

**Glen Ridge Board of Education  
Engineering Graphics - Honors  
Semester  
*Elective***

***New Jersey Student Learning Standards***

## Computer Science, Engineering, and Technology Mission Statement:

Since computational thinking and problem solving are integral parts of our lives and 21st century learning, students must be actively involved in their Computer Science, Engineering, and Technology (CSET) education. The CSET curricula will emphasize thinking skills through a balance of computation, intuition, common sense, logic, design, analysis, and technology. Students will use a combination of technology and critical thinking to solve real-world problems. To achieve these goals, students will be taught a standards-based curriculum that is aligned with the New Jersey Curriculum Standards.

### Course Description:

Upon the successful completion of Computer Aided Design & Drawings II, students develop their knowledge and skills for careers in engineering and industrial design. This is an advanced level course that continues the progression from previous CAD courses with an emphasis on engineering. Basic principles of Engineering graphics, blueprint reading and geometric construction are reviewed. Multiview projections and 3D visualization are introduced. This experience will allow the students to be creative and explore new techniques while reinforcing CAD skills. Autodesk AutoCAD, and Inventor, software will be utilized during this course. Using Inventor students learn dimensioning, creating Sectional, Auxiliary and Detail/Break views. Students will explore college and career opportunities through site visits and guest speakers.

### Engineering Graphics - Honors

#### Unit 1: Introduction to Engineering graphics, CAD & Career Preparation

**Time Allotted (days of instruction): 20 days**

#### New Jersey Student Learning Standards (NJSLS)

- **8.1.12.D.1:** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **8.2.12.C.5:** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
- **8.2.12.D.1:** Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

Essential Questions	Student Learning Objectives	Activities
<ul style="list-style-type: none"> <li>● How do the rules of geometry affect a CAD drawing?</li> <li>● Why should you use specific snap commands and dimensional constraints when controlling geometry in a drawing?</li> <li>● How can geometric constraints be applied to increase efficiency in producing a drawing?</li> </ul>	<ul style="list-style-type: none"> <li>● Understand the method of retrieving private files through the public network and have a positive approach to original design. (8.1.12.D.1)</li> <li>● Draw and dimension 2D mechanical parts with increasing difficulty and apply shortcut functions in CAD. (8.2.12.C.5)</li> </ul>	<ul style="list-style-type: none"> <li>● Students will review procedures for creating a CAD drawing.</li> <li>● Students will create a series of 2D CAD drawing related to the previous years' drawings.</li> <li>● Students will dimension drawings for size, location and accuracy.</li> <li>● Students will apply shortcuts and snap operations to enhance their skills and efficiency when producing a CAD drawing.</li> </ul>

