
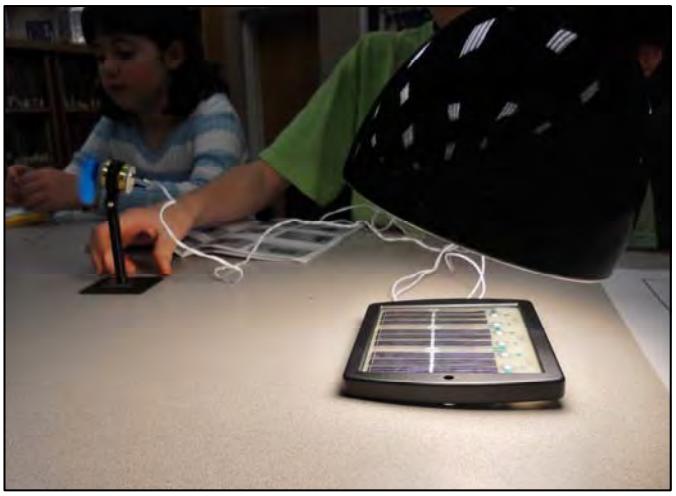

# ENERGY EDUCATION

## Henley Middle School

Global Sustainability, Fall 2011
Prof. Phoebe Crisman
Workshop Leader: Sameer Rayyan
Team members: Holly Mayton, Kiki Vasquez, Rebecca Stoner, Elizabeth Knipp

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## ABSTRACT

The goal of our project on wind and solar power was to educate and inspire the students of Henley Middle School as a part of the overall “Wind for Schools” initiative. The installation of a forty-five foot wind turbine and solar voltaic and thermal panels is planned for December 16, 2011 at Henley Middle School thanks to a grant from the U.S. Department of Energy. The main goal for this “Wind for Schools” project is to make the Henley school system and community more aware of the overall beneficial aspects of wind and solar energy. Our team’s purpose was to continue the project that began last year, which involved interacting with the middle school students as a means to inform and excite them about the sustainable energy coming to their school. During a period of two school days, we educated Henley sixth graders through a PowerPoint presentation and group experiments involving the manipulation of solar and wind energy. Our ideas for the workshop were adapted from close consideration of the results of the workshop held at Henley Middle School last year. Through discussions with teachers and an addition of our own ideas for the workshop, we were able to develop a successful lesson plan that received positive feedback from both students and faculty.

## INTRODUCTION

Henley Middle School received a grant from the United States Department of Energy through the Wind for Schools program that is funding the installation of a wind turbine, photovoltaic panels, and solar heating, making Henley the first school in the state to use a combination of these three systems. These green technologies are not being installed with the goal of providing enough power to take the school off the grid; instead, they are aimed at enhancing the environmental education of Henley students and the Albemarle community. The Skystream turbine will provide about 24 kilowatts of power, while the roof and ground mounted solar panels will provide about 40 kilowatts, close to 6% of the school's total energy usage. Our objective was to spread the knowledge about these different pollution-free, renewable sources of electricity before the installation kicked off. We aimed to educate and excite Henley Middle School students about wind and solar energy, and specifically wanted to teach them about how the technology works and how it will benefit their school and community. Furthermore, we taught the students ways to educate their peers and families about the benefits of renewable energy and how to extend sustainable habits to their everyday lives.

Our main community partner for the project was Susan Guerrant, the librarian and leader of the environmental club at Henley Middle School. Other community partners included the Henley sixth grade teachers, the Albemarle County Public School System and the Virginia Center for Wind Energy, particularly Director of Education, Remy Luerssen. The partner's needs that we were working to fulfill, as previously mentioned, were as follows: to educate within Henley Middle School, to excite and enthuse Henley students, parents and staff, and to see through the completion of this ongoing project successfully. The stakeholders for this project consisted of the teachers, Albemarle County Public School Board, Henley parents, students, the government, and the community as a whole. Through completion of this project, the stakeholders benefitted from becoming better informed about renewable energy in their community. At the same time, the stakeholders could have been negatively affected because they would have had to adjust to the visual appearance and effects of the wind turbine and solar panels, as well as the heightened publicity surrounding the project.

We approached this issue by specifically reaching out and educating sixth grade science classes in line with the renewable energy part of their curriculum, and by giving the teachers the opportunity to come to us with any questions or ideas involving ways to better educate and involve the students. While our group came to them with some topics and activities in mind, it was hugely beneficial to take into account the teachers' experiences and goals for this project. Our hope is that we have left a lasting mark on the students, so that they can continue to spread what they have learned about wind and solar energy to their peers and families even after we leave. When teaching and guiding the sixth graders, we used multiple hands-on activities, web-based presentations, and take-home pieces to keep the students both involved and entertained.

With the completion of this project, we hope that we have not only educated Henley Middle School students about the benefits of sustainability and wind and solar power, but reached the entire Charlottesville community as well. Generating enough enthusiasm about environmental sustainability was the first step towards the students' education of their friends and family into the future, through their use of the upcoming installation of the wind turbine, photovoltaic panels, and solar heating system.

## APPROACH

The following activities were potential ideas that we brainstormed and proposed to our community partners, Susan Guerrant and the 6th grade teachers, for the Henley students to do.

- Build your own wind turbine: By providing a certain amount of materials, we would urge the students to build what they believe a wind turbine looks like. Then, we would ask how they believe the wind turbine functions compared to how it actually works. We could also show diagrams or a model of how the actual wind turbine will look and function.
- PowerPoint Activity: From there, with a PowerPoint presentation, we could move on to educate the students of all the types of energy, such as hydroelectric, biomass, or nuclear, with a specific concentration in solar and wind energy.
- Global Warming Short Slideshow: This short slide show would allow them to build a greater understanding of how the small things they do in their everyday life can have a greater impact on the environment. It's a catchy and engaging visual to give them a step-by-step idea of how to help the greater cause. There is no one solution to this big problem we face every day.
- Group activity: We would divide the students into small groups and give them an interactive quiz to complete prior to our PowerPoint presentation to see what they already know, or think they know, about energy. Then, we would let them see their results in comparison to the facts.

