Hillsborough Township School District

Hillsborough High School

Applied Technology Curriculum

Energy and Power Technology

August, 2012

ELEMENTS OF CURRICULUM

HS Course Description
Curriculum Outlined

COURSE OVERVIEW

In energy and Power Technology, students engage in practical experiences with various systems that produce energy and power. The disassembly, study, and reassembly of an internal combustion engine provide students with a foundation to examine other forms of energy production. Electricity and electronics are studied as sources of power generation and control systems. Alternative sources of energy (solar, wind, and hydroelectric) are also explored in this course. Throughout the semester, students work independently and in groups to learn course concepts through a series of hands-on problem solving experiences.

Unit	Pacing # of Weeks	Essential Questions	Enduring Understandings	Content	Skills	Assessment	NJCCCS CPI	Common Core Literacy
Standard Level: Semester Elective								
Unit 1	2 to 4 days 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What is energy? What are the two types of energy? How do you describe the relationship between work, energy, and power? How do you represent the relationships between the three, using mathematical formulas? What is the relationship between power in kW and in horsepower? What is efficiency? Can energy be created or destroyed?	Energy is the ability to do work. Work is the transferring and transformation of energy. Power is the rate at which work is being done. All three terms are related with one another.	The student will be able to define and contrast energy, work, and power. Given mass, distances, and time, calculate horsepower and power using appropriate units. Given the conversion formulas, calculate horsepower and kilowatt equivalence. Apply measurement tools to apply the concepts of work, power, and energy to a real life example. Calculate Efficiency	Define the following terms: • Force • Joule • Energy • Work • Power • Meter • Kilogram • Btu • Kilowatt • Horsepower • Efficiency Discuss energy and the relationship to power and work. Discuss renewable and non-renewable energy sources. Calculate energy, power, and work on mechanical and electrical systems.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful Completion of safety test and assignments Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process.	RH 9-12.4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
Energy								