<ul style="list-style-type: none"> <li>• What careers can one pursue with CAD experience, post High School and, post college?</li> <li>• What skills are necessary to be successful in the workforce?</li> <li>• How does a portfolio help individuals obtain college acceptance and employment?</li> </ul>	<ul style="list-style-type: none"> <li>• Apply geometric concepts and constraints to advanced 2D drawings to solve technical problems. (M.G-MG.A.3)</li> <li>• Demonstrate an understanding of mathematic principles as they relate to a CAD drawing. (M.G-MG.A.1)</li> <li>• Use Boolean operations; extrude 2D drawing into 3D models for the creation of a product. (8.2.12.D.3)</li> <li>• Assess the advantages of mastering 2D CAD and 3D CAD systems in terms of skills and career paths. (9.2.12.C.3)</li> <li>• Apply the design process in the creation of prototypes to solve real-life technical problems. (8.2.12.D.1)</li> <li>• Apply good elements of design when creating products. (9.3.12.AR-VIS.2)</li> <li>• Use arrays in the creation of objects with mutable incenses. (M.G-CO.A.5)</li> <li>• Understand how CAD and 3D modeling plays a critical role in designing solutions for STEM-related careers. (9.3.ST.4)</li> <li>• Design three-dimensional models that have both function and form. (9.3.12.AR-VIS.3)</li> </ul>	<ul style="list-style-type: none"> <li>• Students will use geometric constraints when producing advanced two-dimensional drawings.</li> <li>• Students will extrude two-dimensional drawings into three-dimensional models.</li> </ul> <p><b>STEAM Activity:</b></p> <ul style="list-style-type: none"> <li>• Headphone Stand: Design and create a headphone holder that has both form and function. It show allows for secure resting and while providing a high end design for the intended user. It must be made with the use of the 3D printer.</li> <li>• Sports equipment: Re-design a sporting equipment to enhance the safety of the players. (e.i. Concussion proof helmet, shock-absorbing footwear.)</li> </ul> <p><b>Enrichment Activities:</b></p> <ul style="list-style-type: none"> <li>• Sample drawings for each assigned drawing will be used.</li> <li>• Drawings will be use to enhance student’s knowledge of CAD operations.</li> <li>• Drawings should use layers for centerlines, hidden lines, extension lines and dimensioning.</li> <li>• Sample real life objects will be used to that the students are drawing.</li> <li>• Tessellation: Students will design an original tessellation. This drawing will use the circular array function.</li> <li>• Discussion on college portfolios and applications. Specific items to include in them.</li> </ul>
<p><b>Resources/Materials</b></p>	<ul style="list-style-type: none"> <li>• Digital handouts of 2D drawings references</li> <li>• Textbooks: Autodesk Inventor 2020 and Engineering Graphics, <i>Mechanical Drawing</i>, &amp; <i>Technical Drawing</i></li> <li>• Computers with AutoCAD and Inventor installed</li> <li>• Plotter/Printers</li> <li>• 3D printer</li> <li>• Smartboard</li> <li>• Calculator</li> </ul>	

	<p><b>Online Resources:</b></p> <ul style="list-style-type: none"> <li>Mr. Shohen's page: <a href="http://www.glenridge.org/Page/3607">http://www.glenridge.org/Page/3607</a></li> </ul> <p>Headphone Stand:</p> <ul style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=j7ZwQa8vYnY">https://www.youtube.com/watch?v=j7ZwQa8vYnY</a></li> <li><a href="http://www.tested.com/tech/accessories/1823-tips-to-make-your-own-awesome-headphone-stand/">http://www.tested.com/tech/accessories/1823-tips-to-make-your-own-awesome-headphone-stand/</a></li> <li><a href="https://www.pinterest.com/pin/419538521512931785/">https://www.pinterest.com/pin/419538521512931785/</a></li> </ul>
<b>Interdisciplinary Connections</b>	<ul style="list-style-type: none"> <li><b>M.G-CO.A.5:</b> Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.</li> </ul>
	<ul style="list-style-type: none"> <li><b>M.G-MG.A.3:</b> Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</li> </ul>
<b>21st Century Life and Careers</b>	<ul style="list-style-type: none"> <li><b>9.2.12.C.3:</b> Identify transferable career skills and design alternate career plans.</li> </ul>
<b>Technology Standards</b>	<ul style="list-style-type: none"> <li><b>9.3.12.AR-VIS.2:</b> Analyze how the application of visual arts elements and principles of design, communicate and express ideas.</li> <li><b>9.3.12.AR-VIS.3:</b> Analyze and create two and three-dimensional visual art forms using various media.</li> <li><b>9.3.ST.4:</b> Understand the nature and scope of the Science, Technology, Engineering &amp; Mathematics Career Cluster and the role of STEM in society and the economy.</li> </ul>

<b>Assessments</b>			
<b>Formative</b>	<b>Summative</b>	<b>Benchmarks</b>	<b>Alternative</b>
<ul style="list-style-type: none"> <li>Questions of the day. (Commands, careers &amp; computer stations)</li> <li>Peer evaluation of drawings.</li> <li>Assessment rubrics to ensure drawings meet the requirements specified.</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes on measuring, dividing and decimal equivalents.</li> <li>AutoCAD and Inventor drawing quiz, and vocabulary quiz.</li> </ul>	<ul style="list-style-type: none"> <li>Students will be assessed on the accuracy and proper use of dimensions in their drawings.</li> <li>Students will complete assigned drawing by the determined due date.</li> </ul>	<ul style="list-style-type: none"> <li>Students will keep a digital portfolio of their drawings.</li> <li>Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.</li> </ul>

