ROCKET SCIENCE: TAKING OFF WITH ENERGY

Grade Level or Special Area: 6th Grade
Written by: Joel E. Jacobson, Lincoln Academy, Arvada, CO
Length of Unit: Nine or ten lessons

I. ABSTRACT

This unit is a hands-on approach to learning the basics of energy as outlined in the *Core Knowledge Sequence*. It looks at the different states and forms of energy, where energy comes from, and how it impacts our everyday lives. This knowledge of energy is applied to model rocketry, as the students participate in building their own rocket and explaining all the types of energy surrounding it.

II. OVERVIEW

A. Concept Objectives
   1. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
   2. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
   3. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)

B. Content from the *Core Knowledge Sequence*
   1. Potential and Kinetic Energy (Not required by Core Knowledge)
   2. The Law of Conservation of Energy (Not required by Core Knowledge)
   3. Energy, Heat, and Energy Transfer (pp. 153-154)
      a. Energy
         i. Six forms of energy: mechanical, heat, electrical, wave, chemical, nuclear
         ii. The many forms of energy are interchangeable, for example, gasoline in a car, windmills, hydroelectric plants
         iii. Sources of energy: for example, heat (coal, natural gas, solar, atomic, geothermal, and thermonuclear), mechanical motion (such as falling water, wind)
         iv. How a model rocket gains/uses/experiences energy. (Not required by Core Knowledge)
         v. Fossil fuels: a finite resource
            a) Coal, oil, natural gas
            b) Environmental impact of fossil fuels: carbon dioxide and global warming theory, greenhouse effect, oil spills, acid rain
         vi. Nuclear Energy
            a) Uranium, fission, nuclear reactor, radioactive waste
            b) Nuclear power plants: safety and accidents
      b. Heat
         i. Heat and temperature: how vigorously atoms are moving and colliding
         ii. Three ways that heat and energy can be transferred: conduction, convection, radiation
            a) The direction of heat transfer.

C. Skill Objectives
1. Students will use scientific information to make decisions. (Jeffco Science Strand 3.2.D)
2. Students will describe objects based on their observable properties and characteristics. (Jeffco Science Strand 6.1.B)
3. Students identify the forces that act on an object. (Jeffco Science Strand 6.2.A)
4. Students will recognize that the motion of an object depends on the forces acting on it. (Jeffco Science Strand 6.2.B)
5. Students will predict what changes and what remains unchanged when an object is acted upon by an external influence. (Jeffco Science Strand 6.3.C)
6. Students practice taking guided notes on a provided worksheet.
7. Students practice identifying energy in everyday life.
8. Students will prepare and assemble materials and equipment to complete and experiment. (Jeffco Science Standards Strand 3.1.A)
9. Students will prepare and assemble materials and equipment to complete and experiment. (Jeffco Science Standards Strand 3.1.A)
10. Students will identify the uses of non-renewable resources. (Jeffco Science Standards Strand 3.2.A)

III. BACKGROUND KNOWLEDGE

A. For Teachers
1. http://www.apogeerockets.com/education/index.asp
2. http://www.energyquest.ca.gov

B. For Students
1. Chemistry: Matter and Change (5th Grade)

IV. RESOURCES

A. Model Rocket Kits
B. Model Rocket Engines
C. Model Rocket Launching Equipment

V. LESSONS

Lesson One: Introduction to Energy: Potential and Kinetic (40 minutes)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
   b. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
   c. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)
2. Lesson Content
   a. Potential and Kinetic Energy
   b. The Law of Conservation of Energy
   c. Sources of energy: for example, heat (coal, natural gas, solar, atomic, geothermal, and thermonuclear), mechanical motion (such as falling water, wind)
3. Skill Objective(s)
   a. Students will use scientific information to make decisions. (Jeffco Science Strand 3.2.D)

b. Students will describe objects based on their observable properties and characteristics. (Jeffco Science Strand 6.1.B)
c. Students identify the forces that act on an object. (Jeffco Science Strand 6.2.A)
d. Students will recognize that the motion of an object depends on the forces acting on it. (Jeffco Science Strand 6.2.B)
e. Students will predict what changes and what remains unchanged when an object is acted upon by an external influence. (Jeffco Science Strand 6.3.C)

B. *Materials*
1. A large, catchable ball (such as a football or softball)
2. A large rubber bouncy ball
3. A ball point pen
4. One balloon

C. *Key Vocabulary*
1. Energy – the ability to do work or cause change
2. Work – the transfer of energy
3. Kinetic Energy – energy in motion, or an object in motion that does work
4. Potential Energy – energy that is stored and held in readiness, or an object that is about to move
5. Potential Energy – energy that is stored and held in readiness, or an object that is about to move

