yourself to speak directly to your contact person and tell them briefly about the Clean Green Power program, what you've done that is newsworthy, and what you want them to do (such as an article, an interview, or to accompany you on your visit to a clean energy site). In addition, be prepared to send them (usually by fax with a call to check that they got it) a press release if they request it.

How to Write a Press Release

1. Type it, and if possible, have your school or organization logo at the top with its name and address. This part is called the letterhead and it helps makes it look sharp and important.

2. Underneath, a heading in this format works well:

   FOR IMMEDIATE RELEASE — CONTACT: - *your name* -
   – *the date* - - *your phone number and email* -

3. Type in a title that describes your achievement or event. For example:

   LOCAL YOUTH BRING ENERGY EXPO
   TO TOWN COMMON ON EARTH DAY

4. Begin the body of your news release with your town and state in parentheses.

5. Tell about your event as if you are the newspaper writer, saving the reporter all the work. Include in your article who, what, when, where, and why. Include a few quotes from yourself and others and name the project sponsors and volunteers if there are any.

6. **Follow Up!** This is very important! Call the reporters who received your press release and ask if they have any questions, would they like a digital photo (if you can offer one), and if they are planning to come or write an article? Be prepared to re-fax them your news release if need be.

7. **Keep you eyes and ears open for your name in the news!**

Return to Table of Contents

Appendices

Massachusetts Science and Technology/Engineering Curriculum Frameworks

Applicable Massachusetts Science and Technology/Engineering Curriculum Frameworks:

Teaching the Clean Green Power unit can fulfill many Massachusetts Science and Technology/Engineering Curriculum Frameworks. Furthermore, Skills of Inquiry, Experimentation and Design for all grade are readily incorporated in the Clean Green Power program. Massachusetts's curriculum frameworks from other areas of study can also be fulfilled due to the interdisciplinary nature of the program. Meeting a particular set of standards depends on choices and adaptations to the Clean Green Power program made by the individual educator.

Strand 1 Earth and Space Science

Grades PreK-2
The Sun as a Source of Light and Heat
Standard 4. Recognize that the sun supplies heat and light to the earth and is necessary for life.

Grades 3-5
Weather
Standard 8. Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.

The Earth in the Solar System
Standard 14. Recognize that the earth revolves around (orbits) the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.

Grades 6-8
Heat Transfer in the Earth System
Standard 3. Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through the earth's system.
Standard 4. Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature difference among water, land and atmosphere.

Return to Table of Contents

Grades 9-10
Content standard 1. Matter and Energy in the Earth System
Central Concepts: The entire Earth system and its various cycles are driven by energy. Earth has both internal and external sources of energy. Two fundamental energy concepts included in the Earth system are gravity and electromagnetism.

1.1 Identify Earth's principal sources of internal and external energy, such as radioactive decay, gravity and solar energy.
1.3 Explain how the transfer of energy through radiation, conduction, and convection contributes to global atmospheric processes, such as storms, winds, and currents.
1.4 Provide examples of how the unequal heating of Earth and the Coriolis effect influence global circulation patterns, and show how they impact Massachusetts weather and climate (e.g. global winds, convection cells, land/sea breezes, mountain/valley breezes).
1.8 Read, interpret, and analyze a combination of ground-based observations, satellite data, and computer models to demonstrate Earth systems and their interconnections.

Content Standard 2. Energy Resources in the Earth System
Central Concepts: Numerous earth resources are used to sustain human affairs. The abundance and accessibility of these resources can influence their use.

2.1 Recognize, describe, and compare renewable energy resources (e.g. solar, wind, water, biomass) and nonrenewable energy resources (e.g. fossil fuels, nuclear energy)
2.2 Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy.

Content Standard 3. Earth Processes and Cycles
Central Concepts: Earth is a dynamic interconnected system. The evolution of Earth has been driven by interactions between the lithosphere, hydrosphere, atmosphere, and biosphere. Over geologic time, the internal motions of Earth have continuously altered the topography and geography of the continents and ocean basins by both constructive and destructive processes.
3.2 Describe the carbon cycle.

Strand 2 Life Science (Biology)

Grades 3-5
Adaptations of Living Things
Standard 7. Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).
Standard 10. Give examples of how organisms can cause changes in their environment to ensure survival. Explain how some of these changes may affect the ecosystem.

Energy and Living Things
Standard 11. Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.

