

# Alternative & Renewable Energy Course!

You can fill out this worksheet as we go along to get the most out of time together, or you can use it as a review exercise at the end of the class. (Answers on last page.)

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## What we're going to cover today:

- Forms of energy
  - Nuclear power
  - Coal and Natural Gas
  - Solar Cells (Photovoltaics)
  - Wind Turbine
  - Solar Thermal Power
  - Hydroelectric Power
  - Wind & Tidal Technologies
  - Geothermal Power
  - Ocean Thermal Conversion
  - Biofuels
  - Algae Fuel
  - Fuel Cells
  - Photoelectric Effect
  - Electricity & Magnetism
  - Temperature
  - Heat & Thermal Energy
  - Piezoelectric Effect
  - Peltier Device
  - Photons & Optics
  - Stirling Engines
  - Waste-to-Energy
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Do this NOW: Write down two things you want to learn about Alternative/Renewable Energy:

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Do this NOW: Write down WHY you want to learn about the things you mentioned on the previous page. What will it give you, or provide you with, or make possible for you if you now understand these things that you wanted to learn?

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# Shopping List for Ultimate Science Curriculum: Alternative & Renewable Energy

Items listed below are for doing *all* experiments in the program. Watch the videos *first* to check out the experiments and projects you want to do before purchasing parts! Listed part numbers are for Jameco ([www.jameco.com](http://www.jameco.com))

- AA batteries
- AA battery case (#216081)
- Alcohol burner or candle with adult help
- Alligator clip leads (#10444)
- Aluminum foil
- Balloons, 7-9"
- Brown paper bag
- Cardboard box, about a 10" cube
- CDs (3 old ones)
- Chemistry stand with glass test tube and holder (can substitute pliers for stand)
- Chocolate, marshmallows, graham crackers
- Compass
- Cookie dough (your favorite)
- Copper metal sheet (1/2 sq. foot)
- Copper tubing (1/8"-1/4" dia x 12" long)
- Corn syrup
- Digital multimeter (#2230002)
- Drill with 1/16" bit
- Electrical tape
- Fire extinguisher (for safety)
- Fishing line
- Flameproof surface (like a ceramic tile)
- Foam block, 4
- Foam cup
- [Fresnel lens](#) (7×10" page magnifier)
- [Fuel cell car kit](#) (KT-FUELCK from [www.hometrainingtools.com](http://www.hometrainingtools.com))
- Funnel
- Hot glue, razor, scissors, tape
- LED (bipolar) (#334182)
- Lids from milk jugs or bottles for wheels
- Lighter with adult help
- Magnet wire, any gage (#2119355)
- Marker
- Masking Tape
- Measuring cups
- Measuring spoons
- Motor, 1.5-3V DC (#231925), get 2
- Motor, 9-18VDC (#232022)
- Nail
- Nylon bushing (from hardware store - for Stirling Engine project)
- Old inner tube from a bike wheel
- Paperclips
- Paper cups
- Paper, black construction type
- Penny
- Pizza box (clean!)
- Plastic soda bottle, 2L
- Plastic wrap
- Pliers
- Poster board (2)
- Propeller (you can rip one off an old small personal fan or find them at hobby stores)
- PVC pipe (any size)
- Raw peanuts
- Reusable plastic baggies
- Coal rock samples (I used bituminous coal and anthracite coal in the video)
- Salt (1 cup)
- Sand paper
- Soda cans, clean and empty (6)
- Solar cell (#2260041 or 2221456)
- Solar motor (#238458)
- Steel wool
- Straws (2)
- Super glue with [accelerator spray](#)
- Swiss army knife (with can opener option)
- Tack
- Tinsel or aluminum foil
- [UV shortwave lamp](#)
- Votive candle
- Watch or clock
- Wire (3- conductor solid wire)
- Wire cutters
- Wire, insulated (#36792)
- Wooden skewers (BBQ-style)
- Yeast

### **During the Lesson:**

You can look over the worksheet so you know what to listen for as you go through the class with me, or you can go through it along with me during class. OR... flip it over and forget about it and just enjoy the class. When class is over, flip it back over and fill it out and be amazed at how much you've picked up and learned!

