



Outdoors

***Note:** sections of the lesson plan template marked with * are optional, but may be useful for your planning.

Renewable & Nonrenewable Energy	
Grade level	4th grade (late elementary)
Standards (NGSS)	NSGS: ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
Learning Objectives (Goals)	<ul style="list-style-type: none"> ● Identify and organize different energy sources into renewable/non-renewable ● Associate natural resources with their ability to create energy ● visualize the time it takes to create natural resources and relate it to their renewability ● Observe how variables change energy conversion using the water wheel ● Evaluate different energy sources based on their pros and cons
Duration	2.5-3 hrs
# students	10-30
Materials	String of varying lengths Cork + sticks (water wheel) water marshmallow + parabolic mirror OR watercooler jug + isopropyl alcohol Optional: Portable solar panel
Location	Classroom with available outdoor space

Logistics	If running the marshmallow combustion, it must be sunny outside. If the classroom does not have a sink, bringing water or using a nearby bathroom to bring water into the class is required for the water wheel.
Accessibility & safety awareness	Accessible to all mobilities. Fine motor skills are needed, so experiments should be conducted in pairs if students are unable to operate the water wheel independently. WARNING: fire hazard, confirm with the teacher any necessary requirement for open flames, ensure experiment is done outside or in a well ventilated area.
GO-Outdoors Missions	<p>At GO-Outdoors, we emphasize the following missions</p> <ul style="list-style-type: none"> • Instructor/Caltech volunteer will incorporate 10 Essentials of hiking and Leave No Trace etiquette into the trip and encourage students that they can do these things themselves, to make these concepts approachable. • We are looking forward to tailor our trips to student interests. At the start of each of our trips, we will ask each student to share what they hope to learn and we will try to incorporate them into the field trip.
<p style="text-align: center;">Lesson activities</p> <p>15 minutes: Personal introductions, hand out pre-lesson poll</p> <p>15 minutes: Introduce energy, brain map with the class different types of energy/sources of energy for electricity (mechanical, electrical, light, thermal, sound; wind, solar, wood, water, oil & gas, nuclear)</p> <ul style="list-style-type: none"> - relate to the previous lessons run (plants get energy from the sun, energy is transferred through soil) - can ask students what they use electricity for, and where it comes from - Light bulbs give light, but they are powered by electricity (energy changes - society wants to make energy useable) <p>20 minutes: Twine exercise. Ask for volunteers to hold different lengths of string. Each length corresponds to an energy source and how long it takes for it to “renew”. 1 inch = 1 year</p> <p>“String” 1: solar/wind = 1 day (0.00274 inches, have them hold a piece of paper)</p> <p>String 2: water = ~season (0.25 inch)</p> <p>String 3: their age = 10 years (10 inches)</p> <p>String 4: Human life = 100 years (8 ft 4 inches)</p>	

String 5: forest = 250 years (20 ft 10 inches)

String 6: oil & gas = >10,000,000 years (largest ball of twine = 19,200,000 inch, 1,600,000 ft) (print picture from Wikipedia for students to hand around, compare to ~300 miles [has anyone ever driven to NorCal])

20 minutes: Think-pair-share with the brain map early which ones are renewable and which aren't. Start by giving them one example (solar)

- can do voting by having students choose a side of the room (point if they can't stand and move)
- Write under each energy if it's renewable or not

30 minutes: Water wheel activity

- We will have a partially-constructed water wheel and show how flowing water moves the wheel. Kids can finish the construction, then conduct an experiment to see how much water goes through relating to the speed of the wheel and what that means for how much energy there is. Students can watch the optional videos to learn more.

15 minute break

30 minutes: Parabolic mirror outdoor activity

- bring the class to an open area outside on a sunny day. Ask students to remember what was talked about for the sun (energy it produces, how can we capture it?). If available, show a portable solar panel.
- set up the parabolic mirror, talking about how it focuses light to a smaller area. Have some flammable material (match, paper, marshmallow that can be painted black (or coated in cocoa powder!)). If using a marshmallow, show how the white surface doesn't absorb much, but then with a marker color it in and see if it combusts.
- Alternatively, fill a large jug with enough 90% isopropyl alcohol to coat the inside. After warming it up in the sun, use a long lighter to ignite the alcohol to demonstrate combustion. Ask students to relate this to another energy source discussed in class (natural gas, oil, heating their homes and powering cars)

20 minutes: think-pair-share about the effects of where we get our energy from (have students heard about CO₂? What happens to rivers when we build a dam?)

- pros and cons of different energies (how do we save renewables?)

15 minutes: Wrap-up, give groups an energy source and think about pros & cons. Discuss how the sun is the original source of energy. Collect supplies, give out post-lesson poll

NOTE: Students may be very excited and hard to control after the fire demonstration. It may be more effective to end with it rather than try and get their attention back for more in-class talking.

Optional extension activities

Videos on hydroelectric power:

https://www.youtube.com/watch?v=pEUzot8Zufo&ab_channel=GreenMountainEnergy

https://www.youtube.com/watch?v=q8HmRLCgDAI&ab_channel=StudentEnergy

***Instructor support**

Instructors should walk around, ask the groups questions to guide their exploration, and assist any groups that require help.

***Common misconceptions about the lesson**

Not all “green” energies are renewable (nuclear).

Renewable energy has environmental impacts (damming rivers changes ecosystems, mining precious metals for batteries can lead to pollution and loss of habitats).

***Opportunities to engage students in planning**

***Handouts**

An accompanying handout is provided to help students follow along with the activities.