Grades 6-8
Changes in Ecosystems Over Time
Standard 17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms. Study changes in an area of the schoolyard or a local ecosystem over an extended period. Students might even compare their observations to those made by students in previous years.

Biology
High School
Learning Standard 6. Ecology
Central Concept: Ecology is the interaction among organisms and their environment.
6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.

Strand 3 Physical Sciences (Chemistry and Physics)

Grades 3-5
Forms of Energy
Standard 4. Identify the basic forms of energy (light, sound, heat, electrical, and magnetic). Recognize that energy is the ability to cause motion or create change.
Standard 5. Give examples of how energy can be transferred from one form to another.

Electrical Energy
Standard 6. Recognize that electricity in circuits requires a complete loop through which an electrical current can pass, and that electricity can produce light, heat, and sound.
Standard 7. Identify and classify objects and materials that conduct electricity and objects and materials that are insulators of electricity.
Standard 8. Explain how electromagnets can be made, and give examples of how they can be used.

Magnetic Energy
Standard 9. Recognize that magnets have poles that repel and attract each other.
Standard 10. Identify and classify objects and materials that a magnet will not attract.

Light Energy
Standard 12. Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

Return to Table of Contents

Strand 3 Physical Sciences (Chemistry and Physics)

Grades 6-8
Forms of Energy
Standard 13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

Heat Energy
Standard 14. Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.
Standard 15. Explain the effect of heat on particle motion through a description of what happens to particles during a change in phase.
Standard 16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.

Grades 9-10
1. Motion and Forces
Central Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.
1.4 Interpret and apply Newton's three laws of motion.
1.6 Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects.
1.8 Describe conceptually the forces involved in circular motion.

2. Conservation of Energy and Momentum
Central Concept: The laws of conservation of energy and momentum provide alternative approaches to predict and describe the movement of objects.
2.1 Interpret and provide examples that illustrate the law of conservation of energy.
2.2 Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa.
2.3 Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.
2.4 Describe both qualitatively and quantitatively the concept of power as work done per unit time.

4. Waves
Central Concept: Waves carry energy from place to place without the transfer of matter.
4.1 Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.
4.2 Distinguish between mechanical and electromagnetic waves.
4.4 Describe qualitatively the basic principles of reflection and refraction of waves.

3. Heat and Heat Transfer
Central Concept: Heat is energy that is transferred by the processes of convection, conduction, and radiation between objects or regions that are at different temperatures.
3.1 Explain how heat energy is transferred by convection, conduction, and radiation.
3.2 Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.

3.3 Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling and warming.
3.4 Explain the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.

5. Electromagnetism
Central Concept: Stationary and moving charged particles result in the phenomena known as electricity and magnetism.

5.1 Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.
5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
5.3 Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.
5.4 Describe conceptually the attractive or repulsive forces between objects relative to their charges and the distance between them (Coulomb's law).
5.5 Explain how electric current is a flow of charge caused by a potential difference (voltage), and how power is equal to current multiplied by voltage.
5.6 Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.

6. Electromagnetic Radiation
Central Concept: Oscillating electric or magnetic fields can generate electromagnetic waves over a wide spectrum.
6.1 Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum.
6.2 Describe the electromagnetic spectrum in terms of frequency and wavelength, and identify the locations of radio waves, microwaves, infrared radiation, visible light (red, orange, yellow, green blue, indigo, and violet), ultraviolet rays, x-rays, and gamma rays on the spectrum.

Strand 4 Technology/Engineering
Grades preK-2
2. Engineering Design
Central Concept: Engineering design requires creative thinking and consideration of a variety of ideas to solve practical problems.
2.1 Identify tools and simple machines used for a specific purpose, e.g., ramp, wheel, pulley, lever.
2.2 Describe how human beings use parts of the body as tools (e.g. teeth for cutting, hands for grasping and catching), and compare their use with the ways in which animals use those parts of their bodies.

Return to Table of Contents

Grades 3-5
2. Engineering Design
Central Concept: Engineering design requires creative thinking and strategies to solve practical problems generated by needs and wants.
2.1 Identify a problem that reflects the need for shelter, storage, or convenience.
2.2 Describe different ways in which a problem can be represented, e.g. sketches, diagrams, graphic organizers, and lists.
2.3 Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem.
2.4 Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird's wings as compared to an airplane's wings.

