Subject: Physics **Grade Level: 11,12** **Unit Title: Unit 6 : Energy, Work, Power** **New 2009 goals are in red**	**Timeframe Needed for Completion: 2 weeks** **Grading Period: 2nd 9wks**
Big Idea/Theme: Relationship between energy, work ,power **Understandings: Students will understand that work is the product of force through a distance.** **Students will understand power is the rate at which work is done.** **Students will understand the differences between potential and kinetic energy.** **Students will understand the "Law of conservation of Energy".** **Students will develop an understanding of energy as the ability to cause change.**	
Essential Questions: **What does the word work mean to you?** **What forms of energy can you identify in the classroom?** **If something is moving, is work being done?** **How does energy cause change, and what kinds of changes occur?**	**Curriculum Goals/Objectives** (to be assessed at the end of the unit/quarter) **2.1.1** Interpret data on work and energy presented graphically and numerically. • Identify work as the transfer of energy by a force acting through a distance, when that force acts in the direction of motion of the object, • Interpret a graph of force vs. distance for the displacement of an object by a constant force; the area under the graph is equal to the work done by the force on the object; work is a scalar quantity. • Explain the work-energy relationship involving work done in lifting an object vertically to the change in gravitational potential energy, . work done in setting an object in motion to the change in kinetic energy, . work done in stretching or compressing a spring to the change in elastic potential energy, . **2.1.2** Compare the concepts of potential and kinetic energy and conservation of total mechanical energy in the description of the motion of objects. • Compare conceptually and mathematically situations involving potential-kinetic energy transformations (pendulum, falling object, roller coaster, inclined plane, block-spring system) indicating the amount of energy at various locations. • Summarize the concept of energy conservation - energy can be stored and transferred, but cannot be created or destroyed. • Conclude that in all situations, energy tends to dissipate throughout the environment generally due to friction resulting in heat transfer.

Essential Skills/Vocabulary: • Develop the concept of energy as the ability to cause change. • Describe energy transfer and storage in different physical systems, including but not limited to those involving gravitational potential energy, elastic potential energy, thermal energy, and kinetic energy. • Apply proportional reasoning to the relationship between an object's kinetic energy and the object's mass and velocity according to the equation: $KE = \frac{1}{2}mv^2$ • Analyze changes in gravitational potential energy when an object's mass and/or height change: $PE_g = mgh$ • Apply proportional reasoning to the relationship between a spring's potential energy and its deformation, x, according to the equation: $PE_s = \frac{1}{2}kx^2$ • Show that PE_s = area under a graph of Force vs. deformation (stretch or compression), where $F = -kx$. The spring constant k is equal to the slope of the graph and is called the elastic constant. • Analyze conceptually that thermal energy increases when an object's temperature increases. • Express an understanding of the conservation of energy in words as well as charts, diagrams and graphs. • Identify work as the transfer of energy by a force acting through a distance, when that force acts in the direction of motion of the object: $W = F\Delta x$ • Recognize that work is equal to the area under a force	**Assessment Tasks:** Major test, quizzes, homework Lab on Energy Lab on Work and Power (stadium steps and stopwatches) **http://www.ncpublicschools.org/curriculum/science/scos/2004/27physics** **(FOR SUPPLIES NEEDED TO ACCOMPANY THE BELOW "INQUIRY SUPPORT LABS")** • **Inquiry Support Lab:** Spring Energy Activities

vs. distance graph.

- Define power as the rate of transferring energy or the rate of doing work.
- Use the power equation to solve mathematical problems involving transfer of energy through work:

$$P = \frac{W}{\Delta t} = F\overline{v}$$

Recognize that a force must cause displacement in order for work to be done.

