Lesson Plan: The Energy Problem

Concepts

1. Energy is a critical resource that is used in all aspects of our daily lives.
2. Currently, society is strongly dependent upon nonrenewable energy resources, mainly fossil fuels.
3. The world's supply of nonrenewable resources is limited and their use can negatively affect our environment and economy.
4. Our personal choices will affect the future of the world's energy.
5. Making smart energy decisions today will prove beneficial later.
6. Energy is consumed not only when we plug an appliance into an outlet or turn on our cars, which is termed direct energy use, but also through the production and transportation of material goods we purchase and consume every day (indirect energy use).

Key Questions

1. How do our individual energy choices affect the global energy problem?
2. How would your life be different if the amount of energy available for use is drastically reduced?
3. Is our supply of energy infinite or finite?
4. What are some choices you can make that help alleviate the energy problem?

Student Learning Objectives
The student will be able to state that the depletion of fossil fuels is a serious global issue
The student will be able to list three decisions they can make that will reduce their own consumption of energy
The student will be able to use mathematics in other fields, using graphs, computation, and models.

Educational Standards:

NCTM Mathematics (6-8): A1.1, A1.4, A3.1, B3.1, E1.2, I3
NSES Science (5-8): F2.2, F3.2, F5.4;
ITEA Technology (2000): 3, 4, 5, 6, 16

Anticipatory Set

- We currently are highly dependent on fossil fuels for most of our energy supply – this energy is instrumental for maintaining our current society
- Our supply of non-renewable energy sources is being depleted and may even reach a point where the limited supply adversely affects their lives.
- The average American uses six times the energy as the global average.
- In the US alone we use one million dollars worth of energy every minute
- We can personally make choices that affect the energy situation

Key Terms

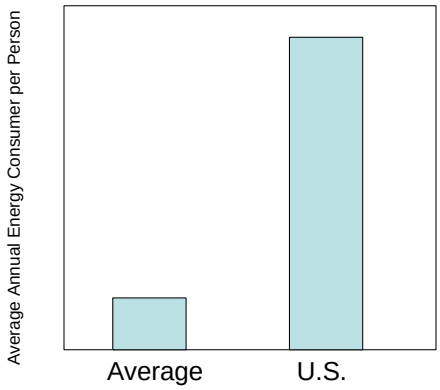
Fossil fuel	Energy consumption
Dependant Variable	Independent Variable

Teaching Plan:

This lesson includes activities to engage students in general energy issues, including playing an award-winning Energy Choices board game, and an optional graphing activity that provides experience with MS Excel graphing and perspectives on how we use energy and how much energy we use.

Day 1:

- Introduce yourselves and what scientists and engineers do
  - You could start by asking what the students think a scientist or engineer looks like and does, then explain that you are and that this semester they will be acting as scientists and engineers.
- ***Alternative A:*** Energy Intelligence Agency Activity
  - Pass out EIA letters and information slips (Make sure the info slips are folded so the students don't see what is written on them and that the important facts are scattered around the room and not in a group)
  - Explain that there are 5 informants in the room with crucial information and the rest are decoys
  - The students must find the 5 crucial facts however they must use a code phrase to get the information. For example, Joe would approach Mary and say "Not Every Cat Hates Mice". Mary would then respond with what is written on her slip of paper even if it is not important.
  - Each student should write down the facts they deem important as they go around the room
- Go over the informants facts as a class
  - Americans use 6 times the energy as the average of people in the rest of the world. (Draw bar chart) Is this fair?



- Fossil fuels are depleted at a rate that is 100,000 times faster than they are formed. What does this mean? What do you think will happen to the supply of fossil fuels within our lifetime?
- Approximately 30,000 lives are cut short in the U.S. each year due to pollution from electricity production. What kind of pollution have you seen from electricity and energy production?
- The average American uses the amount of energy that is equivalent to 7 gallons of gasoline every day. Where do you use energy in your own lives? Mention the 3 main areas of energy use:
    1. Comfort (Heating and Cooling)
    2. Household Activities (Entertainment, cooking, lights, etc.)
    3. Transportation
- A car that gets 20 miles per gallon (mpg) emits approximately 50 tons of global-warming-inducing carbon dioxide over its lifetime. What is global warming? Where have you heard that term before? Mention global warming current events (Polar bears habitats, etc)

