Let us help you make an energy project come to life!

ENERGY EDUCATION
PUD Mini-Grant Program

School Year 2011-12
**Solar Energy**  
*By Marci Bass*

Grade Level: 6th – 8th Grade  
School District: Arlington School District  
School Name: Stillaguamish Valley School  
School Address: 1215 E Fifth Street, Arlington, WA 98223  
E-mail Address: Marci_bass@asd.wednet.edu  
School Phone: 360-618-6440

**Project Description**

Learning about solar power isn't just another EALR or GLE, it is something that can empower students to become better stewards of the planet. Since the class was small, only 10 students grades 6-8, the kids were able to focus on projects in small groups as they designed/carry out investigations that stemmed from the NEED Project materials. To show what they learned, each student prepared a presentation for our Celebration of Learning to teach other students, parents and community members about solar power.

**Learning Objectives**

- Students will learn and educate the public about solar power
- Students will investigate photovoltaic cells and see how they convert sunlight into electricity
- Students will design investigations using photovoltaic cells
- Students will research and design an investigation using solar power
- Students will learn how solar power is a renewable energy source

**WA State Learning Standards**


**Materials Needed**

Silicon Energy Model 180, Deep Cycle Battery 12 Volt, Charge Controller

**Method/Design of Project**

We researched solar energy using the Exploring Photovoltaic unit put together by the NEED Project. The information and activities were really well laid out. Once they learned quite a bit, the students had an amazing field trip opportunity to see how solar panels are made as they picked up the solar panel at Silicon Energy in Marysville. They also put their knowledge to the test by putting together presentations for the end-of-the year Celebration of Learning at the Stillaguamish Valley School to show what they learned this semester, including solar ovens, remote control cars converted to solar power and solar house models complete with circuits and wiring. Thank you, PUD, for this opportunity.
My school has approved another solar class next year and we will both continue our learning and acquire new students who will put solar power to the test.

**Evaluation/Assessment**
Students selected different topics to present to fellow students and parents at the Celebration of Learning at our end-of-the year picnic. They put together presentations to teach others about their projects. The presentations they put together went way above what they learned in class and their excitement and energy on the topic got others excited about solar energy.

**Challenges**
My first challenge was getting the right materials in students’ hands to do the investigations. We went to pick up our amazing solar panel from Silicon Energy, and then didn’t have the equipment to use it right away. My other challenge was that the class meets only once a week and students ended up working on multiple projects at the same time at their own pace. This was also great because students were able to help out their peers when they had questions. Last, our school budget was tight and we didn’t end up purchasing a deep cycle 12 volt battery or a charge controller, but I look forward to that for next year.

**Successes/Strengths of Project**
I think that giving students freedom and time to work on their projects really empowered them to learn more. The groups were composed of students from different grades and each student brought different knowledge to the group and made them very successful. The students were so energetic that they asked me to propose the class for next year, I did and it got approved.

**Budget**
Solar panel $500.00

**Additional Advice for a Successful Project**
Once the students were engaged with hands-on activities, they asked questions that lead them down many paths. All they needed was a little guidance and help with materials and they really took off. Seeing lights run on a battery they charged with our solar panel really got them excited. I am really proud of what my students accomplished.
Photos

Newspaper Article
Mechanical Energy Transformed  
By Donnica Farnsworth & Tani Iverson

Grade Level: 5th grade  
School District: Arlington Public Schools  
School Name: Kent Prairie Elementary  
School Address: 8110 207th St. NE Arlington WA 98223  
E-mail Address: donnica_farnsworth@asd.wednet.edu  
School Phone: 360-618-6260

Project Description
We studied energy transfers; specifically how mechanical energy changes to light, sound, and electrical energy using hand crank devices such as generators, flashlights, radios and chargers. Students first studied how the hand crank generators work and then used their knowledge to design experiments about energy transfers and time.

Learning Objectives
• Students will identify different forms of energy (heat, light, sound, motion, and electricity) in a system.  
• Students will draw and label diagrams showing several different ways energy can be transferred from one place to another.  
• Students will describe how electrical energy is changed from one form to another.  
• Students will describe how electricity is transformed from mechanical energy to other forms, to include light, sound, and motion.  
• Students will work collaboratively with other students to carry out a controlled experiment.  
• Students will gather, record, and organize data using appropriate scientific method and investigations

WA State Learning Standards
• PS 3A: Energy has many forms such as heat, light, sound, motion, and electricity.  
• PS 3B: Energy can be transferred from one place to another.  
• PS 3E: Electrical energy in circuits can be changed to other forms of energy, including light, heat, sound, and motion. Electrical circuits require a complete loop through conducting materials in which an electric current can pass.

Materials Needed
• 3 Hand Crank Generators - Gen100  
• 6 Hand Crank Flashlights - (SS-232)  
• 3 Hand Crank Radios - Kaito SB-1059  
• 3 Hand Crank Cell Phone Chargers - Etón American Red Cross CLIPRAY ARCCR100R_SNG USB  
• 2 12-pks Stopwatches (MyChron) (Stokes Publishing)
Method/Design of Project

Initial Investigation
Starting with hand crank generators, students investigated how the generators convert electrical energy to light energy or sound energy. Students had exploration time to determine how the generators worked and to generate questions. Next, students drew and labeled diagrams showing the complete circuit at work inside the generators. These were completed as large chalk drawings outside the classroom. (See photos.) We also purchased chromium wire as an afterthought and had students experiment how heat energy can also be generated using the hand crank generators. However, since these generators do not store the energy, we moved on to devices that do store the energy.

Controlled Experiments
The investigation will continue with students brainstorming ideas about possible experiments to conduct, using small electronic devices that use hand cranks to generate electricity (radios, flashlights, and cell phone chargers). Using what they have already learned about the scientific process, students planned a controlled experiment regarding how the number of cranks on the device affects the amount of time the device is functional. Students wrote up this experiment using the whole scientific process. There was a lively discussion about what variables must be controlled. In the end they decided each group was responsible for only one device, only one person was to crank the device and the crankers all met together to determine how slow or fast they would crank the device. Students determined all aspects of the experiments, including how many cranks would be completed for each trial, how time would be recorded, and how the data would be recorded.