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Unit 2 **Electricity/Electronics Units and Notations**	1 to 2 days 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What are the two common measurement systems? What are the seven base units in the SI system? What institution adopted the metric system as the standard for all engineering and scientific literature? How is a number expressed in scientific notation? What is the prefix for 10^3?	SI prefixes, also known as a metric prefixes, have names and symbols that precedes a unit of measure or its symbol to form decimal multiples. SI prefixes are used to reduce the quantity of zeroes in numerical equivalencies.	Differentiate between fundamental units and derived units. Demonstrate knowledge of the SI system of measurements. Write numbers in scientific and engineering notation. Recognize and properly use the symbols for SI prefixes. Describe the advantage of engineering notation for use in electronics. Convert SI prefixes from one form to another. Utilize the calculator for entering numbers in engineering notation.	Define the following terms: • Exa • Peta • Tera • Giga • Mega • Kilo • Milli • Micro • Nano • Pico • Femto • Atta Apply prefix conversion to given problems.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of magazine search Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 3 **Electrical Properties**	1 to 2 days 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	Define matter and give two examples. Why is the valence electron important when understanding electricity? Describe the placement of the 29 electrons of the copper atom. What are the differences between conductors, semiconductors, and insulators? Why doesn't an orbiting electron fall into the nucleus of the atom?	Electrons on the outer most shell of the atomic structure of an element have a significant role in the flow of electrons (current).	Define common terms associated with atomic properties. Differentiate between a molecule and a compound. Describe the makeup of atoms via subatomic particles. Compare and contrast the various energy levels within the atom and the basis for existence in the energy levels. Identify the valence shell and state its importance to understanding electricity. Compare and contrast the terms conductors, semiconductors, and insulators.	Define the following terms: • Matter • Atom • Element • Compound • Valence shell • Conductor • Insulator Illustrate the structure of given elements and show their subatomic particles. Give example of conductors, insulators, and semiconductors. Discuss the Law of Charges. Project on magnetic and electrical properties.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process projects.	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 4 **Electrical Quantities**	2 to 5 days 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What is the difference between the charge of an electron and a coulomb? What instrument is used to measure voltage? How is voltage, current, and resistance calculated? Why are schematic symbols and diagrams used?	Schematic diagrams and symbols show the representation of various electronic components and movement of electricity.	Define voltage in terms of work and charge. Compare and contrast potential difference and voltage. Describe the conditions needed for electron flow. Describe a voltage drop. Describe how current is measured. Describe the factors that affect resistance. Construct a practical electric circuit.	Define the following terms: • Voltage • Current • Resistance • Power • Circuits • Schematics • Resistance • Conductance • Voltage Drop Give student breadboard, wires, LEDs, battery, and motor to discuss the electrical quantities. Introduction to Ohm's Law.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	9.4.12.O.(2).4 Use scientific and mathematical problem-solving skills and abilities to develop realistic solutions to assigned projects, and illustrate how science and mathematics impact problem-solving in modern society. 9.4.12.O.(2).1 Develop an understanding of how science and mathematics function to provide results, answers, and algorithms for engineering activities to solve problems and issues in the real world.	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 5 **Series DC Circuits**	2 to 4 days 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What constitutes a series circuit? What does component dependency mean in series strung lights? How is total resistance found in a series circuit? What are the three characteristics of a series circuit? How would you describe the term troubleshooting?	A complete circuit requires a voltage source, load, controller, and path for electricity.	State the rules for a series-connected circuit. Solve for circuit and component resistance, voltage, current, and power. Analyze series circuits to determine unknown quantities. Determine voltage polarity using a variety of notations. Compare the terms ground, common, and reference. Troubleshoot series circuits and determine faults. Differentiate between open and shorts in series circuits.	Introduction to series circuits. Introduction to resistors. Build a simple electrical circuit and apply components to merge into a series circuit. Identify schematic symbols and components. Illustrate a schematic diagram of a series circuit and have students label components and calculate unknown quantities.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.4.D.1 Repair an electric circuit by completing a closed loop that includes wires, a battery (or batteries), and at least one other electrical component to produce observable change. 5.2.6.D.1 Use simple circuits involving batteries and motors to compare and predict the current flow with different circuit arrangements. 5.2.2.D.1 Predict and confirm the brightness of a light, the volume of sound, or the amount of heat when given the number of batteries, or the size of batteries.	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 6 **Transportation Technical Systems**	2 to 4 weeks 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	How is energy converted from one form to another? How does "degrees of freedom" relate to vehicle technical systems? Why is the framework of a transportation system important? How are internal and external combustion different?	Land, air, ground, sea, each mode of transport has a fundamentally different technological solution, and some require a separate environment.	Define what is meant by a vehicle technical system. Briefly explain each of the technical systems: Structure, Controls, Propulsion, Guidance, Suspension, and Support. Identify in a given transportation system the six basic technical systems. Differentiate between control and guidance. List and describe the types of support systems needed to operate a transportation vehicle or system.	Discuss the following energy conversions: external and internal combustion, mechanical, chemical, electrical. Identify the following energy transmissions: mechanical drives, hydraulic drives, and electric drives. Build an ROV to reinforce unit content and understanding.