Unit 8: *Energy*

This unit will take approximately 5 weeks. The pace is always determined by the ability of your students. Some areas can be skipped or used as enrichment, while other areas include more challenges to those more advanced students. In this outline, you may find that the pace is too quick for your students and may want to insert some "processing time" for them.
This timeline is based on 55-minute periods.

Outline	Teacher Notes
Day 1 ***Objective***: Introducing the context of Energy ***Activity***: Framing questions - Whiteboard ***Due***: None ***QOD***: Does a boulder just sitting on top of a hill have energy?	Pre-Test Energy Framing Questions: Be sure to share these ideas. This will give you some clues as to what misconceptions students may have. Have the students whiteboard their answers for class discussion
Day 2 ***Objective***: I can Identifying a system, types of energy storage and whether energy is be transformed or transferred. ***Activity***: Exploring Energy Lab ***Due***: None ***QOD***: If a stretched rubber band is released, does it have energy as it is flying through the air?	The pre-lab will get students to think about energy, but coming up with their own "names" for each type of energy identified at each station. Make a list of these, and identify what the system is, and that energy can be transformed or transferred. Also, group these names and come up with a common terminology. Real names for each type of energy.
Day 3 ***Objective***: I can identify a system, type of energy storage and the initial and final state of a scenario. ***Activity***: Reading Page: Energy ***Homework***: Practice 8.1 ***Due***: Lab ***QOD***: If a stretched rubber band is released, what is its initial state? It's final state?	Go through the reading pages and include Finish the lab and questions for yesterday. Review these new terms! Include these new terms, and go back through the lab including the initial and final state. Do some of the practice 8.1 in class. Assign the rest for homework.
Day 4 ***Objective***: I can use the law of Conservation of Energy to trace the process of energy transformation in an energy pie chart. ***Activity***: Exploring Energy Transformations Lab ***Due***: Practice 8.1 ***QOD***: If a stretched rubber band has the potential to move, how did the rubber band get its energy in the first place?	Begin by reviewing the homework. Whiteboard this if you can afford the time. Next, start with the reading page: Law of Conservation of Energy. Now take what they know about energy transformations and turn it into a pie chart. Be sure to identify the system! There is a LOT of new vocab here, so take it slow and use the terms in class **often**. Get started on the lab, but you will have to finish it tomorrow.

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Day 5 ***Objective***: I can translate energy into a pie chart if I know the system, and two or more stages of the objects of question. ***Homework***: Practice 8.2 ***Due***: Exploring Energy Transformations Lab ***QOD***: Energy pie charts only work for which of these? Energy transformations or Energy transfers. How do you know?	Finish the class discussion of the lab. Students should have a good grasp of the new vocab by now. Do part of the Practice 8.2 Energy Pie Charts in class and assign the rest for practice. Energy Quiz 1
Day 6 ***Objective***: I can use pie charts to represent energy storage and transformations in different situations. ***Activity***: White board the homework Practice 8.2 ***Due***: Practice 8.2 ***QOD***: Draw an energy pie chart of a boy stretching a rubber band, releasing it, and it is shot across the room. System; boy, rubber band and earth.	Review Energy Quiz 1. Review Pie charts and whiteboard the homework. Make sure you discuss #6 and 8. These 2 questions can lead to a good discussion. Review the QOD. Now ask the same question, but take the boy out of the system. You won't have time to do the lab, so set it up with the question of the day. Ask for student's ideas for answers.
Day 7 ***Objective***: I can explain that the mechanical energy of a system may be conserved or not, depending on how the system is defined. ***Activity***: Exploring Energy Transfers Lab ***Due***: Exploring Energy Transfers Lab ***QOD***: How can we show that energy is being transferred into out of a system?	Now do the exploring energy transfers lab. Conduct a class discussion about ways of representing energy storage and transformations in a drawing. But now include a transfer of energy.
Day 8 ***Objective***: I can draw bar graphs to represent energy storage, transfer and transformations for different situations. ***Activity***: Review Lab, Reading page: Using Bar Graphs to Represent Energy Transfers ***Homework***: Practice 8.3 ***Due***: ***QOD***: Can you use a pie chart to represent a **transfer** of energy? Why or Why not?	Review the Lab, except now use pictorial description using bar charts. Use the reading page to help students translate pie charts to bar graphs. Start with transformations, then move to transfers. Be sure to use the circle in the middle as a system and show that energy entering or leaving the system is now called **work**.