D. *Procedures/Activities*
1. Pass out Appendix B: Potentially Kinetic, An Introduction to Energy.
2. Pose this question to the class: Why do we eat? Accept all reasonable answers. Explain to the students that food gives us energy; it allows our body to do work. For example, our heart has the energy to keep beating because of the resources we get from food.
3. Define ENERGY and have the students write the definition on the worksheet.
4. Explain to the class that there are two states in which energy exists. The first is KINETIC ENERGY.
5. Ask for a volunteer that is comfortable with his/her ability to catch. Have that student stand up. Pick up a football and tell the student you are going to throw it to them. Explain that while you are holding the football, it doesn't have any energy. Throw the ball. Tell the class that while the football is flying through the air, it has KINETIC ENERGY. Have the student return the ball in a respectful manner. Explain that the work the football does is parting the air molecules, as well as bruising the student who catches it.
6. Define KINETIC ENERGY and have the students record it on the worksheet.
7. Hold up a deflated balloon and ask if it has kinetic energy. The answer should be no. Why? Because the balloon is not in motion. Inflate the balloon. Tell the class that the second state of energy is POTENTIAL ENERGY. Tell them that the balloon now has potential energy. Ask for guesses as to why.
8. Define POTENTIAL ENERGY and have the students record it on the worksheet.
9. Let go of the balloon. Once it comes to rest, ask the class what happened to the POTENTIAL ENERGY. Lead them to the discovery that energy can change between potential and kinetic.
10. Define the LAW OF CONSERVATION OF ENERGY and have the students record it in their worksheet.
11. Tell the class that if an object has energy, it must be either POTENTIAL or KINETIC. Compare it to humans. If you are human, you are either boy or girl.

12. Ask the students, “So where does energy come from?” Encourage students to think about every aspect of their lives in order to come up with sources of energy. Guide them to the following answers: pedaling a bike, pushing a cart, water, volcanoes, tornadoes, heat, light, wind, snow, sun, lightning, pulling a wagon (or your little brother/sister), earthquakes, and hurricanes.
13. Take the rubber ball and stab it with the ball point pen. Make sure it is lodged somewhat solidly so that the pen doesn't fall out. Hold the ball out in front of you, with the pen sticking straight up (MAKE SURE IT ISN”T AIMED AT A STUDENT!!!). Ask if the ball has any energy, if so what kind. If they answer no, respond with “So you're telling me that if I drop this ball, nothing will happen to it?” Lead them to the discovery that gravity can/will give objects energy.
14. Ask the class to guess what will happen when you drop the ball. Accept any reasonable answers. Drop the ball and dive for cover as to avoid injuring yourself with the pen. (If done properly, the pen will shoot from the ball when it hits the floor.)
15. As a class, explore how energy was transferred from one state to another, and what the result was. Have them record this process in their own words on their worksheet.

E. *Assessment/Evaluation*
   1. Collect Worksheets.

Lesson Two: The Hair Colors of Energy (40 minutes)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
      b. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
      c. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)
   2. Lesson Content
      a. Six forms of energy: mechanical, heat, electrical, wave, chemical, nuclear
   3. Skill Objective(s)
      a. Students practice taking guided notes on a provided worksheet.
      b. Students practice identifying energy in everyday life.

B. *Materials*
   1. Copies for each student of Appendix C
   2. Copies for each student of Appendix D

C. *Key Vocabulary*
   1. Mechanical Energy – energy associated with the motion or position of an object; potential and Kinetic energy together are considered as Mechanical Energy
   2. Heat Energy – how hot an object is
   3. Electrical Energy – the energy contained in batteries, power lines, and lightning
   4. Wave Energy – any form of energy that travels in waves: sound, light and electromagnetic energy
   5. Chemical Energy – potential energy stored in chemical bonds that hold chemical compounds together; for example, wood, wax, and food such as chocolate and broccoli store Chemical Energy

6. Nuclear Energy – potential Energy that is stored in the nucleus of an atom and is released during nuclear reactions
7. Nuclear Fission – the nuclear reaction that occurs when the nucleus of an atom is split. This is used by nuclear power plants to make electricity
8. Nuclear Fusion – the nuclear reaction that occurs when nuclei from more than one atom are joined together
9. Uranium 235 – the most common fuel used by fission reactors to create nuclear power