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.12.E.1 Compare the calculated and measured speed, average speed, and acceleration of an object in motion, and account for differences that may exist between calculated and measured values. 5.2.12.E.4 Measure and describe the relationship between the force acting on an object and the resulting acceleration. 5.2.12.E.2 Compare the translational and rotational motions of a thrown object and potential applications of this understanding.	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 7 **Safety in the Small Engines Shop**	1 – 2 days 18 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	When working around small engines, what should you avoid wearing to prevent injury? How are fire extinguishers categorized? What is the most common cause of shop fires? Where should gasoline always be stored?	Safety in the small engines shop is fundamental to have a successful working environment.	Explain why a clean, well-organized shop is extremely important. List several dangers associated with working in a small engine shop. Explain the importance of maintaining and using tools properly. Describe methods for minimizing the risks involved in working with small engines. Explain the function of OSHA.	Demonstrate safety procedures within the small engine shop. List fire classifications. Discuss OSHA rules and regulations. Define the following terms: • Hazards • Solvent • Flammable • Gas • Goggles • OSHA • Toxic fumes • Carbon Monoxide • Tool Safety • Machine Safety • General Safety	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 8 **Tools and Measuring Instruments**	1 week Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What kind of wrench is open on one end and boxed on the other? Which kind of wrench should be used only as a last resort if others are not available? To remove a spark plug, what kind of wrench would be to use avoid damaging the plug during removal? Why is the torque wrench used in most cases? Name several types of measuring instruments used to determine if engine parts are within manufacture's tolerance.	Tools and equipment will be demonstrated and applied on small engines and other project designs.	Explain why quality tools and measuring instruments should be used when servicing small gas engines. Use common hand tools properly. Summarize the reasons that small engine components must be measured carefully. Demonstrate several of the common measuring techniques.	Demonstrate the proper use of shop tools and equipment. Demonstrate the proper way to read and calibrate a standard micrometer. Define the following terms: • Torque wrench • Micrometer types • Wrench • Vise grips • Pliers • Center punch • Telescoping gauge • Sockets • Other tools as needed.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 9 **Engine Construction and Principles of Operation**	5-6 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What kind of wrench is open on one end and boxed on the other? Which kind of wrench should be used only as a last resort if others are not available? To remove a spark plug, what kind of wrench would be to use avoid damaging the plug during removal? Why is the torque wrench used in most cases? Name several types of measuring instruments used to determine if engine parts are within manufacture's tolerance.	The four stroke cycle: intake, compression, power, and exhaust are the order of operation for most small engines.	Explain simple engine operation. List the qualities of gasoline that make it an efficient fuel for small engines. Explain why gasoline is atomized in the small engine. Identify the basic components of a small engine and describe the function of each part. Breakdown and rebuild a small gas engine. Describe four stroke cycle engine operations and explain the purpose of each stroke.	Discuss simple engine operation. Discuss the four stroke cycle. Reinforce knowledge of content by disassembling and reassembling small gas engine. Define the following terms: • Crankshaft • Camshaft • Valves • Timing marks • Cylinder • Combustion • Sparkplug • Flywheel • Keyways • Sump cover • Piston • Connecting rod • Carburetor • Head • Block • Cooling	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 10 **Mechanical Energy and Simple Machines**	3-4 weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What are the different simple machines? What is mechanical Energy? What are the different types of levers?	Simple machines Mechanical Energy Forces on materials	Explain simple machine operation. List the different simple machines and how they are utilized. Define the difference between load and force. Identify the basic components of simple machines and describe the function of each part.	Use mechanical Energy to move an object. Calculate Forces applied to an object Design a product that uses simple machines.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 11	3-4 Weeks	What are applications of solar energy?	Solar Energy Wind Energy Hydroelectric Energy Electrical	Photovoltaic applications	Select one of the alternative energy sources and devise a device to generate and utilize electricity.	Teacher observation of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy.	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
Energy Types	Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What are applications of wind energy? What are applications of hydroelectric energy? How is energy used?		Turbine and blade design Generator design		Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Teacher questioning of student	5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Unit 12 **General Tools and Material Processing**	1 week 18 Weeks Embedded, discussed, introduced, integrated, and reviewed throughout all units during the semester.	What tools are used to process materials? Demonstrate how to properly operate hand tools. Name several types of tools to process wood and materials. Explain the many ways materials can be fastened together. What are the proper ways to read and utilize a ruler?	Tools and equipment will be demonstrated and applied on project designs.	Explain why quality tools and measuring instruments should be used. Use common hand tools properly. Demonstrate ways to process materials. Using wood and other common materials to assemble projects	Demonstrate the proper use of shop tools and equipment. Demonstrate the proper way to read a ruler. Define the following terms: • Hammers • Files • Saws • Drilling • Sanding • Power Tools • Glue Guns • Soldering Iron • Routers • Modeling tools • Other tools as needed.	Teacher observation of student Student completing teacher assigned evaluation with rubric Successful completion of projects and assignments with terminology and content Safety Test Teacher questioning of student	5.2.8.C.2 Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy. 5.2.8.E.2 Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario. 9.4.12.O.1.12 Model technical competence by developing and applying processes and concepts in the design process	RH 9-12.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. WHST 9-12.6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.