Hot and Cold Energy Villages

Mount Alvernia Academy

Maria Lyons Science Teacher

Grade 4 and Grade 5 students conducted the NEED investigations on The Science of Energy, The Energy House and The Power of Wind. This included Renewable Energy vs Non-Renewable Energy, Solar Panels, Wind Turbines, Thermal Energy and Electric Circuitry.

One 5th Grade class made Energy Houses built for a cold environment and the other 5th Grade class made Energy Houses built for a hot environment. After constructing and testing their Energy Houses, they painted and added features helpful in their environments. They constructed electric circuits and added lighting. They then combined their houses into two villages, one hot, one cold.

Grade 4 decided,based on given criteria and what they had learned about energy sources that the hot, sunny town should be powered by Solar Energy and the cold, breezy town by Wind Turbines. They constructed and added a Solar Farm to the Hot Town, Arizona desert, and a Wind Farm to the Cold Town, coast of Northern Maine.

The students presented their village, explaining how the houses were made and about the different sources of energy in the village to the other classes and staff in the school and on the school's social media. This was a fun and exciting project.,

Grade 4 and 5
Goals of Project

The goals of the Hot and Cold Energy Villages Project were to

- incorporate all that was learned about energy, both concepts and skills, into a final project highlighting the knowledge gained from the NEED Energy Curriculum
- apply what was learned to a real life situation, solving energy problems in a village and create the village
- distinguish between the needs of a hot and cold village environment
- share their creation and their knowledge of energy with the other students and staff in the school and on the school social media

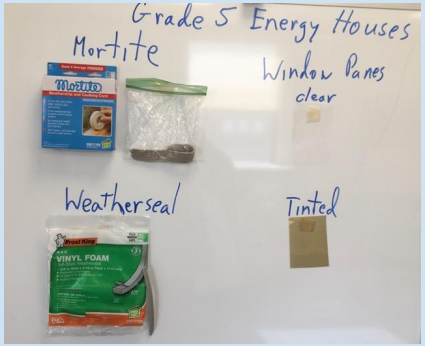
Grade 5

Construction of Energy Houses

We followed the guidelines from the NEED Energy House and working in groups, we insulated our houses and added windows, Mortite and weatherstriping.

We used polyester batting. It was fluffy and cotton-like. It was like what people use in actual houses.Christina

I used mylar. Mylar looks like foil, it is a silvery material that if you look very closely you can see through it. Chiara



I put in mortite because it covers up the cracks and it keeps hot air from getting in. Alannah

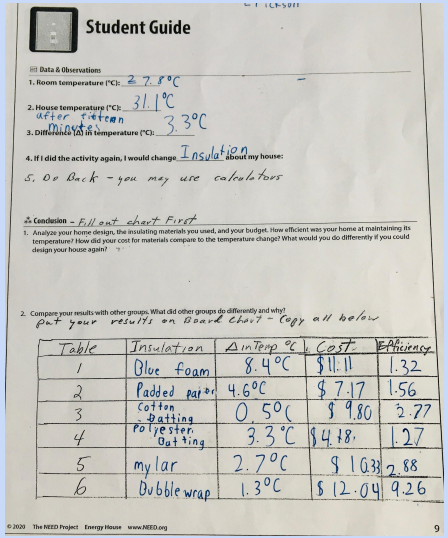
Our house was in a hot environment. To help it save energy, Our team added Mortite, weatherstripping, tinted windows, and painted the house with a light color so that it would reflect the heat. Luke

Testing for Energy Efficiency

Our insulation (bubble wrap) did not work that well. Our temperature difference was 1.3 degrees celsius. I think the bubble wrap was too thin. Meg H

We used cotton batting and it was soft warm and light.Owen

Table	Insulation	Δ Temperature	Total Cost	Efficiency
1	Blue Foam	8.4°C	$11.11	1.32
2	Padded Paper	4.6°C	$7.17	1.56
3	Cotton Batting	3.5°	$9.80	2.8
4	Polyester Batting	3.3°	$4.18	1.27
5	mylar	2.7°	$10.33	2.88
6	Bubble Wrap	1.3	$12.04	9.26