Extension
Discussions revolved around how to store this energy that was transformed and why some devices store the energy and some do not. We wrote scenarios where each of our devices could be used and discussed their use in a more energy conscious and energy efficient world today.

Evaluation/Assessment
Students were assessed on their groups drawing of the working components of the generator circuit and their ability to verbalize the process. Groups each submitted their initial experimental write-up and their data collection and conclusion.

Challenges
Our greatest challenge was that the hand crank generators we purchased broke almost immediately and took several months to get replacements. PUD was generous and loaned us some of their hand crank generators to allow the grant project to continue. Even so, there was a feeling of frustration as each one broke quickly and my repair attempts were unsuccessful. A second challenge occurred during the experimental phase. We quickly realized that there is a strong correlation between the number of cranks and the time the device stays functional. However, there was considerable debate about the word “functional” and when it could be said that the device was off.
**Successes/Strengths of Project**
I truly feel that this project cemented in students’ minds the concept of an energy “transfer”. They were extremely intrigued by the hand crank generators and were eager to use them. This hands-on approach showed them how energy can be changed from one form to another. In years past, this has been an ambiguous understanding but with this project, that idea of transferring mechanical energy to sound, light, and heat was made crystal clear.

Students also developed a greater appreciation for energy. They physically felt how tiring it can be to keep something functional. They brainstormed many uses for alternative energy sources and how devices such as these could be used in their own lives. However, with that comes some understanding of how convenient and precious the electricity that we do have is and how it should be preserved.

**Budget**

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<th>Item Description</th>
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<td>1 spool chromium wire (this was purchased later by Donnica)</td>
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**TOTAL AMOUNT REQUESTED**

$456.02

**Additional Advice for a Successful Project**
Spend the additional money to purchase the GenCon hand crank generators.
The hand cranking generator gets energy by the mechanical energy.
Energy and Water books and DVDs for grades K-3
By Beth Trafton

Grade Level: 2nd grade
School District: Arlington
School Name: Pioneer Elementary
School Address: 8213 Eaglefield Drive, Arlington, WA 98223
E-mail Address: beth_trafton@asd.wednet.edu
School Phone: 360-618-6230

Project Description
Our school library lacks primary science books and DVDs that introduce and expand on the topics of Energy and Water. Our students in grades K-3, especially, need access to nonfiction science books.

Learning Objectives for Water Grant
Students will learn the importance of water and its role in shaping landforms; identify where natural water bodies occur in their local environment; measure and record weather changes across the seasons; interpret graphs of weather conditions; study ecosystems and watersheds.

Learning Objectives for Energy Grant
Students will learn how plants and animals get energy as they learn about food chains, make food webs, sequence what animals do to get energy, and sort information. Students will learn how people get energy as they sort objects and foods into energy groups, survey classmates on foods they like and dislike and compare, discuss where foods come from, talk about vitamins and food groups, and plan healthy meals.

WA State Learning Standards for Water Grant Addressed
ES2A, B, C- Weather and Water; LS2A, B, C, D- Ecosystems

WA State Learning Standards for Energy Grant Addressed
Organisms and their Environments- All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants. Humans depend on their natural and constructed environments.

Materials
Energy and Water books and DVD resources for K-3 students and teachers to access in the library

Method/Design of Project
Students and teachers access energy and water books and DVDs from the library throughout the school year.

Evaluation/Assessment for Energy and Water Grants
Students participate in a Science Fair in the spring, perform Readers’ Theatres across grade levels, and use books and DVDs during research projects.
**Challenges**
Books were ordered in December, but weren’t received until March.

**Successes/Strengths**
Students loved performing the Reader’s Theatre for their peers; the Science Fair planning is complete and students are finalizing their projects; the books and DVDs are being used; The Arlington Times attended three of the Reader’s Theatre productions and took photographs for an article in the paper that speaks to our receiving the PUD mini-grant this school year.

**Budget**
Scholastic books and DVDs = $250.00; Follett books and DVDs = $250.00
Energy Books
By Stephanie Smith and Marilyn Hall

Grade Level: 4th grade
School District: Edmonds
School Name: Terrace Park School
School Address: 5409 228th St. S.W., Mountlake Terrace, WA 98043
E-mail Address: SmithSte@edmonds.wednet.edu; hallm@edmonds.wednet.edu
School Phone: 425-431-7482

Project Description
For the past 3 years we have taught our highly capable students (beginning in 4th grade) lessons of wind, water, and solar energy with discussions of kinetic and potential energy using hydropower kits, and the wind turbine kits showing the technology for renewable energy sources. We now wanted to provide books for students who are already interested in renewable resources and conservation topics, to have a year round book source helping them extend their understanding of classroom work. These students shared their learning with other students by creating book-talks as photo-stories that will be put on teacher and library websites making the information available to the whole community.

Learning Objectives
1. Students will explore books about the alternative sources of renewable energy using wind, water, and solar technology for classroom assignments.
2. Students will expand their understanding of energy and controversies of energy generation when readings these books.
3. Students will read and create several photo-story and/or podcasts as a means to explain concepts of clean renewable energy to younger students and other neighborhood students.
4. Students will show in another photo-story the many perspectives in the controversies that hydroelectric facilities have on salmon habitat and water usage in the state.

WA State Learning Standards
• 4-5 SYSC : Systems have inputs and outputs. Changes in inputs may change the outputs of a system.
• 4-5 LS2F: People affect ecosystems both positively and negatively.
• 4-5 APPA: Technology involves changing the natural world to meet human needs and wants.

