Renewable Energy Sources

Strand	Earth Resources	
Topic	Renewable resources	
Primary SOL	3.11	The student will investigate and understand different sources of energy. Key concepts include a) energy from the sun; b) sources of renewable energy; and
Related SOL	3.1	The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which c) objects with similar characteristics or properties are classified into at least two sets and two subsets; h) data are gathered, charted, graphed, and analyzed; j) inferences are made and conclusions are drawn; m) current applications are used to reinforce science concepts.

Background Information

The five most common renewable energy sources are solar power, hydropower, geothermal, wind power, and biomass. Like nonrenewable energy sources, wind, hydropower, geothermal heat, and biomass create mechanical energy which generators convert into electrical energy. Wind is used to turn huge turbines which are harnessed to generators which produce electricity. Hydropower plants use water currents to turn turbines which are attached to generators. In geothermal power plants, the heat from inside the core of the earth is used to boil underground water supplies. When the water boils, it creates steam, which is used to turn turbines attached to generators. Biomass is simply any supply of organisms that can be replenished at the same rate it is consumed. Examples of biomass include trees, food waste, and even manure. Some power plants burn biomass in order to heat water and produce the steam needed to turn a generator.

Unlike other renewable and nonrenewable energy sources, solar energy is not produced from the conversion mechanical energy, but from the conversion of heat energy. When rays from the sun hit solar panels, the panels absorb the sun's light and heat, and convert it into electric energy through a chemical process.

Renewable energy sources provide a solution for the primary problem with nonrenewable sources. Because renewable energy sources can be repeatedly produced, there is not much danger of running out of these energy sources. However, renewable energy sources also pose several unsolved problems. Though wind power is inexpensive, wind farms require extensive amounts of land and depend on varying and often unpredictable quantities of wind. Hydropower plants use dams which cause flooding and erosion, disturbing the habitats of natural wildlife. Geothermal sites are uncommon, and may produce air pollution. Biomass power provides a promising method to dispose of unwanted waste materials, but burning biomass can produce even more air pollution than burning fossil fuels. In addition biomass facilities must ensure that they consume no more biomass than what they can simultaneously produce. Solar power is expensive because it requires the installation of high-priced solar panels.

Because of these concerns with renewable energy sources, many producers are hesitant to transition to power supplies that are relatively untested and do not promise to be reliable.

Materials

- Supplies for the Build a Solar Oven and Build a Wind Turbine projects.

Vocabulary

energy, renewable energy source, solar power, hydropower, geothermal, wind power, biomass

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Review the definition of electricity.

   Electricity is a kind of energy that makes heat, light, and motion.
2. Ask students to name resources that are used to produce electricity. Review the four nonrenewable energy sources and their advantages and disadvantages. Reference the Renewable and Nonrenewable Energy Sources Factsheet as necessary.

Procedure

1. Ask students to name alternatives to nonrenewable energy sources. A complete list should include solar power, hydropower, geothermal, wind, and biomass.
2. Explain how power plants use these resources to produce energy.

   Like nonrenewable energy sources, wind, hydropower, geothermal heat, and biomass create mechanical energy which generators convert into electrical energy.
   - Wind is used to turn huge turbines which are harnessed to generators which produce electricity.
   - Hydropower plants use water currents to turn turbines which are attached to generators.
   - In geothermal power plants, the heat from inside the core of the earth is used to boil underground water supplies, creating steam which turns turbines attached to generators.
   - Biomass is simply any supply of organisms that can be replenished at the same rate it is consumed. Examples of biomass include trees, food waste, and even manure. Biomass is burnt in order to heat water and produce the steam needed to turn a generator.
   - Unlike other renewable and nonrenewable energy sources, solar energy is not produced from the conversion mechanical energy, but from the conversion of heat energy. When rays from the sun hit solar panels, the panels absorb the sun's light and heat, and convert it into electric energy through a chemical process.