The approach we decided to take is by using the Teacher-Learning Model:

The first part, "Invite", is where we presented the problem. In the first fifteen minutes, three of our group members gave the opening PowerPoint presentation. We began with a simple and concise quiz, focusing on wind and solar energy, to gauge the students' knowledge and interest in the potential of alternative energies. The opening presentation consisted of dispelling myths about renewable energy sources, simple explanations of how the wind turbines, photovoltaic's, and solar heating work, and ways the amount of energy produced can relate the concerns of a sixth grader.

Following the presentation, we then shifted into the second part, "Explore, Discover, Create". The students were separated by their classes into two groups, with approximately twenty-five minutes allotted for each of two different activities. The first activity was focused primarily on wind energy, and it was run by two of our group members. We demonstrated and explained the hands-on activity that involved small groups of the students to construct a fan from a pie plate, place candles beneath it, and see how heat moves air and can produce wind energy. The activity sheet provided to the students for this workshop can be found at the end of this report.

The second activity once again involved the students dividing into small groups. This workshop involved the construction of a circuit that consisted of a small photovoltaic, wires, and a light bulb, fan, and toy telephone that buzzed. The students were prompted to experiment with the panel, and observe what happened when changes were made, such as position of the solar panel tilting toward or away from the light source, distance from the light source, and other variables that solar energy systems can experience (See activity design at end of report). A lamp was used as a light source for each group's solar panel.

In the end, we shifted into the third and fourth parts of the teaching-learning model, "Propose Explanations and Solutions" and "Take Action", in which we reserved up to fifteen minutes for a debriefing session, as requested by the sixth grade teachers. We had a conclusion PowerPoint prepared to summarize the take-home points from the two hands-on workshops. This PowerPoint also included slides about interpreting the web-based panel that will be located in the lobby to show energy savings from the wind and solar technologies, and slides to inform the students of the purpose of the wind turbine, photovoltaic cells, and solar heating system at Henley Middle School. Additionally, we provided a "take home" outline that informed students about the kick-off event on December 16th and additional "green" practices they could practice in their everyday lives.

# TIMELINE

## Defining Goals

The first steps towards a successful project included conversing as a group and discussing our goals for the semester. In late September, we defined our goals and expectations for our project at Henley Middle School. In setting these goals, we considered the precedence that had been set before us. A group of students in the previous year had reached out the Henley Middle School sixth grade science classes to teach them about renewable energies, and we hoped to follow a similar plan.

We did research about the wind and solar technologies that would be going into Henley and we generated a handful of ideas for activities to do with the kids. One of the main goals was to put together hands-on workshops that would generate a lot of enthusiasm for renewable energy, since the school was approaching the installation date of the turbine and panels. Lastly, we included our plan to remain flexible while trying to coordinate our group's goals with those goals of our community partners.

## Coordinating and Contacting

Near the end of September, we heard from community partners Lindsay Snotty, Albemarle County Schools Middle School Coordinator, and Remy Luersson, Director of Education for the Virginia Center for Wind Energy. Between the two of them, we learned a variety of details about the schools getting involved, green energy technologies that were being put in place, precedence at Henley Middle School, and other events that would be a part of this overall project to get the community excited and engaged in the wind and solar opportunities.

From there, we quickly emailed our specific community partner at Henley Middle School, Susan Guerrant, librarian and leader of the environmental club. We informed her of our previously discussed project goals and expectations, as well as some of our ideas for working with the sixth graders that differed from the project last year. Mrs. Guerrant proposed that our project with the sixth graders be arranged in late November, but before Thanksgiving, in order to conveniently match up with the science curriculum that involved the subject matter of renewable energy. A meeting was set up for late October, when we would meet with Mrs. Guerrant and the sixth grade teachers in order to finalize dates and details.

We met with Mrs. Guerrant and discussed the ideas we had with her to see what she wanted us to implement. She liked our ideas but in the end the sixth grade science teachers, Leslie Kenner, Kayla Carter, and Dana Stokes, already had in mind what they wanted us to do. The UVA students that had come to Henley during the previous year had tried to do too many activities and their days became very chaotic, so the teachers wanted to simplify last year's project. They gave us the instructions for the wind turbine activity and told us what they wanted for the solar activity. They liked our original idea of the initial quiz, and also supported the idea of "debriefing" the students at the end of the activity to give them information the students could use in their everyday life.

## Preparation and Resources

With a set plan in mind, we now turned our focus towards preparations and collection of necessary resources. We found that our community partners could provide much of the needed equipment. Remy Luerssen transported a functional, large turbine head and solar panel to Henley Middle to be on display before, during, and after our visit. She also had the means to provide the circuit supplies for our solar powered activity, which we tested out ourselves prior to the experiments with the students. Susan Guerrant had a budget and the ability to provide the small, household items necessary to put together the wind activity. We also decided that we would need a projector and screen to run our presentations and we had access to these pieces of equipment through Henley Middle School. We

originally wanted to include a solar-powered backpack and solar beads in the workshop, but through the simplification of our activities, we decided against the use of these items.

## Middle School Visit

We visited Henley Middle School as a group on Wednesday, November 16th after Henley's school hours to set up our activities in the library, test out the equipment, and finalize details with Mrs. Guerrant and the Henley teachers. On Thursday and Friday, the 17th and 18th, our group spent the day at Henley, from 9 a.m. to 4 p.m., working with three separate groups of sixty sixth graders each day. The groups came to the library during their normal science class period.

Each influx of sixth graders had about eighty minutes in the library per segment, so our group followed a strict time schedule in order to upkeep a well balanced lesson plan. In the first fifteen minutes, three of our group members gave the opening PowerPoint presentation. We began with a simple and concise quiz and it also consisted of dispelling myths and information about renewable energy sources. There was a section of slides about wind energy, and a section of slides about solar energy.

Following the presentation, the students were separated into two groups, with approximately twenty-five minutes allotted for each of two different activities. One activity focused primarily on wind energy, and the other activity mainly focused on solar energy. Each activity required students to be in groups of three to five, which had already been determined by their teachers before the students entered the library.