Materials
Books on energy related topics.
• Non-fiction books:
  o alternative energy sources
  o healthy salmon habitats
• Photo-Story program
  o Students trained to do script writing
• Students trained to record
• Teachers to produce/save project

• **Script written from the books to highlight:**
  - What alternative energy sources:
    - Can do to save expenses
    - Can do to save resources
    - Can do to provide renewable energy sources
  - Science concepts showing text:
    - Explaining vocabulary
    - Concepts of ways to harness the energy of wind, water, solar, and nuclear
    - Concepts of other ways to use food:
      - Bio-fuels
  - How people can really make a difference for animal, salmon, and other people using alternative energy sources

**Method/Design of Project**
1. These books allowed many different kinds of access to energy information. Teachers using differentiation (different skill groupings) had the resources in these books to allow different kinds and levels of interest groups time for energy investigations in the classroom.
2. Students created Photo-Stories so teachers could use them when working with literacy as well as within a science context.
3. The Photo-Stories were written and produced by students. It caused the students to think deeper about what was important as points of literacy for the literacy stories, and what was important for the science content stories (vocabulary, examples of alternative energy, what alternative energy is, how to support renewable energy sources).
4. Each viewing of the Photo-Story is intended to be used (in classrooms or the library) with the book that is explained in the story.
5. The Photo-Story book talk walks students through the books pointing out features of non-fiction text for literacy, and concepts for the science. Then the student reads the book introduced. Afterwards, questions, discussion groups, and charts reflect the student learning.

Our students, once the designated books were done (Photo-Story created), wanted to do more with all the books purchased. This will be an on-going project for all classes: the ones that created the Photo-Stories and the ones that use them.

**Evaluation/Assessment**
Assessment was in 5 main areas:
1. Teacher observations of student informal use of specific energy concepts and vocabulary during the unit as a whole through journal writing, presentations, and verbal responses.
2. The projects will be monitored through the writing process for vocabulary and content accuracy through journal note-taking, pre-written work, revisions, and final product.
3. Students will produce photo-stories scripts that reflect the concepts and vocabulary learned during the unit and from the reading the books. The projects will be evaluated for content and overall understanding, writing quality, interest levels generated. The intended audience will be other classes and eventually the community at large through posting the work on teacher websites.

4. Students will be given a formal assessment over material covered in the books.

5. Classes that review the photo-story will provide feedback.

Challenges
- Once we had the books, we needed to create time for the students that were going to produce the “book talks” to have time to read and discuss the issues within the books.
- Students learned to write interesting scripts that would hold other students attention.
- Getting teams to agree on specific information.
- There were some production issues:
  - Quiet places to record
  - Practice recording
- Once the initial book was done, it became evident the students wanted to do *all the books* available on alternative energy sources, and the project grew in size tremendously.

Successes/Strengths
- One of the challenges became one of the strengths: motivating students to learn about alternative energy sources by publishing their Photo Stories motivated them to want to do all the books available.
- Students became motivated to read the books after watching and participating with the Photo Story, when the initial interest level in learning about energy and its alternatives were low.
- There was more talk between different classes (producers/readers) about what they thought about the Photo Story books, but the conversations moved beyond the production into talking about energy concepts learned.
- Students wanted to do/learn more about energy by doing the book talks, and other students wanted to do more. (We will probably add this as a class in our After School Program in the fall.)

Budget
Book total=$474.77

Additional Advice for a Successful Project
Have fun! This project grew beyond our conception initially when the students became so excited about doing the book talks for other classes. The “authentic” audience really made a difference in motivation levels.

To see a video example of this project, contact education@snopud.com
Electricity Circuits
By Erica Taggart

Grade Level: 3rd – 5th Grade
School District: Everett School District
School Name: Garfield Elementary
School Address: 2215 Pine ST, Everett, WA 98201
E-mail Address: etaggart@everettsd.org
School Phone: 425-385-4701

Project Description
Three Electronic Snap Circuit kits and a Caddy Electricity kit were used to run extension science classes once a week with third, fourth, and fifth graders.

Learning Objectives
• Students will be able to know the difference between an open and closed circuit.
• Students will be able to know the difference between a series and parallel circuit.
• Students will be able to demonstrate how to build an AM radio, burglar alarm, flashlight, or doorbell within a small group using the Snap Circuit Kit.

WA State Learning Standards
• 4-5 PS3B Energy can be transferred from one place to another.
• 4-5 PS3E Electrical energy in circuits can be changed to other forms of energy, including light, heat, sound, and motion.
• Electric circuits require a complete loop through conducting materials in which an electric current can pass.

Materials
• 3 – Snap Circuit Kits
• 1 – Caddy Stack Electricity Kit

Method/Design of Project
Students were in groups of 4-6 and used the student manual given within the snap circuit kit to work together to create numerous different circuits. This project was all hands-on discovery and problem solving with their classmates.

Evaluation/Assessment
The challenge was to create one of the 300 different circuits mapped out in the student book. In overseeing and observing the groups as they worked, I could see if students were participating and understanding how the circuits were put together. Each week I changed the student groups and made a different student the leader for the day to hear their understanding with their group discussions in creating the circuits. Students also were able to see if they were correct quickly if the circuit successfully did what it was supposed to do when they were done snapping the pieces together. This was a great way for them to work together and problem-solve to make a complete circuit.
Challenges
One of the biggest challenges for this project was not having enough kits. Ideal group numbers are 3-4 for these kits and sometimes groups had up to 6 students.

Successes/Strengths of Project
These snap circuits were very appropriate for 3rd-5th graders and they are very easy for them to understand. Having a total of 300 different projects also challenges all students at their level of understanding. Designating 30 minutes once a week for a total of 6 weeks before rotating to a new small group of 3rd-5th graders was a perfect amount of time to see great success with a hands-on activity where students had to get actively involved.

Budget
- Caddy Stack Electricity Kit = $176.90
- Snap Circuits Sets (3 sets) = $226.05
- Total cost with shipping and tax = $479.52
Woods Creek Field Trip
By Crosby Carpenter

Grade Level: 10th - 12th Grade
School District: Granite Falls School District
School Name: Granite Falls High School
School Address: 1401 100th Street NE, Granite Falls, WA 98252
Email Address: ccarpenter@gfalls.wednet.edu
School Phone: 360-283-4358

Project Description
A key component of Sustainable Green Technology and Design is student exploration and evaluation of renewable, sustainable energy systems. As a capstone project for the hydroelectric energy unit, students developed a comprehensive proposal for a new hydroelectric site in Snohomish County. Funding was provided to subsidize the transportation cost of a field trip to the Woods Creek Project.