Grades 6-8
2. Engineering Design
Central Concept: Engineering Design is an iterative process that involves modeling and optimizing to develop technological solutions to problems within given constraints.
2.1 Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
2.2 Demonstrate methods of representing solutions to a design problem, e.g. sketches, orthographic projections, multi-view drawings.
2.3 Describe and explain the purpose of a given prototype.
2.4 Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.
2.5 Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.
2.6 Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.

5. Construction Technologies
Central Concept: Construction technology involves building structures in order to contain, shelter, manufacture, transport, communicate, and provide recreation.

5.1 Describe and explain parts of a structure, e.g., foundation, flooring, decking, wall, roofing systems.

5.2 Identify and describe three major types of bridges (e.g., arch, beam, and suspension) and their appropriate uses (e.g., site, span, resources, and load).

5.3 Explain how the forces of tension, compression, torsion, bending, and shear affect the performance of bridges.

5.4 Describe and explain the effects of loads and structural shapes on bridges.

6. Transportation Technologies
Central Concept: Transportation technologies are systems and devices that move goods and people from one place to another across or through land, air, water, or space.

6.1 Identify and compare examples of transportation systems and devices that operate on or in each of the following: land, air, water, and space.

6.2 Given a transportation problem, explain a possible solution using the universal systems model.

6.3 Identify and describe three subsystems of a transportation vehicle or device, i.e., structural, propulsion, guidance, suspension, control, and support.

6.4 Identify and explain lift, drag, friction, thrust, and gravity in a vehicle or device, e.g., cars, boats, airplanes, rockets.

7. Bioengineering Technologies

Central Concept: Bioengineering technologies explore the production of mechanical devices, products, biological substances, and organisms to improve heath and/or contribute improvement to our daily lives.

7.1 Explain examples of adaptive or assistive devices, e.g. prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces.

7.2 Describe and explain adaptive and assistive bioengineered products, e.g. food, bio-fuels, irradiation, integrated pest management.

Grades 9-10

1. Engineering Design

Central Concepts: Engineering design involves practical problem solving, research, development, and invention/innovation, and requires designing, drawing, building, testing and redesigning. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge.

1.1 Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.

1.2 Understand that the engineering design process is used in the solution of problems and the advancement of society. Identify examples of technologies, objects, and processes that have been modified to advance society, and explain how they were modified.

1.3 Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.

1.4 Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼′ = 1′0″, 1 cm = 1 m).

1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models.

2. Construction Technologies

Central Concepts: The construction process is a series of actions taken to build a structure, including preparing a site, setting a foundation, erecting a structure, installing utilities, and finishing a site. Various materials, processes, and systems are used to build structures. Students should demonstrate and apply the concepts of construction technology through building and constructing either full-size models or scale models using various materials commonly used in construction. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in construction technology.

2.1 Identify and explain the engineering properties of materials used in structures (e.g., elasticity, plasticity, R value, density, strength).

Return to Table of Contents

2.2 Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures.
2.3 Explain Bernoulli's principle and its effect on structures such as buildings and bridges.
2.4 Calculate the resultant force(s) for a combination of live loads and dead loads.
2.5 Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
2.6 Recognize the purposes of zoning laws and building codes in the design and use of structures.

3. Energy and Power Technologies—Fluid Systems
Central Concepts: Fluid systems are made up of liquids or gases and allow force to be transferred from one location to another. They can also provide water, gas, and/or oil, and/or remove waste. They can be moving or stationary and have associated pressures and velocities. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in a fluid system.

3.1 Explain the basic differences between open fluid systems (e.g., irrigation, forced hot air system, air compressors) and closed fluid systems (e.g., forced hot water system, hydraulic brakes).

3.2 Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.
3.3 Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change.
3.4 Recognize that the velocity of a liquid moving in a pipe varies inversely with changes in the cross-sectional area of the pipe.
3.5 Identify and explain sources of resistance (e.g., 45º elbow, 90º elbow, changes in diameter) for water moving through a pipe.

4. Energy and Power Technologies--Thermal Systems
Central Concepts: Thermal systems involve transfer of energy through conduction, convection, and radiation, and are used to control the environment. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in a thermal system.
4.1 Differentiate among conduction, convection, and radiation in a thermal system (e.g., heating and cooling a house, cooking).
4.2 Give examples of how conduction, convection, and radiation are considered in the selection of materials for buildings and in the design of a heating system.
4.3 Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings.
4.4 Identify and explain alternatives to nonrenewable energies (e.g., wind and solar energy conversion systems)

5. Energy and Power Technologies--Electrical Systems

CLEAN GREEN POWER

Central Concepts: Electrical systems generate, transfer, and distribute electricity. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in an electrical system.
5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.
5.2 Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.
5.3 Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.
5.4 Recognize that resistance is affected by external factors (e.g., temperature)
5.5 Compare and contrast alternating current (AC) and direct current (DC), and give examples of each.