<b>Modifications</b>		
<b>English Language Learners</b>	<b>Special Education/504</b>	<b>Gifted and Talented</b>
<ul style="list-style-type: none"> <li>Step by step instructions with pictures are provided for learning how to draw each part.</li> </ul>	<ul style="list-style-type: none"> <li>Step by step instructions with pictures are provided for learning how to draw each part.</li> <li>Extended time and reduced work</li> <li>One on one instructions and review of</li> </ul>	<ul style="list-style-type: none"> <li>Additional advanced part drawings are available for extra credit.</li> <li>Students can create original instructions for other students to use in the future.</li> </ul>

drawing procedures.

**Engineering Graphics - Honors**

**Unit 2: Advanced Mechanical Engineering**

**Time Allotted (days of instruction): 25 Days**

**New Jersey Student Learning Standards (NJSLS)**

- **8.2.12.C.4:** Explain and identify interdependent systems and their functions.
- **8.2.12.C.5:** Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
- **8.2.12.D.1:** Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

Essential Questions	Student Learning Objectives	Activities
<ul style="list-style-type: none"> <li>● How has parametric modeling with advanced 3D software changed the drafting industries?</li> <li>● Is there more than one way to set up a drawing?</li> <li>● Is efficiency and speed more or less important than accuracy when creating 3D models?</li> <li>● How can different techniques for assembly drawing be applied to increase efficiency?</li> <li>● What kinds of object require an auxiliary view for surface representation?</li> <li>● What are the advantages of creating multiview and pictorial drawings when you can create three-dimensional models?</li> <li>● How could a drawing with a minor error impact the manufacturing process?</li> </ul>	<ul style="list-style-type: none"> <li>● Create complex three-dimensional objects and produce, multi-view, isometric, full and half section drawings and dimension them. (8.2.12.C.5)</li> <li>● Draw advanced 3D solid models using revolves, sweeps, lofts and arrays to produce accurate representations of objects. (9.3.12.AR-VIS.3)</li> <li>● Use parametric modeling software to transfer drawing from the textbook to the computer program. (8.2.12.D.3)</li> <li>● Create industrial drawings for the manufacturing of a part or product. (9.3.MN.6)</li> <li>● Build technical vocabulary by understanding key terms used in CAD and geometry. (M.G-MG.A.1)</li> <li>● Design and manufacture a prototype of a product and provide a description of how the product could be manufactured. (8.2.12.D.1)</li> <li>● Draw real life objects that can be full</li> </ul>	<ul style="list-style-type: none"> <li>● Students will create a series of CAD drawings containing multi-views, isometric, full and half section, and auxiliary drawings</li> <li>● Finish the sketch and extrude to a three dimensional object.</li> <li>● Add concentric and linear holes by applying the hole tool.</li> <li>● Students will use parametric modeling software to draw sectional views of objects with increasing difficulties.</li> <li>● Students will use parametric modeling software to draw auxiliary projections of objects with increasing difficulties.</li> <li>● Multi-View CAD Drawings: Students will re-create multi-view drawings from a drafting textbook to include in their portfolio. Each drawing will be dimensioned using proper dimensioning rules.</li> </ul> <p><b>STEAM Activities:</b></p> <ul style="list-style-type: none"> <li>● Aviation Design: The students will design detailed drawing of an aeronautical object using multi view projection and dimensioning.</li> </ul>