Learning Objectives
1. Apply research skills to examine and outline a specific requirements for hydroelectric site development
2. Analyze the relationship between natural and built environments.
3. Apply understanding of systems thinking and system dynamics.

WA State Learning Standards
1. Apply understanding of energy efficiency, conservation, and reduction (C-4.1)
2. Apply understanding of hydro generation (C-4.5)

Materials Needed
1. Topographical maps of Western Washington
2. River flow data from USGS
3. Computer and Printer
4. Google Mapping software
5. Microsoft Word and PowerPoint
6. Poster board

Methods/Design of the Project
The students cross-referenced topographical maps of Western Washington with data from Google maps and stream flow from the USGS. Using this data, students proposed a specific site for a new low impact, hydroelectric facility. Once the site was established, student prepared a presentation included projected costs, community impacts, and power generation.
Evaluation/Assessment

Sustainable Design Project: Deliverables Rubric
Green Technology and Design | Granite Falls High School | 2011-2012

Objective:
Students will apply 1systems thinking and 2elements of sustainability to design a sustainable solution to a societal challenge/concern.

Assessment:
This portion of the project is worth 100 points (Approximately 50% of your sustainable design project. So...what have you designed?...what is your product (solution)? Projects must apply systems thinking and elements of sustainability. Additionally, your project should address your objective and has a lasting impact on the community and/or stakeholder(s).

Preliminary Rubric:
Each component will be scored on a scale from 0 to 10 (or 0 - 20)
(10-9 = A, 8 = B, 7 = C, 6 = D, <5 = No Credit).

Clearly explains the application of sustainability in response to a contemporary societal issue
Represent significant student investment (40 hours) and creative effort
The project has lasting impact on the community and/or stakeholders
The objective is clearly defined.
Provides an accurate analysis of sustainability (economic, social, environmental)
Accurately references system dynamics
Accurately references built vs. natural environments, externalized costs, and resources distribution

Challenges
The majority of challenges occurred when one of the student groups extended the project to include a built micro hydroelectric turbine.

Successes
One of the student groups competed in the Imagine Tomorrow competition at WSU. Not only did the students propose a new low impact micro hydroelectric site for Granite Falls on the Stillaguamish River, but the students also built a model micro hydroelectric turbine using copper wire, magnets, and PVC piping.
**Budget**

The field trip cost was $450 including transportation and substitute fees. An additional $400 was allocated by the district to transport the two students to and from Pullman. Once at the competition, WSU paid for room and board.

**Photos**
Adopt A Stream Junior Stream Keepers Field Trip
By Darlene Moe

Grade Level: 3rd Grade
School District: Lake Stevens School District
School Name: Hillcrest Elementary
School Address: 9315 4th St SE Lake Stevens, WA 98258
Email Address: Darlene_moe@lkstevens.wednet.edu
School Phone: 425-335-1545

Project Description
One hundred eight students had the most valuable field trip of the year on May 7, 2012. Students had the opportunity to learn about the importance of water, our ecosystem, the role the salmon play in the lives of humans, and what it means to conserve water. Besides the amazing and interesting lessons, students had the chance to take in nature by going on a scavenger hunt in the forest for over an hour.

Learning Objectives
Three key objectives, i.e. water conservation, our local watershed, and why salmon are so important. Students may have gathered other purposeful learning, such as the insects in the ponds, why are they there and what affect they have on the environment, the trees and plants that are near streams, ponds, creeks, and the wildlife that make their homes nearby. As well students learned how pesticides, fertilizers, used oil, etc. that drizzles down into the rain drains affect our local watersheds.

WA State Learning Standards
Writing
• EALR 2: The student writes in a variety of forms for different audiences and purposes.
• EALR 3: The student writes clearly and effectively.

Science
• EALR 4: Life Science. Big Idea: Ecosystems
• EALR 4: Life Science. Big Idea: Structures and Functions of Living Organisms

Materials Needed
The materials we used were clipboards, pencils and paper to record data and take in other useful information to use for writing purposes. A bus for transportation was also needed.

Method/Design of the Project
The way this presentation and field trip was designed was three fold. The presentation in itself, was well planned and thought out to meet the needs of the students being taught. The staff at the foundation is well educated and equipped to instruct, demonstrate and present information in a fun and interesting way, a way that captivates the students. They use props such as 8 foot salmon, salmon egg and a fry. Also there was activity where students made several circular connections and passed water from hand to hand, which quickly demonstrated
how quickly it runs out if it isn’t taken care of. Students watched and also participated in an activity demonstrating pollution that comes in water drains. They used food coloring to show different pollutants put in the drains, and then how all the water ends up in the watershed. Later we took students on a scavenger nature walk through the amazing forest of trails connected to the Adopt a Stream location. Though I named many of the methods and the design of the project, it was so enriching I can’t possibly list them all.

Evaluation/Assessment
Assessing my students was easy because they were so excited to write about all that they had learned. My favorite way of assessing my students learning was by having them do a mini presentation to the class and by writing a small paper, including pictures that represent the important learning that took place. Third graders are expected to write 3 paragraphs by the end of the year. Therefore, my students demonstrated in writing, 3 key lessons they learned (water conservation, ecosystem, and structures of living systems), and why would they encourage another class to go. I like to add the persuasive piece when it is something that someone else may or may not like. I graded my students on a 4 being the highest and on down to a 1 being the lowest. 80% of my students received a 3 or 4 which is grade level expectation. The students who received a 2 did so because of their skill level. No 1s to report!

Challenges
The only challenges that I had in implementing the project was orchestrating buses and times for all 4 classes to participate on the same day.

Successes/Strengths of Project
The greatest achievement of the entire project was hearing my peers and parents say how well put together the program was, and how much they learned as adults. Hearing that from my teaching peers was important for me to hear for the planning of future trips. The next very important evidence in telling me this was a successful field trip is hearing the mingling of students and their comments on how much they loved it. To see such focused energy in their learning was awesome!

Budget
The cost of the vendor was $250 per 50 students, which we had 108- $500. Transportation ran about $296.00. I got very clever and used the same bus to pick up the 4 classes in a staggered way and return them the same.