Student Guide

Data & Observations

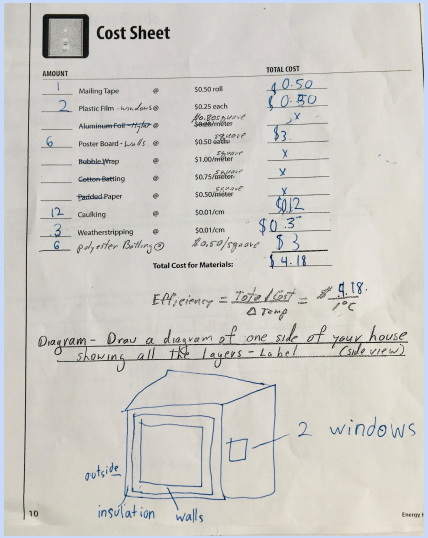
1. Room temperature (°C): 27.8°C
2. House temperature (°C): 31.1°C after fifteen minutes
3. Difference in temperature (°C): 3.3°C
4. If I did the activity again, I would change Insulation about my house:
5. Do Back - you may use calculators

Conclusion - Fill out chart First

1. Analyze your home design, the insulating materials you used, and your budget. How efficient was your home at maintaining its temperature? How did your cost for materials compare to the temperature change? What would you do differently if you could design your house again?

2. Compare your results with other groups. What did other groups do differently and why? put your results on Board Chart - copy all below

Table	Insulation	ΔInTemp °C	Cost	Efficiency
1	Blue foam	8.4°C	$11.11	1.32
2	Padded paper	4.6°C	$ 7.17	1.56
3	Cotton Batting	0.50°C	$ 9.80	2.77
4	Polyester Batting	3.3°C	$4.18.	1.27
5	mylar	2.7°C	$ 10.33	2.88
6	Bubble wrap	1.3°C	$ 12.04	9.26



Cost Sheet

AMOUNT			TOTAL COST
1	Mailing Tape @	$0.50 roll	$0.50
2	Plastic Film - windows @	$0.25 each	$0.50
	Aluminum Foil - mylar @	$0.80/square meter	x
6	Poster Board - walls @	$0.50 each	$3
	Bubble Wrap @	$1.00/meter	x
	Cotton Batting @	$0.75/square meter	x
	Padded Paper @	$0.50/meter	x
12	Caulking @	$0.01/cm	$0.12
3	Weatherstripping @	$0.01/cm	$0.3
6	pol,ester Batting @	$0.50/square	$3
	Total Cost for Materials:		$ 4.18

Efficiency = Total Cost / ΔTemp = $4.18 / 3°C

Diagram - Draw a diagram of one side of your house showing all the layers - Label (side view)

2 windows

outside

insulation

walls

Table	Insulation	Change in Temperature	Total Cost $/Hour	Efficiency = Cost ÷ change in Temp
1	Thick Paper	8.1°C	$7.78	0.9604938
2*	Cotton Batting	6.7°C	$8.99	1.34
3	polyester Batting	6.2°C	$7.36	$1.276
4	Bubble Wrap	5.8°C	$10.90	1.87
5	green foam	5.5	6.42	1.26
6	mylar	5.2	9.94	$1.91

Super-well! Mine, (polyester fiber) was probably one of the best houses. I got really good efficiency and a great increase in temperature because of it . And me and my teammates had the lowest cost in our class! We were the best! Rhys

The Cold Villagers used Hot Hands to test their Houses and the Hot Villagers used bags of ice.

My team used blue foam, it was puffy,lightweight warm, and really soft. -Valentina

Designing and Painting Houses

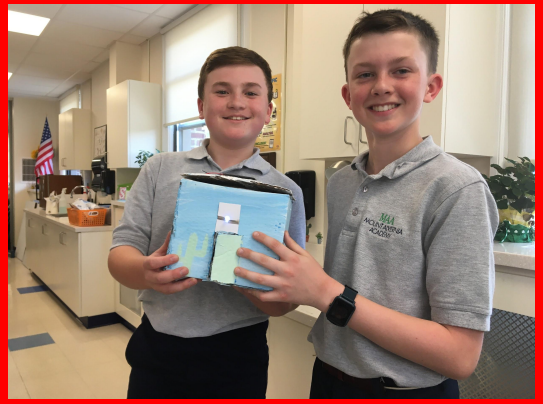
We created dark colored houses with steep roofs for the Cold Village and light colored houses with flat roofs for the Hot Village.