1. \_\_\_\_\_ energy is generated from natural processes that are constantly replenished, like solar, wind, and waves.
2. \_\_\_\_\_ energy is an energy source that is an alternative to using fossil fuels and doesn't harm the environment, like fuel cells and natural gas.
3. \_\_\_\_\_ has different forms: kinetic, potential, thermal, chemical, electrical, sound, electrochemical, electromagnetic, and nuclear.
4. Light is \_\_\_\_\_ that can travel through \_\_\_\_\_.
5. Greenhouse \_\_\_\_\_ in the atmosphere trap and hold heat.
6. Nuclear reactors are used for generating \_\_\_\_\_ and propulsion in ships.
7. Solar panels can heat \_\_\_\_\_ or generate electricity.
8. A packet of light is called a \_\_\_\_\_.

9. Phosphorescence is light \_\_\_\_\_ after being excited to a higher energy state.
10. The Photoelectric Effect is when \_\_\_\_\_ are emitted from an object when light hits the surface.
11. Solar cells convert \_\_\_\_\_ into electricity.
12. NEVER look at the \_\_\_\_\_ through anything with \_\_\_\_\_!
13. Solar thermal power stations heat \_\_\_\_\_ into \_\_\_\_\_ to generate electricity.
14. The energy in molten \_\_\_\_\_ heats water to make \_\_\_\_\_ to generate electricity.
15. Electromagnets have their magnetic field produced by an \_\_\_\_\_ current.
16. Electricity \_\_\_\_\_ magnetism.
17. Wind turbines convert the wind's \_\_\_\_\_ energy into electrical energy.

18. Draw a picture of your favorite Wave Technology device:

19. Draw a picture of your favorite Tidal Stream Technology device:

20. Dams protect people, store \_\_\_\_\_ for drinking and growing plants, and make hydro-electric \_\_\_\_\_.

21. Hydroelectric power plants use \_\_\_\_\_ to generate electricity.

22. Geothermal power stations use \_\_\_\_\_ from the Earth's core to produce electricity.

23. Water vapor \_\_\_\_\_ into liquid water.

24. Temperature is a speedometer for \_\_\_\_\_!

25. Temperature measures \_\_\_\_\_ energy, which is how fast the molecules in something are vibrating and moving.

26. Thermal energy is how much the molecules are \_\_\_\_\_ inside an object.
27. The \_\_\_\_\_ the temperature, the faster the molecules are moving.
28. The movement of thermal energy is called \_\_\_\_\_.
29. Heat goes from \_\_\_\_\_ to \_\_\_\_\_.
30. Ocean thermal energy conversion uses the \_\_\_\_\_ difference in seawater to run a heat engine to produce electricity.
31. A Peltier device is a thermoelectric \_\_\_\_\_ pump that transfers heat from one side to the other using electrical energy.
32. Biofuels are fuels made directly from \_\_\_\_\_.
33. \_\_\_\_\_ fuel is an alternative to liquid fossil fuels and other biofuels.
34. Fuel cells produce electric current directly from a \_\_\_\_\_ reaction.

35. Fuel cell vehicles are a type of \_\_\_\_\_ vehicle that use a fuel cell instead of a battery to power an electric motor.

36. Solar Fuel Cell systems use electricity from \_\_\_\_\_ cells to split liquid water into  $H_2$  and  $O_2$  gases, which are then recombined in a \_\_\_\_\_ cell module to generate energy.

37. A Fresnel lens is a type of \_\_\_\_\_ lens originally developed for lighthouses.

38. Piezoelectric Effect: certain materials generate an electric \_\_\_\_\_ when mechanical stress is applied.

39. Waste-to-Energy Facilities produce electricity and heat through \_\_\_\_\_.

40. What I didn't know about robotics until class today was:

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## **Vocabulary Words**

**Alternative energy** is an energy source that is an alternative to using fossil fuels and doesn't harm the environment, like fuel cells and natural gas.

An **atom** is the smallest bit of stable matter. Atoms are made of a group of neutrons and protons, with an electron cloud circling the nucleus.

**Combustion** is rapid chemical combination of a substance with oxygen, involving the production of heat and light.

**Current** is electric charge that is moving. Electric current flows in a closed loop of an electrical circuit.

Reservoirs created by **dams** not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use, aquaculture, and navigability. Hydropower is often used in conjunction with dams to generate electricity.