For the solar activity, each group had a kit with a tiny solar panel and certain accessories that were powered once the solar panel was exposed to light. The students had approximately three different accessories and after the students built the circuit for the solar panel, they connected each accessory individually. Afterwards, they tried to connect more than one accessory at the same time to the same panel. Consequently, the students found out that when more than one accessory was connected, the accessories did not work as efficiently because too much energy was being used by each individual accessory. The students seemed to both enjoy the experiment and learn a lot about the details of solar power.

For the wind activity, each group of students had their own materials to make a model wind turbine (the instructions for making this model are attached). We explained, step by step, how to construct the wind model. Next we took safety precautions by asking the students to clear any papers or extra materials away from the model, to be careful around the flames, and to not blow out the candles or play with the wax. We then went to each group and lit their candles. The students watched as the blades on their turbine started to turn. Some groups had problems with the construction of their model, so we went to individual groups and helped them fix any problems. Also, we gave them tips on how to make the turbines turn faster (i.e. holding their hands around the turbine to act as a barrier to keep the heat in). After each group had seen their turbine spin on its own, we asked the students to blow out their candles. Next we asked for a volunteer to read the explanation of the turbine's motion on the sheet that was on their table (the final sheet of the wind activity instruction packet). This explained that the heat from the candles made the hot air rise and in turn, push the blade. We explained this aloud as well. Next we gave the students handouts and asked them to draw their own wind turbine. We asked for specifics on where the turbine would be, what it would be made of, how big it would be, and what the blade design was. We encouraged them to be creative, and received several interesting responses. Some were practical where students showed us their knowledge by designing them to be efficient, but some were quite silly and were obviously not meant for actual use. We invited students to present their designs in front of the class, and at the end we talked about what materials, shapes, sizes, and locations were used in the construction of real wind farms.

In the final fifteen minutes, we conducted a "debriefing" session. It consisted of a conclusion PowerPoint summarizing the take-home points from the two hands on workshops, a list of take-home energy conservation tips, and information concerning the kick off event.

## CHALLENGES FACED

Our original plan for teaching the sixth graders included four different activities where we worked closely with the Environmental Club at Henley Middle to have them assist us as “experts” in wind and solar energy. After meeting with Susan Guerrant and the sixth grade teachers and discussing the previous year’s project, we changed our plan. We decided that spending a longer amount of time on two productive and worthwhile activities would be the best for the students and for us as well. Fewer activities meant that we had fewer materials to prepare beforehand, and the students hopefully focus more on the projects individually. The Environmental Club at Henley was not very active in the school, and as it would have been difficult to remove the club members from their classes, we decided against this original plan of action.

Once we decided on two activities, one pertaining to wind power and the other pertaining solar power, we had approximately a week to obtain all the necessary materials. These two activities were of little to no outside costs, but we were concerned about preparing the pieces for the wind activity and receiving the delivered solar panel activities in time. Luckily, one of our community partners, Remy, provided the funds and fast delivery of the solar panel circuit supplies. The wind activity budget required money for cake pans, small candles, pens and styrofoam cups, and Susan Guerrant had a budget allotted for these materials’ use. We started preparing the library area on Wednesday, November 16th when we visited the school after hours to set up our workshops for the sections of students that would be attending on the following day. This was a great plan in that it gave us the opportunity to address any last-minute issues like faulty light bulbs and missing pieces.

Unfortunately, there were a few setbacks during the workshop activities. The first set of students was unable to watch the short video about wind energy because of technical problems, but this problem was fixed for the following classes. Also, on the first day, some of the pieces of the solar circuits activity started to malfunction as the day wore on. Luckily, we were able to fix this problem for the next workshop on Friday. Overall, our group handled the problems we faced with ease and quickly found solutions without a waste in valuable time.

## CONCLUSION

During our time spent with the Henley sixth graders, the activities and presentations went smoothly and seemed to be meaningful for the students. The students enjoyed the workshop activities in which they were able to experiment and test out new strategies with the makeshift windmills and solar power circuits. They were engaged by the quiz on alternative energies and the short clip outlining the basic steps that a turbine takes to turn wind power into clean, reusable energy during our opening presentation. Overall, we feel that our workshop enlightened the students on the wind and solar energy that will benefit their school and our efforts were a great way to both generate excitement and spread knowledge to the students and their community.

Now, the question remains: how will this project impact and fit into the future of Henley Middle School? We hope that with the installation of the wind turbine and solar panel installations there will come even more enthusiasm and interest in alternative energy amongst the Henley community. The energy savings will be recorded and displayed at the school that will be a great learning tool for the kids. That system will be put to good use in that the sixth graders will be able to continue to learn about renewable energy into the future. There even remains the potential for groups like ours to visit Henley every year with new workshops, information, and ideas to teach the students using the functioning wind and solar power.

Throughout our visit, we saved the activity sheets that the sixth graders completed (see Appendix) as a means to document and review our work. We found a lot of creative designs for wind turbines while the solar activity helped the students understand solar cell variables and test their knowledge of how basic circuits work. Taking digital photographs during the workshops was another successful documentation method. Afterwards, we assessed our work by requesting feedback from the sixth grade teachers. We received mostly positive responses, with small details concerning instruction methods to consider for improvement. We are pleased with the results, documentation, and assessment of our work at Henley Middle School.

## FUTURE WORK

At the conclusion of our workshops with the sixth graders, the solar panels and turbine remained on display at Henley for approximately a week. Our group will certainly remain available to the teachers and faculty for any resources they might need and for other teachers of other schools who have interest in a similar project. The major kickoff event, when the turbine and panels will be “unveiled”, is scheduled for December 16, we plan to attend along with the students, faculty, and community surrounding Henley Middle School. It is our hope that by that time the students will be both excited and prepared for the renewable energy projects happening around their school. We know that they are now knowledgeable about the wind and solar power, and hopefully, they will share their knowledge with family and peers. The students should have a real understanding of the importance of the event, and be proud to be attending a school that is leading the nation in its renewable energy technology.

