Rationale:
The following unit is one I have thoroughly enjoyed constructing. My CI asked me to design a unit on energy, after considering the fifth-grade curriculum and SOLs. The unit is for forty-nine students. Seventeen of these students participate in the gifted and talented program; thirteen other students receive assistance from one of the resource teachers in the school for different needs. Considering the many different needs and academic levels of my forty-nine students, I realized that my unit needed to include differentiation wherever possible. This is demonstrated by the variety of materials, activities, and assessments found within this unit of study. This hopefully allows for maintaining the interest of all students, and provides multiple ways for the students to master the concepts related to energy.

As I began designing the unit, I first considered what I thought fifth-grade students need most in order to master energy-related concepts, many of which are complex (energy vs. work vs. power, the many forms of energy, the law of conservation of energy, energy conversions, etc.) I came to the conclusion that students need demonstrations, hands-on activities, and experiments in order to build a fun, inviting, and interactive science unit. I have constructed my unit with these things in mind, trying to incorporate demonstrations to show how energy might be converted, hands-on activities such as "Can you Push a Wall!", and several different experiments, including "Balloon Blow-Up" and "Clever Levers."

I also devised a plan for projects that would allow for differentiation within the unit: an "Energy Portfolio." Although a portfolio seems like a language-arts idea, a portfolio works great for science as well. Developing a portfolio for this unit is a wonderful way for students to inquire and to explore areas of the unit which are most interesting. Yet, their self-directed exploration will hopefully demonstrate individualized learning and growth once they have completed their portfolios. Including seventeen different options for students to pick from allows students choice and ownership. Students select two options from the seventeen in order to create individualized projects which will be included as
entries in their portfolio. Perhaps, however, the biggest advantage of developing a portfolio is that it allows students a means for organizing, reviewing, and reflecting on what they have learned. The portfolio is individualized and flexible. In addition, constructing a portfolio provides students the opportunity to demonstrate their strengths, to explore an area relating to energy they are most interested in, and to develop their intellectual selves as they pursue an enrichment activity or project they otherwise would not have completed for classwork or homework during the unit.

**Learning Objectives:**

1) Students will be able to differentiate between kinetic energy and potential energy, realizing that all forms of energy can be categorized into these two major groups.

2) Students will recognize the difference between work, power, and energy, and will know a scientific definition of each.

3) Students will further develop interpersonal skills as they work in cooperative groups during labs. Experimental labs are designed to enhance learning of the concepts relating to energy being studied, as well as to provide students hands-on opportunities to explore such concepts.

4) Students will learn that energy can be converted from one form to another; energy is changed, but it is neither created nor destroyed.

5) Students will recognize that simple and complex machines make work easier, and will be able to give examples of both simple and complex machines. Also, students will be able to recognize which simple machines construct complex machines.

6) Students will work on building personal "energy" portfolios which will allow for individual inquiry, exploration, and growth in high-interest areas not covered in-depth during class.

**Select Lesson Plans**

*Day 1: Kinetic energy vs. Potential energy*

**Objectives:**
1. Students will be able to differentiate between kinetic energy (energy in
motion) and potential energy (stored energy), realizing that all forms of energy can be categorized under these two major groups.

**Materials:**
- assorted items for demonstration (ball, rubber band, flashlight, etc.)
- Learning Logs (name for the students' Science journals)
- Destinations in Science, Energy and Motion, books
- Eyewitness Science, Energy book
- homework sheets

**Procedures:**
1. Attention Grabber: Energy Check! This is something I learned from camp that is a lot of fun. Someone calls out, "Energy Check!" when an energy boost is necessary. Everyone else claps in this order: 5 times, 5 times, 3 times, 3 times, pauses to say "Woo-woo," then ends on a final clap.
2. Introduce the concepts of kinetic energy and potential energy by the following demonstrations: a ball suspended in the air (potential energy), the ball falling (kinetic energy); a stretched rubber band (potential energy), the rubber band released (kinetic energy); myself in a squatting position (potential energy), myself jumping in the air (kinetic energy); a battery from a flashlight (potential energy), a lighted flashlight (kinetic energy).
3. Ask the students to write in their Learning Logs what they think potential energy and kinetic energy are, based on what they have witnessed during the demonstrations.
4. Discuss what students have written in their Learning Logs. Verify the scientific meaning of potential energy and kinetic energy by reading Destinations, p. D50-51.
5. If time permits, read aloud p. 14-17 from Eyewitness Science, Energy.
6. Explain homework.