The paint (colored very dark-blue) really absorbed a lot of heat.. Me and my team worked together to paint it very strongly, even though it was challenging, and we painted it so dark that it absorbed and trapped heat more easily. Rhys

The hardest part was putting the roof on because at one point it wouldn't stay in place. Isaiah

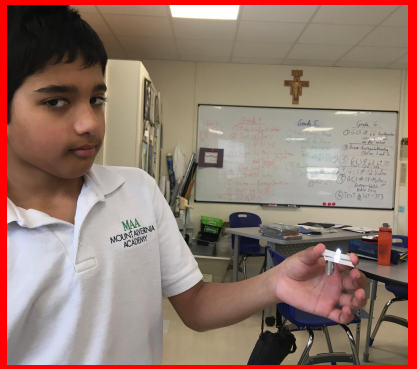
I like designing the house because I can really get into the whole house structure. I learned from the trial and errors to see what works. Emma

Adding Electric Circuits

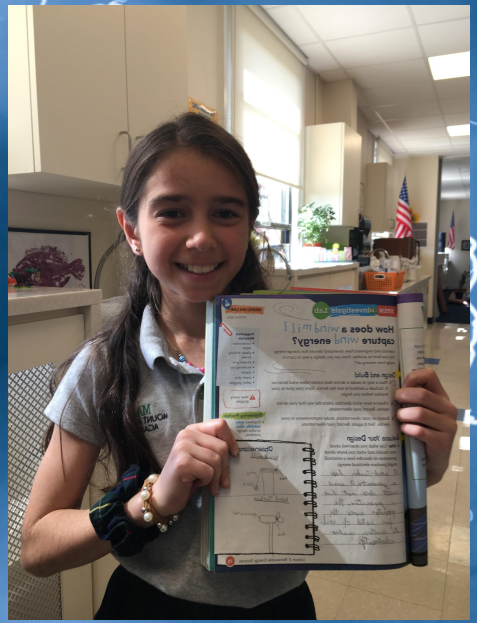


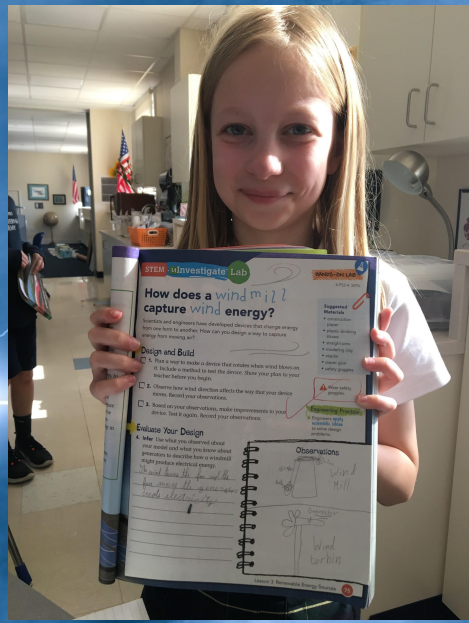
Using button batteries, conductive tape and diodes from Brown Dog Gadgets, we made electric circuits and then attached them to our houses as porch lights.

I loved designing the house with all of my friends and experiencing how most builders work in the environments that we worked in. Charlotte