We will share the results of our project with the remainder of our discussion group, as well as the rest of our Global Sustainability class. Also, we will be able to obtain project publicity through the kickoff event that will be held at Henley Middle School. We also hope that our final project report can be used as a “how-to guide” for others who are trying to do projects similar to ours. Other schools that receive money from Wind for Schools and teachers could use our lesson plans and other information as tools to educate their students about the benefits of renewable energy.

## LESSONS LEARNED

Throughout this project, we were in constant communication with our community partners, Susan Guerrant and Remy Luerssen. We learned the importance of having a good relationship with our community partners. We were friendly and helpful when possible. Our efforts hopefully made our community partners enjoy the experience to help us fully meet our needs.

We also learned a lot about the local community where we decided to spend four years of our lives. It was great to work with adults outside of the university and interact with younger students. This project has made us feel more like a part of the Charlottesville and Crozet community, and we are grateful that we could be part of the larger Wind for Schools project. We feel that it is important, if possible, for college students to reach out to the community outside of UVA and feel connected to a community-related sustainable project.

Our project covered a broad range of interests within Charlottesville and the Albemarle community. With so many different stakeholders involved, we learned a lot about the importance of flexibility in our schedule and plans. In order to make the most of our time and resources available for the project at Henley Middle School, we tried to take as many interests and opinions into account as possible. In the end, we were delighted with the way the ideas of our team, the Virginia Wind for Schools Program, and Henley Middle School faculty inevitable came together to form a successful and enjoyable program for the students.

# APPENDIX

## Acknowledgements

We'd like to especially thank Susan Guerrant for all of her help planning and arranging for successful workshops with the sixth graders in the library, obtaining the necessary resources for our activities, and answering our many questions; Remy Luerssen for working with us to get the turbine and panels set up, and for supplying the great solar circuit equipment; and Henley sixth grade teachers for their cooperation and advice throughout the entire process.

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Caduto, Michael J. 2011. Catch the Wind, Harness the Sun: 22 Super-Charged Science Projects for Kids, p. , “Learn How Wind is Created with Pie-Plate Wind Maker”
(see below)

# LEARN HOW WIND IS CREATED WITH THE PIE-PLATE WIND MAKER.

## ! SAFETY FIRST !

*Ask an adult to help you when using matches and candle flames.* Use caution when handling lit matches. Make sure that each match flame is completely out and that the tip has stopped glowing and smoking, then place the match on a surface that cannot catch fire.

## WHAT YOU WILL NEED

- Scissors
- Aluminum pie plate
- Fine-tipped permanent marker
- Ruler
- Small Phillips-head screwdriver
- Small jelly jar or glass with an opening about 2 inches (5 cm) wide
- Pair of cutting pliers to cut the tail off the pen cap
- Pen cap that is pointed at the closed end
- Modeling clay
- Clean, dry, short glass soda bottle with a narrow neck, 8- to 16-ounce size (0.25–0.5 L)
- 3-inch (7.5 cm) sewing needle
- Four tea light candles
- Matches

## MAYBE YOU'VE BEEN ASKED THIS OLD RIDDLE:

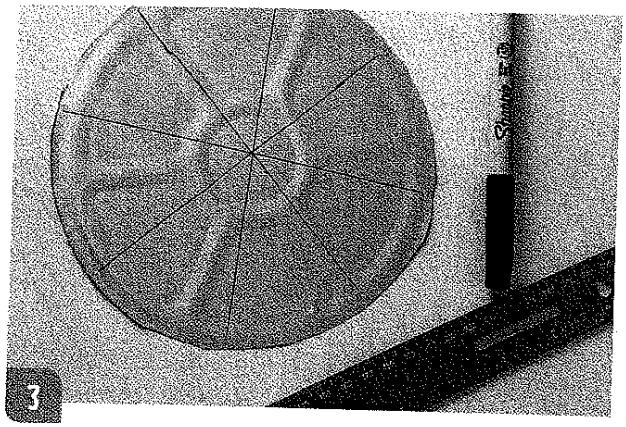
**"If someone on a ship flushes a toilet and the water in the bowl starts to drain clockwise and then the ship crosses the equator, will the water start draining in the opposite direction?" (For the answer, see page 141).**

## DO THE DEED

Are you ready to manipulate the forces of nature to create wind power?


Use scissors to cut the edge from an aluminum pie plate, leaving just the flat center disk. Be careful to not cut yourself on the edge of the aluminum.


Locate the center of the aluminum circle: Place the disk on a table and with the marker and ruler draw one line from the top of the disk to the bottom, passing directly through the center. Draw another line from the left side to the right side, crossing the first line in the center. Your lines will look like the lines of a compass drawn north to south and east to west. The place where the lines cross marks the center of the aluminum disk.

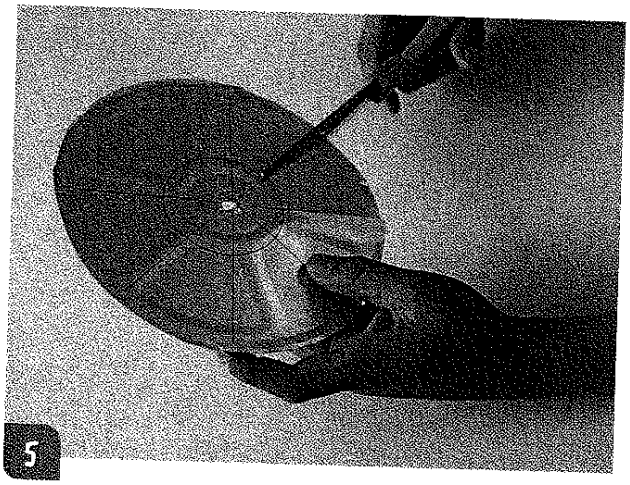


3

You've already drawn two lines that make your aluminum disk look like a pie cut into four pieces. Now you want to make eight equal-size pie wedges, so draw two more lines from one side of the plate to the other, cutting each of the four "pie" pieces in half.