D. *Procedures/Activities*

1. With the class, review the states of energy from the previous lesson while you return their worksheets from the previous day:
   a. Who can tell me what energy is?
   b. What are the two states of energy and define them?
   c. Is energy ever destroyed?
   d. Where does energy come from?
2. Tell the class that today's lesson will be mostly note taking, with a lab for the next lesson. Pass out Appendix D: The Hair Colors of Energy.
3. Explain to the class that humans, or people, are just like energy. If you are a human, you are either a boy or a girl. If you are energy, you are either potential or kinetic. People have different attributes—not everybody looks alike. There are different colors of hair, eyes, skin, and (unfortunately) teeth. Energy is the same as we are. We are going to look at the six different "hair colors" of energy.
4. Explain to the students that the first "hair color" of energy is MECHANICAL ENERGY. Ask if anybody has a guess as to what MECHANICAL ENERGY is. Accept all reasonable answers, guiding them towards the definition.
5. Define MECHANICAL ENERGY and have the students write the word and its definition on the worksheet. Give the class several examples: a car engine, a rocket, and an airplane.
6. Explain to the class that the second "hair color" of energy is HEAT. Using the definition of heat (Lesson One) ask the students why HEAT is considered energy.
7. Define HEAT ENERGY. Give example of heat energy: ice melting, hot air balloons, and fire. Heat energy can be useful and destructive.
8. Define ELECTRICAL ENERGY as the third "hair color" of energy. Give examples of ways that we use ELECTRICAL ENERGY: flashlights, electronic cars, computers, lights, vacuum cleaners, and first graders. Okay, not really first graders but we are still surrounded by ELECTRICAL ENERGY.
9. Review the first three types, or "hair colors," of energy.
10. Define WAVE ENERGY as the fourth "hair color" of energy. Explain that anything that travels in waves is included here. Ask the students why light is considered energy? Can it do any work? What about sound? Lead the students to discover that sound does work through vibrations. A good example of this is sonar. A good example of light doing work is a solar powered calculator, or car.
11. Define CHEMICAL ENERGY as the fifth "hair color" of energy. Help the students discover how to access the energy in wood, gasoline, and food. A good example question would be "If wood has chemical energy, how do we access it (especially when camping)?" Ask the students why food is considered to be chemical energy.
12. Discuss with the class where we get our food from. Use Appendix C: Food Energy as a guide to draw the chart on the board. Walk through each step as a review. What is photosynthesis? In our example, corn is created from CO2

combining minerals. Energy is stored as sugar and starch. This becomes food for animals such as chickens. The chicken eats the corn, and that energy that originally came from the photosynthesis process, is now stored as protein. Who eats chicken? We do! Our bodies use protein to do work. This is a basic process of how we can tap into the energy known as food.

13. Define the sixth "hair color" of energy as NUCLEAR ENERGY. Define FUSION and FISSION. Define URANIUM. Once all the definitions are out, explain that nuclear power plants use reactors to cause the nuclear fusion, but the byproduct, or result, is nuclear waste. Tell the students that we will go into more detail in a later lesson, when we will look at nuclear plants a little more in depth.
14. Tell the students to think of a car. What makes our cars run? (Gasoline) What type of energy does gasoline have? (Chemical) What two types of energy come from gasoline when we start the car? Ask the students if they think that energy can change from one form to the next.
15. Revisit the Law of Conservation of Energy (Lesson One). Remind the students that even though energy can not be created or destroyed, it can change states as well as types or forms.

E. *Assessment/Evaluation*
   1. Collect the worksheets.

Lesson Three: Rocket Science Part I (40 minutes)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
      b. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
      c. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)
   2. Lesson Content
      a. How a model rocket gains/uses/experiences energy. (Not required by Core Knowledge)
   3. Skill Objective(s)
      a. Students will prepare and assemble materials and equipment to complete and experiment. (Jeffco Science Standards Strand 3.1.A)
      b. Students will build simple models to explain types of energy and how it is transformed.

B. *Materials*
   1. A completed model rocket
   2. A model rocket engine
   3. A model rocket launching pad
   4. Model rocket packages for the students to assemble
   5. Copies of Appendix E for each student
   6. Copy of Appendix F for teacher use

C. *Key Vocabulary*
   None

D. *Procedures/Activities*
   1. Setup the launch pad on a table in front of the class room. Keep the engine and the rocket separate and off to the side.
   2. Review from previous lessons:

a. What is energy?
b. Define Potential and Kinetic Energy.
c. What are the six forms of energy and their definitions?
d. What is the Law of Conservation of Energy?
e. Can energy change from one form to another?

3. Explain to the class that today we are going to apply all of this knowledge about energy to a real life project. Be sure to remind them that in order for this project to work, the students need to act like 6th graders, not 1st graders.
4. Show them the rocket and ask the students what they think it is. (Uh, a rocket). Set it on the table and ask the students if there is any energy in the rocket. No there isn't, because the rocket isn't moving, and it isn't planning on going anywhere. Ask for ideas on how we can give the rocket energy. Lead them to the conclusion that for it to be a rocket, it needs fuel.
5. Help the students discover all of the different types of energy used to (or just a part of) launch the rocket (electrical, chemical, heat, mechanical, and sound)
6. Show them the rocket engine. Ask them if it has any energy. (Yes, potential chemical energy. All it needs is a little spark and it is outta here!) Place the engine in the rocket and find out from the students if the rocket now has energy.
7. Inform the students that as we study energy, they will have the opportunity to build their own rocket. Explain the process of construction and proper use of tools.
8. Hand out Appendix E: Rocket Science: Pre-flight Checklist. Explain that this needs to be updated and shown to the teacher after every stopping point.
9. Distribute the model supplies. And allow the students to work. Be sure to be available for assistance.
10. NOTE: Students are not expected to finish this in one setting. Glue needs time to set, etc.

E. *Assessment/Evaluation*

1. Check off the students' checklist, Appendix E, to make sure that they are making acceptable progress. Use Appendix F to track each of the students and their progress.