	<p>and half sectioned by using cut planes. (M.G-GMD.B.4)</p> <ul style="list-style-type: none"> <li>● Draw real life technical objects that are on non-perpendicular angles. (9.3.MN.6)</li> </ul>	<ul style="list-style-type: none"> <li>● Chess Set: Use advanced techniques in Inventor to create a 3D chess set with a design theme. Use revolves, sweeps, lofts and mesh modeling to create the figures.</li> </ul> <p><b>Enrichment Activities:</b></p> <ul style="list-style-type: none"> <li>● Sample drawings for each assigned project and each assigned drawing.</li> <li>● Sample real life objects for the students to draw.</li> <li>● The Paramedic Modeling text can be used for basic tutorials of how to draw advanced three-dimensional parts.</li> <li>● Pats can be drawn from the Parametric Modeling Text or the Engineering Drawing and design Text.</li> <li>● Each drawing should be dimensioned using proper dimensioning rules.</li> <li>● Drawings should allow students to become efficient with the process of creating a 2D sketch and extrude the sketch to 3D.</li> </ul>
<p><b>Resources/Materials</b></p>	<ul style="list-style-type: none"> <li>● Digital handouts of drawings and procedures.</li> <li>● Parametric Modeling Textbook.</li> <li>● Textbooks: Autodesk Inventor 2020 and Engineering Graphics, <i>Mechanical Drafting, Technical Drawing: Engineering Drafting And Design.</i></li> <li>● Computers with Autodesk Inventor installed</li> <li>● Plotter/Printers</li> <li>● 3D printer</li> <li>● Smartboard</li> <li>● Calculator</li> <li>● Rulers</li> <li>● Calipers</li> </ul> <p><b>Online Resources:</b></p> <ul style="list-style-type: none"> <li>● Mr. Shohen's page: <a href="http://www.glenridge.org/Page/3607">http://www.glenridge.org/Page/3607</a></li> </ul> <p>Chess Set:</p> <ul style="list-style-type: none"> <li>● <a href="https://www.youtube.com/watch?v=z7xv9bUXAVc">https://www.youtube.com/watch?v=z7xv9bUXAVc</a></li> <li>● <a href="https://www.youtube.com/watch?v=TiPN6NyfcsU">https://www.youtube.com/watch?v=TiPN6NyfcsU</a></li> </ul>	
<p><b>Interdisciplinary Connections</b></p>	<ul style="list-style-type: none"> <li>● <b>M.G-GMD.B.4:</b> Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</li> <li>● <b>M.G-MG.A.1:</b> Use geometric shapes, their measures, and their properties to describe objects.</li> </ul>	

<b>21st Century Life and Careers</b>	<ul style="list-style-type: none"> <li>● <b>9.2.12.C.1:</b> Review career goals and determine steps necessary for attainment.</li> </ul>
<b>Technology Standards</b>	<ul style="list-style-type: none"> <li>● <b>9.3.12.AR-VIS.3:</b> Analyze and create two and three-dimensional visual art forms using various media.</li> <li>● <b>9.3.MN.6:</b> Demonstrate workplace knowledge and skills common to manufacturing.</li> </ul>

<b>Assessments</b>			
<b>Formative</b>	<b>Summative</b>	<b>Benchmarks</b>	<b>Alternative</b>
<ul style="list-style-type: none"> <li>● Questions of the day. (Commands, careers &amp; computer stations)</li> <li>● Peer evaluation of drawings.</li> <li>● Assessment rubrics to ensure drawings meet the requirements specified.</li> </ul>	<ul style="list-style-type: none"> <li>● Quizzes on Model history tree.</li> <li>● Inventor drawing, and vocabulary quiz.</li> </ul>	<ul style="list-style-type: none"> <li>● Students will be assessed on the accuracy and proper use of dimensions in their drawings.</li> <li>● Students will complete assigned drawing by the determined due date.</li> </ul>	<ul style="list-style-type: none"> <li>● Students will keep a digital portfolio of their drawings.</li> <li>● Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.</li> </ul>

<b>Modifications</b>		
<b>English Language Learners</b>	<b>Special Education/504</b>	<b>Gifted and Talented</b>
<ul style="list-style-type: none"> <li>● Step by step instructions with pictures are provided for learning how to draw each part.</li> </ul>	<ul style="list-style-type: none"> <li>● Step by step instructions with pictures are provided for learning how to draw each part.</li> <li>● Extended time and reduced work</li> <li>● One on one instructions and review of drawing procedures.</li> </ul>	<ul style="list-style-type: none"> <li>● Additional advanced part drawings are available for extra credit.</li> <li>● Students can create original instructions for other students to use in the future.</li> </ul>