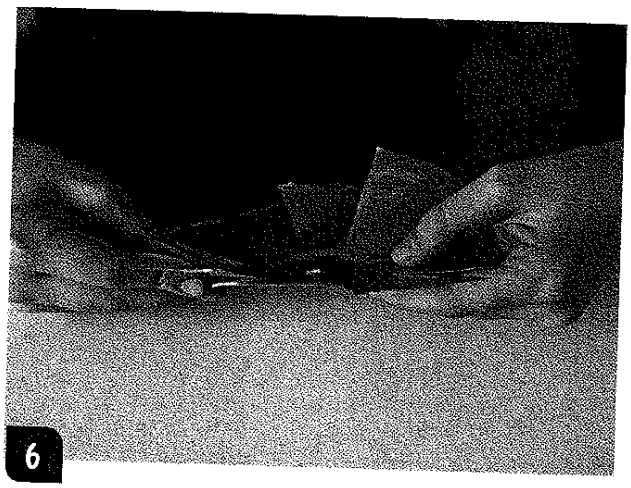
4

Use the Phillips-head screwdriver to poke a small hole through the center of the disk. Using the bottom of a drinking glass or jelly jar as a stencil, trace a circle about 2 inches (5 cm) wide around the center hole while keeping the hole directly in the center of the jar.



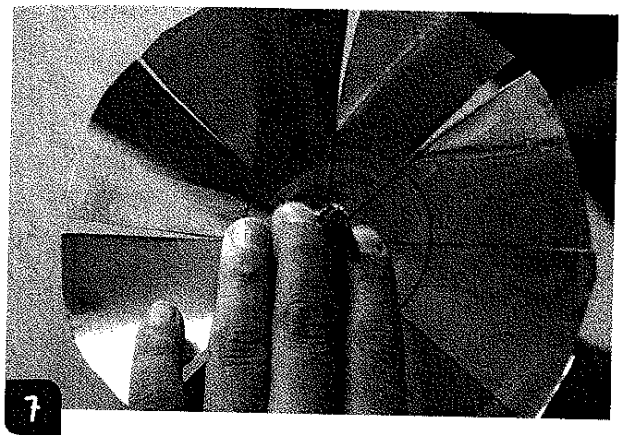
5

With the scissors, cut along all the lines from the edge of the disk up to the outer edge of the circle drawn in the center. (Don't cut into the center circle.)



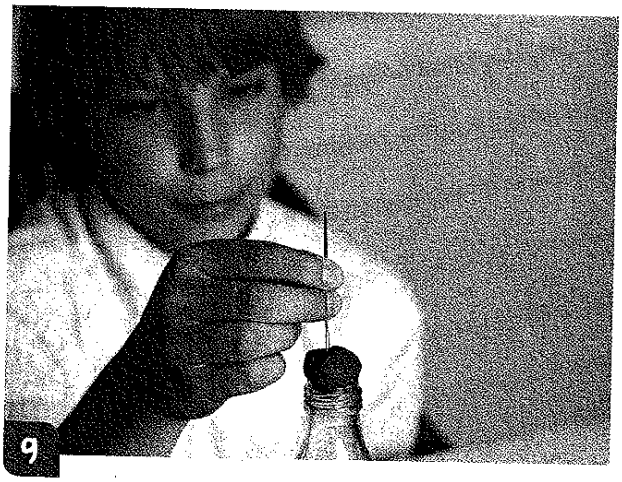
6

Twist each blade slightly by about 30 degrees so they are all angled in the same direction, like the blades of a windmill or propeller. This will make the disk turn in the rising warm air.

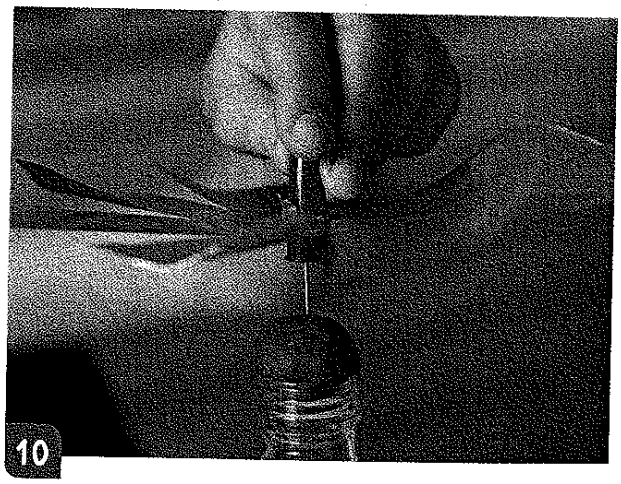



Cut the tail off the plastic pen cap with the cutting pliers. Then push the tip of the pen cap through the center hole of the pie plate. Use the screwdriver to expand the hole if necessary. Set this aside.


Roll the modeling clay into a ball about the size of a golf ball. Push the ball halfway into the opening in the neck of the soda bottle.

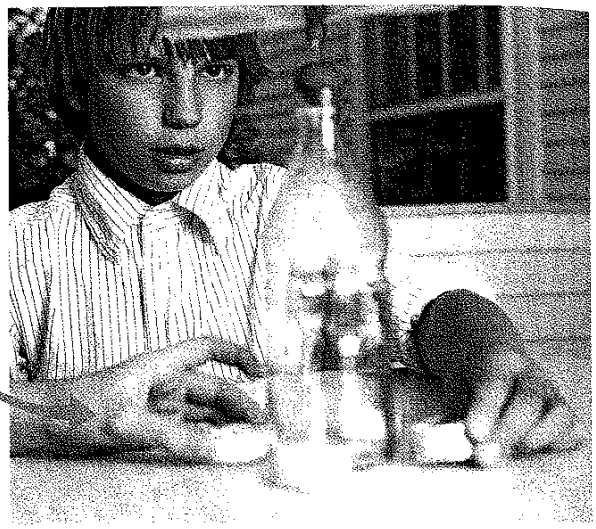



Push the thread-hole end of the sewing needle down into the clay about an inch (2.5 cm), leaving the sharp point sticking up. The part of the needle sticking up above the clay must be long enough so that the pen cap will spin freely on the needle without touching the clay along the bottom edges.