Additional Advice for a Successful Project
My advice to someone planning this top of the line field trip is plan early, and be sure to shoot for a sunny day.
Photos
Rocky Reach Field Trip
By Angela Brickey, 5th Grade Teacher/Science Fair Chairperson

Grade Level: 1st – 5th Grades
School District: Marysville
School: Sunnyside Elementary
School Address: 3707 Sunnyside BL, Marysville, WA 98270
Email Address: angela_brickey@msvl.k12.wa.us
School Phone: 360-653-0645

Project Description
Our project was a visit to Rocky Reach Hydroelectric Project in Chelan County. 42 students grades 1, 2, 4 and 5 attended as a reward for exemplar Science Projects. Our school has chosen to reward a busload of students rather than a top 3 or 5 for Science Fair awards. PUD paid for our bus to get there.

Learning Objectives
Students built on their understanding of energy produced by water and how that energy is processed/transferred into electrical energy. It was also a demonstration on how technology is used to solve real world problems, i.e., harnessing energy while protecting the natural process of salmon migration.

WA State Standards
4-5 APPD, APPC, PSC, LS2F

Materials needed
Transportation by bus

Method
Coordinate with Rocky Reach Dam, MSD Transportation and Parents and students for field trip

Evaluation/Assessment
Observation/Oral Assessment

Challenges
None

Successes/Strength of Project
All students saw firsthand energy transfer, hydropower and engineering approaches to problem solving on this trip. The presenters were perfect for elementary students. They were able to present information in a fun way. The students were entertained while learning.

Budget
The grant paid for $500.00 of the $650.00 needed for transportation.
Solar Powered Cars

By Scott Schafer, Jon Melby, Marilyn Johnson, Dawn Halvorson

Grade Level: 4th grade (plus sharing with 3rd grade classes)
School District: Mukilteo School District
School Name: Columbia Elementary
School Address: 10520 Harbour Pointe Blvd., Mukilteo, WA 98275
Email Address: schafers@mukilteo.wednet.edu
School Phone: 425-366-2600

Project Description
Fourth grade students learned about solar energy after our electricity unit and, as a culminating project, constructed solar cars. They performed experiments to determine what variables affect the efficiency of the solar panels and the solar cars. Finally they shared their knowledge by demonstrating and explaining how the solar powered car works and the experiments they tried with the cars to a student from a buddy class.

Learning Objectives
1. Students learned that energy from the sun can be transformed into electricity and then into motion energy in a motor.
2. Students worked hands-on with solar panels and motors to determine what factors, such as angle of the panel and time of day (angle of the sun), affect performance of the solar panels and thus the solar-powered cars.
3. Students tested the efficiency of the cars to see how types of surfaces, inclines, and construction modifications to the cars affect performance.
4. Students learned to isolate variables when performing their experiments.
5. Students recorded their findings in their Science Notebooks and summarized the evidence they found to support their findings.
6. Students verbally communicated their learning about solar energy to students from another class and demonstrated how the car works.

WA State Learning Standards
1. 4-5 PS3A Energy has many forms, such as heat, light, sound, motion, and electricity.
2. 4-5 PS3B Energy can be transferred from one place to another.

Materials Needed
SunnySide Up Solar Car Kits
Voltmeters
Glue gun
Meter Sticks
Timers

Method/Design of the Project
As preparation for learning about solar powered cars, the 4th grade students at Columbia Elementary first learned how electricity works in a circuit. They began with simply lighting a
light bulb with a D-cell, then learning how a switch works. Later they explored what materials make good conductors vs. insulators. They then learned about more advanced circuits such as the difference between series and parallel circuits and eventually they learned about electromagnetism and designed a simple electromagnet. All of these lessons gave the students a solid background with electricity. The solar car kits provided the opportunity to extend their learning further to examine sources of energy. Instead of using batteries to power their circuits, students learned how solar energy works and got a hands-on experience with using solar energy to power their cars. Students first learned about the advantages of clean, renewable energy, such as solar energy. Next, students performed experiments with their solar panels to see how they could maximize the energy performance. They used voltage meters to measure the energy they could get from their solar panels. They tested such things as the angle of the panel relative to the sun, the size of the panel (by covering up a portion of the panel), and time.

After that, the students were taught how to assemble their cars. Then they tested variables directly related to the cars, such as inclines, types of surfaces, and adjustments to the cars’ wheels (especially school day so we could share with a third grade class. Another challenge was that some of the students were taught how to assemble their cars. Then they tested variables directly related to the cars, such as inclines, types of surfaces, and adjustments to the cars’ wheels.

They recorded these results and then, as a culminating project, they synthesized their findings and presented that information to students from a buddy class.

**Evaluation/Assessment**

Student learning was assessed in multiple ways. First, students recorded the results of their multiple experiments with the solar panels and the cars in their science journals. They also summarized what they learned in their science journals with supportive evidence from their experiments. In addition to assessment of the written work, students were assessed on a verbal explanation of how their solar car works and how they could maximize performance of the solar panels based on their experiments. They explained to both the teacher and to a student in a buddy class. Their verbal explanations were part of the assessment of their learning.

**Challenges**

The biggest challenge we faced was the weather. The cars do not move on cloudy days and we had over two weeks after building the cars in which we could not find a sun break during the school day so we could share with a third grade class. Another challenge was that some of the wheels (especially the one next to the pulley) fell off easily. This was fixed with hot-melt glue. Students needed some assistance during parts of the assembly so a couple parent volunteers were necessary.

**Successes/Strengths of Project**

This project provided an excellent opportunity for students to review their knowledge of electricity and learn about sources of energy. It resulted in discussions of clean and renewable types of energy and advantages/disadvantages of different types of energy. The students also had the opportunity to design and conduct experiments on their own with the goal of exploring the affects of different variables on the efficiency of their car. Not only did they learn what would help their car to be more efficient, but also they practiced controlling variables in their experiments.