<b>Engineering Graphics - Honors</b>		
<b>Unit 3: Geometric Dimensioning &amp; Tolerance</b>		
<b>Time Allotted (days of instruction): 10 days</b>		
<b>New Jersey Student Learning Standards (NJSLs)</b>		
<ul style="list-style-type: none"> <li>● <b>8.1.12.D.1:</b> Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.</li> </ul>		
<ul style="list-style-type: none"> <li>● <b>8.2.12.C.5:</b> Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.</li> </ul>		
<ul style="list-style-type: none"> <li>● <b>8.2.12.D.1:</b> Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.</li> </ul>		
<ul style="list-style-type: none"> <li>● <b>8.2.12.D.3:</b> Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.</li> </ul>		
<b>Essential Questions</b>	<b>Student Learning Objectives</b>	<b>Activities</b>

<ul style="list-style-type: none"> <li>• What general guidelines must be followed when applying dimensions?</li> <li>• How are manufacturers and designers affected by the dimension and tolerance methods?</li> <li>• Is true position theoretically an exact location for finding features on a drawing?</li> <li>• What would happen if dimensions were exact with no tolerance?</li> <li>• How does dimensioning affect the cost of products?</li> <li>• How can dimensioning and tolerance be applied to cases and packaging to reduce waste materials?</li> </ul>	<ul style="list-style-type: none"> <li>• Create and extrude 3D mechanical sub-assemblies and assemblies with parts lists and dimensions. (8.2.12.C.5)</li> <li>• Draw and assemble 3D solid models from several smaller parts by aligning planes mating surfaces and inserting shafts and hardware. (8.2.12.C.4)</li> <li>• Import or create fasteners for mechanical assemblies. (9.3.12.AC-DES.8)</li> <li>• Apply notes for type of hardware and thread sizes. (9.3.MN.6)</li> <li>• Create threads by using the coil cut command to create screws, bolts and mating nuts using the reverse coil cut command. (9.3.MN.6)</li> <li>• Design and prototype products that use threads and coils. (8.2.12.D.3)</li> <li>• Create sheet metal parts through the use of surface development. (M.G-MG.A.1)</li> <li>• Assign materials to parts and create a materials list for exploded views of assemblies. (8.2.12.C.5)</li> <li>• Produce mechanical motion and part interaction by creating surface contacts. (9.3.ST.1)</li> <li>• Determine the amount of tolerance accumulation in a simple assembly. (M.G-MG.A.3)</li> <li>• Communicate with peers to design an original mechanical device or re-create an existing mechanical device. (8.2.12.D.1)</li> </ul>	<ul style="list-style-type: none"> <li>• Students will create a series of CAD drawings containing multi-views, assemblies, and exploded views.</li> <li>• Students will become acquainted with reading and understanding fasteners, materials, and standards as they relate to manufacturing of parts.</li> <li>• Students will use modeling software to create advanced 3D parts of increasing difficulty with concern for geometric tolerance.</li> <li>• Students will use 3D CAD to produce plastic mating parts for fabrication.</li> <li>• Students will use 3D CAD to produce sheet metal parts and layouts.</li> <li>• Students will create parts with threads using ANSI standards.</li> </ul> <p><b>STEAM Activities:</b></p> <ul style="list-style-type: none"> <li>• Clock It: Students will design a mechanical gear clock for the 3D printer or a 3D sculpture to add a clock inset or mechanical hand movement. Students will focus on creating parts with proper geometric tolerance to allow for interaction between other corresponding parts.</li> <li>• Wood Mechanical Assembly: As part of a team the students will choose a wooden mechanical device that can produce motion. The device can be recreated by using existing dimensions from a book or plan. The students will use 3D modeling software to draw parts individually to be assembled as a team. The final presentations should include orthographic views, an Isometric view, exploded assembly views with a parts list and an animation with a presentation of the working device. The device can be printed using the three-dimensional printer as a fully functional part or to be assembled using hardware.</li> </ul>
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		<p><b>Enrichment Activities:</b></p> <ul style="list-style-type: none"> <li>• The <i>Paramedic Modeling</i> text can be used for basic tutorials of how to draw advanced three-dimensional parts using the boss feature command.</li> <li>• Parts can be drawn from the <i>Parametric Modeling Text</i> or the <i>Engineering Drawing and Design Text</i>.</li> <li>• Students can recreate parts from the <i>Parametric Modeling Text</i> or the <i>Engineering Drawing and Design</i> text to be assembled and include in their portfolio. Each drawing should be dimensioned and tolerances should be placed using proper dimensioning rules.</li> <li>• 3D Modeling competition in class and online.</li> </ul>
<p><b>Resources/Materials</b></p>	<ul style="list-style-type: none"> <li>• Digital handouts of drawings and procedures.</li> <li>• Parametric Modeling Textbook. <i>Parametric Modeling with Autodesk Inventor</i></li> <li>• Textbooks: Autodesk Inventor 2020 and Engineering Graphics, <i>Mechanical Drafting, Technical Drawing: Engineering Drafting And Design</i>.</li> <li>• Computers with Autodesk Inventor installed</li> <li>• Plotter/Printers</li> <li>• 3D printer</li> <li>• Smartboard</li> <li>• Calculator</li> <li>• Rulers</li> <li>• Calipers</li> </ul> <p><b>Online Resources:</b></p> <ul style="list-style-type: none"> <li>• Mr. Shohen's page: <a href="http://www.glenridge.org/Page/3607">http://www.glenridge.org/Page/3607</a></li> </ul> <p>Clock:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=I9BgXWP1Jag">https://www.youtube.com/watch?v=I9BgXWP1Jag</a></li> <li>• <a href="https://pinshape.com/items/1128-3d-printed-number-clock-frame">https://pinshape.com/items/1128-3d-printed-number-clock-frame</a></li> </ul>	
<p><b>Interdisciplinary Connections</b></p>		<ul style="list-style-type: none"> <li>• <b>M.G-MG.A.1:</b> Use geometric shapes, their measures, and their properties to describe objects.</li> <li>• <b>M.G-MG.A.3:</b> Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</li> </ul>
<p><b>21st Century Life and Careers</b></p>		<ul style="list-style-type: none"> <li>• <b>9.2.12.C.2:</b> Modify Personalized Student Learning Plans to support declared career goals.</li> </ul>