Grade 4 Energy Lessons

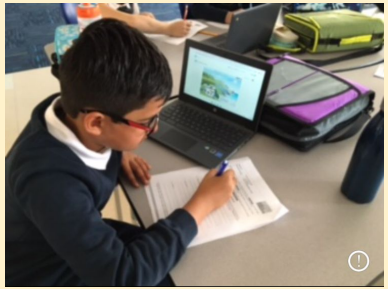


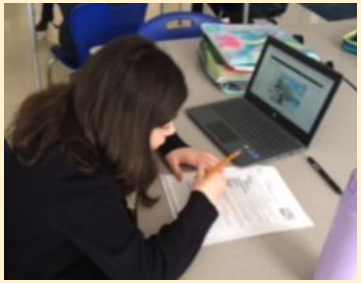


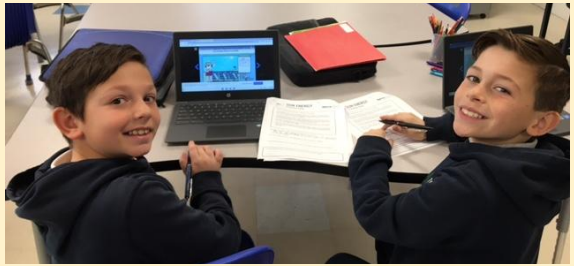
Grade 4 studied forms of energy, sources of energy, renewable and nonrenewable energy and the environmental impacts of using energy sources. Their studies and activities included work from their Science Text and Website from Savass Learning, The Mystery Science “Where does Energy Come From” Renewable vs Nonrenewable Resources Program and the NEED Project- Elementary Science of Energy and Power of the Wind Kits.

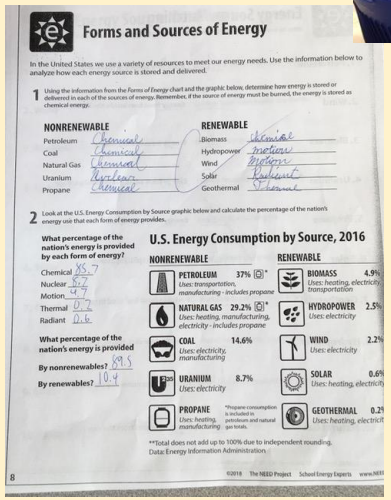
Grade 4 Energy Work

We studied different types of Energy Sources and became Energy Experts to make an Energy Plan for the Fictional Town of Boulderville.









Forms and Sources of Energy

In the United States we use a variety of resources to meet our energy needs. Use the information below to analyze how each energy source is stored and delivered.

1 Using the information from the *Forms of Energy* chart and the graphic below, determine how energy is stored or delivered in each of the sources of energy. Remember, if the source of energy must be burned, the energy is stored as chemical energy.

NONRENEWABLE		RENEWABLE	
Petroleum	Chemical	Biomass	Chemical
Coal	Chemical	Hydropower	Motion
Natural Gas	Chemical	Wind	Motion
Uranium	Nuclear	Solar	Radiant
Propane	Chemical	Geothermal	Thermal

2 Look at the U.S. Energy Consumption by Source graphic below and calculate the percentage of the nation's energy use that each form of energy provides.

What percentage of the nation's energy is provided by each form of energy?

Chemical 85.7
Nuclear 8.7
Motion 4.7
Thermal 0.2
Radiant 0.6

What percentage of the nation's energy is provided

By nonrenewables? 89.5
By renewables? 10.4

U.S. Energy Consumption by Source, 2016

NONRENEWABLE		RENEWABLE	
PETROLEUM	37%	BIOMASS	4.9%
Uses: transportation, manufacturing - includes propane		Uses: heating, electricity, transportation	
NATURAL GAS	29.2%	HYDROPOWER	2.5%
Uses: heating, manufacturing, electricity - includes propane		Uses: electricity	
COAL	14.6%	WIND	2.2%
Uses: electricity, manufacturing		Uses: electricity	
URANIUM	8.7%	SOLAR	0.6%
Uses: electricity		Uses: heating, electricity	
PROPANE	*Propane consumption is included in petroleum and natural gas totals.	GEOTHERMAL	0.2%
Uses: heating, manufacturing		Uses: heating, electricity	