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Outline	Teacher Notes
Day 9 ***Objective***: I can relate working to external forces acting on a system. ***Due***: Practice 8.3 ***QOD***: Draw a bar graph of a boy stretching a rubber band, releasing it, and it is shot across the room. System; rubber band and earth.	Review everything you've done in class the last 2 weeks. Whiteboard the homework, practice 8.3. Students must be proficient at this point before moving on.
Day 10 ***Objective***: ***Handouts***: Energy Quiz 2 ***Due***: ***QOD***:	This segment completes a qualitative review of Energy. Moving forward, the unit includes graphing and calculation, some of it extensive. It will be helpful if you have already covered the forces unit (Unit 5) as you will be drawing force diagrams. Energy Quiz 2
Day 11 ***Objective***: I can construct a graph to calculate the amount of work that is transferred into/out of a system. ***Activity***: What is Work Lab ***Due***: None ***QOD***: A car at rest is at the bottom of a ramp. If ***you*** push it up a ramp, what would an energy bar chart look like? System: Car, ramp, earth	Review Energy Quiz 2. Reading and calibrating the scales might need a little "pre-lab" instruction. Introducing Force (N) instead of weight (lbs) will be new for the students. QOD will help set up this lab. Using foam core board works well for all the ramps. Remember, we are only pulling to get the car to a *specific* height, *not different heights!* Start by whiteboarding the Pre-Lab Discussion. This will help students develop an idea of what data they will be collecting.
Day 12 ***Objective***: I can find a mathematical equation to calculate the amount of work that is put into a system. ***Activity***: What is Work Lab ***Due***: What is Work? Lab ***QOD***: As a ramp gets steeper, what happens to the amount of force when pulling it up a ramp?	Finish the lab. Have the students do multiple ramps and graph each ramp on the same graph. It might be useful to turn these into line graphs instead of bar graphs. You'll have to get students to find the area under each line. This area is called work, and to find the area, you take the $\boldsymbol{F} \times \boldsymbol{\Delta x} =$ ***Work***

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Day 13 ***Objective***: I can derive an equation to calculate the gravitational potential energy of a system. ***Activity***: Relating Work to change in energy Conceptual Lab ***Homework***: Practice 8.4 ***Due***: None ***QOD***: What are the units for Work? What are the units for Energy?	Review Work equation. The next part (Lab) can either be done as a demo or whole class. Refer to the reading page: Work and Energy for some direction. After deriving the equation, do some of the practice problems from the homework 8.4. Assign some of it for homework.
Day 14 ***Objective***: I can relate the work done by the force of gravity to the change in gravitational potential energy of a system. ***Activity***: whiteboard the Lab: Work and Energy ***Homework***: Practice 8.5 ***Due***: Practice 8.4 ***QOD***: When a boy is pushing a shopping cart forward, why isn't the weight of the shopping cart used in the calculation of work done by the boy?	Whiteboard the Lab results from yesterday. Finish with the Reading Pages: Gravitational Potential Energy By now students should have been able to comprehend the association of Work and Energy.
Day 15 ***Objective***: I can calculate the quantity of work and energy done on a system. ***Activity***: Review homework ***Due***: Practice 8.5 ***QOD***: If a 2kg water balloon drops from a 10 m tall building, what is the amount of work done to get it from the bottom floor to the top? How much Eg does the balloon have?	Review the homework Energy Quiz 3