3. Have students work in groups to complete the steps in the Build a Solar Oven instruction packet to observe one useful application of solar energy. **30 minutes**
4. Explain that solar ovens store heat by taking energy directly from the sun.
5. Ask students for other applications of solar energy. Explain that solar energy can be used indirectly when it is collected in solar panels, converted into electrical energy, and used to produce heat, light, or motion.
6. Have students follow the directions on the Build a Pinwheel Turbine instruction sheet to create their own turbines by making paper pinwheels. **10 minutes**
7. Take students outside, and have them observe the motion of their turbine pinwheels when the wind blows. If there is no wind, have students blow on each other's turbines, or wave a sheet of heavy cardstock to simulate wind. **5 minutes**
8. You may also simulate hydropower with a large bowl and a cup of water. Place the bowl somewhere where all the students can see it. Make sure the pinwheel is securely attached to the pencil, and, grasping the pencil, hold the pinwheel upside-down over the bowl. Use the cup to pour a steady stream of water over one side of the turbine pinwheel into the bowl. The pinwheel should spin like a hydropower turbine. **5 minutes**
9. Complete the Renewable and Nonrenewable Energy Sources booklet which students created in Lesson 1 by illustrating the renewable energy sources and noting their advantages and disadvantages. **10 minutes**

Conclusion

1. Have students review the following vocabulary terms by drawing simple icons to represent each energy source. Then have students color each renewable energy source blue and each nonrenewable energy source orange. **10 minutes**
   - renewable, nonrenewable fossil fuel oil, nuclear fission, coal, natural gas, solar power, hydropower, geothermal, wind power, biomass

Assessment

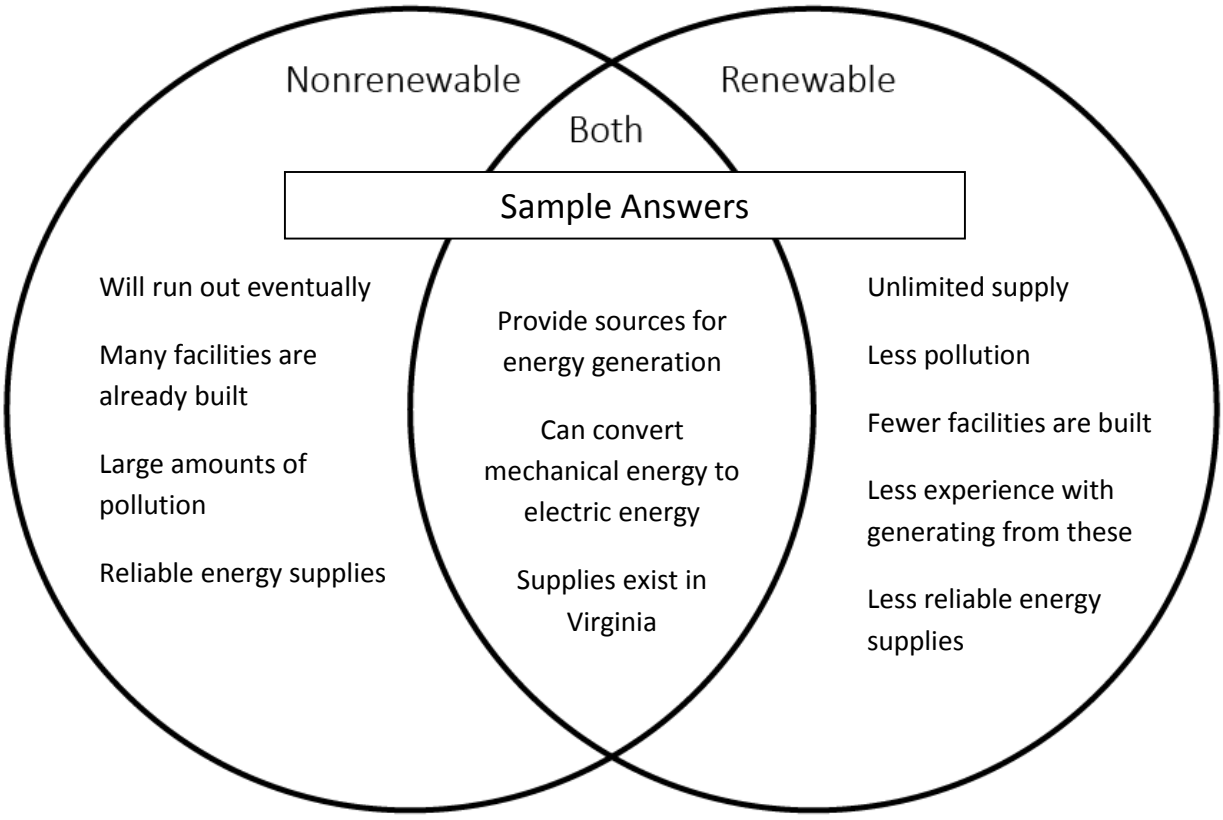
- **Questions**
  - How would weather patterns influence energy production at a hydroelectric, wind, or solar power plant?
    Changes in tide, current, or water level would cause fluctuation in the water supply at a hydroelectric generator.
    Wind speeds and levels would vary, providing varying levels of movement for wind turbines.
    Clouds, rainy weather, and night-time would decrease the amount
  - What renewable resources would be good options for power plants in Virginia?
    Using a map, examine Virginia's water supply. Discuss how Virginia's trees and mountain ranges weaken the strength an amount of wind.
    Discuss Virginia's large daily supply of sunlight.
- **Other**
  - Have students create charts or Venn Diagrams depicting the advantages and disadvantages of renewable and nonrenewable energy sources.
  - Grade the Renewable and Nonrenewable Energy Sources booklets which students created.