- Verify through investigations the conservation of energy in situations involving transfer of energy among kinetic energy, elastic potential energy and gravitational potential energy.
- Develop the concept of energy as the ability to cause change.
- Describe energy transfer and storage in different physical systems, including but not limited to those involving gravitational potential energy, elastic potential energy, thermal energy, and kinetic energy.
- Apply proportional reasoning to the relationship between an object's kinetic energy and the object's mass and velocity according to the equation: $KE = \frac{1}{2}mv^2$
- Analyze changes in gravitational potential energy when an object's mass and/or height change: $PE_g = mgh$
- Apply proportional reasoning to the relationship between a spring's potential energy and its deformation, x, according to the equation: $PE_s = \frac{1}{2}kx^2$
- Show that PE_s = area under a graph of Force vs. deformation (stretch or compression), where $F = -kx$. The spring constant k is equal to the slope of the graph and is called the elastic constant.
- Analyze conceptually that thermal energy increases when an object's temperature increases.
- Apply the idea that energy can be transferred when objects interact. (See work under 6.02)

- Express and apply the idea that in all situations, energy tends to dissipate throughout the environment.
- Express the concept of energy conservation by applying the idea that energy can be stored and transferred, but cannot be created or destroyed.
- Express an understanding of the conservation of energy in words as well as charts, diagrams and graphs. Use conceptual analysis and mathematical formulas for energy to determine amounts of energy stored as kinetic energy, elastic potential energy, gravitational potential energy, and amounts of energy transferred through work.
- Analyze and investigate the relationship among kinetic, potential, and other forms of energy to see that total energy is conserved. (pendulum in various positions, ball in flight, stretching a rubber band, hand generator, turbine)
- Solve problems relating the amounts of energy stored and transferred applying the principle of conservation of energy. Identify work as the transfer of energy by a force acting through a distance, when that force acts in the direction of motion of the object: $W = F\Delta x$
- Recognize that work is equal to the area under a force vs. distance graph.
- Define power as the rate of transferring energy or the rate of doing work.
- Use the power equation to solve mathematical problems involving transfer of energy through work:

  $$P = \frac{W}{\Delta t} = F\overline{v}$$

- Recognize that a force must cause displacement in order for work to be done.
- Verify through investigations the conservation of energy in situations involving transfer of energy among kinetic energy, elastic potential energy and gravitational potential energy.

Investigate power.

Materials Suggestions:
Stadium stairs
Stopwatches
Spring balances
Varoius weights
Meter sticks
Dynamics cart (very low friction)
String
Spring
CBL or MBL motion detector or photogate

http://www.ncpublicschools.org/curriculum/science/scos/2004/27physics (FOR SUPPLIES NEEDED TO ACCOMPANY THE ABOVE "INQUIRY SUPPORT LABS")

21st Century Skills	Activity
Communication Skills	
Conveying thought or opinions effectively	• Analysis questions in all labs
When presenting information, distinguishing between relevant and irrelevant information	• Data collection in all Lab Activities
Explaining a concept to others	• Sign Off—Energy lab • Stadium Steps lab
Interviewing others or being interviewed	• Sign Off— Energy lab • Stadium Steps lab

Computer Knowledge	
Using word-processing and database programs	• Making graphs in labs
Developing visual aides for presentations	• Free Body Diagrams Activities
Using a computer for communication	• Free Body Diagrams Activities
Learning new software programs	• Momentum Website
Employability Skills	
Assuming responsibility for own learning	• Free Body Diagrams • Sign Off –Spring Energy
Persisting until job is completed	
Working independently	• Spring Energy Activity
Developing career interest/goals	
Responding to criticism or questions	• Sign Off —– Energy lab • Stadium Steps lab
Information-retrieval Skills	
Searching for information via the computer	• Spring Energy Activity
Searching for print information	• Spring Energy Activity
Searching for information using community members	• Stadium Stairs
Language Skills - Reading	
Following written directions	Most of the activities can be presented as opportunities for students to follow written directions. The teacher will have to work with most students to develop this skill over time.
Identifying cause and effect relationships	• Catapult
Summarizing main points after reading	
Locating and choosing appropriate reference materials	• All lab activities
Reading for personal learning	
Language Skill - Writing	

Using language accurately	
Organizing and relating ideas when writing	• "Explain" and "Evaluate" sections in all lab activities
Proofing and Editing	
Synthesizing information from several sources	• Free Body Activities • Sign Off Activity
Documenting sources	
Developing an outline	
Writing to persuade or justify a position	• Sign Off Activity
Creating memos, letters, other forms of correspondence	
Teamwork	
Taking initiative	• All lab activities • Sign Off Activity
Working on a team	• All lab activities • Sign Off Activity
Thinking/Problem-Solving Skills	
Identifying key problems or questions	• All lab activities • Sign Off Activity
Evaluating results	• All lab activities • Sign Off Activity
Developing strategies to address problems	
Developing an action plan or timeline	