<b>Technology Standards</b>	<ul style="list-style-type: none"> <li>● <b>9.3.12.AR-VIS.3:</b> Analyze and create two and three-dimensional visual art forms using various media.</li> <li>● <b>9.3.12.AC-DES.8:</b> Apply standards, applications and restrictions pertaining to the selection and use of construction materials, components and assemblies in the project design.</li> <li>● <b>9.3.MN.6:</b> Demonstrate workplace knowledge and skills common to manufacturing.</li> <li>● <b>9.3.ST.1:</b> Apply engineering skills in a project that requires project management, process control and quality assurance.</li> </ul>
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Assessments			
Formative	Summative	Benchmarks	Alternative
<ul style="list-style-type: none"> <li>● Questions of the day. (Commands, careers &amp; computer stations)</li> <li>● Peer evaluation of drawings.</li> <li>● Assessment rubrics to ensure drawings meet the requirements specified.</li> </ul>	<ul style="list-style-type: none"> <li>● Quizzes on tolerancing and fits.</li> <li>● Inventor drawing, and vocabulary quiz.</li> </ul>	<ul style="list-style-type: none"> <li>● Students will be assessed on the accuracy and proper use of dimensions in their drawings.</li> <li>● Students will complete assigned drawing by the determined due date.</li> </ul>	<ul style="list-style-type: none"> <li>● Students will keep a digital portfolio of their drawings.</li> <li>● Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.</li> </ul>

Modifications		
English Language Learners	Special Education/504	Gifted and Talented
<ul style="list-style-type: none"> <li>● Step by step instructions with pictures are provided for learning how to draw each part.</li> </ul>	<ul style="list-style-type: none"> <li>● Step by step instructions with pictures are provided for learning how to draw each part.</li> <li>● Extended time and reduced work</li> <li>● One on one instructions and review of drawing procedures.</li> </ul>	<ul style="list-style-type: none"> <li>● Additional advanced part drawings are available for extra credit.</li> <li>● Students can create original instructions for other students to use in the future.</li> </ul>