Extensions and Connections (for all students)

- Locate the closest power plant to your school and mark it on the map. Research to find out what kind of generator and power source this plant uses.
- Have student work in teams to create videos which explain energy production. Give students creative freedom in selecting an appropriate method to depict the process, constructing mock interviews, dramatizations, or documentaries. However, whatever the format, videos should deal with at least three energy sources, and describe the process of energy production and the path of energy from the power plant to the team's houses or school.

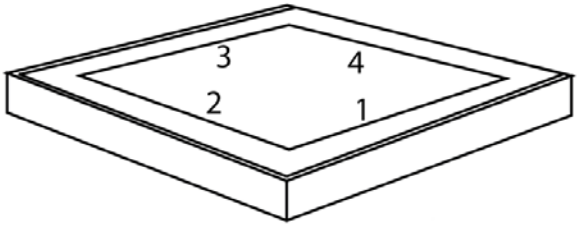
Strategies for Differentiation

- Give clues that point students in the right direction when creating their booklets.
- Allow students to use the Nonrenewable/Renewable Energy Sources factsheet as they complete their Renewable and Nonrenewable Energy Sources booklets.
- Work with struggling students in small groups to help them assemble pinwheels. Alternatively, provide students with pre-assembled pinwheels.
- Place struggling students in groups with gifted or excelling students, and have them work together.



Build a Solar Oven

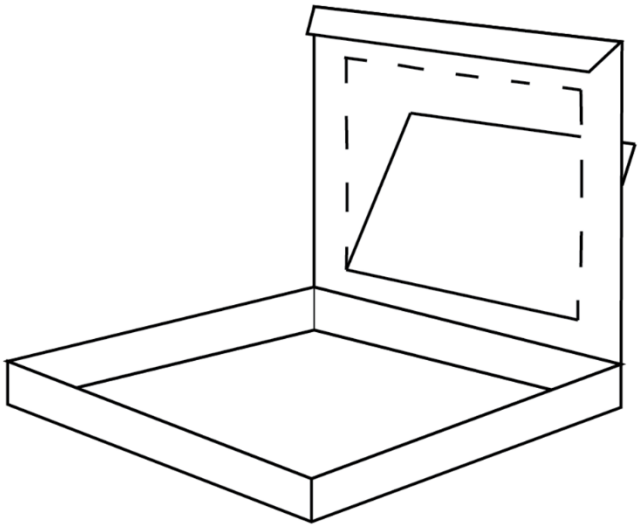
1. Collect your materials.
    - 1 pizza box
    - 1 box cutter
    - Clear plastic wrap or a clear gallon storage bag, cut apart at the seams
    - Heavy-duty tape, at least 2” wide
    - Aluminum foil
    - Black construction paper
    - Newspaper
    - Glue
    - Ruler
    - Clear plastic plate
    - Food for cooking