- ***Alternative B:*** Get students engaged with energy topic through a "carousel" activity. Divide class into groups of three or four students each. Have them circulate fairly rapidly among poster boards tacked to wall with various energy related questions to get them to think about how they use energy. Each group should have a different colored marker to differentiate their responses on the posters. Questions could include:
    - How do you use energy for your mobility? What sources do you use?
    - How do you use energy for your entertainment activities?
    - How do you use energy for your personal comfort? What energy sources are used?
    - How is energy used in the food that you consume (other material goods you consume)
    - How would your life be different if we have very limited petroleum? (would expect answers to include issues related to materials (e.g., plastics) and chemicals made out of petroleum, not just loss of transportation fuel)
- Regroup and discuss responses and our dependence on energy (can integrate some of detective activity facts during this discussion if that activity not done)
- Discuss places one could conserve in your own lives

- Wrap up by asking “Do you think that the choices you make everyday have any effect on the energy issue?”

Day 2:

- Goal – to “live” thinking about energy through a board game to become actively engaged with every day energy choices.
- The Energy Choices Game
  - Pass out instructions and tally sheets
  - Explain each card and how it is used (see game instructions)
  - If it is a large class you may want to use an overhead of the game board and take a couple turns
  - If the class is smaller it may be easier to let the students break into groups and try it out themselves. The fellows can walk around and guide them along.
  - Break into groups and let the students try it out. This first day of game play is just to get the students acclimated to the game and all the components.

Day 3(and 4):

- Play the Energy Choices Game
  - Ask students why they are making the decisions they make and how it affects their energy use.
- An extra day may be needed to finish the game. If this is the case have the students paper clip their money and put it in a marked envelopes with:
  1. Their Name
  2. The square on the board they last landed on
  3. The number of gas cards they have

  All other information (car, home system, etc.) should be on their tally sheets. An envelope should also be allotted for the banker’s money, labeled with:
  1. The names of the group members or the bankers name
  2. The number of gas cards that are left in the pile.

Day 4(or 5):

- Review Energy Choices Game Discussion questions as a class
  - How did the choices you made affect how much money you had at the end?
  - Which home system wound up with the most money at the end? Why?
  - Which car wound up with the most gas cards at the end? What do you know about this type of car? (big, gas guzzler) How did having a lot of gas cards affect their financial state?

- What do you think the carbon tax you paid at the end of the game represent? (carbon in fossil fuels causes depletion of fossil fuels and CO_2 emissions that contribute to global warming)
- Why did gasoline and home energy prices increase throughout the game? Do you think this will be an issue in your own lives?
- Did any teams run out of gasoline cards? What does this represent? Which transportation contributed most to the depletion of gasoline cards?

- Quick assessment (optional)
  - Write down and pass in: List three energy choices that you would make the next time you played this game (or in your own lives) to reduce the cost and impact of your energy consumption.

Day 5-6: Excel graphing (possibly three days depending on experience with graphing)

- Preparation – load excel workbook onto all computers and open file
- Review facts compiled during first day activities regarding how we use energy and how much to convey – we use energy in all aspects of our lives and we use a lot of energy in the USA (Canada too!)
- Explain goals of today's class – use data from the U.S. Department of Energy – Energy Information Agency (EIA) to graph information about how we use energy and how much we use
- Demonstrate the generation of one of the graphs and what interpretation can be made
- Introduce and define dependant and independent variables
- Have students work in pairs, each group can create one graph. Each pair should print their graph and be able to describe their interpretation to the class
- Explore the following discussion questions:

Which energy use sector is increasing the fastest? What energy resource does this sector primarily use? Where does most of this energy resource come from?

Which type of fuel is used most in the U.S.? Which is used the least?

Which country consumes the most oil? The least oil?

Compare how much oil the U.S. consumes with the amount we produce.

How much oil does the U.S. need per day? How much do we produce? Where does the rest come from?

What uses the most energy in the average U.S. household? What energy resource does this activity typically use?