**Budget**

$160/10-pack X 11 10-packs of Sunnyside Solar power car kits=$1,760 + $56.10 for shipping
**Additional Advice for a Successful Project**

Students needed to practice explaining what they learned about solar powered cars with a partner. Lining up the bearings is critical to getting the car to go straight. The little pieces of tubing that goes between the wheels and the bearings needs to be cut to a length that keeps the wheels away from the chassis (body) but not so long that it rubs against the screw eyes (bearings). If it is too long it will rub against the bearings causing friction and slowing down the car.

**Photos**
Tour of Henry M. Jackson (HMJ) Powerhouse

By Jim Sparks

Grade: 8th grade
School District: Mukilteo School District
School Name: Voyager Middle School
School Address: 11711 4th Ave W, Everett, WA 98012
Email Address: sparksjw@mukilteo.wednet.edu
School Phone: 425-366-5300

Project Description
Eighth graders in Washington State learn a great deal about energy and how it is converted from one form to another. A tour of the powerhouse at the Jackson Project gave our students a firsthand look at how our electricity is generated, how our water supply is secured and how the environment is preserved in these processes. The PUD provided experts in engineering, conservation, fisheries and wildlife, to name a few, to speak to our students as they toured the facility.

Learning Objectives
• Students will see electrical generators in use.
• Students will see how gravitational potential energy is utilized in the design of the HMJ project.
• Students will see where we get our drinking water.
• Students will understand why we need to use resources wisely as they are not without limit and not free.
• Students will understand all the environmental considerations that must be addressed when building a project of this nature.

WA State Learning Standards

<table>
<thead>
<tr>
<th>GLE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.4</td>
<td>Understand that energy is a property of matter, objects, and systems and comes in many forms (i.e., heat [thermal] energy, sound energy, light energy, electrical energy, kinetic energy, potential energy, and chemical energy). W (8) Compare the potential and kinetic energy within a system at various locations or times (i.e., kinetic energy is an object’s energy of motion; potential energy is an object’s energy of position).</td>
</tr>
<tr>
<td>1.2.1</td>
<td>Analyze how the parts of a system interconnect and influence each other. W (8) Describe the interactions and influences between two or more simple systems.</td>
</tr>
<tr>
<td>1.2.2</td>
<td>Understand how various factors affect energy transfers and that energy can be transformed from one form of energy to another. (8) Explain the transfer and transformations of energy within a system (e.g., conduction and convection of heat [thermal] energy).</td>
</tr>
</tbody>
</table>
Materials Needed

- HMJ Powerhouse
- Speakers provided by PUD (electrical/mechanical engineer, environmental/biological scientists, etc...)
- Transportation from Voyager Middle School to HMJ Project

Method/Design of the Project

Prior to our field trip, students became well versed in:

- energy - how it is produced/converted and transported
- gravitational potential energy of water and how it is converted into mechanical energy and then into electrical energy
- the electromagnetic effect/how electricity and magnetism are related
- how an electrical generator operates
- the weather of the region and why Culmback Dam is so ideally located
- how the dam affects the environment and wildlife

When touring the facility, students looked for examples of what they already knew about. They had an outline for note taking (see evaluation/assessment below) in order to record and focus their observations. This was challenging because of the rainy weather. They rotated between the speakers made available by the PUD that day.

Evaluation/Assessment

Students took with them the document, *HMJ Field Notes* (attached), for note taking. It is general as the specific speakers available for the day are not known in advance. Because it was a rainy day, we did not have the kids take notes as planned. In the past when we have done so on a rainy day, the notes turned back into pulp and became unworkable. I do believe it freed them up to become better listeners without having to worry about an assignment. We had excellent discussions the next few days to recall and reinforce ideas. As we continued to study...
energy, the trip to HMJ was continually be referenced. There was a paper due that simply presented what they learned. I also had students emphasize something that they learned on the trip that was new information or of particular interest to them.

**Challenges**
The challenge of this project is student safety and all the logistics of a field trip, for us at school and certainly for the staff at HMJ! Also, a challenge for me is that I want my students well prepared to understand the concepts of electromagnetic induction, water pressure, power distribution and energy conversion, to name a few, so they can appreciate what they are seeing. I want them to recognize, in the field, what we have studied in the classroom. I also hope they come away with new enthusiasm to study more science and pursue it in their education.

**Successes/Strengths of Project**
Having taken students on this field trip in the past, I can say that it leaves a lasting memory and has tremendous impact. Aside from the knowledge gained from first-hand viewing of the site, getting out in a natural setting is valuable for those who would not get a chance otherwise. Also, when they see the complexity of electrical generation and what it takes to provide a clean and abundant water supply, they will hopefully become more mindful of their electrical and water use, and less reluctant rate payers one day.

**Budget**
The cost of transportation is approximately $590.00. This grant leaves the school and students with a minimal and affordable payment. The trip otherwise would be cost prohibitive.

**Additional Advice**
Have students prepared to understand what they are seeing on the tour.
**Square Science**  
**HMJ Powerhouse Field Notes**

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
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<tbody>
<tr>
<td></td>
<td><strong>June 7, 2012</strong></td>
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</table>

*Collected after the tour! Stay close (not too close!) to your speaker so you can hear. Absolutely no conversations while the speaker is speaking!!!*

### Speaker’s Name
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### Speaker’s Job Title
__________________________________________________

### What are the speaker’s responsibilities at the facility?
__________________________________________________

Name something you learned from the speaker.
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<tr>
<td>Name something you learned from the speaker.</td>
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</tbody>
</table>
Energy Grant: Exploring Renewable Energy
By Rebecca Klein

Grade Level: 6th grade Science
School District: Stanwood/Camano School District
School Name: Port Susan Middle School
School Address: 7506 267th St. NW, Stanwood, WA 98292
E-mail Address: rklein@stanwood.wednet.edu
School Phone: 360-629-1360

Project Description
Students explored different ways that energy can be transferred through a “Solar Energy” kit (provided by grant). The kit contributed to research and presentations students did about different sources of energy: renewable and non-renewable. Finally, students voted on what types of energy we should use more or less of and state why they think that.

Learning Objectives
• Explore how energy is transferred and transformed.
• Evaluate the use of various types of energy.