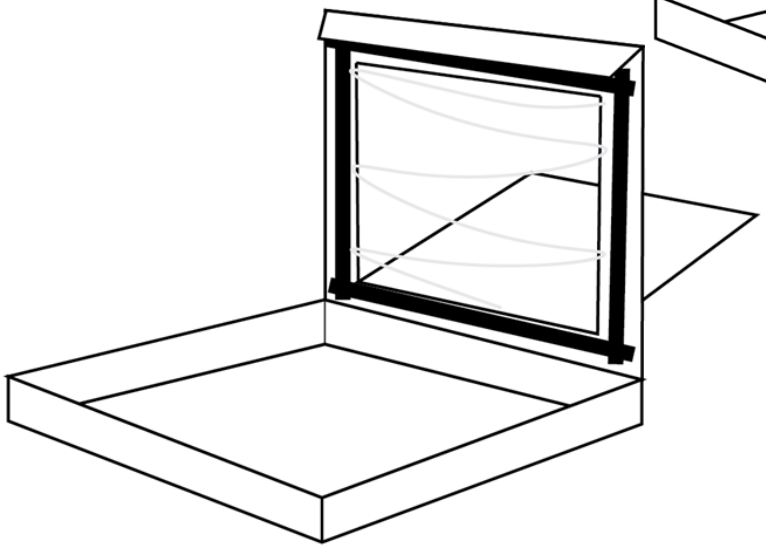


2. Draw a square on the top of the pizza box, 1 ½ inches from each edge.

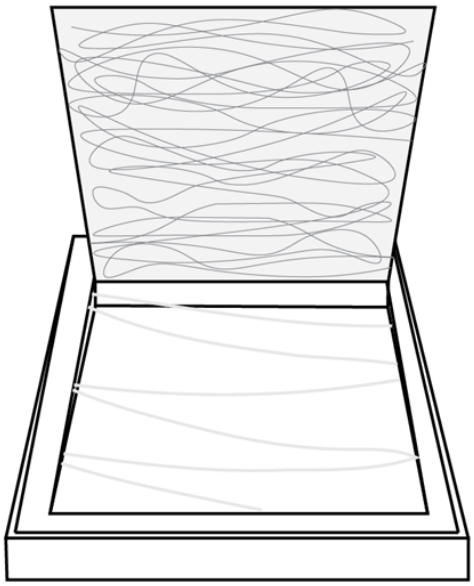
3. Wait for your teacher to cut the square out along the first three sides. Do not cut the fourth edge.

4. Bend the flap along the fourth edge to create a hinge.

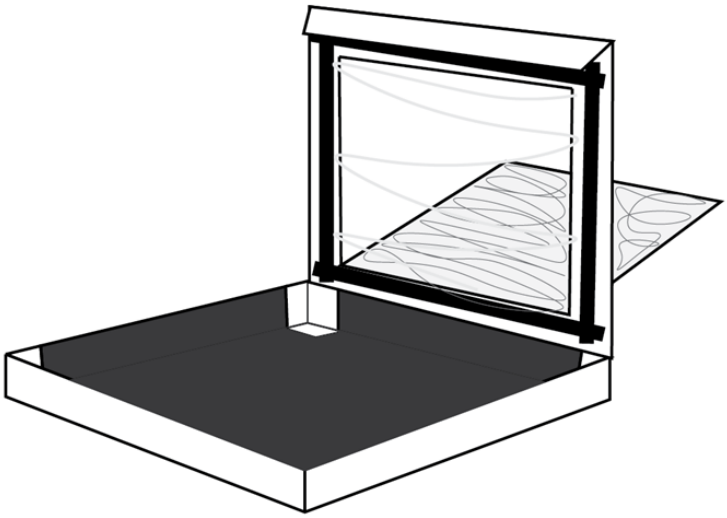




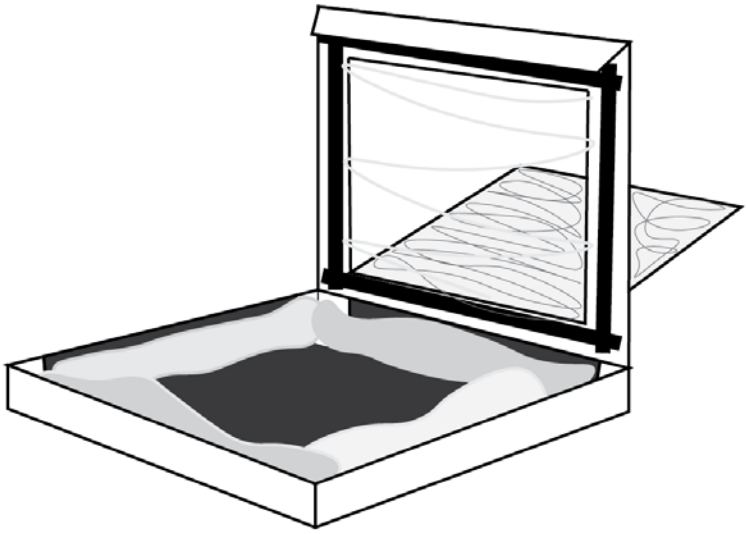
5. Tape clear plastic to the underside of the box lid to create a window under the flap.