Engineering Graphics - Honors
<b>Unit 4: Advanced 3D Modeling &amp; 3D Printing</b>
<b>Time Allotted (days of instruction): 35 days</b>
<b>New Jersey Student Learning Standards (NJSLs)</b>
<ul style="list-style-type: none"> <li>● <b>8.2.12.C.5:</b> Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.</li> <li>● <b>8.2.12.C.6:</b> Research an existing product, reverse engineer and redesign it to improve form and function.</li> <li>● <b>8.2.12.D.1:</b> Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.</li> </ul>

- **8.2.12.D.3:** Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

Essential Questions	Student Learning Objectives	Activities
<ul style="list-style-type: none"> <li>● Why skills are needed for designing advanced mechanical parts?</li> <li>● How can a designed enhance their ability by using 3D modeling and 3D printing in the creation of mechanical parts and systems?</li> <li>● How is redesigning during the manufacturing process improved with the use of history-based part modification?</li> <li>● How do engineers use contact presentations to show the interactions between parts?</li> <li>● How can 3D printed models be used as prototypes and finished products?</li> </ul>	<ul style="list-style-type: none"> <li>● Use plans or design plans to create complex 3D moles for mechanical systems. (8.2.12.C.4)</li> <li>● Export parts for the 3D printer and evaluate their interaction. (9.3.MN.6)</li> <li>● Create products following guidelines for 3D modeling competitions. (8.2.12.D.3)</li> <li>● Create parts with advanced features such as lofts, sweeps, coils, engraving, embossing and decaling. (9.3.12.AR-VIS.3)</li> <li>● Create appropriate views, exploded views and a parts list for assembly drawings and produce balloons for individual parts for presentation purposes. (8.2.12.C.5)</li> <li>● Demonstrate mathematics knowledge and skills required to produce a mechanical motion through an assembly working drawing. (M.G-MG.A.3)</li> <li>● Develop and deliver presentations using CAD software to engage and inform audiences. (9.3.ST.1)</li> <li>● Work with a team to establish a goal and set a timeline to complete the assigned drawings and project. (8.2.12.D.1)</li> </ul>	<ul style="list-style-type: none"> <li>● Students will work in groups to create an assembly working drawing of advanced mechanical devices with several motions.</li> <li>● Students will use CAD software to assemble each part and create working drawings.</li> <li>● Students will use CAD software to produce an exploded assembly view of the device. Each part should be numbered with balloons.</li> <li>● Students will create a parts list on the final drawing.</li> <li>● Students will test the operation of their device by using the contact solver.</li> <li>● Students will present the drawing though animation of the working parts and a final print using the dimension three-dimensional printer.</li> </ul> <p><b>STEAM Activities:</b></p> <ul style="list-style-type: none"> <li>● Cam motion device: Students will design a device that uses a cam or camshaft to crate mechanical motion. (Example: Marble Mover with a cam or automata mechanical toy.)</li> <li>● Assembly Modeling: As part of a team the students will choose a mechanical device that can produce several motions. Students can pre order advanced plans for this unit. Example drawings: Combination lock, Mechanical or cam toy, gear clock, marble mover, engine, bike or fishing reel. The device can be recreated by using calipers or existing dimensions from a textbook or plan. The students will use 3D modeling software to draw parts individually to be assembled as a team. The final presentations should include orthographic views, Sectional or auxiliary views, an Isometric view, exploded assembly views with a parts list and an animation</li> </ul>