Lesson Four: From the Flintstones with Love: Fossil Fuels

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
   b. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
   c. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)
2. Lesson Content
   a. Fossil fuels: a finite resource (p. 153)
      i. Coal, oil, natural gas
      ii. Environmental impact of fossil fuels: carbon dioxide and global warming theory, greenhouse effect, oil spills, acid rain
3. Skill Objective(s)
   a. Students practice taking guided notes on a provided worksheet.
   b. Students will identify the uses of non-renewable resources. (Jeffco Science Standards Strand 3.2.A)

B. *Materials*
   1. A computer lab with Internet access
   2. Copies for each student of APPENDIX G
   3. Copy of APPENDIX H for teacher reference

C. *Key Vocabulary*
   1. Fossil Fuels – formed by the remains of prehistoric plants and animals that were covered with sand and clay and compressed for millions of years
   2. Peat – the layer of materials formerly known as dead plants; it has all the water squeezed out of it and eventually turns to fossil fuel
   3. Diatoms – the layer of materials formerly known as dead animals; used to make oil and natural gas
   4. Sedimentary – the layer of sand and clay that cover and create the peat

D. *Procedures/Activities*
   1. Take the students to the computer lab, preferably each student with his or her own computer.
   2. Pass out APPENDIX G: From the Flintstones with Love: Fossil Fuels. Read the directions at the top of the page out load. Explain that the students are to write in complete sentences. Incomplete sentences will be worth zero points.
   3. Remind students to write in complete sentences.
   4. To avoid any discrepancies, make sure that students use complete sentences.
   5. Students should finish in one class period.

E. *Assessment/Evaluation*
   1. Collect worksheets. Use APPENDIX H as a key for grading.

Lesson Five: Oil Spills

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
      b. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
      c. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)
   2. Lesson Content
      a. Environmental impact of fossil fuels: oil spills
   3. Skill Objective(s)
      a. Students will describe objects based on their observable properties and characteristics. (Jeffco Science Strand 6.1.B)
      b. Students will prepare and assemble materials and equipment to complete and experiment. (Jeffco Science Standards Strand 3.1.A)

B. *Materials*
   1. Trays
   2. Water
   3. Oil
   4. Food Coloring
   5. Q Tips
   6. String
   7. Pebbles
   8. Kleenex
   9. Paper Towels

10. Butcher Paper
11. Copies for each student of APPENDIX I

C. *Key Vocabulary*

None

D. *Procedures/Activities*

1. Have materials for the lab set up for the students. If you do labs at the students' desks, please be sure to remind them to keep hands off until further instruction. Pass out APPENDIX I: Oil Spills. Walk through the directions quickly. Remind the students to write in complete sentences. Go over clean up procedures: where the materials go when they are done, what needs to be thrown away, etc.
2. Remind the students that the water and oil need to stay in the tray—especially if you have new carpet.
3. When the students are finished, have them clean up their area, or set it up for the next class depending on the circumstances.

E. *Assessment/Evaluation*

1. Collect labs.

Lesson Six: Final Exam

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students understand interrelationships among science, technology, and human activities and how these affect the world. (Jeffco Science Standard 3)
   b. Students understand how to use scientific information to make decisions. (Jeffco Science Standards Strand 3.2.D)
   c. Students understand common properties, interactions, and transformations of matter and energy. (Jeffco Science Standards 6)
2. Lesson Content
   a. Potential and Kinetic Energy (Not required by Core Knowledge)
   b. The Law of Conservation of Energy (Not required by Core Knowledge)
   c. Six forms of energy: mechanical, heat, electrical, wave, chemical, nuclear
   d. The many forms of energy are interchangeable, for example, gasoline in a car, windmills, hydroelectric plants
   e. Sources of energy: for example, heat (coal, natural gas, solar, atomic, geothermal, and thermonuclear), mechanical motion (such as falling water, wind)
   f. How a model rocket gains/uses/experiences energy. (Not required by Core Knowledge)
   g. Fossil fuels: a finite resource
   h. Coal, oil, natural gas
   i. Environmental impact of fossil fuels: oil spills
3. Skill Objective(s)
   a. The students will exercise their knowledge of energy from memory.

B. *Materials*

1. Copies for each student of APPENDIX J
2. Copy of APPENDIX K for teacher reference

C. *Key Vocabulary*

See Appendix A

D. *Procedures/Activities*
   1. Have the students put everything away. They should only have a pencil out on their desks. Remind them that cheaters never win. A good example would be Sammy Sosa and his corked bat.
   2. Pass out the APPENDIX J: Rocket Science Final Exam.

E. *Assessment/Evaluation*
   1. Collect tests. Use APPENDIX K as a key.

VI. CULMINATING ACTIVITY

A. Have everybody gather their rockets. Walk to the parking lot, playground, or nearby park. Be sure to bring the launching pad, rocket engines, APPENDIX L, and a stopwatch.