**Total does not add up to 100% due to independent rounding.
Data: Energy Information Administration

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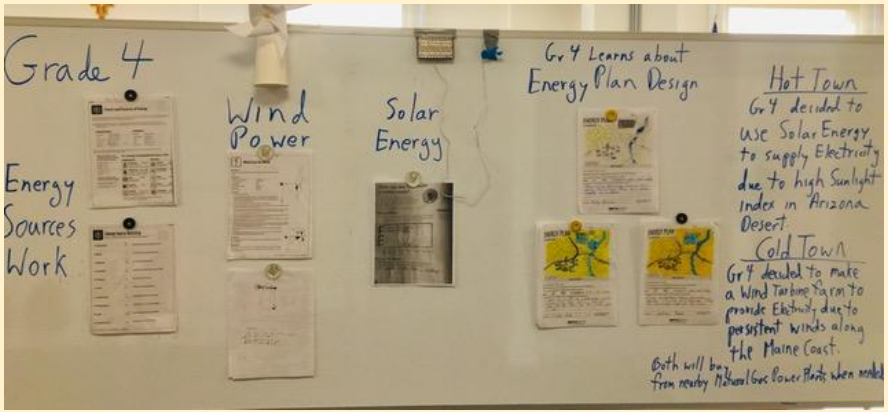
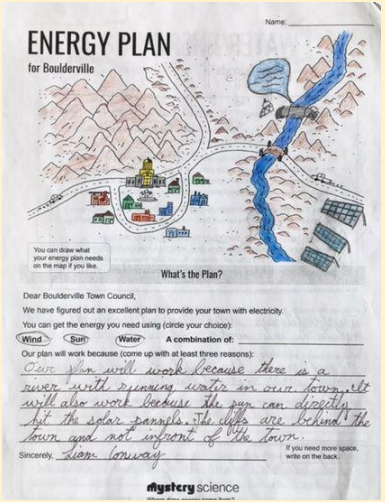




ENERGY PLAN

for Boulderville

Name:

You can draw what your energy plan needs on the map if you like.

What's the Plan?

Dear Boulderville Town Council,

We have figured out an excellent plan to provide your town with electricity.

You can get the energy you need using (circle your choice):

Wind Sun Water A combination of:

Our plan will work because (come up with at least three reasons):

One plan will work because there is a river with spinning water in our town. It will also work because the sun can directly hit the solar panels. The cliffs are behind the town and not infront of the town.

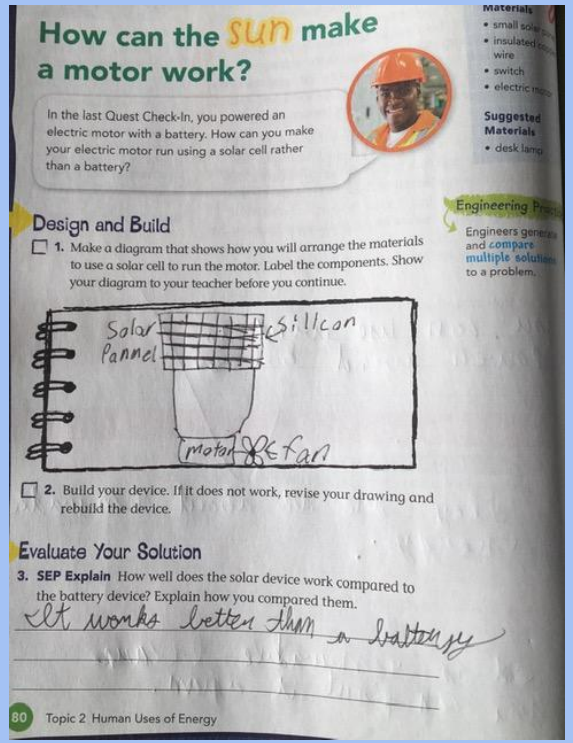
If you need more space, write on the back.

Sincerely, Team Conway

mystery science

Solar Energy

We studied energy conversions and Solar Energy by connecting Solar Panels to a motor that spun a fan. This changed Solar Energy into Electrical Energy into Mechanical Energy into Kinetic Energy of Motion.



How can the sun make a motor work?

In the last Quest Check-In, you powered an electric motor with a battery. How can you make your electric motor run using a solar cell rather than a battery?

Materials
- small solar cell
- insulated wire
- switch
- electric motor

Suggested Materials
- desk lamp

Engineering Practice
Engineers generate and compare multiple solutions to a problem.

Design and Build

1. Make a diagram that shows how you will arrange the materials to use a solar cell to run the motor. Label the components. Show your diagram to your teacher before you continue.

Solar Pannel
Silicon
motor
fan

2. Build your device. If it does not work, revise your drawing and rebuild the device.

Evaluate Your Solution

3. **SEP Explain** How well does the solar device work compared to the battery device? Explain how you compared them.