How does energy consumption, by source, compare between New York State and the U.S. average? What are some reasons for the differences?

Identify the dependant and independent variables in the given data set.

What portion of our household energy use is provided by electricity? How do the New York numbers compare with average U.S.?

And what uses most of that electricity? Do you think this is comparable to your household? How can we use this information to save energy?

Notice the difference between the "primary electric energy" (generated at the utility plant) and the electricity consumed in the household. Why such a big difference?

- Close with a discussion of what the real problems are that they see in our energy consumption, define any results they might have found surprising
- Look forward to next class and rest of unit – goal is to come up with ways we can actually contribute to the solution of the problem.

Resources

Energy Intelligence Agency Activity (included below)
EIA Letter
Informant Facts

Carousel Activity
Large poster size pieces of paper
markers

Energy Game (separate files, see http://www.clarkson.edu/highschool/k12/project/energychoicesgame.html)

Graphing activity
Activity Sheet
Excel workbook with data (separate file)

Lesson Assessment

Quick energy choices quiz after the game

URL

All lesson plans in this unit are included at
http://www.clarkson.edu/highschool/k12/project/energysystems.html

This URL has been included in the Engineering Pathways web site (http://www.engineeringpathway.com/ep/index.jhtml) and can be found with a search on "energy choices."

Owner

Office of Educational Partnerships, Clarkson University, Potsdam, NY

Contributors

Susan Powers, Jan DeWaters, and a number of Clarkson and St. Lawrence students in the K-12 Project Based Learning Partnership Program. This unit was developed under National Science Foundation DTS and GK-12 grants No. DUE-0428127 and DGE-0338216. These contents do not necessarily represent the policies of the National Science Foundation, and you should not assume endorsement by the federal government.

Copyright

Version: December 2008

Activity: Energy Intelligence Agency -
Student Hand out

:

EIA agents,

There is a global situation on the horizon that is threatening our very existence. I have been notified that there are 5 secret informants among you that hold crucial information about this problem. Your mission, should you choose to accept it, is to find these informants, interrogate them, and obtain the crucial information within the next 20 minutes. Be aware that there are also decoys that do not hold crucial information but may waste your valuable time. Good Luck and be careful.

PS.- This message will self destruct in 30 seconds.

(the following should be printed, cut apart and distributed to students)

Americans use 6 times the energy that the average person in the rest of the world does.

Fossil fuels are depleted at a rate that is 100,000 times faster than they are formed.

Approximately 30,000 lives are cut short in the U.S. each year due to pollution from electricity production.

The average American uses the equivalent to 7 gallons of gasoline of energy per day.

A car that gets 20 miles per gallon (mpg) emits approximately 50 tons of global-warming-inducing carbon dioxide over its lifetime.

I let the dog's out.

I'm Batman.

The Hokey Pokey is what it's all about.

The itsy bitsy spider climbed up the water spout.

_____, I am your father.

I love bugs.

People say I look like a young Albert Einstein.

I eat dirt.

I am Mr./Mrs. Squarepants.

Te amo, queso.

My dog speaks Russian.

I just saved a bunch of money on my car insurance by switching to Geico.

Can you hear me now?

My uncle invented the internet.

Chuck Norris does not like pie.

Rainbows really do taste like Skittles.

I can make a sound like a car alarm. Woo Woo Woo Woo!

Drop it like it's hot.

I love you

Activity – Energy Perspectives

Background and Purpose

Americans use a lot of energy! Even though our population is only about 5% of the globe's total, we use almost 30% of the world's energy resources! The energy we use comes from a variety of resources, some provided within our own borders and some imported from other countries. Every year we need to import larger and larger amounts of resources to meet our growing energy demand. Even though we are beginning to develop renewable energy resources, they still provide only a small fraction (about 6%) of our energy use. Most of our energy (about 85%) comes from non-renewable fossil fuels.

We rely on energy for almost everything we do. Different types of energy resources are used for different end uses – transportation, which is the fastest growing of all the energy consumption sectors in the US, mainly uses petroleum (and last year we imported about 60% of our total petroleum use). Energy is used in our homes for many things including heating and cooling, cooking, lighting, and appliance use. Our homes use a lot of electric energy, and most of that is produced by burning fossil fuels (mainly coal). Industries are the third energy consumption sector.