B. Once the launch pad is set up (or if it was previously set up), line the class up for instructions. "Attention 6th graders! You have qualified to be (School Name) Rocket Scientists. But what is a rocket scientist without a rocket? You now have the opportunity to test your experiment. Are you excited to see what your rockets can do?" Pause for response. "What are your rockets missing in order to take flight? Your engines! You must answer one question about energy in order to earn your engine. Then you will be able to see what your rockets are made of. In addition to thrill of soaring projectiles, a special prize goes to the rocket that stays in the air the longest. I will run the stopwatch, and you are responsible for recording the time." Give an example of how to load the engine, and launch "the teacher's rocket." Once all glee and excitement has subsided, continue with your motivational speech. "Do scientists succeed at every experiment all the time? If your rocket crashes or burns or blows up does that mean that you are a failure as a rocket scientist? No. Is failure a part of science? Yes! Is success a part of science? Yes. Regardless of what happens to your rocket, you will have finished this experiment with excellence. Are you ready?"

C. Begin with the first student and ask them a question from the final exam. If they get it right, give them an engine and allow them to load the rocket. When everything is ready, launch the rocket. Use the stopwatch to track the time. When the rocket lands, have the student retrieve it AFTER they record their time on APPENDIX L. If a student misses the question, have them return to the end of the line. If one student keeps missing question after question, give them something easy so that everybody has an opportunity to enjoy the excitement of rocketry.

D. REMINDER: Be sure to emphasize that sometimes rockets crash and break or even catch on fire. It is important to be safe and responsible during this activity. It's all fun and games until a rocket pokes someone's eyes out.

E. SUGGESTION: If you have two or more classes it might be necessary to get more than one launching pad so that this process doesn't take forever.

VII. HANDOUTS/WORKSHEETS

A. Appendix A: Energy Vocabulary
B. Appendix B: Potentially Kinetic: An Introduction to Energy
C. Appendix C: Food Energy
D. Appendix D: The Hair Colors of Energy
E. Appendix E: Rocket Science: Pre-Flight Checklist
F. Appendix F: Rocket Science: Pre-Flight Checklist Teacher Copy
G. Appendix G: From the Flintstones with Love: Fossil Fuels
H. Appendix H: From the Flintstones with Love: Fossil Fuels-Key
I. Appendix I: Oil Spills
J. Appendix J: Rocket Science: Final Exam

K. Appendix K: Rocket Science: Final Exam Answer Key

VIII. BIBLIOGRAPHY

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I. http://www.apogeerockets.com/education/index.asp

J. http://www.energyquest.ca.gov

APPENDIX A

Energy Vocabulary

(For Teacher's On-The-Fly Use)

These words are not alphabetized. They are listed in order of appearance . . . like a movie.

Energy – The ability to do work or cause change.
Work – The transfer of energy.
Kinetic Energy – Energy in motion, or an object in motion that does work.
Potential Energy – Energy that is stored and held in readiness, or an object that is about to move.
Law of Conservation of Energy – Energy can neither be created nor destroyed. There is always the same amount of energy in the world.
Mechanical Energy – Energy associated with the motion or position of an object. Potential and Kinetic energy together are considered as Mechanical Energy.
Heat Energy – How hot an object is
Electrical Energy – The energy contained in batteries, power lines, and lightning.
Wave Energy – Any form of energy that travels in waves: sound, light and electromagnetic energy.
Chemical Energy – Potential energy stored in chemical bonds that hold chemical compounds together. For example, wood, wax, and food such as chocolate and broccoli store Chemical Energy.
Nuclear Energy – Potential Energy that is stored in the nucleus of an atom and is released during nuclear reactions.
Nuclear Fission – The nuclear reaction that occurs when the nucleus of an atom is split. This is used by nuclear power plants to make electricity.
Nuclear Fusion – The nuclear reaction that occurs when nuclei from more than one atom are joined together.
Uranium 235 – The most common fuel used by fission reactors to create nuclear power.
Fossil Fuels – Formed by the remains of prehistoric plants and animals that were covered with sand and clay and compressed for millions of years.
Peat – The layer of materials formerly known as dead plants. It has all the water squeezed out of it and eventually turns to fossil fuel.
Diatoms – The layer of materials formerly known as dead animals. Used to make oil and natural gas.
Sedimentary – The layer of sand and clay that cover and create the peat.

APPENDIX B

Name:_____ A/B

Potentially Kinetic: An Introduction to Energy

Energy:

Work:

Kinetic Energy:

Example:

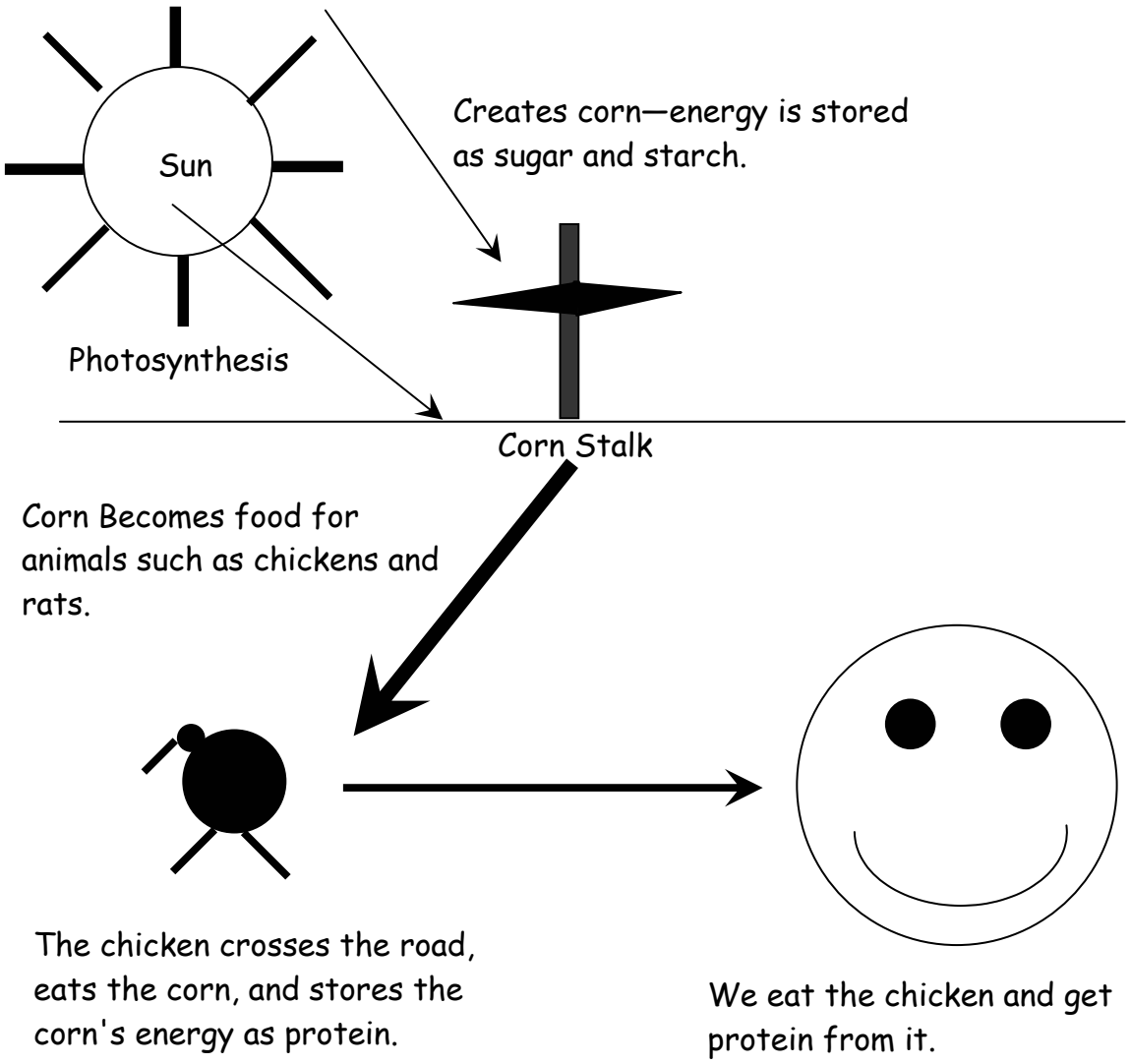
Potential Energy:

Example:

Law of Conservation of Energy:

Explain the Ball Point Missile:

APPENDIX C
(Note: This is meant to be a guide, not the Mona Lisa)



APPENDIX D

Name:_____ A/B

The Hair Colors of Energy

Forms of Energy (include definitions):

1.

2.

3.

4.

5.

6.

Changing Energy:

Food Energy Diagram

APPENDIX E

Rocket Science: Pre-Flight Checklist

	yes	*no*
Did you properly glue your fins to the body?		
Did you attach your launching rod guides?		
Did you follow the directions included with your rocket kit?		
Did you use proper materials and tools?		
Did you put your name somewhere on the rocket?		
Did you clean up your workspace?		

APPENDIX F

Rocket Science: Pre-Flight Checklist

(Teacher Copy)

Class List of Completed Rockets

Students Name	*Yes*	*No*

Name:_____ **A/B**

From the Flintstones with Love:
Fossil Fuels

Directions: Open a web browser and go to www.energyquest.ca.gov/story/chapter08.html. Read the information and answer the following questions. Write in complete sentences—failure to do so will result in a zero.

1.What period do fossil fuels come from?

2.In your own words, explain the formation of fossil fuels.

3.Describe coal.

4.What elements are in coal?

5.What are the three types of coal? Which one has the most energy and why?

6.When and where was coal first used?

7.What is coal used for?

8.What are diatoms and what do they do?

9.Draw a picture with labels to explain how oil is formed.

10.How long has oil been used for?

11.What two civilizations used oil for medicine?

12.Where does the word asphalt come from?

13.What happens and an oil refinery and how?

14.List as many products as you can that came from oil.

15.How many gallons of gas are in a barrel of oil? Asphalt? Propane?

16. When and where was natural gas discovered?

17. What is natural gas used for in our everyday lives? (If you can't find the answer in your text, use your head.)

18. Are fossil fuels renewable? Why?

19. Give an example of how you can save fossil fuels.

20. BONUS QUESTION: Think of our model rocket project. What is the link between real rockets and fossil fuels?

From the Flintstones with Love: Fossil Fuels (Key)

1.What period do fossil fuels come from?