Washington State Standards
• 6-8 PS3A- Energy exists in many forms which include: heat, light, chemical, electrical, motion of objects and sound. Energy can be transformed from one form to another and transferred from one place to another.
• 6-8 APPD- Technological design begins with defining problem, criteria for solution, research and brainstorming potential solutions
• 6-8 APPE- Scientists and Engineers often work together to generate creative solutions to problems and decide which ones are most promising

Materials Needed
• Materials provided through the kit: Solar panels with fan (5), Radiation Cans (black and silver)(5 sets), Thermometers (10), Solar Balloon
• Other Materials: Beakers for measuring water, timers (4), Light source if raining, protractor for measuring angles, Modified worksheets from the kit

Method/Design of Project
• Day 1-2: Students talk about energy and where it comes from. We used the energy kits to demonstrate energy being transferred from one form to another. (See worksheets)
• Day 4-5: Students researched different types of energy: solar, hydropower/tidal, geothermal, biomass, petroleum, natural gas, coal, nuclear, and wind. They filled out the papers about their energy.
• Day 6: Students used the writing rubric to evaluate their papers before they presented.
• Day7: They presented their type of energy to the class. Students filled out a paper whether or not we should use an energy type more or less. Finally, we tallied the results as a class.
**Evaluation/Assessment**
Students created diagrams of energy transformations. Also, students evaluated which energy sources should be used more or less with a reason to back up their thinking.

**Challenges**
1. The kits only had enough supplies for 5 groups, so we had to do stations to complete the project.
2. The thermometers roll and break easily. We broke two in the first day! (My students are really responsible and felt really bad about this.)

**Successes/ Strength of Project**
- This is a hands-on approach to working with energy transformations.
- It makes students think about where their energy is coming from.
- Also, they get to decide how we should be gathering and using energy.

**Budget**
**NEED Project: ENERGY FROM THE SUN AND KIT**
$350 before shipping and taxes

Intermediate Kit
Intermediate students learn about solar energy transformations through investigations that explore solar energy transforming into thermal energy, kinetic energy, chemical energy, and electricity. The kit includes a Teacher Guide, a class set of Student Guides, and the materials necessary to conduct the activities.

**Additional Advice for a Successful Project**
Make sure you have heat lamps with the old fashioned light bulb (incandescent). This is especially important here in Washington where it rains a lot. (I waited an extra week hoping the rain would stop!) Warn the students that the motors are fragile and so are the thermometers. If you have time extend the heat time for the shiny vs. black can and closer to the light source the better.
Examples
Name_________________________________ Period_________________

Solar Energy Transformation Labs

Radiation Cans
Question: What happens when sun’s radiant energy comes in contact with a black can compared to a shiny can?
Materials: 1 set of radiation cans (one black one shiny), 2 thermometers, light source, room temperature water, beaker
Procedure:
1. Fill the cans with 150 mL of water and record the starting temp.
2. Place the cans in the sun and record the temp. for 10 min. in the data table.
3. Answer the conclusion questions.

Radiation Can Temperatures

<table>
<thead>
<tr>
<th></th>
<th>Start</th>
<th>1 min</th>
<th>2 min</th>
<th>3 min</th>
<th>4 min</th>
<th>5 min</th>
<th>6 min</th>
<th>7 min</th>
<th>8 min</th>
<th>9 min</th>
<th>10 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Temp.</td>
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<td></td>
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<td></td>
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<tr>
<td>Shiny Temp.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</table>

Conclusion:
Which can black or shiny makes a better conductor?

Draw the energy transformations that occurred.
Photovoltaic Cells

**Question:** How does changing the angle of the solar panel affect the panel's electrical output?

**Procedure:**
1. Place the module under a bright light.
2. Change the angle at which the panel is facing the light.
3. Which angle seems to be the most efficient and least efficient?
4. Draw and write observations.

<table>
<thead>
<tr>
<th>Best Angle</th>
<th>Worst Angle</th>
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</table>

Why would solar energy be a beneficial way of harnessing energy?

How are angles a problem when it comes to harnessing solar energy?

Draw the energy transformations that occurred.
Solar Balloon

**Observations:**
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Diagram the energy transformations that occurred.
Solar Energy Transformation Labs

Radiation Cans

Question: What happens when sun’s radiant energy comes in contact with a black can compared to a shiny can?

Materials: 1 set of radiation cans (one black one shiny), 2 thermometers, light source, room temperature water, beaker

Procedure:

1. Fill the cans with 150 mL of water and record the starting temp.
2. Place the cans in the sun and record the temp. for 10 min. in the data table.
3. Answer the conclusion questions.

<table>
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<tr>
<th></th>
<th>Start</th>
<th>1 min</th>
<th>2 min</th>
<th>3 min</th>
<th>4 min</th>
<th>5 min</th>
<th>6 min</th>
<th>7 min</th>
<th>8 min</th>
<th>9 min</th>
<th>10 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Temp.</td>
<td>90°</td>
<td>86°</td>
<td>82°</td>
<td>81.5°</td>
<td>82°</td>
<td>83°</td>
<td>83°</td>
<td>83°</td>
<td>83°</td>
<td>83°</td>
<td>83°</td>
</tr>
<tr>
<td>Shiny Temp.</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
<td>33°</td>
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</tbody>
</table>

Conclusion:

Which can black or shiny makes a better conductor?

The black can make a better conductor because the black went up 4°C more than the shiny.

Draw the energy transformations that occurred.

1. Kinetic
2. Radiant
3. Potential
4. Electric
Photovoltaic Cells

Question: How does changing the angle of the solar panel affect the panel’s electrical output?

Procedure:

1. Place the module under a bright light.
2. Change the angle at which the panel is facing the light.
3. Which angle seems to be the most efficient and least efficient?
4. Draw and write observations.

<table>
<thead>
<tr>
<th>Best Angle</th>
<th>Worst Angle</th>
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</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Why would solar energy be a beneficial way of harnessing energy?

- Solar power would be beneficial way because solar power causes less pollution.

How are angles a problem when it comes to harnessing solar energy?

- As the sun rises and sets, the sun provides less energy at these angles.

Draw the energy transformations that occurred.