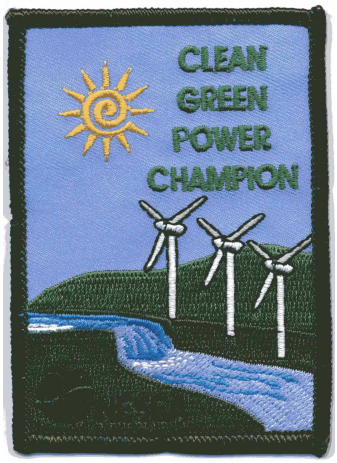
Clean Energy Tidbit

Natural gas school buses emit 90% less toxic soot and 30% less smog forming pollution than new diesel school buses. At least 130 U.S. school districts in 19 states transport students in nearly 4000 alternative fuel buses. http://go.ucsusa.org/just_the_facts/112.html

Over a 70 year life-time of exposure, it is estimated that 125,000 people get cancer caused by our burning of diesel fuel. http://go.ucsusa.org/just_the_facts/106.html

Return to Table of Contents

Clean Green Power Champion Patch Order Form



Send this order form along with a completed *Requirements Worksheet* to:

Clean Green Power Patch
Northeast Sustainable Energy Association
50 Miles St., Suite 3
Greenfield, MA 01501

Patch Recipient(s): _____

_____

Affiliated Organization: _____

Address: _____

City/Town/Zip: _____

Phone: _____

Patches & Certificates are free to Massachusetts's residents due to grant funding through the Massachusetts Technology Collaborative Renewable Energy Trust. www.mtpc.org. Residents of all other states must pay a fee of $5.00 per patch earned. Inquire about a discount for a large group. Note: Girl Scouts please use the patch & requirements form on pp. 45-46

CLEAN GREEN POWER PROGRAM EVALUATION

Please let us know how this program and resources worked for you and your group.

1. In what context did you use this teacher guide? (Formal classroom or informal education) Grade or age of students:_____

2. What was your overall experience of the unit?

3. What was best about the web site, teacher's guide and program?

4. What suggestions would you have to improve the guide, web site, or program?

5. Other comments:

Thank you for taking the time to tell us about this program!

Optional:
Your Name:
Address:
City/Town, State, Zip:
Email:

Send responses to:
Susan Reyes, NESEA, 50 Miles St., Greenfield, MA 01301
Or email to: sreyes@nesea.org

Return to Table of Contents

Girl Scouts

Girl Scouts
CLEAN GREEN POWER PATCH
Requirements Worksheet & Patch Order Form

Girl Scouts are eligible to earn a special Girl Scout patch for their completion of the Clean Green Power program.

Name(s) of girl(s) earning the patch(es) :_____
_____
Troop & Level:_____Council:_____
Completion Date:_____Please send_____ patch(es) to:
Name:_____
Full street address:_____
City or Town:_____State:_____Zip Code:_____
Phone(s):_____
Email:_____

How Girl Scouts Earn the Clean Green Power Patch:
In the Clean Green Power Patch, all Girl Scouts fully complete the requirements in each of the sections: Learn, Explore and Act. On these two sheets the troop leader or adult mentor initials each requirement to indicate that each one has been completed with excellent effort & high quality work.

_____**Learn: What is clean green power? Why change?**
Find out why people are choosing clean energy.

A. All Girl Scouts read and/or discuss with leader, the content of "What Do We Mean, Clean Green Power?" for an introduction.

B. Complete the additional activity or activities required for your Girl Scout level. Circle which one(s) you did:

1. "A Breath of Fresh Air" (Daisy & Brownie Girl Scouts)
2. True and False Quiz (Brownie, Junior, & Teen GS)
3. A Web Warm Up (Junior and Teen Girl Scouts)

C. Easy Energy Survey (Junior and Teen Girl Scouts)

____**Explore: A. Visit a clean energy site and conduct an interview OR B. Identify clean energy sites in your community and interview a guest speaker.** Learn how people living near you are taking action to keep our air, water and land clean. Choose a "clean energy site" and arrange a

visit or take a community tour looking for use of renewable energy. Interview someone who can tell you their story and show you how they conserve our valuable energy resources. You can locate places to visit and people to interview at http://www.nesea.org/k-12/cleanenergyforacleanenvironment/destinationsites/ or you can also locate your own. An adult mentor, troop leader or parent must closely accompany and supervise youth throughout any visit.