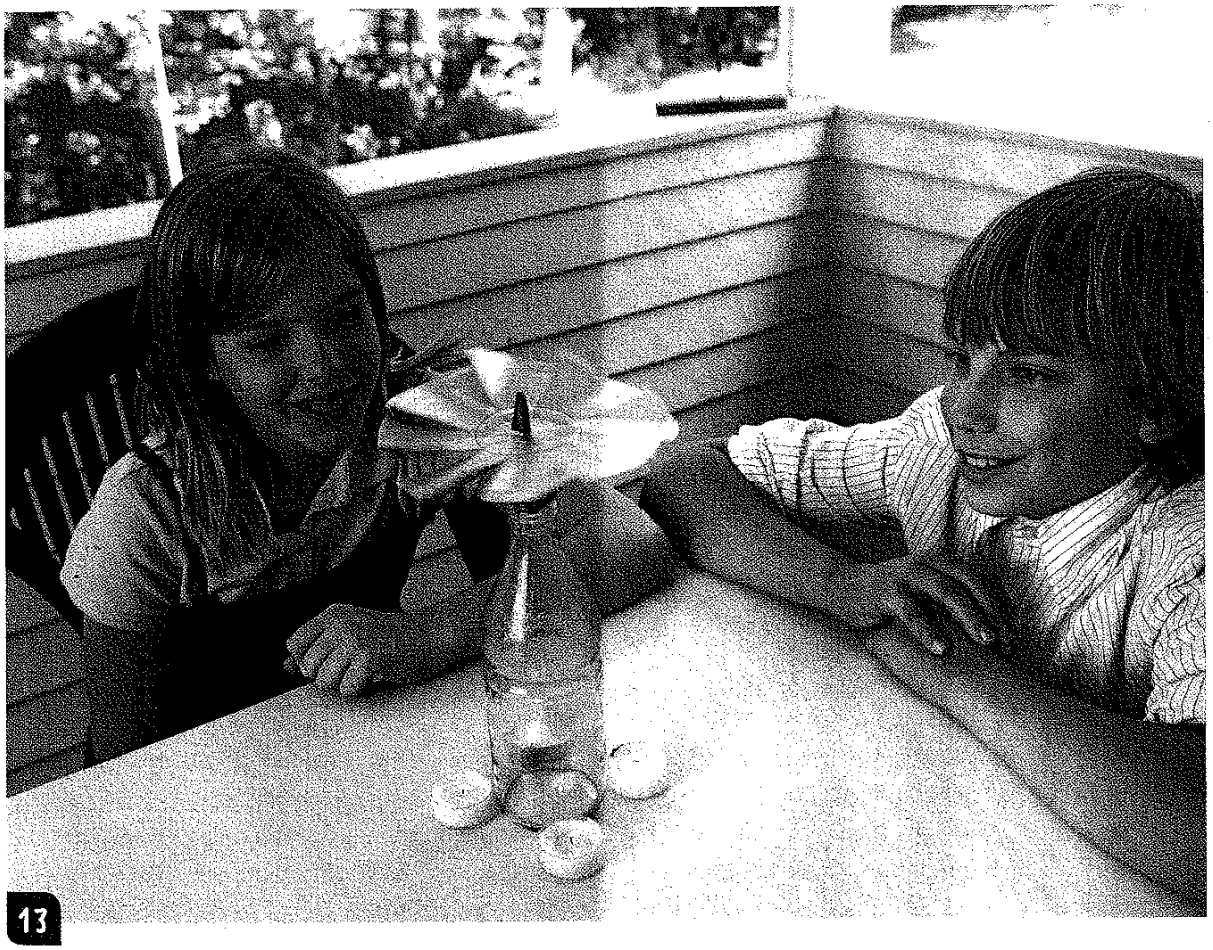



Set the open end of the pen cap over the needle. If the pen cap drags in the clay, either raise the needle up a bit higher or use the cutting pliers to cut enough off the bottom of the pen cap so that it spins freely.

11 It's important that the windmill be well balanced. If it is tilting to one side, trim about ⅛ of an inch (3 mm) off two or three blades on the heavy side. Repeat if necessary until the windmill rides evenly on the pen cap.



12 Place the four candles around the base of the soda bottle, evenly spaced, with each wick directly underneath the middle of the windmill blades.



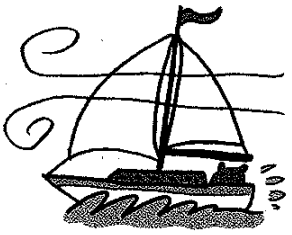
13 Light the candles; the rising warm air will cause the windmill to spin.

## THE BIGGER PICTURE

Why does the pie-plate windmill turn? As the air warms, it becomes less dense and weighs less, so it rises. In this activity, the wind is generated by the energy of the burning candles; in nature, the wind is driven by energy from the Sun.

Pilots of hot-air ballons use large gas torches to fill giant bags with hot air. The lightweight hot air rises and carries the balloons up into the sky.

## THINK ABOUT IT



- **If you live near a lake or pond, go down to the water's edge on a calm, clear morning just before sunrise and float a toy sailboat, or even a leaf, upon the water. What happens to the sailboat when the Sun rises? Why? Be careful if you do this at the end of the day, however, because the land breeze will blow your boat out toward the open water.**

- **Hang a lightweight piece of fabric outside by tying it, as high as you can reach, to a fence, to the branch of a tree or shrub — to whatever is available. The next time there's a still, sunny morning, watch the cloth just before sunrise, and continue to check it periodically for about an hour afterward. What happens? Why? Make similar observations during several other calm sunny days and compare the results.**

## THINK HARDER

- **Since colder air is heavier than warmer air, what should happen when you open the door to a refrigerator or freezer? Will you feel the cold breeze by placing your hand in the crack above the door as it opens or in the crack below it? Try doing both to see what happens.**

## NOW, REALLY THINK

- **How could you use a small, toy electric motor and some wire to make this power-plate turbine generate electricity? Design and sketch your own invention.**

### ANSWER TO RIDDLE ON PAGE 137:

No. If the water has started draining, it will not change direction when the ship crosses the equator. The direction water drains depends more on the shape of the toilet bowl and the direction of flow from the water jets in the toilet. The Coriolis effect (page 133) doesn't tend to affect the movement of such a small amount of water.