**Evaluation:**
Evaluation will be based on student participation and the homework, the picture sort and the fill-in-the blank sheet, both which allow students to practice differentiating between examples of potential and kinetic energy. Both of these sheets will hopefully show what students' have learned/retained from information presented during today's lesson.

*Day 2: Work/Force/Power*

**Objectives:**
1. Students will be able to relate work to force and distance, and characterize the relationship between work and power.
2. Students will correctly define the terms "work" and "power," and will know how these terms are different.

**Materials:**
- 3 books for "Attention Grabber"
- Destinations in Science, Motion and Energy books
- Important Vocabulary sheets
- jump rope
- homework sheets

**Procedures:**
1. Review examples of kinetic energy and potential energy. What is the definition of each term? What is the definition of the word "energy?"
2. Attention grabber: Select three student volunteers. One student will hold a book while standing still. Another student will walk across the room holding the book, and a third student will raise and lower the book several times. Ask which students did "work." Take a vote; explain that we will come back to this later.
3. Seeking prior knowledge: "What does the word "work" mean to you?"
4. Let's see what Destinations in Science says. Read p. D46-D47 and write the appropriate definition on the board for "work." (Tell students they do not have to copy it because they will receive an "Important vocabulary" sheet.)
5. Take a short trip outside to do the activity, "Can you move a wall?" Ask students to think carefully about why their arms get tired while pushing against the wall. Also, are students performing work on the wall? (This activity will demonstrate that students' muscles use energy to apply force to the wall, but students do NOT perform work because the wall did not MOVE.)
6. Inside, discuss the activity just completed. Also, discuss students who either held, carried, or raised a book at the beginning of the lesson in order to reiterate who was and who was not performing work.
7. Seek prior knowledge: "What does the word "power" mean to you?"
8. Read p. D48-D49 and write the appropriate definition on the board for "power."
9. Have four students volunteer for a brief demonstration of tug-of-war. Discuss how a game of tug-of-war shows the difference between "work" and "power." (Both sides are doing work because each team is moving an object in the direction of a force that is applied to it. However, the team which wins demonstrates greater power, or a greater rate at which work is being done.

**Evaluation:**
Evaluation will be based on student participation and the homework, Mind Bender and the Concept Map. Both of these sheets will hopefully show what
students' have learned/retained from information presented during lessons on Day 1 and Day 2.

Day 3: Lab, "Effect of Height on Potential Energy"
(adapted from http://www.teachers.net/lessons/posts/655.html)

Materials (per group of 4 students):
- toy car
- 6 text books
- tagboard or other material for track
- 3 one-cup milk cartons
- meter stick
- tape

Procedures:
1. Place the track so that one end is on top of ONE of the books, and the track slants down to the floor (or table). Tape the track to the floor so that it does not move.
2. With the cartons, build a tower at the lower end of the track. Two cartons should be on the bottom of the tower; one carton should be on the top.
3. Place the car at the top of the track and allow the car to roll down the track (DO NOT PUSH THE CAR).
4. Measure from the bottom of the track to the carton that was knocked off. Measure the distance in centimeters (meters, if necessary) from the lower end of the track to the edge of the carton that is FURTHEST from the track. If the car did not knock over the cartons, record this information. Repeat three times and record information.
5. Raise the track so that one end is on top of THREE books total now. Rebuild the tower of cartons.
6. Place the car at the top of the track and allow the car to roll down the track. Measure how far the carton traveled in centimeters. Repeat three times and record information.
7. Raise the track so that one end is on top of SIX books total. Rebuild the tower of cartons.
8. Place the car at the top of the track and allow the car to roll down the track. Measure how far the carton traveled in centimeters. Repeat three times and record information.

Recording and Analyzing Data:
Questions: (Students write answers in Science logs)
1. How did the height of the hill change in your demonstrations?
2. What kind of energy did the car have at the top of the hill?
3. What kind of energy did the car have as it was rolling down the hill?
4. When did the car have the least energy-----at one, three, or six books? When did the car have the most energy?
5. How does the height of the hill affect the amount of potential energy in the car?
BONUS: Write a paragraph or two, explaining the demonstration and its results.

Note: See picture of students working on this experiment.