		<p>with a presentation of the working device. The device can be printed using the three-dimensional printer as a fully functional part or to be assembled using hardware.</p> <ul style="list-style-type: none"> <li>● Mechanical devices can incorporate an electric motor to show motion for the prototype.</li> <li>●</li> </ul> <p><b>Enrichment Activities:</b></p> <ul style="list-style-type: none"> <li>● Sample drawings for each assigned project and each assigned drawing.</li> <li>● Sample real life objects for the students to draw.</li> <li>● Drawings should allow students to become familiar with assembling parts and creating presentation of animation and exploded views.</li> <li>● Drawings should allow students to become familiar with the process of creating a mechanical part with motion</li> <li>● Wind Turbine Parts: The students can use the parts drawn from the previous unit to be assembled in order to create a wind turbine. The wind turbines can be placed in a presentation in order to show basic motion of parts.</li> </ul>
<p><b>Resources/Materials</b></p>	<ul style="list-style-type: none"> <li>● Digital handouts of drawings and procedures.</li> <li>● Parametric Modeling Textbook.</li> <li>● Textbooks: Autodesk Inventor 2020 and Engineering Graphics, <i>Mechanical Drafting, Technical Drawing: Engineering Drafting And Design.</i></li> <li>● Computers with Autodesk Inventor installed</li> <li>● Plotter/Printers</li> <li>● 3D printer</li> <li>● Smartboard</li> <li>● Calculator</li> <li>● Rulers</li> <li>● Calipers</li> </ul> <p><b>Online Resources:</b></p> <ul style="list-style-type: none"> <li>● Mr. Shohen's page: <a href="http://www.glenridge.org/Page/3607">http://www.glenridge.org/Page/3607</a></li> </ul> <p>Cam Devices:</p> <ul style="list-style-type: none"> <li>● <a href="https://www.youtube.com/watch?v=UAzyRKIT710">https://www.youtube.com/watch?v=UAzyRKIT710</a></li> <li>● <a href="https://www.youtube.com/watch?v=m_3qTO-e0bl">https://www.youtube.com/watch?v=m_3qTO-e0bl</a></li> </ul>	

	<ul style="list-style-type: none"> <li>• <a href="https://www.pinterest.com/pin/451626668861225448/">https://www.pinterest.com/pin/451626668861225448/</a></li> <li>• <a href="http://www.mr-dt.com/graphics/camwheelcard.htm">http://www.mr-dt.com/graphics/camwheelcard.htm</a></li> </ul>
<b>Interdisciplinary Connections</b>	<ul style="list-style-type: none"> <li>• <b>M.G-MG.A.3:</b> Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</li> </ul>
<b>21st Century Life and Careers</b>	<ul style="list-style-type: none"> <li>• <b>9.2.12.C.6:</b> Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.</li> </ul>
<b>Technology Standards</b>	<ul style="list-style-type: none"> <li>• <b>9.3.12.AR-VIS.3:</b> Analyze and create two and three-dimensional visual art forms using various media.</li> <li>• <b>9.3.ST.1:</b> Apply engineering skills in a project that requires project management, process control and quality assurance.</li> <li>• <b>9.3.MN.6:</b> Demonstrate workplace knowledge and skills common to manufacturing.</li> </ul>

<b>Assessments</b>			
<b>Formative</b>	<b>Summative</b>	<b>Benchmarks</b>	<b>Alternative</b>
<ul style="list-style-type: none"> <li>• Questions of the day. (Commands, careers &amp; computer stations)</li> <li>• Peer evaluation of drawings.</li> <li>• Assessment rubrics to ensure drawings meet the requirements specified.</li> </ul>	<ul style="list-style-type: none"> <li>• Practical quiz on mechanical assembly and contact solver using prepared components.</li> <li>• Quizzes on auxiliary views, section views, break and detail views, reference and geometry.</li> <li>• Inventor drawing, and vocabulary quiz.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will be assessed on the accuracy and proper use of dimensions in their drawings.</li> <li>• Students will complete assigned drawing by the determined due date.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will keep a digital portfolio of their drawings.</li> <li>• Students will make all necessary revisions for final flawless drawing to include in their digital portfolios.</li> </ul>

<b>Modifications</b>		
<b>English Language Learners</b>	<b>Special Education/504</b>	<b>Gifted and Talented</b>
<ul style="list-style-type: none"> <li>• Step by step instructions with pictures are provided for learning how to draw each part.</li> </ul>	<ul style="list-style-type: none"> <li>• Step by step instructions with pictures are provided for learning how to draw each part.</li> <li>• Extended time and reduced work</li> <li>• One on one instructions and review of drawing procedures.</li> </ul>	<ul style="list-style-type: none"> <li>• Additional advanced part drawings are available for extra credit.</li> <li>• Students can create original instructions for other students to use in the future.</li> </ul>