Solar/Wind Activity Sheet - Example

# Solar Circuits

## Activity 1:

| | Brighter | Dimmer |
|---|---|---|
| ~~Parallel~~ | | |
| ~~Series~~ | | |
| Closer to source | yes | |
| Farther from source | | yes |
| **Half shaded** | yes | |
| **Fully shaded** | | yes |
| Tilted away | | yes |
| Tilted towards | yes | |

## Activity 2:

Imagine the power is out at your house and you want to listen to the radio. You're in luck! You have six solar cells, and it's a sunny day. All you need to do is figure out how to connect them to the radio.

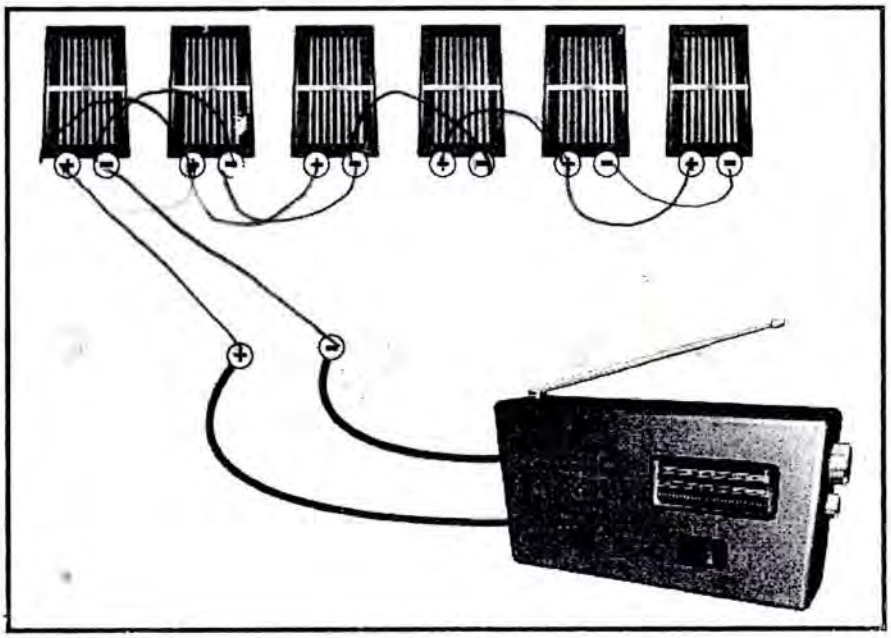
You know the following information:

1. Each solar cell produces 0.5 volts and 0.4 amps in full sun.
2. The radio needs 3 volts and 0.3 amps.

Draw the wires between the solar cells, and connect them to the radio wires. But *remember:*

-Wiring cells in series adds volts, PV amps stay the same.

-Wiring cells in parallel adds amps, volts stay the same.



**Final output:** 3 volts
2.4 amps

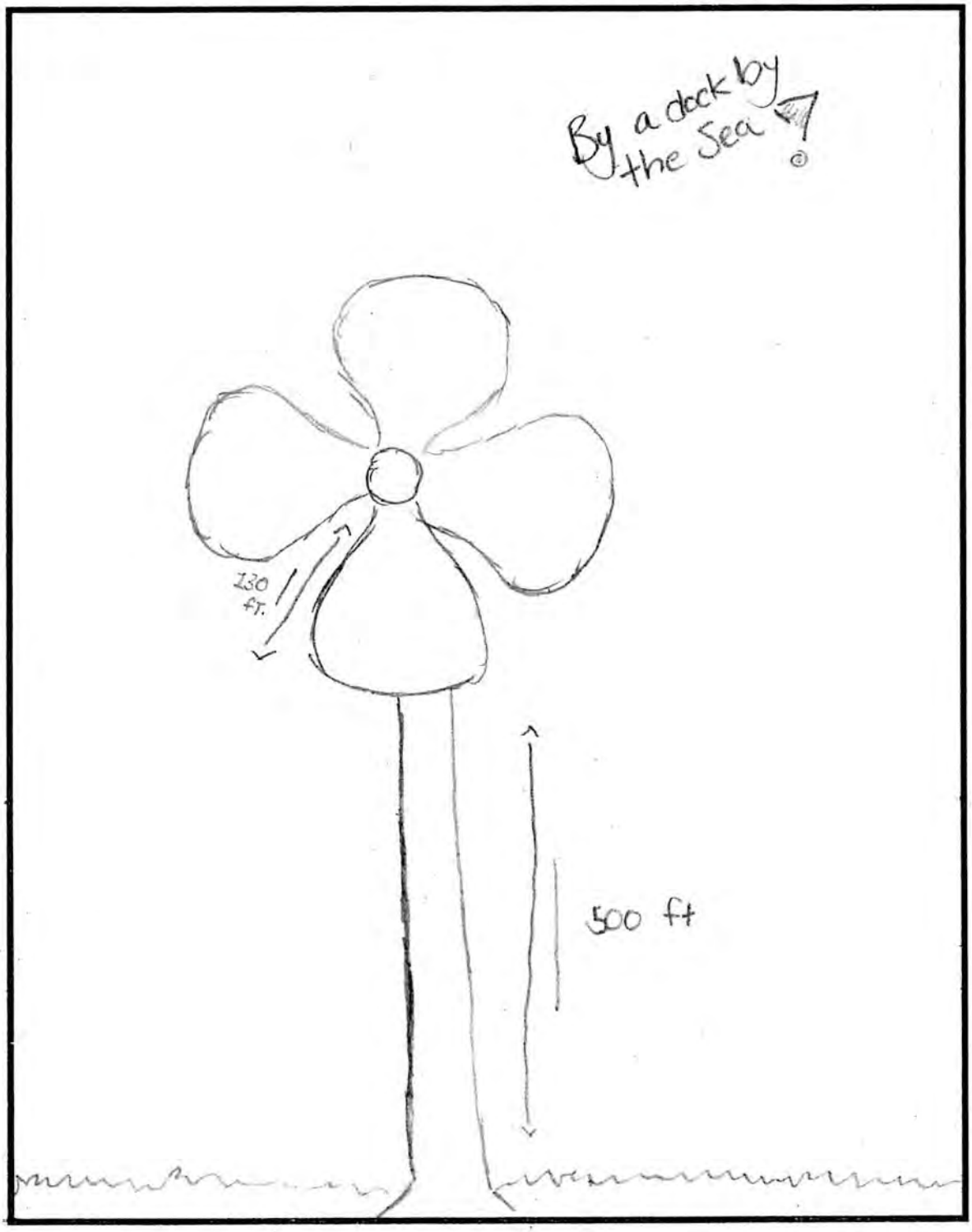
**Power:** 7.2 watts
(power = volts x amps)