Day 5: Six Major Forms of Energy and Energy Conversions

Objectives:
1. Students will be able to state the law of conservation of energy (that energy can neither be created nor destroyed).
2. Students will be able to identify the six major forms of energy (Heat, Chemical, Electrical, Mechanical, Light, and Sound).
3. Students will be able to identify energy conversions, when one form of energy changes to another.
4. Students will be able to apply the law of conservation of energy to energy conversions. Although energy is changing from one form to another, energy is neither created nor destroyed.

Materials:
- Hanger, masking tape (for "The Hot Spot" demonstration)
- Lamp without a shade, aluminum foil, thread, tape (for "Sally the Silvery Snake" demonstration)
- Overheads
- Destinations in Science, Motion and Energy books
- homework sheets

Procedures:
1. Read p. D52-53 in Destinations in order to discover the law of conservation
of energy.
2. Introduce the six major forms of energy (Heat, Chemical, Electrical, Mechanical, Light, and Sound) with the overhead. Explain that although one form of energy may change into another, the law of conservation of energy still applies.
3. Demonstrate two examples of energy conversions. Explain to students that they will observe one form of energy changing into another. Ask student volunteers to assist with "The Hot Spot" and "Sally the Silvery Snake." See "The Hot Spot" page in the Resources section of this unit for a more detailed explanation of these demonstrations.
4. Discuss with the class the energy conversions they witnessed. Which form of energy was present before the conversion? Which form of energy was present after the conversion? (In the Hot Spot demonstration, mechanical energy changed to heat energy. In Sally's demonstration, electrical energy changed to heat energy and mechanical energy as Sally spun and twisted around).
5. Introduce the overhead of the Energy Conversion cartoon, which shows energy changing from light energy to chemical energy to mechanical energy to electrical energy to heat energy to sound energy. Have students explain which parts of the cartoon show the energy changes, and list them on the overhead.
6. Explain homework.

**Evaluation:**
Evaluation will be based on student participation and the homework, the Energy Conversion cartoon. Although we discussed the cartoon's examples of energy conversions, I thought it would be good practice to try to name the parts of the cartoon that show the energy conversions, independently.

*Day 6: Lab, "Balloon Blow-Up: An Energy Conversion"*
(adapted from [http://www.teachers.net/lessons/posts/192.html](http://www.teachers.net/lessons/posts/192.html))

**Materials (per group of six students):**
- 2 film cans
- ½ and ¼ teaspoon measuring spoons
- Water
- 2 balloons
- Paper towels
- Double-acting baking powder

**Procedures:**
1. Fill a film can ¾ full of water.
2. Pour the water from the film can into a balloon.
3. Repeat steps #1 and #2 to fill up the second balloon.
4. Dry the film can with paper towels.
5. Put ¾ teaspoon of baking powder into one film can and 1 teaspoon baking powder into the other can.
6. Stretch one balloon over the top of each can.
7. Dump the water from each balloon into the can.
8. Watch what happens and draw a picture in your Learning Log to record your results.

**Questions: (Students write answers in Science logs)**
1. Which materials had potential (or stored) energy?
2. When did the potential energy become kinetic energy?
3. Is "work" being performed on the balloon? How do you know?
4. What type of energy (light, chemical, mechanical, electrical, heat, sound) is present before the conversion?
5. What type of energy is present after the conversion?
6. State the "law of conservation of energy." Does this experiment demonstrate this law? Why or why not?

**BONUS:** Write a paragraph or two, explaining the demonstration and results.

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**Day 9: An Energy Conversion Card Game**

**Objectives:**
1. Students will be able to further their understanding of energy conversions, that one form of energy may change into another, while playing the Energy Conversion card game.
2. Students will further develop interpersonal skills as they play the game in small cooperative groups. There will be approximately six groups of four students each.

**Materials:**
- Each student needs an "Answer Key."
- Each cooperative group needs a deck of the Energy Conversion cards.
- Each cooperative group needs one piece of paper and a pencil in order to record scores.

**Procedures:**
1. Have students independently work on developing their own answer keys. Students need to examine the pictures on the cards, and write the appropriate form(s) of energy which follow the energy conversion. Example: Card 10 shows a picture of a hair dryer, and reads Electrical--------___________.

Students fill in the words, "Mechanical" or "Heat" in order to show that electrical energy is converting to mechanical or heat energy in this energy
2. After all students have created their answer keys, review all answers as a whole group, in order to ensure all students have the correct answers available.
3. Explain procedures of the game to the students. Please see the game's rules and procedures in the Resources section of this unit.
4. Break the students into their cooperative groups. Play a couple of hands together in order to ensure all students understand how to set up and begin playing the game.
5. Have students play the game!

