

Permaculture Power-Up: Harvesting Energy from Nature

Subject: Science, Permaculture, Engineering Design

Grade Level: Ages 9-11 (approx. 4th-5th Grade)

Time Allotment: 3 hours

Lesson Focus: This hands-on lesson introduces the concept of sustainable energy through the lens of permaculture. The student will learn about solar, wind, and bio-energy by building creative, functional models. The focus is on application and design rather than memorization.

Materials Needed:

- **General:** Notebook/sketchbook, pencil, scissors, tape.
- **For Solar Oven:** A cardboard pizza box (or similar shallow box with an attached lid), aluminum foil, clear plastic wrap, black construction paper, a wooden skewer or stick, a craft knife (adult supervision recommended).
- **For S'mores (optional treat):** Graham crackers, chocolate, marshmallows.
- **For Wind Turbine:** A square piece of paper (6x6 inches is good), a pushpin, a pencil with an eraser on top.
- **For Lemon Battery:** 2-3 fresh lemons, 3 copper pennies (or a piece of copper wire), 3 zinc-coated (galvanized) nails, 4 alligator clip wires, 1 low-voltage LED bulb (1.5-3 volts).

Lesson Plan & Activities

Part 1: Introduction - The Energy Detective (30 Minutes)

1. Learning Objectives:

- Student will be able to define "renewable energy" in their own words.
- Student will identify at least three sources of natural energy in their immediate environment.
- Student will connect renewable energy to the permaculture principle: "Use and Value Renewable Resources."

2. Activity Steps:

1. **Spark Curiosity (5 mins):** Start with a question: "If you couldn't plug anything into a wall, how would you cook your food, warm your house, or listen to music? Nature gives us clues!" Introduce the permaculture idea of working *with* nature, not against it. Explain that today, we're going to be energy detectives and engineers, finding and using nature's power.
2. **Energy Hunt (15 mins):** Go on a walk around the house and yard. The mission is to find examples of energy at work.
 - **Fossil Fuel Energy:** Point out outlets, lights, cars. Where does this power come from? (A power plant, often burning coal or gas).
 - **Natural/Renewable Energy:** Find a sunny spot on the floor. Feel the heat? That's solar energy. See leaves rustling? That's wind energy. A compost pile? That's bio-energy (heat from decomposition).
3. **Discussion & Connection (10 mins):** In the notebook, create two columns: "Grid Power" and "Nature Power." List the findings. Discuss why "Nature Power" (renewable energy) is so important in permaculture. It doesn't run out, it's clean, and it's right there for us to use if we

are clever!

Part 2: Harnessing the Sun - The Solar Oven Challenge (75 Minutes)

1. Learning Objectives:

- Student will be able to construct a simple, functional solar oven.
- Student will explain the roles of reflection (foil), insulation (box), and the greenhouse effect (plastic wrap) in capturing heat.
- Student will successfully use their oven to melt a food item (e.g., chocolate for s'mores).

2. Activity Steps:

1. **Introduction (5 mins):** "Let's capture that sunlight we felt earlier. We're going to build an oven that cooks with nothing but the sun!"
 2. **Build the Solar Oven (45 mins):**
 - On the lid of the pizza box, draw a square about an inch from the edges. An adult should help cut three of the four sides, creating a flap that opens.
 - Line the inside of the flap with aluminum foil, shiny side out. This is your reflector panel.
 - Cover the opening you just cut with a tight, double layer of clear plastic wrap, taping it down to create an airtight window.
 - Line the bottom inside of the box with black construction paper. Why black? (It absorbs heat!).
 - To prop the reflector flap open, use a wooden skewer or stick. Position it to reflect the most sunlight possible down through the plastic window.
 3. **Cook & Observe (25 mins):**
 - Place a s'more (or just a marshmallow and piece of chocolate on a graham cracker) inside the oven on the black paper. Close the lid.
 - Take the oven outside into direct sunlight. Aim the foil flap to catch the sun's rays and direct them inside.
 - Observe! It may take 20-30 minutes on a sunny day. While waiting, the student can sketch the oven in their notebook and label the parts: reflector, window, heat-absorber.
 - Discuss what's happening. The light comes in, gets absorbed by the black paper, turns into heat, and then the heat is trapped by the plastic wrap window—just like a greenhouse!
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Part 3: Capturing the Wind - The Pinwheel Turbine (30 Minutes)

1. Learning Objectives:

- Student will design and build a pinwheel that spins in the wind.
- Student will explain that wind is moving air and that its energy (kinetic energy) can be captured to do work.

2. Activity Steps:

1. **Introduction (5 mins):** "The sun heats the earth, which makes the air move, creating wind! We can capture that movement. Big wind farms use giant turbines. We're going to make a mini-one."
 2. **Build the Pinwheel (15 mins):**
 - Take the square piece of paper. Draw lines from each corner to the center, stopping about half an inch from the center point.
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- Cut along these four lines.
 - Fold every other point into the center. Don't crease the folds.
 - Carefully push the pushpin through all four folded points and then through the center of the paper.
 - Push the end of the pin into the eraser on top of the pencil. Make sure it's loose enough to spin freely.
3. **Test & Improve (10 mins):** Take the pinwheel outside. Does it spin? What happens if you run with it? What happens if you blow on it? **Challenge:** Can you redesign the blades (e.g., curve them) to make it spin faster? This encourages creative problem-solving and iteration, key parts of engineering.
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Part 4: The Amazing Lemon Battery (30 Minutes)

1. Learning Objectives:

- Student will be able to construct a simple battery from lemons.
- Student will demonstrate that energy can be created from a chemical reaction between different metals and an acid.

2. Activity Steps:

1. **Introduction (5 mins):** "This is the most surprising one. Did you know we can make electricity from a lemon? It's not magic, it's science! We are going to unlock the hidden bio-energy inside."
 2. **Build the Circuit (20 mins):**
 - Gently roll the lemons on a table to release the juice inside.
 - In the first lemon, insert one penny and one galvanized nail. Don't let them touch inside the lemon. The two different metals (copper and zinc) reacting with the citric acid is what starts the flow of electrons.
 - This is one "cell" of your battery. To power an LED, you need more voltage. Let's link them together!
 - Take a second lemon and do the same. Now, use an alligator clip wire to connect the **nail** of the first lemon to the **penny** of the second lemon.
 - You have created a circuit! Now, take two more alligator clip wires. Attach one to the penny in the first lemon and the other to the nail in the second lemon.
 - Touch the loose ends of the wires to the two legs of the LED bulb. If it doesn't light up, try swapping the wires on the legs. The LED only allows electricity to flow in one direction.
 3. **The "Aha!" Moment (5 mins):** Watch the LED light up! Discuss what's happening: the acid in the lemon is causing a chemical reaction, creating a tiny electrical current, and by linking the lemons, you made the current strong enough to power a light.
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Part 5: Permaculture Designer Challenge & Wrap-Up (15 Minutes)

1. Learning Objectives:

- Student will synthesize the day's learning by designing a system that uses at least two different renewable energy sources.

2. Activity:

1. **Review (5 mins):** Quickly recap the three types of energy harvested today: Solar (oven),
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Wind (pinwheel), and Bio-chemical (lemon).

2. **Design Challenge (10 mins):** "You are now a permaculture energy expert! Your final mission is to design a dream backyard, treehouse, or tiny house. In your sketchbook, draw a design that includes at least two of the energy ideas we explored today. How would you use a solar oven? Where would you put a mini wind turbine? Could you have a lemon-powered porch light?" Encourage creativity and labeling the parts of their design. This serves as a fun, creative assessment of their understanding.