Fossil fuels were formed in the Carboniferous period.

2.In your own words, explain the formation of fossil fuels. Include the words peat and sedimentary.

Dead trees, plants, and animals fell to the ocean floor forming a layer called peat. Over time, the peat was covered by sand and clay which turned into sedimentary. As more and more rock piled on top of the peat, the water was squeezed out of it. Over millions of years, the peat turned to oil, coal, or natural gas.

3.Describe coal.

Coal as a hard rock substance with black coloring.

4.What elements are in coal?

The elements in coal are: carbon, hydrogen, oxygen, nitrogen, and sulfur.

5.What are the three types of coal? Which one has the most energy and why?

The three types of coal are anthracite, bituminous, and lignite. Anthracite has the most energy because it has more carbon than the others.

6.When and where was coal first used?

Coal was first used in China over 3,000 years ago.

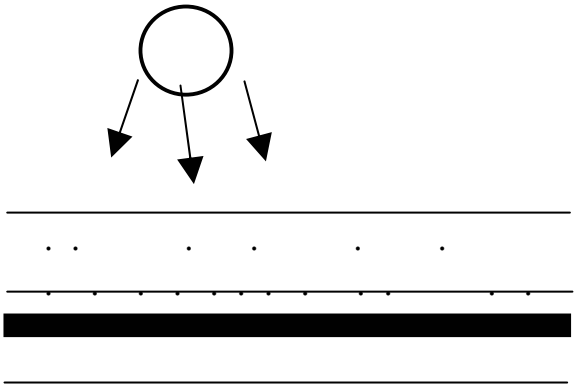
7.What is coal used for?

Coal is used to power plants and other factories.

8.What are diatoms and what do they do?

Diatoms are sea creatures the size of a pin-head. They convert sunlight directly into stored energy.

9.Draw a picture with labels to explain how oil is formed.



Peat falls to the ocean floor. It is covered by sand and clay. Over time, rocks add to the covering and squeeze the water out of the peat. Over millions of years, the peat becomes fossil fuels.

APPENDIX H, PAGE 2

10.How long has oil been used for?

Oil has been used for 5,000 to 6,000 years.

11.What two civilizations used oil for medicine?

The Ancient Egyptians and Native Americans used oil for medicine.

12.Where does the word asphalt come from?

The word “asphalt” comes from Lake Asphaltites because it had lumps of gooey petroleum that washed up on shore from underwater seeps.

13.What happens at an oil refinery and how?

Crude oil is split into various types of products by heating the black oil.

14.List as many products as you can that came from oil.

These are the products that come from oil: fertilizers, clothes, toothbrushes, plastic bottles, plastic pens, gasoline, diesel, jet fuel, and home heating oil.

15.How many gallons of gas are in a barrel of oil? Asphalt? Propane?

There are 19.5 gallons of gas and 1.3 gallons of asphalt in a barrel of oil. There is no propane in a barrel of oil.

16.When and where was natural gas discovered?

Natural gas was first discovered in Iran between 6,000 and 2,000 BC.

17.What is natural gas used for in our everyday lives? (If you can't find the answer in your text, use your head.)

Natural gas is used to heat homes, water, and to cook food.

18.Are fossil fuels renewable? Why?

Fossil fuels are not renewable because they were made over 300 million years ago, and when we run out, we run out.

19.Give an example of how you can save fossil fuels.

Answers may vary.

20.BONUS QUESTION: Think of our model rocket project. What is the link between real rockets and fossil fuels?

Real rockets take off using fuel which comes from fossil fuels.

Name:_____ **A/B**

Oils Spills

Materials:

tray	paper towels
water	butcher paper
oil	food coloring
q tips	string
pebbles	Kleenex

Directions:

1.Pour water into tray. Then add food coloring to oil. Make a prediction about what will happen when you add the oil to the water.

2.Add oil to the water. Observe what happens. Record observations.

3.Attempt to eliminate or contain the spill. Write the solutions you attempt here:

4.Which solution worked best? Why?

5.How can this experiment be applied to real oil spills in the ocean?

6. What other problems effect the clean up of oil spills in the ocean?

7.What can we do to prevent oil spills in the future?

Rubric for Lab

Follows directions and process of the experiment	1	2	3	4	5
Produces a viable solution/conclusion	1	2	3	4	5
Organized thoughts and neatly written	1	2	3	4	5
Correct Mechanics and complete sentences	1	2	3	4	5

1=Missing 2=Needs Improvement 3=Okay 4=Nice 5=Fantastic

Rocket Science: Final Exam

Name:_____ A/B

1. Define energy:

2. What are the two states of energy?

3. Give an example of both states:

Match the "hair color" with its definition by writing the proper letter in the blank.

a.	Mechanical	d.	Chemical
b.	Heat	e.	Electrical
c.	Wave	f.	Nuclear

4. _____ Energy contained in power lines, batteries, and lightning.

5. _____ Sound, light, and electromagnetic energy.

6. _____ Energy stored in wood, wax, and food.

7. _____ Energy stored in the nucleus of an atom.