**Evaluation:**
Evaluation will be based on student participation.

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**Day 10: Simple Machines**

**Objectives:**
1. Students will be able to recognize that simple machines make work easier by changing forces (changing either the direction, or the strength, of a force).
2. Students will be able to identify the four major simple machines (lever, inclined plane, pulley, wheel and axle).
3. Students will be able to recognize commonly seen objects as having simple machines within them.

**Materials:**
- Destinations in Science, Motion and Energy books
- index cards for the class sort
- poster
- homework sheet

**Procedures:**
1. Attention grabber: Place a large dictionary on your desktop with about 1 inch of the book hanging over the edge of the desk. Ask a student to try to lift the dictionary with one pinkie finger. Slide the end of a sturdy ruler about 2 inches beneath the dictionary. Have the student use a pinkie finger to push down on the edge of the ruler. Which way was easier?
2. Seek prior knowledge of students by asking them, "Why do people use machines?" and "What are some machines you can name?"
4. Display the poster of simple machines. Have students, as a whole group, match the simple machine to the person who would need it to make work
5. Have the class make one large circle around the room. Give each student a note card with an object on it. Have students take turns reading their objects one at a time.

6. Explain to students that we are going to sort all these objects into the four major simple machine categories. Each object has at least one of the four major simple machines within it. Ex. Flagpole goes in the pulley group. For a complete list of the objects, see Class Sorting Activity in the Resources section of this unit.

7. Students sort themselves into the four groups, one group per corner I assigned, in the room. Once students are in their groups, they need to sit down and read all of the objects. Does each object belong in this group of simple machines? Tell students that they need to make sure everyone agrees.

8. One group at a time comes to the front of the classroom. One student at a time reads his/her object and acts it out in a creative way. See picture of a group of students acting out a simple machine.

9. I ask the other students if they disagree with any of the objects that were placed in this group of simple machines? If all agree, I ask for characteristics all the objects share within the group.

10. Repeat procedures #8-9 for all groups.

**Evaluation:**
Evaluation will be based on student participation and the homework, the Simple Machine worksheet.

*Day 11: Lab, "Clever Levers"*

**Objectives:**
1. Students will be able to work cooperatively as they perform the experiment in small groups.

2. Students will more fully grasp the concept of the lever as a simple machine: how it works, why it works, its different parts (the fulcrum, the effort force, the effort arm, the resistance arm, the resistance force, etc.).

3. Students will be able to explain, in writing, that a lever is more useful when the effort arm is longer because less effort is required to move the resistance (a concept demonstrated by the experiment).

4. Students will be able to draw and label a lever, with its appropriate parts.

**Materials:**
- Chalkboard eraser
- Rigid yard stick
- Novel
- Learning Log

**Procedures:**
1. Place the eraser under the 33 inches mark of the yard stick, and put the book on the 36 inches mark so the book is half on and half off the yard stick.
2. Press down on the free end of the yard stick. Observe how hard you have to push to lift the book. Observe how far the book rises.
3. Move the eraser to the 28, 23, 18, 13, and 8 inches mark of the yard stick, one at a time. Repeat procedure #2 for each new placement of the eraser.
4. Be sure *each* member of your experimental team has a chance to try the lever with the eraser at *each* of the different marks on the yard stick.

**Questions: (Students write answers in Science logs)**
1. What was considered the fulcrum, or fixed point, in this experiment?
2. What was considered the effort force in this experiment?
3. What was considered the effort arm in this experiment?
4. What was considered the resistance arm in this experiment?
5. What was the resistance force in this experiment?
6. How did the amount of force you used to lift the book depend on the placement of the eraser?
7. How did the distance you pushed down depend on the placement of the eraser?
8. How did the distance the book rose depend on the placement of the eraser?
9. Is the lever you constructed in this experiment a first-class, second-class, or third-class lever? How do you know?
10. A longer effort arm requires (more/less) effort to move the resistance.
11. Make conclusions from your observations. Is a lever more useful when the effort arm is longer or when it is shorter? Explain.

See picture of students working on this experiment.

**Unit Resources:**
- Assorted library books
- Students' textbooks
- Teacher's Edition textbook
- Backpack Science: A Student Activity Book
- Supplement Booklet
- and many, many other books, pamphlets, magazines, etc.