Toil for Oil Tag

Overview: Learn about renewable and non-renewable resources and identify issues related to the environment from using them.

Keywords: Renewable, Non-renewable, Environmental Impact

Age / Grade Range: 5th-6th grade

Background: Renewable resources can be categorized as resources that can be regenerated in a human's lifetime. Wind, solar, geothermal, hydroelectric, and biomass are examples of renewable resources.

Non-renewable resources cannot be regenerated in a human's lifetime. Examples of non-renewable resources are coal, natural gas, crude oil, and uranium.

There are pros and cons to each type of resource that should be considered when using them for energy.

Solar
Solar collection systems can be used to generate heat or electricity. Using photovoltaic cells sunlight can be directly converted into electricity. Additional solar systems can be used to heat water or homes.
Benefits:

- No need to connect to a existing electrical grid, you can create your own making solar useful for remote areas
- No green house gas emissions when producing electricity
- Can be efficiently placed around structures such as on top of covered parking spots, on roofs, along walls.
- Resource regenerates each day no fuel costs.

Drawbacks:

- Solar energy varies based on the time of day, time of year, geographic location on the globe and weather events. (http://www.eia.gov/energyexplained/index.cfm?page=solar_home)
- Solar panels have a high initial cost with panels recouping the cost in energy savings over the lifetime of the panel. Panels can have lifespan of 20-25 years (http://www.solarpanelinfo.com/solar-panels/solar-panel-cost.php). As panels age their efficiency decreases in generating electricity.
- Solar energy needs to be collected over a large space to be efficient. Solar collectors are one way to increase solar panel efficiency by

having mirrors redirect sunlight to a solar collector. While this increases the energy collection from the sun, any wildlife passing through the collection point can be killed from the intense heat reflected from the mirrors. The heat is dependant on the number of mirrors used in the system. Industrial/commercial systems have this capacity. (http://www.scientificamerican.com/article/solar-farms-threaten-birds/)

Wind

Electricity is generated by wind spinning giant blades connect to a generator creating electricity. Wind is created by uneven heating of the Earth's surface from the sun. This uneven heating creates convection, air currents, high pressure and low pressure zones. At night uneven cooling creates the same patterns.
(http://www.eia.gov/energyexplained/index.cfm?page=wind_home)
Benefits:

- Can work whenever there is wind, no dependency on day or night.
- Does not generate green house gas emissions when generating electricity
- Regenerates with the heating and cooling of the Earth
- No fuel costs

Drawbacks:

- Wind turbines can kill birds. (http://news.nationalgeographic.com/news/energy/2014/04/140427-altamont-pass-will-newer-wind-turbines-mean-fewer-bird-deaths/)
- Need to be placed in high wind areas to work efficiently.
- Turbines generate a lot of noise which reduces their placement in residential areas. (http://www.conserve-energy-future.com/Disadvantages_WindEnergy.php)
- Turbines have are negatively associated by disrupting the visual impact of a landscape.

Geothermal

Water that is heated by the Earth's magma is used to drive turbines to generate electricity (http://energy.gov/eere/geothermal/geothermal-faqs).
Benefits:

- Do not produce GHG when producing electricity
- Renewable as the heat is gathered from the Earth
- Stable output of electricity and low cost of maintenance
- No fuel costs

Drawbacks

- Immense initial costs to drill wells, one 1,500 meter well could cost $2.3 million and it might not work. (https://www1.eere.energy.gov/geothermal/pdfs/egs_chapter_6.pdf)

- Without proper management, geothermal plants can siphon heat faster than it can be replenished (http://energy.gov/eere/geothermal/geothermal-faqs).
- Restricted to locations with high geothermal activity (http://energyinformative.org/geothermal-energy-pros-and-cons/).
- May cause earthquakes (http://energyinformative.org/geothermal-energy-pros-and-cons/).

Hydroelectric

There are several forms of hydroelectric generation. Typical generation is from a dam that blocks a river and lets water out past a turbine to generate electricity. New technology and ideas are expanding hydropower to include using tides to generate electricity. (http://www.eia.gov/energyexplained/index.cfm?page=hydropower_home, http://education.nationalgeographic.com/education/encyclopedia/tidal-energy/?ar_a=1)

Benefits:

- Constant generation of electricity
- No GHG emissions from producing electricity
- Renewable through the water cycle

Drawbacks:

- Costly to install and may divert stream flow
- Can cause stream bank erosion
- Will move stream bank habitat and cause a body of water to form behind them
- Can emit the green house gas methane as plants submerged decay. (http://ecowatch.com/2014/08/14/dams-not-clean-energy-climate-change/)
- Disrupts water quality downstream as nutrients are blocked by the dam
- Can disrupt fish spawning if fish ladders/cannons not installed.