8. _____ Energy dependant on the temperature of an object.

9. _____ Associated with the motion or position of an object.

Mark the following statements as either true or false. If false, rewrite the statement to make it true.

10. _____ Nuclear Fission is a nuclear reaction that occurs when the nucleus of an atom is split.

11. _____ Energy can neither be created nor destroyed.

12. _____ An object can only have one "hair color" of energy and it will never change.

13. _____ Nuclear Fusion is a nuclear reaction that occurs when the nucleus of an atom is split.

14. _____ Diatoms are dead plants that have sunk to the ocean's floor.

15. _____ The three types of fossil fuels are coal, oil, and natural gas.

16. _____ Work is the transfer of energy.

17. _____ Fossil Fuels are made by a clothing company.

18. _____ Potential Energy is energy in motion.

19. _____ Kinetic Energy is energy in motion.

20. _____ There is an unlimited supply of fossil fuels.

Short Essay

21. Using the image of a model rocket, explain the Law of Conservation of Energy in complete sentences.

22. Using complete sentences, explain how food energy is created and passed on to us. (For example, explain the food energy diagram)

23. Using complete sentences, explain how fossil fuels are formed. (Use as many vocabulary words as you can)

24. Explain in complete sentences how you can conserve energy. Give at least three examples.

Rocket Science: Final Exam Answer Key

Name:_____ A/B

1. Define energy:

   The ability to do work or cause change.

2. What are the two states of energy?

   The two states of energy are potential and kinetic.

3. Give an example of both states:

   Answers may vary. Make sure that the potential example refers to an object about to move, while kinetic is an object in motion.

Match the "hair color" with its definition by writing the proper letter in the blank.

a.	Mechanical	d.	Chemical
b.	Heat	e.	Electrical
c.	Wave	f.	Nuclear

4. __e__ Energy contained in power lines, batteries, and lightning.

5. __c__ Sound, light, and electromagnetic energy.

6. __d__ Energy stored in wood, wax, and food.

7. __f__ Energy stored in the nucleus of an atom.

8. __b__ Energy dependant on the temperature of an object.

9. __a__ Associated with the motion or position of an object.

Mark the following statements as either true or false. If false, rewrite the statement to make it true.

10. **TRUE** Nuclear Fission is a nuclear reaction that occurs when the nucleus of an atom is split.

11. **TRUE** Energy can neither be created nor destroyed.

12. **FALSE** An object can only have one "hair color" of energy and it will never change.
    Energy can change from one form to another.

13. **FALSE** Nuclear Fusion is a nuclear reaction that occurs when the nucleus of an atom is split.
Nuclear Fusion is a nuclear reaction that occurs when nuclei from more than one atom are joined together.

14. **FALSE** Diatoms are dead plants that have sunk to the ocean's floor.
Diatoms are tiny dead animals that fell to the ocean floor millions of years ago.

15. **TRUE** The three types of fossil fuels are coal, oil, and natural gas.

16. **TRUE** Work is the transfer of energy.

17. **FALSE** Fossil Fuels are made by a clothing company.
Fossil Fuels were made millions of years ago when layers of sediment compressed peat and diatoms.

18. **FALSE** Potential Energy is energy in motion.
Potential Energy is energy that is about to be put into motion.

19. **TRUE** Kinetic Energy is energy in motion.

20. **FALSE** There is an unlimited supply of fossil fuels.
There is a limited supply of fossil fuels.

Short Essay

21. Using the image of a model rocket, explain the Law of Conservation of Energy in complete sentences.

Rubric					
Uses definition of the Law of Conservation of energy	1	2	3	4	5
Includes and explains different forms and states of energy.	1	2	3	4	5
Uses the rocket to explain their ideas	1	2	3	4	5
Uses complete thoughts and sentences	1	2	3	4	5

1=Missing 2=Needs Improvement 3=Okay 4=Nice 5=Fantastic

22. Using complete sentences, explain how food energy is created and passed on to us.

Rubric					
Includes how the sun and photosynthesis creates corn, storing energy as sugar and starch.	1	2	3	4	5
Includes how animals eat food which creates and stores energy as protein.	1	2	3	4	5
Well organized thought process	1	2	3	4	5
Uses complete sentences	1	2	3	4	5

1=Missing 2=Needs Improvement 3=Okay 4=Nice 5=Fantastic

23. Using complete sentences, explain how fossil fuels are formed.

Rubric					
Properly explains the process	1	2	3	4	5
Includes vocabulary words	1	2	3	4	5
Well organized thought process	1	2	3	4	5
Uses complete sentences	1	2	3	4	5

1=Missing 2=Needs Improvement 3=Okay 4=Nice 5=Fantastic

24. Explain in complete sentences how you can conserve energy. Give at least three examples.

Rubric					
Gives at least three examples	1	2	3	4	5
Provides reasonable and believable solutions.	1	2	3	4	5
Well organized thought process	1	2	3	4	5
Uses complete sentences	1	2	3	4	5

1=Missing 2=Needs Improvement 3=Okay 4=Nice 5=Fantastic