Name of person interviewed:_____
Type of clean energy alternative:_____
_____
Address of site visited **or** number and description of sites identified in the community:_____
_____
_____

____**Act: Create a project** inspired by what you've learned, or based on a special area of interest. Many project ideas for each level can be found in the Clean Green Power Teacher's Guide. Project description and who took part:

_____
_____
_____
_____

____**Act: Spread the good news about clean energy!** Share your project with others, get publicity, and get the word out about how we can all live in a cleaner, healthier environment. Check out the ideas for getting publicity in the patch program guide. Explain how and where you shared your project and got publicity with information such as news media contacted, etc:

_____
_____
_____
_____

Safety: Troop leaders, educators, parents and adult mentors must assume responsibility for children and youth in their care and use their own best judgment in each situation. Follow all Girl Scout guidelines for safety. No responsibility for safety is assumed by the Northeast Sustainable Energy Association.

Please mail this completed form and your payment if applicable to:

Clean Green Power Patch,
Northeast Sustainable Energy Association,
50 Miles St., Greenfield, MA 01301

You are welcome to send pictures of your projects, and by sending them you are giving us permission to use them for educational purposes.

Cost: $5.00 per patch or call if there is a large group. There is no charge for the patch for Massachusetts Girls Scouts due to funding by the Massachusetts Technology Collaborative Renewable Energy Trust Fund.

Call 413-774-6051 x27 with any questions.

Clean Energy Glossary

There may be many new terms that both adults and students might encounter in their journey through this unit. Below you will find a short energy glossary in simple language. For more terms and additional definitions, you are encouraged to browse some of the glossaries on the Internet at the end of this section. Sometimes you might have to explore a topic a bit deeper to get an understanding you are satisfied with. Keep asking questions, looking up information and helping each other learn!

Alternative Fuel: Fuels not usually used but which may have human health or national security benefits. Some examples of alternative fuels would be natural gas, biodiesel, propane, or electricity. You can get more information than imaginable at this adult-oriented site, the Alternative Fuels Data Center: www.eere.energy.gov/afdc

For more accessible information, download the fact sheets from Cars of Tomorrow and the American Community and Planet Connecticut at: http://www.nesea.org/k-12/curricularunits/

Atmosphere: Layers of gases around the earth, including the air we breath, which is mostly nitrogen (78%), about 21% oxygen, with the rest being small but very important amounts of other gases including water vapor, argon, carbon dioxide, neon, helium, methane, hydrogen, nitrous oxide and ozone.

Biodiesel: An alternative fuel made from fat or vegetable oil that can be used directly or mixed with a conventional diesel in a diesel engine.

Climate: Moisture, temperature, and weather averaged over a long time period in a particular region. Usually it is measured over a 30 year time period. Check out Columbia University's Climate Kids Corner for more information: http://ocp.ldeo.columbia.edu/climatekidscorner/

Climate Change: Patterns of change observed in climate-may be used to describe natural changes over time or human caused changes such as global warming. The National Atmospheric and Oceanic Association has an educational site that provides an extensive resource

on climate change and many other topics for students of all levels: www.education.noaa.gov/students.html

Electrical Circuit: An unbroken loop of material that electricity can flow through-like copper metal wires. If there is a break in the circuit, the electricity does not flow and cannot do work.

Electricity: A form of energy. We can use it for power when we get the electricity to flow (in the form of tiny parts of atoms called electrons) through wires in large numbers. Try this site for deeper exploration: http://science.howstuffworks.com/electricity.htm

Electricity Generation: Electrical energy is produced in different ways. Most electrical generating stations today use steam to spin coils of copper wire inside a magnetic field, which creates electricity. To make steam, we usually burn fossil fuels, mostly coal or oil, although sometimes the water is heated from splitting atoms (nuclear energy) and sometimes it is heated by concentrating sunlight. Moving water or wind can also be used to spin a turbine, which in turn spin coils of copper wire inside a magnetic field. Solar-electric cells can also be used to generate electricity. They convert sunlight into electricity with no moving parts.