Activity

Graphs are tools that scientists use to help them understand, analyze, and present information.
In this activity you will prepare graphs of energy resource consumption or development data.

You will receive a table that contains information about energy consumption or energy resource development. Your task is to create a graph (bar, pie, or line graph) of your data, so that you can present and describe the information to the rest of your class.

Procedure

There are 10 different sets of data. Once you receive your assignment, prepare the graphs and answer the questions, then be prepared to share your information and discuss with the rest of the class. Review the discussion questions to see which you can address with your information.

Group 1. Energy Imports and Exports

Prepare a line graph that shows energy imports and energy exports over time. You may use a different color for each energy source, or you may choose to just plot the total imports and total exports. Be sure to include units! Identify the dependant and independent variables.

Group 2. Energy Production and Energy Consumption

Prepare a line graph that shows energy production and energy consumption in the U.S. over time. You may use a different color for each energy source, or you may choose to just plot the total amounts. (Hint: you may want to plot "total renewables" and then prepare a separate graph showing each renewable, because of the difference in scale.) Be sure to include units! Identify the dependant and independent variables.

Group 3. Energy Consumption by the Different "Energy Sectors"

Prepare a graph that shows the relative energy (total) use by the 4 major sectors for 2006 (include residential, commercial, industrial, and transportation - the "total" numbers already include their portion of the electric power sector column). You may use a pie or bar graph. Then prepare a line graph that shows the change in energy use over time for the different sectors -- note the differences in the rates that each sector increases. Which is increasing the most? Identify the dependant and independent variables.

Group 4. Residential Energy Consumption, by Source

Prepare a graph that shows the types of fuel that provided energy in the residential sector (household energy use) in 2006. Plot the different fossil fuels and total renewables in a bar graph, then make a separate plot of the different renewables (all for 2006). What about the electrical energy - where do you think that should fit into your graph? Identify the dependant and independent variables.

Look at the numbers for the electricity retail sales (that is the amount you pay for on your bill) compared to the system losses. About what percentage of the total electricity generated at the utility plant is usable to the consumer?

Group 5. Residential Energy Consumption, by Source and User

Prepare a graph (or a few graphs) to show the amount of energy used by each source in the average household, both in the US and in New York State. Would you use a bar or a PIE chart? Why? Identify the dependant and independent variables.

Look at the numbers for the electricity retail sales (that is the amount you pay for on your bill) compared to the system losses. About what percentage of the electricity generated at the plant do you use in your home? Does this surprise you?

Group 6. Household Energy Consumption, by End-Use

Prepare a graph that shows the ways we use energy in our homes, both in the U.S. and in New York State. Do you think a PIE or a BAR chart would be better? Identify the dependant and independent variables.

Group 7. Household Electricity Consumption, by End-Use

Prepare a graph that shows the ways we use electricity in our homes. Do you think a PIE or a BAR chart would be better? Identify the dependant and independent variables.

Prepare a graph that shows the electricity use by kitchen appliances. What is the biggest electricity user in the kitchen?

Group 8. Energy Consumption by House Type, Size, and Year of Construction *(note – you have 2 excel worksheets)*

Prepare a graph that shows the relationship between energy use and type of house (a line graph would be best). How does your graph show possible reasons why our energy use in the U.S. is so much higher than other parts of the developed world?

Prepare a graph that shows the relationship between size of house and energy use (a line graph would be best). Identify the dependant and independent variables.

Prepare a graph that shows the relationship between energy use and the year in which the house was built (again, a line graph). Identify the dependant and independent variables.

Compare your graphs. What does the information tell us about the trends in new home construction?

Group 9. Oil Importers and Exporters

Prepare two bar graphs that show the major oil exporters and importers. Where does the U.S. stand on each graph? Identify the dependant and independent variables.

Group 10. Oil Producers and Consumers

Prepare two bar graphs that show the major oil producers and consumers. Where does the U.S. stand on each graph? Identify the dependant and independent variables.