It wonks better than a battery

80 Topic 2 Human Uses of Energy

Solar energy is energy made from the sun (solar panels) which is a great source of energy because the sun has virtually unlimited energy. It also has disadvantages. One of them is that the solar panels don't get energy at night. Wesley

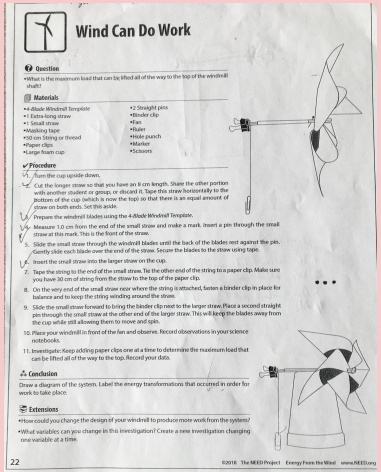
“Solar Farms”

We used our Energy Planning skills and decided the the Hot Environment town, Arizona Desert, should have Solar Energy since it has a high Solar Index. We constructed a Solar Farm and Solar Roof Panels and added them to the Hot Village. The Town will also need to buy energy from a neighboring town that has a Natural Gas Power Plant since the Sun does not shine at night.

Solar energy is renewable and there are two common ways to use it in your home. In one way, sunlight directly heats the house or heats water for washing laundry. The other way uses photovoltaic cells to keep inside a battery for later storage. Lara

Wind Power

In teams, we constructed windmills that used wind power to lift a heavy load, a cup of rocks. We each also made pinwheels, to study the wind and also for fun!



Wind Can Do Work

Question

•What is the maximum load that can be lifted all of the way to the top of the windmill shaft?

Materials

•4 *Blade Windmill Template*
•1 Extra-long straw
•1 Small straw
•Masking tape
•50 cm String or thread
•Paper clips
•Large foam cup
•2 Straight pins
•Binder clip
•Fan
•Ruler
•Hole punch
•Marker
•Scissors

Procedure

1. Turn the cup upside down.
2. Cut the longer straw so that you have an 8 cm length. Share the other portion with another student or group, or discard it. Tape this straw horizontally to the bottom of the cup (which is now the top) so that there is an equal amount of straw on both ends. Set this aside.
3. Prepare the windmill blades using the *4-Blade Windmill Template*.
4. Measure 1.0 cm from the end of the small straw and make a mark. Insert a pin through the small straw at this mark. This is the front of the straw.
5. Slide the small straw through the windmill blades until the back of the blades rest against the pin. Gently slide each blade over the end of the straw. Secure the blades to the straw using tape.
6. Insert the small straw into the larger straw on the cup.
7. Tape the string to the end of the small straw. Tie the other end of the string to a paper clip. Make sure you have 30 cm of string from the straw to the top of the paper clip.
8. On the very end of the small straw near where the string is attached, fasten a binder clip in place for balance and to keep the string winding around the straw.
9. Slide the small straw forward to bring the binder clip next to the larger straw. Place a second straight pin through the small straw at the other end of the larger straw. This will keep the blades away from the cup while still allowing them to move and spin.
10. Place your windmill in front of the fan and observe. Record observations in your science notebooks.
11. Investigate: Keep adding paper clips one at a time to determine the maximum load that can be lifted all of the way to the top. Record your data.

Conclusion

Draw a diagram of the system. Label the energy transformations that occurred in order for work to take place.

Extensions

•How could you change the design of your windmill to produce more work from the system?
•What variables can you change in this investigation? Create a new investigation changing one variable at a time.

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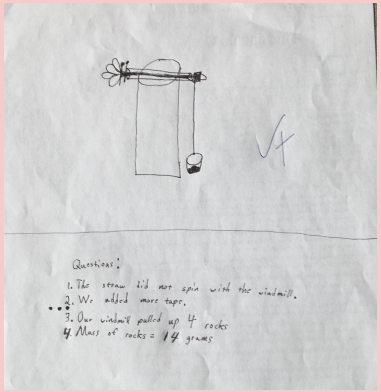
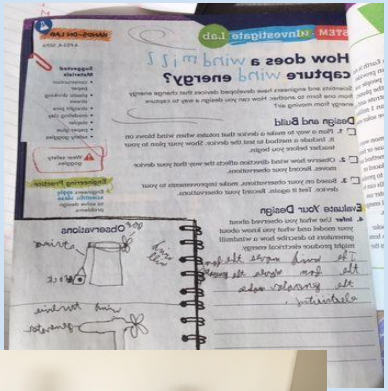