Generate your own electricity by following Activity #2 in the Wind Wisdom guide – a free download from http://www.nesea.org/k-12/curricularunits/

Emissions: Gases, particles, and materials released or emitted into the environment often due to combustion or burning of a fuel.

Energy: The capacity to do work. A resource for producing power.

Energy Conservation Strategies: Techniques for avoiding wasteful and unnecessary use of energy. Avoiding excessive or unneeded use of energy prevents pollution, and keeps animals, people, and plants healthier. Many people are surprised about how much money they can save, too!

Energy Star: A government-backed program helping businesses and individuals protect the environment through superior energy efficiency. It include an efficiency rating that is given to appliances, like a refrigerator or computer, that use significantly less energy compared

to other similar appliances. For more information see www.energystar.gov

Fuel: Anything we burn or can burn to get energy, such as wood, gasoline, coal, heating oil, propane, natural gas, etc. Note that some fuels are cleaner when they burn then others.

Fossil Fuels: Natural fuels such as oil, coal, and natural gas that took millions of years to form in the earth. They are rich in the elements carbon and hydrogen and come from the remains of ancient living things. A friendly way to learn about fossil fuels with games, history, activities and more is found at U.S. Energy Information Administration, Energy Kids Page: www.eia.doe.gov/kids/energyfacts/index.html

Geothermal Energy: Heat energy from inside the earth.
Alliant Energy has a clear explanation with pictures and is friendly for a wide range of ages. www.powerhousekids.com

Global Warming: A term given to the observable fact that the earth's average temperature is increasing. There is strong evidence that human's use of fossil fuels is responsible for much of the observed warming although changes in land use, such as cutting down large tracks of rain forests, and some natural climate trends also seem to contribute to the warming.

For more information see the U.S. Environmental Protection Agency sites: www.epa.gov/globalwarming/kids/index.html, and www.epa.gov/climatechange/index.html

Greenhouse Gases: Gases in our atmosphere that absorb heat energy (infrared radiation) that is given off by earth, heat up, and re-radiate that heat energy, some of it back to the earth. Carbon dioxide, water vapor, methane, nitrous oxide, and a number of other gases can do this. Humans have made great changes in how much carbon dioxide is in the atmosphere due to burning fossil fuels and changes in land use, such as clearing forests of trees.

High Efficiency: Getting a lot more work out of a small amount of energy.

Return to Table of Contents

Hydrogen Fuel Cell: A device that converts hydrogen and oxygen into electricity, water, and heat. www.fuelcellstore.com

Kilowatt-hour (kWh): A unit of electric energy often used to keep track of the amount of energy you bought from the electric company. It tells you how much electric power or rate of energy use (measured in kilowatts) was used over a given time (measured in hours). Check out your electric bill and it will show how many kWh you used each month for the last year, and you can even learn to read the figure off your own meter.

Mercury: A poisonous metal that is released into the air when coal is burned among other things. It can build up in the bodies of living things over time. Too much mercury in the body causes brain and nerve damage, and developing babies and young children are most vulnerable. That is why there are warnings for women who could have children not to eat or to limit eating fish from Massachusetts's waters.

Good basic information for different ages can be found at:
http://faculty.washington.edu/chudler/merc.html

For an adult site that is still useful to teens see:
www.epa.gov/waterscience/fishadvice/advice.html

Nonrenewable: Once it's used up, it's gone. For example, coal, oil, and natural gas are non-renewable energy sources. It may have taken nature 100 million years to make them and we cannot replace them once used.

Nuclear Power: Splitting atoms produces heat that is used to heat water to move turbines and generate electricity. For a teacher created web site with interesting interviews, activities, and information see:
www.naschools.net/teachers/nuclear/nuclear.htm

Ozone: An important gas made up of three oxygen atoms, which is good for us up high in the atmosphere and bad for us and the environment down low.

Up high, ozone shields us from harmful radiation. Some human made chemicals can break down the layer of ozone up high in the atmosphere.

Ozone is bad for us down low where we breathe (it damages lung tissue) and where it damages plants, especially food crops. Ozone is the major pollutant in smog, and a lot of it is created from our use of gasoline and other fossil fuels.