6. Cover the inside of the flap with aluminum foil.



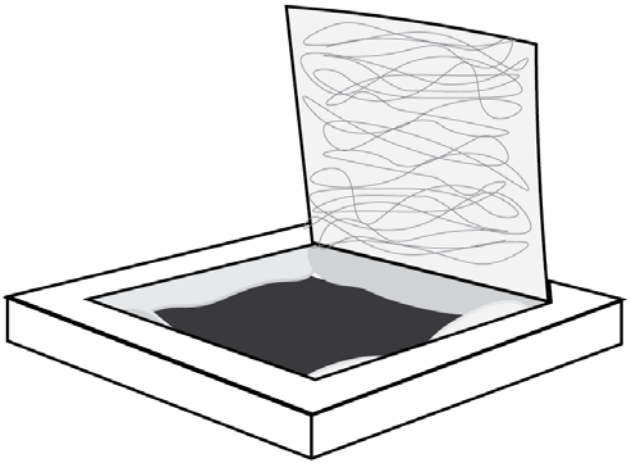
7. Line the inside of the box with black paper. Glue or tape it in place.



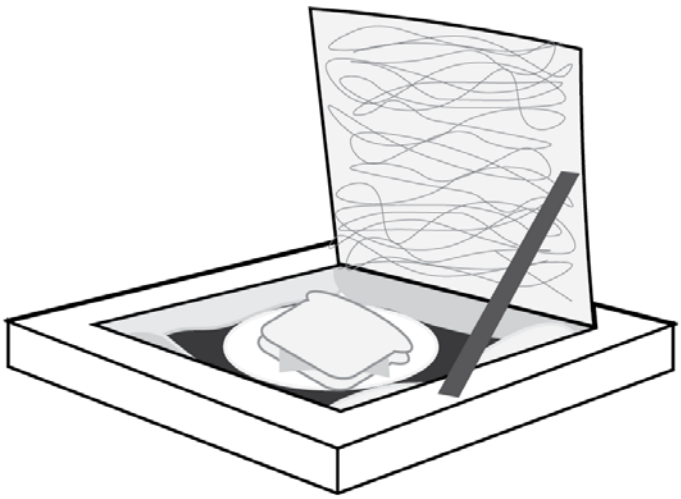
8. Twist sheets of newspaper into tight rolls and place them along the edges of the box to insulate the solar energy. Leave ¼ inch gap between the edge of the box and the rolls of newspaper so the box still closes.

9. Glue or tape the newspaper in place.

10. Set your solar oven outside in a sunny area.



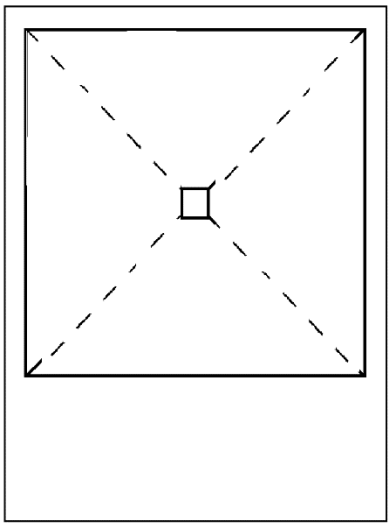
11. Place food on a clear plate and set it inside your oven. Nachos, s'mores, and grilled cheese sandwiches are great foods to cook in your solar oven.
12. Close the box lid and angle the flap so it reflects sunlight into the solar oven. Prop the flap with a ruler.



13. Let your food cook for 30-45 minutes.
14. Hint: Look through the window in the top of your solar oven to check your food occasionally, but do not open the oven because heat will escape.