Biomass

Biomass is using plant or animal matter to create fuels from. Biomass can be directly burned or converted into biofuels. A notable example of this would be soy bean and corn being converted into alcohol. Corn and soybeans are categorized as 1st generation biofuels. Second generation biofuels are produced from woody sources such as Juniper, left over piles of unused timber from harvesting called slash, and unused lumber from construction sites. Biomass can also come in the form of animal manure and human waste. Harvesting natural gas from landfills is considered a type of biomass. (http://www.eia.gov/energyexplained/index.cfm?page=biomass_home)

Benefits:

- Depending on the source, biomass can be renewed in years or months.

- Is a carbon neutral process, burning the fuel releases carbon dioxide, but growing the next batch absorbs carbon dioxide.

Drawbacks:

- Expensive to produce. Technology has allowed us to harness plants for fuel, however the process is still being refined.
- There needs to be enough space to grow the biomass.
- The rate of consumption of biomass must be monitored careful to avoid harvesting at a higher rate than production. (http://energyinformative.org/biomass-energy-pros-and-cons/)

Coal

The most common fossil fuel produced in the US. Coal is a sedimentary rock composed of carbon and hydrocarbons formed from decaying plant matter over millions of years.
(http://www.eia.gov/energyexplained/index.cfm?page=coal_home)

Benefits:

- Provides a constant predictable generation of electricity.
- Energy source is stable enough for transportation and handling. Coal will remain coal at room temperature.

Drawbacks:

- Creates GHG's when burned. Harvesting, transporting and refining coal also emits GHGs.
- Burning coal can also release additional gases that can combine with water and create sulfuric and carbonic acids which fall to Earth as acid rain.
- Harvesting crude can damage the environment.
- If an accident occurs such as spills or leaks the environment will be harmed.

Natural Gas

Created in the same process as coal. Decaying plant and organic matter is covered by sand and silt. Over millions of years heat and pressure convert the matter into coal and natural gas. Geologists study the bedrock to determine where natural gas deposits are likely located to drill. Most natural gas consumed in the US is produced in the US. Natural Gas is a fossil fuel.
(http://www.eia.gov/energyexplained/index.cfm?page=natural_gas_home)

Benefit:

- Energy security, since the US produces most of what it consumes the risk of a shortage is low.
- Provide a constant generation of electricity.
- High energy release when being burned.

Drawback:

- When used, emits GHG's. Also emits GHG's in transportation.
- Extremely flammable and must be contained and transported in a

special way to prevent explosions.
- Harvesting crude can damage the environment.
- If an accident occurs such as spills or leaks the environment will be harmed.

Crude Oil
Oil is formed from the remains of plants and animals that lived in a marine environment. Creation of oil takes place over millions of years. Many products can be created out of oil such as jet fuel, heating oil, diesel, other petroleum products (Vaseline), and gasoline. Plastics come from oil and can be made into many products like store containers, clothing, shovels, and many more things.
(http://www.eia.gov/energyexplained/index.cfm?page=oil_home)
Benefits:
- Several other products can be created from crude oil. It is a versatile resource.
- Generates a constant amount of electricity

Drawback:
- When used, transported, and refined; generates GHG's
- Types of crude oil vary in composition, depending on the type of crude it could require little or significant refining. Canadian Tar Sand oil would require significant refining due to its composition.
- Harvesting crude can damage the environment.
- If an accident occurs such as spills or leaks the environment will be harmed.

Uranium
The only non-renewable non-fossil fuel. Uranium is a radioactive element that undergoes nuclear fission. Fission is when atoms split apart releasing energy in the process. As the uranium undergoes fission it heats water surrounding it, this energy is transferred to a closed system with a turbine generator. The heated water from the uranium heats the water with the turbine creating steam which spins the turbine and generates electricity. Control rods regulate the rate of fission.
(http://www.eia.gov/energyexplained/index.cfm?page=nuclear_home)
Benefits:
- Stable generation of electricity.
- Resource can generate electricity for a long period of time before being replaced.

Drawbacks:
- After the fuel is spent, the uranium is still highly radioactive and needs to be carefully stored to prevent leakage and water contamination. This spent fuel will remain dangerous to humans for thousands of years before become safe again.
- While power plants are engineered for durability, if a reactor

overheats, fails, or becomes damaged the surrounding area would have to be evacuated until the reactor is fixed or indefinitely. Examples would be the Fukashima reactor and Chernobyl reactor. The area affected by radiation depends on the damage. Traces of radioactive water was detected on the west coast of the US several months after the reactor in Fukashima was damaged.

- Retired reactor water also needs to be stored safely since it is heavily contaminated with radiation.

It is important to understand that there is no easy solution to fulfill the energy demands of the people. It is important to understand the risks involved when building different types of energy plants. It is risky to wildlife to build solar collector plants and wind turbines in a migratory bird flyway. Less risky to wildlife to build a biofuel processing plant in the same area.

Next Generation Science Standards & Common Core:

Goals:

Students will participate in a resource harvesting simulation to learn about renewable and non-renewable resources while exploring the benefits and drawbacks of each resource.

Students will be able to compare and contrast renewable and non-renewable energy sources.
Students will be able to distinguish the benefits and drawbacks from using specific types of energy.