PV Cells, or Photovoltaic Cells: A solid-state device, mostly silicon, that enables light energy from the sun to be transformed into electrical energy and transported through wires to do work in an electrical circuit.

Photovoltaic (PV) System: A system of electrical energy generation that uses photovoltaic (PV) cells to convert sunlight into usable electric energy. Get many of your questions about PV systems answered at www.solarenergy.org/resources/olderkids.html#1

To learn more technical details about how photovoltaic cells work, see www.howstuffworks.com/solar-cell1.htm

For inspiring profiles of interesting people involved in solar energy and a kid-friendly Q and A format, try Solar Energy International www.solarenergy.org/resources/kids.html

Power: The rate at which work is accomplished.

Renewable: A resource that renews or replenishes itself on a short time scale. Examples include solar, wind, geothermal, hydropower, and biomass. Here are a few sites:

For kids, Alliance Energy a company that serves utility customers with natural gas and electricity has basic simple information. www.alliantenergykids.com

The Energy Efficiency and Renewable Energy government site offers a kids home page with video clips, fact sheets, activities and more: http://www.eere.energy.gov/kids/

For older elementary through adult, The Union of Concerned Scientists has very readable information in "Energy 101" as well as sound information on how biomass, solar, hydroelectric wind and geothermal work. www.ucsusa.org

Smog: A mixture of air pollutants, mostly ozone. You cannot see as far when there is smog, and even at low levels, it can harm some people, inflaming their lungs, and making breathing difficult. Try out this interactive site: www.smogcity.com

Solar panels: When referring to solar electric energy, a solar panel is a group of PV cells wired together and packaged in a protective case so that, when mounted in a sunny location, it can be used to convert sunlight into electricity.

When referring to solar heat energy, a solar panel is a collection of pipes connected together and packaged in a protective case so that, when mounted in a sunny location, it can be used to convert sunlight into hot water or, less often, hot air.

Strip Mining: A form of mining where the surface soil is stripped off to expose the substance being mined. Coal is often mined from the surface by mountain top removal.

This site offers information and resources about coal mining including strip mining: http://www.enviroliteracy.org/article.php/1122.html

This Public Broadcasting Station site offers a short description of a film "Razing Appalachia" some pictures and an insight on the controversies around the method:
www.pbs.org/independentlens/razingappalachia/mtop.html

Sustainable: A practice of resource use that can be maintained indefinitely without causing major harm to the environment, animals, and plants.

Technology: Anything people have made could be called technology, but usually people think of advances in using scientific knowledge and applying it to a practical use, like creating photovoltaic cells or wind turbines.

Turbine: A machine that spins to generate power. Electricity can be generated if you spin magnets inside coils of wire. Michael Faraday was a scientist from the 1800s who figured out this important scientific idea that has been put to practical use ever since!

Watt: A watt is a measure of power often used to measure electric power. In other words, the rate, or how fast electric energy gets used. A 100-watt bulb can receive more energy per second than a 60-watt bulb and so it is brighter and hotter. A kilowatt (kW) means 1000 watts, a megawatt (MW) means a million (1,000,000) watts, and a gigawatt (GW) is a billion (1,000,000,000) watts.

Wind Energy: Today, wind energy refers to using blades attached to a turbine to convert wind energy into electric energy. In could also refer to converting wind energy into mechanical energy. Wind energy has been used for centuries to pump water and grind grains. Wind energy is the fastest growing source of electric energy in the world and in the United States. The American Wind Energy Association offers a thorough tutorial for more in depth and advanced exploration. Visit www.awea.org/

The Renewable Energy Research Laboratory Center for Energy Efficiency and Renewable Energy offers a series of reliable fact sheets on wind energy, perfect for an in-depth study on wind. See www.ceere.org/rerl/about_wind/

Clean Energy Tidbit

To generate the same amount of electricity as a single 1-MW wind turbine for 20 years would require burning 26,000 tons of coal (a line of 10-ton trucks 10 miles long) or 87,000 barrels of oil. To generate the same amount of electricity as today's U.S. wind turbine fleet (6,374 MW) would require burning 8.6 million tons of coal (a line of 10-ton trucks 4,321 miles long) or 28 million barrels of oil *each year.* www.masstech.org/renewableenergy/Community_Wind/FAQ.htm

Bird deaths from wind turbines are small compared with other human structures. http://go.ucsusa.org/just_the_facts/42.html

Energy Glossaries on the Internet

Massachusetts Technology Collaborative's Energy Glossary
Organized alphabetically and by topic.
http://www.masstech.org/cleanenergy/energy/glossaryMAgov.htm

U.S. Environmental Protection Agency's Clean Energy Glossary
Written with adults in mind: www.epa.gov/cleanenergy/energy-and-you/glossary.html

U.S. Department of Energy, Energy Information Administration
Though found on the Energy Kids Page, it uses many terms that could be challenging for kids to understand.
www.eia.doe.gov/kids/glossary/index.html

Additional Helpful Websites

Here are a handful of sites especially selected for adult mentors. They offer various and curriculum materials to select from.