24
3
72

# Wind Power

Group wind turbine design:

By: IANAMOS



# Opening and Closing Presentation to Students

## WIND AND SOLAR POWER COME TO HENLEY MIDDLE SCHOOL

ELIZABETH KNIPP, REBECCA STONER, ANFRANZ VAZQUEZ, AND HOLLY WAYTON

## Virginia Wind for Schools

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b. Sulfur dioxide
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c. One uses solar heat and one uses solar light to generate power
d. I don't know

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b. Wind turbines generate about 3% of global electricity
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## WIND POWER AT HENLEY MIDDLE SCHOOL

- Grant money from U.S. Department of Energy
- Virginia is one of 11 states
  - Skystream - up to 400 kWh/month
  - Estimated to provide about 6% annual energy usage

## WIND AND ENERGY FACTS

- Wind blows all over the planet, but mountains and coastal areas have most steady and reliable winds
- Energy: defined as the ability to do work
  - Potential vs. Kinetic
  - Conservation of energy

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## SOURCES OF ENERGY

Renewable:
- Wind, biomass, geothermal, hydropower, solar

Non-renewable:
- Coal, petroleum, natural gas, propane, uranium

## AMERICAN WINDMILL HISTORY

Mid-1600s: Europeans came to the colonies and brought windmill designs

1800s: Exploring the dry West led to invention of windmill that pumped water
- Provided water at railroad stations across Great Plains

By 1940s: fossil fuels became an inexpensive and most used source of power generation
- Oil crisis of 1970s: wind power and windmill design increased
- Today: U.S. wind power capacity represents more than 20% of the world's wind power.

## MODERN WIND TURBINES

- Parts: blades, tower, gearbox
  - -Moving air spins turbine blades
  - -Gearbox inside generate electricity
  - -Electric current sent through cables down turbine tower
- Most efficient when they're built where wind blows consistently
- Many different types of wind turbines:
  - -tower/hub heights
  - -blade designs/lengths
- Aerodynamics
  - Designed to minimize drag

## SO WHY IS SOLAR ENERGY IMPORTANT?

- It is clean, renewable (unlike gas, oil and coal) and sustainable
- It does not pollute our air by releasing carbon dioxide
- It does not contribute to global warming, acid rain or smog
- It will never be obsolete, controlled by foreign powers, or run out

## HANDS-ON!

Solar Circuits
&Wind Power

## WIND FARMS

- Wind farms - clusters of wind turbines grouped together to produce large amounts of electricity
  - Best sites: hilltops, open plains, mountain passes, near the coast
  - Built in rows facing into prevailing wind
  - Should consider impacts on wildlife in area
- Offshore
  - Wind blows stronger and steadier with no obstacles to block wind
  - Cost more to build and operate

## WHAT IS SOLAR ENERGY AND HOW DOES IT WORK?

- Solar energy: a renewable energy source produced from heat and light produced by the Sun
- Two types of solar energy technology:
- Photovoltaic energy - when sunlight photons hit a solar panel, they knock the electrons in the material loose and creates an electrical current
- Solar thermal energy - since the sun produces heat, that heat is harnessed via collectors and it is then used to power water heaters and electric plants.

## The Renewable Energy Resource Center:

**Solar photovoltaic** - on the ground, in a visible location for students. This electricity will be used to offset the school's usage.

**Solar Thermal Hot Water** - used to heat approximately 60 percent of the hot water used at Henley Middle School.

**Wind Turbine** - The Skystream 3.7, rated at 2.4 kW. The energy produced by this system will tracked.

**Web-based Tracking** - Data on electricity production by the solar photovoltaic and wind systems and on heat produced by the solar thermal system. Students and community members outside Henley can access it

**Signage** - Informational signage will be included near the learning center.

URBAN GRID


## HOW DO SOLAR PANELS WORK?

-Made of silicon, the second most abundant element on Earth

-Combined with an impurity so to increase conductivity.

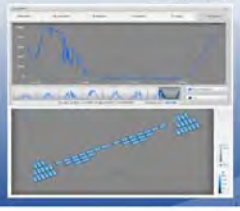
-From direct sunlight, photons free electrons, which subsequently creates direct current electricity.

## WHAT ARE SOME MYTHS SURROUNDING SOLAR?

1) It only provides power when it is sunny or windy. **NOT TRUE**
   - Solar technology operates efficiently on cloudy days as well. Many photovoltaic systems utilize batteries to store electricity for a long period of time. This stored energy can be retrieved later when it's not sunny enough

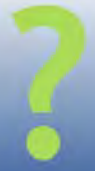
2) Solar power won't work during the winter, or at all in some areas of the world. **NOT TRUE**
   - Solar power utilizes light not heat, so even during the winter, solar-powered devices will continue to work efficiently.

URBAN GRID




## TAKE-HOME TIPS

- Turn off lights when not in a room
- Turn off water while brushing your teeth
- Turn off (and unplug) electronics when not in use
- Use reusable (not plastic!) water bottles
- Take shorter showers, do not take baths because they use more water
- During the hot part of the day, close the blinds
- Finishing the food on your plate!
- Open the blinds when it is cooler outside
- Use reusable bags at the store
- Start thrifting
- Reduce, reuse, recycle!



Pictures