

MARLBORO CENTRAL SCHOOL DISTRICT

HS SCIENCE: Engineering & Robotics

Title or Topics	Concepts / Skills	Major Assessments (Tests, projects, etc.)	Time Frame (Number of weeks) All time frames are subject to change based on students needs
Introduction to Statics (Material design and testing)	<ol style="list-style-type: none"> 1. Laws of motion describe the interaction of forces acting on a body. 2. Structural member properties including centroid location, moment of inertia, and modulus of elasticity are important considerations for structure design. 3. Static equilibrium occurs when the sum of all forces acting on a body are equal to zero. 4. Applied forces are vector quantities with a defined magnitude, direction, and sense, and can be broken into vector components. 5. Forces acting at a distance from an axis or point attempt or cause an object to rotate. 6. In a statically determinate truss, translational and rotational equilibrium equations can be used to calculate external and internal forces. 7. Free body diagrams are used to illustrate and calculate forces acting upon a given body. 	<p>File Folder Bridge Competition</p> <p>Summation of forces acting on a truss bridge</p> <p>West Point Bridge Builder Contest</p>	8
Introduction to mechanical engineering	<ol style="list-style-type: none"> 1. Engineers and engineering technologists apply math, science, and discipline-specific skills to solve problems. 	Construction and competition of a four wheel drive vehicle	4

	<ol style="list-style-type: none"> 2. Engineering and engineering technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals. 3. Technical communication can be accomplished in oral, written, and visual forms and must be organized in a clear and concise manner. 4. Most mechanisms are composed of gears, sprockets, pulley systems, and simple machines. 5. Mechanisms are used to redirect energy within a system by manipulating force, speed, and distance. 6. Mechanical advantage ratios mathematically evaluate input work versus output work of mechanisms. 	<p>Construction and competition of a two speed transmission drag racer.</p>	
<p>Introduction to computer programming and robotics</p>	<ol style="list-style-type: none"> 1. 1. Flowcharts provide a step by step schematic representation of an algorithm or process. 2. 2. Control systems are designed to provide consistent process control and reliability. 3. 3. Control system protocols are an established set of commands or functions typically created in a computer programming language. 4. 4. Closed loop systems use digital and analog sensor feedback to make operational and process decisions. 5. 5. Open loop systems use programming constants such as time to make operational and process decisions. 	<p>Various Challenges:</p> <p>Go one meter Go around the box Go through the maze Remote control Go Stay in the box Follow the line Smart car construction</p> <p>Free Build</p>	<p>12</p>

<p>Introduction to electrical engineering</p>	<ol style="list-style-type: none"> 1. Energy source classifications include nonrenewable, renewable, and inexhaustible. 2. Energy source processes include harnessing, storing, transporting, and converting. 3. Energy often needs to be converted from one form to another to meet the needs of a given system. 4. An understanding of work, energy, and power is required to determine system efficiency. 5. An understanding of the basics of electricity requires the understanding of three fundamental concepts of voltage, current, and resistance. 6. The atomic structure of a material determines whether it is a conductor, an insulator, or a semiconductor. 7. Energy management is focused on efficient and accessible energy use. 8. System energy requirements must be understood in order to select the proper energy source. 9. Energy systems can include multiple energy sources that can be combined to convert energy into useful forms. 10. Hydrogen fuel cells create electricity and heat through an electrochemical process that converts hydrogen and oxygen into water. 11. Solar cells convert light energy into electricity by using photons to create electron flow. 12. Thermodynamics is the study of the effects of work, thermo energy, and energy on a system. 13. Thermo energy can transfer via convection, conduction, or radiation. 14. Material conductivity, resistance, and energy transfer can be calculated. 	<p>Various challenges: Make your own battery</p> <p>Compare and contrast from fuel cells to photovoltaic cells</p> <p>Construct and wire a two story model house</p>	<p>4</p>
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<p>Introduction to 3D Printing and 3D Modeling</p>	<ol style="list-style-type: none"> 1. Teamwork requires constant communication to achieve the desired goal. 2. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions. 	<p>Design with primitive shapes.</p> <p>Manipulate with primitive shapes.</p> <p>Add and subtract 3D Models</p> <p>Scan and create 3D Models</p> <p>Design and slice 3D Models</p>	<p>4</p>
<p>Introduction to Aerodynamics via rocketry and model aviation</p>	<ol style="list-style-type: none"> 1. Fluid Dynamics <ol style="list-style-type: none"> a. Turbulence 2. Forces of flight <ol style="list-style-type: none"> a. Drag b. Lift c. Weight d. Thrust 3. Trajectories 	<p>Constructing Gliders</p> <p>Learning how rudders and ailerons work via model airplanes</p> <p>Learning how trajectories work via rocketry.</p> <p>Learning how wind can effect both rockets and airplanes.</p>	<p>4</p>