Alliance to Save Energy
Students Leading the Way 2004-2005
Energy Saving Success Stories From California
This guide offers dozens of clean energy action projects classes have carried out and provides a gold mine of ideas for projects.
www.ase.org/images/lib/educators/Success%20Book%2005.pdf

DSIRE
This is a database of state incentives for renewable energy (such as rebates for solar energy) included here since adults you meet everywhere are sure to get excited about clean green power when you tell them what a difference it makes.
www.dsireusa.org/

The Massachusetts Technology Collaborative Renewable Energy Trust -The Guide to Teaching Renewable Energy Here is an educator's perfect one-stop guide to activities and resources related to renewable energy and global warming. Over 120 materials are described and assessed by educators.
http://masstech.org/cleanenergy/curriculum/about.htm

Return to Table of Contents

Mrs. Mitchell's Virtual School
Here's an organized selection of energy links for educational purposes:
www.kathimitchell.com/energy.htm

Northeast Sustainable Energy Association – K-12 Educators
A good place to browse around for activities to download. This is where you will find the Clean Energy for a Clean Environment web site, information on other projects for youth, the Junior Solar Sprint model solar car competition, and more.
http://www.nesea.org/k-12/

U.S. Department of Energy
Energy Efficiency and Renewable Energy
This is an important gateway web site for many clean energy sites. On the home page you can go straight to links for Kids, Consumers, Education, specific areas of renewable energy and more.
www.eere.energy.gov/

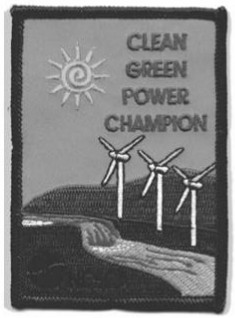
Clean Energy Tidbit

"Coal generates 54% of our electricity, and is the single biggest air polluter in the U.S." The Union of Concerned Scientists offers you a comparison of coal vs. wind as energy sources.
www.ucsusa.org/clean_energy/coalvswind/c01.html
For more interesting tidbits of clean energy information, you can choose the topic areas such as Clean Energy, Air Pollution, Renewable Energy, etc. at the Union for Concerned Scientists' web site:
http://go.ucsusa.org/just_the_facts/index.html

Return to Table of Content

Download a full page color certificate
http://www.nesea.org/k-12/cleanenergyforacleanenvironment/cleangreenpowerproject/

Certificate of Recognition



_____

has been awarded the status of

CLEAN GREEN POWER CHAMPION

for contributions toward the vision of a cleaner, healthier environment by raising awareness and taking action on renewable, sustainable energy use and energy conservation in the local community.

MASSACHUSETTS TECHNOLOGY COLLABORATIVE
RENEWABLE ENERGY TRUST

Western Massachusetts Electric
The Northeast Utilities System

NESEA
Northeast Sustainable Energy Association
www.nesea.org

Contacts

For questions and feedback about the teacher's guide, web sites, site destinations, and clean, renewable energy:

Arianna Alexsandra Collins, NESEA Education Director
413-774-6051 x21 acollins@nesea.org

Susan Reyes, Science Educator
413-774-6051 x27 sreyes@nesea.org

www.nesea.org
Northeast Sustainable Energy Association
50 Miles St. Greenfield, MA 01301

Return to Table of Contents

Clean Energy Tidbit

One of the unique features of Massachusetts is its diversity of clean energy resources. The state boasts an abundant bio-energy stock, excellent wind potential in a number of areas, existing hydropower facilities and infrastructure, and sufficient solar energy for widespread solar photovoltaic installations. The actual amount of clean energy that could be developed in the state is far greater than what is currently being utilized. For more information, check out: www.masstech.org/cleanenergy/massenvironment/potential.htm