An **electrical circuit** is a closed loop path in which electrons flow.

An **electromagnet** is a soft metal core made into a magnet by the passage of electric current through a coil surrounding it.

**Electrons** carry the charge in an electric circuit. Electrons have a negative charge.

Energy has a number of different forms; kinetic, potential, thermal, chemical, electrical, electrochemical, electromagnetic, sound and nuclear. Energy is derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines.

**Geothermal energy** is the heat from the Earth that is clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

A **greenhouse gas** is any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere.

**Light** is electromagnetic energy within a certain portion of the electromagnetic spectrum. The word usually refers to visible light, which is visible to the human eye and is responsible for the sense of sight.

A **magnet** is a piece of iron (or an ore, alloy, or other material) that has its component atoms so ordered that the material exhibits properties of magnetism.

**Nuclear energy** is the energy released during nuclear fission or fusion, especially when used to generate electricity.



The **photoelectric effect** explains the experimental observations of the emission of electrons from an illuminated metal surface. For a given metal, there exists a certain minimum frequency of incident radiation below which no photoelectrons are emitted. This frequency is called the threshold frequency.

**Renewable energy** is generated from natural processes that are constantly replenished, like solar, wind, and waves.

**Solar panels** are designed to absorb the sun's rays as a source of energy for generating electricity or heating.

A **static charge** is when there is an imbalance of electric charge (more protons or more electrons).

A **wind turbine** is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of vertical and horizontal axis types.

## **Answer Key**

1. Renewable energy is generated from natural processes that are constantly replenished, like solar, wind, and waves.
2. Alternative energy is an energy source that is an alternative to using fossil fuels and doesn't harm the environment, like fuel cells and natural gas.
3. Energy has different forms: kinetic, potential, thermal, chemical, electrical, sound, electrochemical, electromagnetic, and nuclear.
4. Light is energy that can travel through space.
5. Greenhouse gases in the atmosphere trap and hold heat.
6. Nuclear reactors are used for generating electricity and propulsion in ships.
7. Solar panels can heat water or generate electricity.
8. A packet of light is called a photon.
9. Phosphorescence is light emitted after being excited to a higher energy state.
10. The Photoelectric Effect is when electrons are emitted from an object when light hits the surface.
11. Solar cells convert sunlight into electricity.
12. NEVER look at the sun through anything with lenses!
13. Solar thermal power stations heat water into steam to generate electricity.
14. The energy in molten salt heats water to make steam to generate electricity.
15. Electromagnets have their magnetic field produced by an electric current.
16. Electricity causes magnetism.
17. Wind turbines convert the wind's kinetic energy into electrical energy.
18. Draw a picture of your favorite Wave Technology device:
19. Draw a picture of your favorite Tidal Stream Technology device:
20. Dams protect people, store water for drinking and growing plants, and make hydro-electric power.
21. Hydroelectric power plants use water to generate electricity.
22. Geothermal power stations use heat from the Earth's core to produce electricity.
23. Water vapor condenses into liquid water.
24. Temperature is a speedometer for molecules!
25. Temperature measures thermal energy, which is how fast the molecules in something are vibrating and moving.
26. Thermal energy is how much the molecules are moving inside an object.
27. The higher the temperature, the faster the molecules are moving.
28. The movement of thermal energy is called heat.

29. Heat goes from hot to cold.
30. Ocean thermal energy conversion uses the temperature difference in seawater to run a heat engine to produce electricity.
31. A Peltier device is a thermoelectric heat pump that transfers heat from one side to the other using electrical energy.
32. Biofuels are fuels made directly from living matter.
33. Algae fuel is an alternative to liquid fossil fuels and other biofuels.
34. Fuel cells produces electric current directly from a chemical reaction.
35. Fuel cell vehicles are a type of electric vehicle that use a fuel cell instead of a battery to power an electric motor.
36. Solar Fuel Cell systems use electricity from solar cells to split liquid water into H<sub>2</sub> and O<sub>2</sub> gases, which are then recombined in a fuel cell module to generate energy.
37. A Fresnel lens is a type of compact lens originally developed for lighthouses.
38. Piezoelectric Effect: certain materials generate an electric charge when mechanical stress is applied.
39. Waste-to-Energy Facilities produce electricity and heat through combustion.