- ![Energy Transformations](image)
Name_________________________________________Date_________________
Type of Energy_________________________________________________________
Explain, describe or how your energy is gathered or works.

Topic Sentence___________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Transition Sentence: **Now that you know a little about my energy let’s talk about the drawbacks.**

Resources:

Name_________________________________________Date_________________
Type of Energy_________________________________________________________
Explain or describe how your energy has negative side effects.

Topic Sentence___________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Supporting Detail_________________________________________________________________

Transition Sentence: **Even though there are drawbacks to my energy; there are still some good qualities.**

Resources:
Explain or describe how your energy has positive side effects.

Topic Sentence

Supporting Detail

Supporting Detail

Supporting Detail

Supporting Detail

Transition Sentence: Even with all the positive things I just told you; you now need to decide if this energy should be used more or less.

Resources:

Defend your groups point on view: Should you use your energy more or less and why?

Topic Sentence: I think we should use this energy

Supporting Detail

Supporting Detail

Supporting Detail

Supporting Detail

Supporting Detail
Conclusion Statement

Resources:
<table>
<thead>
<tr>
<th>Energy Research Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/2 Topic Sentence</strong></td>
</tr>
<tr>
<td>Indent</td>
</tr>
<tr>
<td>States “purpose or asks a question to be answered, <em>it does not list facts or details!</em>”</td>
</tr>
<tr>
<td><strong>/4 Word choice</strong></td>
</tr>
<tr>
<td>Uses adverbs (<strong>strongly</strong> feel, <strong>quickly</strong> depleting, <strong>very</strong>...)</td>
</tr>
<tr>
<td>Starts each sentence differently</td>
</tr>
<tr>
<td>Came up with more than one way of saying your energy source. (example: solar, radiant, light...)</td>
</tr>
<tr>
<td>Each sentence is paraphrased in your <strong>own words</strong> (Look for words that don’t sound like a 6th grader...)</td>
</tr>
<tr>
<td><strong>/2 Organization</strong></td>
</tr>
<tr>
<td>Sentences should follow each other; they are not bulleted points.</td>
</tr>
<tr>
<td>Topic sentence, 4 supporting details, transition sentence</td>
</tr>
<tr>
<td><strong>/4 Conventions</strong></td>
</tr>
<tr>
<td>Each Sentence starts with a capital letter and ends with proper punctuation.</td>
</tr>
<tr>
<td>Only proper nouns are capitalized in the middle of a sentence.</td>
</tr>
<tr>
<td><strong>NO SPELLING ERRORS</strong></td>
</tr>
<tr>
<td>Sentences are complete with a subject and predicate.</td>
</tr>
<tr>
<td><strong>/8 Supporting Details</strong></td>
</tr>
<tr>
<td>Each supporting detail is supported with evidence.</td>
</tr>
<tr>
<td>(It doesn’t just say <strong>it is dangerous</strong>, it explains how or why it is dangerous.)</td>
</tr>
<tr>
<td>Detail x 4</td>
</tr>
<tr>
<td>Evidence x 4</td>
</tr>
<tr>
<td><strong>/20 Total</strong></td>
</tr>
<tr>
<td>18-20 A</td>
</tr>
<tr>
<td>16-17 B</td>
</tr>
<tr>
<td>14-15 C</td>
</tr>
<tr>
<td>13 &amp; Below rewrite</td>
</tr>
<tr>
<td><strong>Comments:</strong></td>
</tr>
</tbody>
</table>
Name__________________________ Period__________

What energies should we use more or less of?

I believe we should use Nuclear Energy more or less because

I believe we should use Geothermal Energy more or less because

I believe we should use Hydropower more or less because

I believe we should use Wind more or less because

I believe we should use Petroleum more or less because

I believe we should use Solar more or less because

I believe we should use Biomass more or less because

I believe we should use Natural Gas more or less because

I believe we should use Coal more or less because
Which energy should we use more of?
Mrs. Klein’s class 2012
6th grade science classes

Students were allowed to vote for any energy they wanted and could vote for as many types of energy they wanted. These are the results from 98 students voting; 12 students were absent that day.
Solar Cars
By William Catey and Karla Henning

Grade Level: 4th grade
School District: Archdiocese of Seattle
School Name: St. Mary Magdalen School
School Address: 8615 7th Ave SE, Everett, WA 98208
Email Addresses: billc@stmarym.org; karlah@stmarym.org
School Phone: 425-353-7559

Project Description
This was a project to build solar cars. It was used to re-enforce what the students had been learning about alternative sources of energy.

Learning Objectives
1. Students will research varied forms of energy, and in particular, the uses of renewable solar energy.
2. Students will journal highlights of their research.
3. Students will utilize and journal results of various hypothesizes they make while constructing and testing their solar cars.

WA State Learning Standards
• SCI EALR 2.1 Scientific Inquiry- The student knows and applies the skill and processes of science and technology.
• SCI EALR 3.2-Science in the Social Context- Although people using scientific inquiry have learned much about energy in nature, much more remains to be understood.

Materials Needed
2 Sunnyside Up Classroom 10 packs
3 individual cars
Science journal
Pencil

Method/Design of Project
1. Students will research solar, electric, and gasoline powered cars. They will write the benefits and challenges of each form of energy in their journals.
2. Using the step by step directions provided by the solar car kit company, students will construct individual solar cars.
3. Students will write a hypothesis regarding their car’s performance.
4. Students will experiment with the energy the cars receive from the sun on various days. Students will list variables such as inclines, varying surfaces, and construction adjustments.
Evaluation/Assessment
Students will be assessed on the functionality of their solar powered car as well as a written test.

Challenges
One of the challenges the students encountered in assembling their solar cars was lining up the wooden blocks that act as an axle. The eye screws were difficult for some of the students to attach to the base. Another challenge was finding the right amount of distance to attach the motor mount. We also had two motors that did not work.

Successes/Strengths of the Project
The enthusiasm level was very high for this project. The students spent a month studying alternative energy sources and comparing and contrasting renewable and non-renewable energy. At the end of the unit we raced the solar cars. Each student had to write in their science journal about how their cars preformed and what could have been done to make it perform better.

Budget
$777.50