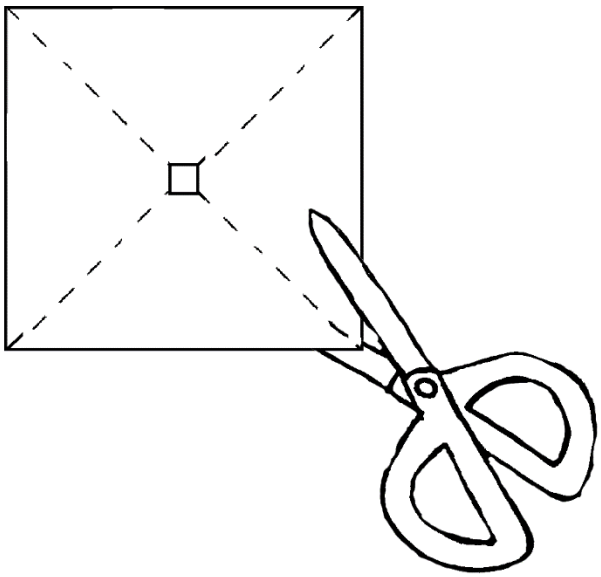
Build a Wind Turbine

15. Collect your materials.
    - CVEC Pinwheel Template
    - Scissors
    - Glue
    - 1 thumb tack
    - 1 unsharpened pencil

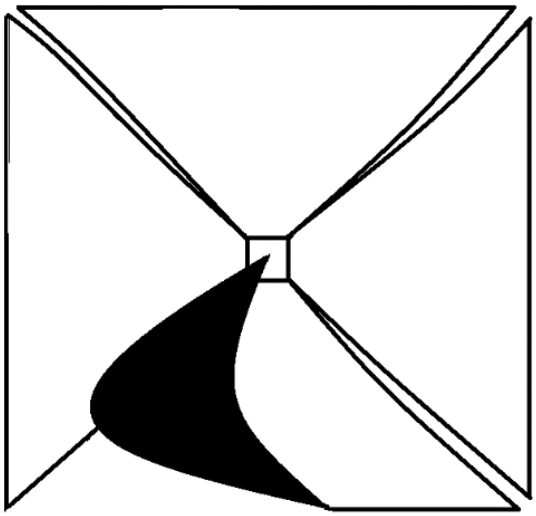


16. Use scissors to trim the extra paper from around the large box on the pinwheel template.

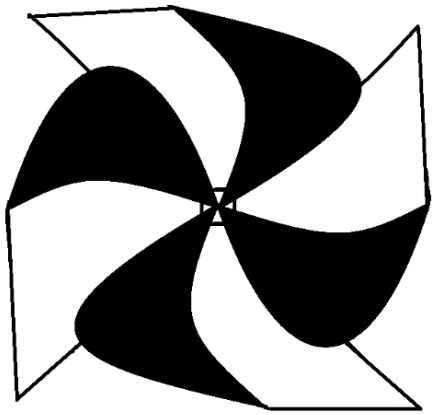
17. Cut along the dotted lines from each corner to the small center square.



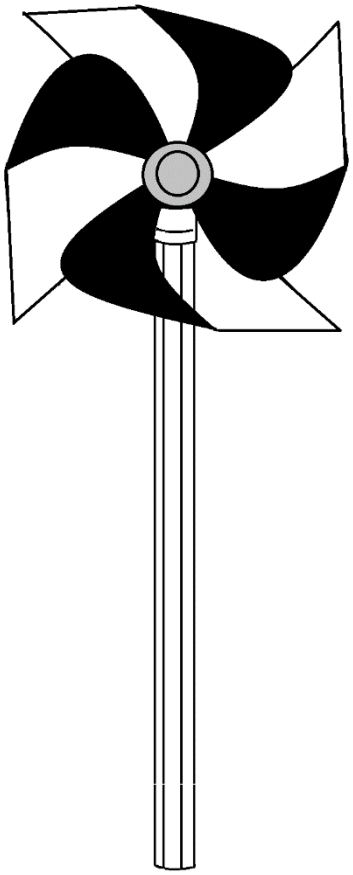
18. Starting with the bottom section, turn the left corner toward the center and glue it in place. ***Use as little glue as possible.



19. Work your way around the pinwheel, gluing the left corner of each section to the center.



20. Once the glue has dried, push a thumb tack through the center of the pinwheel. Then push the tack into the eraser on your pencil.



21. Watch your pinwheel spin as you blow on it or set it in the wind.

Pinwheel Template