Objectives:

Students will be able to compare and contrast renewable and non-renewable energy sources.
Students will be able to distinguish the benefits and drawbacks from using specific types of energy.

Materials:

Energy Cards (Same information in Background Section, student friendly)
Flags or cones to mark boundary

Set up:

Find a space large enough for your group to run around in. Try to make the space a little smaller to ensure the simulation runs quicker.

You might be asked if the person tagging can guard/puppy guard/hover. Yes they can.

Classroom Time:

One 30 minute community

Introduction (Engage):

Note: Text in "quotations" signifies suggested dialogue to engage

students in and is not intended to be a script. Use your best judgment when delivering these lessons.

Activity (Explore):

"What do you use at home that requires electricity?" (field answers)
"Where does that electricity come from?" (field answers)
"Did you know there are many different ways to generate electricity? Can anyone name one that they know?" (field answers until all are said, coal, oil, natural gas, nuclear, wind, solar, geothermal, hydroelectric, and biomass<- might be hard to get).
"We're going to simulate how humans gather the resources needed to generate electricity." (Setup field now, or you could do it before they arrive in the morning)
(Standing in the boundaries) "This area represents a gathering site. You will be representing a resource and you must stay within these boundaries. Since humans can't reach down and grab resources with their hand we have to be creative. For oil and coal we have to dig for it, a difficult job. So to simulate this effort exerted by humans when gathering resources, if you are a resource you get to run around and from the human. This is a tag game! One of you will be the human and your job will be to go around 'gathering' resources by tagging them. We will play this game for 2 rounds. I will give you a resource card, keep this information private to yourself. DO NOT SHARE ANYTHING ON YOUR CARD UNTIL I SAY SO, IT'S PART OF THE GAME! (Super serious because this can affect the dynamic of the game. Each card has a picture of what is being represented on the front. On the back has instructions on what the student needs to do if they are tagged. It will provide them a time to crouch down until they are back into the game and how many lives they have. ie. Coal, when tagged crouch down and count to 4 before resuming game play. You have 4 lives.) On the back side of the card there are instructions for you to follow if you are tagged. Read them to yourself and if you have any questions COME SEE ME PERSONALLY! For example the back of your card might say when tagged crouch down and count to 4 before resuming game play. You have 4 lives. (demonstrate counting and crouching). How many lives do I have left after being tagged? (using this example, 3) Great! Who wants to be the human? (However you want to sort out the human). Ok my human gatherer wait over by that flag/cone. Everyone else I'll give you a resource card, remember if you have questions let me know. (hand out ROUND 1 resource cards)."
"Ok resources, spread out get ready! Human ready? Resources ready? GAME ON!" (Round 1 has all non-renewable cards, game play will end when there is nothing left to harvest).

"Ok that was round 1, lets simulate a different resource field! Pass back your cards to me. Who wants to be the new human? Ok human wait over by that cone/flag. Alright resources go ahead and scatter, remember to keep your card information to yourself, don't shout anything out! (Go to each student and give them a ROUND 2 resource card. These cards will give students an

	infinite amount of lives.) Ok, everyone ready? Game on! (You should see a difference in how resources run, Round 1 will be hectic and fast, round 2 might have a lot less running and a lot of not caring if they get tagged. You will need to end this after a period of time since everyone has infinite lives. When you are done collect the ROUND 2 cards and have your group get in a circle.)
Explanation	"Think about how you felt as a resource in round 1 or if you were the human at the end of round 1 and sum it up in 1 word. Who wants to start first? (Hopefully you will hear 'scared, afraid, fearful') Now think to round 2, how did you feel, again summing up in 1 word. (field answers) Why did you feel that way? (field answers) "What were you in round 1 compared to round 2?" (Have them share what they were.) What differences did you have from round 1 to round 2? (field answers) You can bring this up again in Energy Audit and Value of a Tree
Content-Tie in	Energy Audit: A brief review of where does electricity come from and what sources generate it. Value of a Tree: When referring to the slash piles this activity could be brought up as a way to use the leftovers for creating biofuels with or leaving them on the ground to recycle nutrients back into the soil.
Elaboration:	"Round 1 was a resource field made up of non-renewable resources. Your card may have said how long it would take in years to regenerate. Round 2 was a resource field made up of renewable resources. That feeling you described in round 1, is how I feel about using non-renewable resources, when is it going to run out. How you felt during Round 2 is how I feel about renewable resources. However there might have been benefits to using each resource and drawbacks. Who had Coal? What were some drawbacks or benefits you remembers? (field answer for Coal. Continue to do this for all energy resources.) "Depending on where you live, how you live and what you chose will influence the resources you need. Should we use all of one resource? Should we diversify? These questions you will come up again and again as you get older. Now you have the knowledge to help make a decision. Any questions?"
Evaluation:	Working with a partner, come up with an energy plan for the future and what types of resources they would want to use and why. Present to the whole group.

Additional resources: Where can the teacher go to learn more? List websites or books that might be useful.