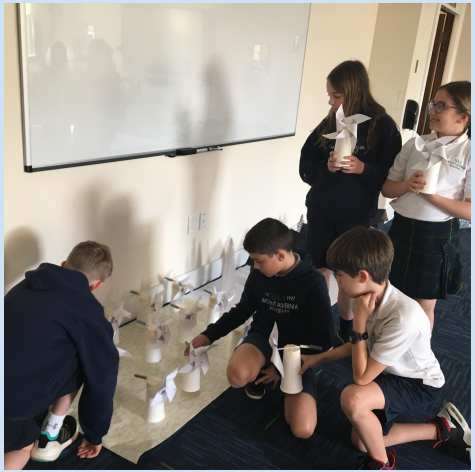
Renewable energy is energy that never runs out. Unlike fossil fuels, renewable energy doesn't pollute the environment. Even so, renewable energy does have disadvantages. For example, solar panels take up a lot of space and cost a lot of money, they also can't work at night. That's where windmills come in. Windmills can be used at night when solar panels don't work. Michael

“ Wind Farm ”

We turned our windmills into Wind Turbines and created a Wind Farm next to the Cold Town because coastal Northern Maine gets lots of wind. The town will also buy energy from the Hydroelectric Grid to have enough energy all the time.

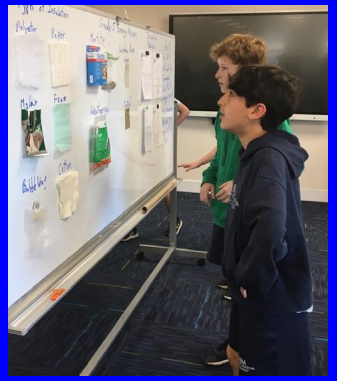


We use wind power to make electricity by having the wind push the turbine and then the turbine moves a generator.-Ryan



Presentations

Students from kindergarten to grade 6 and school staff visited our villages. We took turns as Energy Ambassadors and guided them through, explaining everything we learned about Energy!



If you were a contractor, what advice would you give someone who wanted to build a house in the hot or cold environment?

I would say to focus on material and color because if you are in a warm environment you would do a light color and if you were in a cold environment you would do a dark color. For the material it doesn't matter which environment you are in so the best ones are padded paper and blue foam because if you are trying to block heat or let heat out it will still work either way. Venessa

Results

Students successfully conducted the NEED Science of Energy Investigations

Students studied Sources of Energy, and learned about Renewable and Nonrenewable Sources of Energy, what are they and how are the used.

Students constructed and experimented with solar panels, and wind turbines.

Students constructed the Energy House, following the NEED Guidelines, and successfully completed the Thermal Energy testing of the various insulations.

Students painted and environmentally adapted their Energy Houses. They added electrical circuits made from button batteries , conductive tape and a diode to make porch lights.

Students successfully planned and constructed two villages from their Energy Houses, meeting the energy needs of a hot climate and a cold climate village. They added “Solar Panels” and “Wind turbines” to give their villages sources of renewable energy.

Students presented their project to other students and staff in the school They loved seeing the villages and listening to the presentations about how they made the houses, values of insulation, how to make a circuit, and the use and value of solar and wind energy in each village.

Thank You NEED !

My favorite part of this project was learning about all the different ways that we can make energy and also I loved working together with my classmates and friends to do things like make windmills and answer questions working together. Zachary

I think MAA should use solar power because we have a big tall roof with no trees blocking it. We could fit a lot of solar panels up there. -Nicky

My favorite part of the project was making the windmills because I liked seeing them spin with wind and lift rocks.I thought that the project was very fun. Nora

My favorite part of the project was being able to learn,and engineer things. I liked when we started a project, and when we accomplished it, I felt really proud of myself. These projects have taught me things I thought I could never do, but I did it! Anna

Mt. Alvernia should use solar energy because when you go up the hill lots of sunlight gets in your eyes. Also wind energy because in the winter there isn't much sunlight but there is a lot of wind. Ian

My favorite part of the project was working with my friends and putting the insolation. Anastasia

My favorite part of the project was making the solar panels. I thought it was really fun to make miniature panels.Lily

My favorite part of the project was the painting and designing, because we used our teamwork to figure out the measurements and one of us cuts and one of us glues so it'll be faster.Mia

My favorite part of the project was gluing and cutting because I had to measure to make sure it was exact. Parker