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Day 16 ***Objective***: I can relate work done by the elastic force to the change in elastic potential energy of the system. ***Activity***: Elastic Potential Energy Lab ***Due***: None ***QOD***: In our bar charts, we mention elastic energy. Does a spring count, and is it capable of doing work?	Review Quiz 3 Today students will revisit Hooke's Law. They will also see that the amount energy stored in a spring, amount of work done by the spring and the deformation of the spring are all related. Key: Don't let students measure the length of the spring, but only how far the spring stretches. Do the pre-lab discussion before you begin the lab. Review what the graph will look like, and relate it back to their car on a ramp lab.
Day 17 ***Objective***: I can develop a mathematical equation for calculating elastic potential energy using a graph. ***Activity***: Finish: Elastic Potential Energy Lab ***Homework***: Practice 8.6 ***Due***: Elastic Potential Energy Lab ***QOD***: If a spring has an constant k = 1.5N/m, what does this mean? Is this a tough or soft spring?	Finish the lab and make sure students have the graph completed correctly. This should allow them to find the area under a curve to find the work done, and understanding the spring constant *k.* Relate this to the equation $W_{F\ elastic} = -\Delta E_e$ Do some of the homework problems in class. Assign other problems for homework.
Day 18 ***Objective***: I can relate work done by the elastic force to the change in elastic potential energy of the system. ***Activity***: Whiteboard practice 8.6 ***Due***: Practice 8.6 ***QOD***: Calculate the elastic force required to move a 1.2kg bowling ball on the ground up to a vertical height of 2 m.	If students are having trouble with the calculations, it might help to review using the reading pages: Elastic Potential Energy
This might be a good time for a break. The amount of content you've covered is enormous, and a review before moving on to a tough lab would be a good idea. I would consider giving the quiz today. You'll be covering a difficult lab (Kinetic Energy) and if you start today, you'll have a quiz (Energy Quiz 4) in the middle of completing the lab.	

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Day 19 ***Objective***: To collect data that will show a relationship between the height of a car on a ramp and its speed. ***Activity***: Kinetic Energy Lab ***Due***: None ***QOD***: What factors do you think effect the amount of Kinetic Energy an object has?	Show students a bar graph of a simple scenario that involves Work, Gravitational, Elastic and Kinetic Energy. Note that we've covered all of them but Kinetic. There are multiple ways to do this lab without expensive equipment. Even via online simulations. Be sure to cover the pre-lab discussion, especially question #5. Try to collect all the data... finish tomorrow.
Day 20 ***Objective***: To develop a mathematical equation for calculating Kinetic Energy. ***Activity***: Finish lab, Energy Quiz 4? ***Due***: Lab ***QOD***: What happens to the kinetic energy of a car as it moves down a ramp? Why must we ignore friction?	Energy Quiz 4 – unless you gave it already To derive the equation for kinetic energy. After filling out the chart, make a graph of a velocity vs. time graph, and then a kinetic energy vs. speed squared graph. After finding the slope, students should derive the equation for E_k.
Day 21 ***Objective***: I can use the mathematical equation for calculating kinetic energy. ***Homework***: Practice 8.7 ***Due***: None ***QOD***: If a rock has 145 J of gravitational energy when it is 4 meters above the ground, how much kinetic energy will have just before it hits the dirt?	Review the lab and the equations derived from the lab. Go through the reading page, "Kinetic Energy" as practice to solving problems. Go through the Practice 8.7 and assign some for homework.
Day 22 ***Objective***: I can apply the conservation of energy theorem to different scenarios. ***Activity***: Whiteboard 8.7 ***Homework***: Practice 8.8 ***Due***: Practice 8.7 ***QOD***: Do you think the law of conservation of energy apply to all the energy we've discussed previously?	Whiteboard the homework 8.7 This is where you'll start to tie energy and net work together (Work/Energy Theorem). Do some of the problems from practice 8.8 and assign other problems for homework.

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Day 23 ***Objective***: I can calculate the amount of work, energy and power I have when climbing stairs. ***Activity***: Human Power Lab ***Due***: Practice 8.8 ***QOD***: Can you produce more horsepower than a lawnmower? How about a can opener?	Of course, you need a set of stairs to accomplish this lab. Two to three floors is more than sufficient. Use a tape measure (m) to measure the height of the stairs from the ground to the floor of the highest level. You should remind students that they don't have to participate to the best of their ability.
Day 24 ***Objective***: I can relate power to work done in an amount of time, or the change in energy over a time interval. ***Homework***: Practice 8.9 ***Due***: Human Power Lab ***QOD***: Jim and Jontay tied as they ran up two flights of stairs. How was it possible that Jim produced more power?	Review the lab. Find the horse power of different appliances and have them compare their power to those items. Do problems 1-5, 8 in class. Assign the rest for homework.
Day 25 ***Objective***: I can relate power to work, and work to the change in Energy. I can use the conservation of energy to solve for E_k, E_g and E_e. ***Activity***: Review ***Due***: Practice 8.9 ***QOD***: If a lawnmower can produce 1.5 horsepower, how much energy can it produce?	Review the homework and the rest of the unit. Go back over the framing questions to see if they make sense now. Energy Test tomorrow.
Day 26 ***Objective***: ***Activity***: Energy Test ***Due***: ***QOD***:	Unit 8 Test

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