

SHORE REGIONAL HIGH SCHOOL DISTRICT

A Regional Collaborative of the Communities Served by the Monmouth Beach, Oceanport, Shore Regional, and West Long Branch School Districts

Aligned to the New Jersey Student Learning Standards as Applicable

Course Title: Engineering Drawing

Content Area: Technology/Industrial Arts

Grade Level(s): 9-12

Course Description: Engineering Drawing is a one-year, five-credit course designed for students who may be considering post-secondary education programs or employment in related areas. The course is focused on the principles, concepts, and use of Autodesk Autocad software in the fields of engineering design. Students will master traditional drafting and sketching techniques in addition to learning to use industry-standard CAD (computer assisted design) software. Students will be tasked with designing solutions to real-world problems. These designs will be brought to life as models via 3D printing. Students will explore ergonomic design, industrial design, and product redesign throughout the course. This course will provide an understanding of basic drawing fundamentals. The students will prepare working drawings. Students will be able to communicate engineering ideas in an understandable, efficient, and accurate manner.

Curriculum Writer(s): Gregg Malfa

Date Created: December 2017

Date Approved by Board of Education: April 2018

Pacing Guide

Unit 1	(3-4 weeks)
Unit 2	(4-5 weeks)
Unit 3	(4-5 weeks)
Unit 4	(4-5 weeks)
Unit 5	(4-5 weeks)
Unit 6	(4-5 weeks)
Unit 7	(4-5 weeks)

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Unit 1 Introduction to Autocad Engineering Software

Unit Summary:

Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today’s workplace.

Interdisciplinary Connections/Content Area Integrations Including Technology:

All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.

NJSLS Number	NJSLS Content
8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
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.
8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types, and conditional statements).
RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

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WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
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Summative Assessments:

- Portfolios, Self and Peer Assessment
- Performance Assessment
- Midterm/Final Exam
- Projects
- Rubric Assessment

Formative Assessments:

- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

Enduring Understandings:

- Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today's workplace.

Essential Questions:

- How do I know when to use each tool in engineering drawing?
- How do I determine when to use CAD versus traditional drafting?
- Why do we build prototypes when we can model them on a computer?
- Is there a best way to create prototype models?

Instructional Outcomes:

- Students will be able to accurately create working drawings within a specific scale, describing and/or demonstrating various applications of CAD

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and technical drawing.

Suggested Learning Activities:

- Students will navigate through the commands and icons of the architectural software, with guided instruction from the teacher, who will use the projector to view and demonstrate to the class.

Suggested Differentiation:

- Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time
- Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts
- Tier 3 Learners: follow basic instruction by following teacher instruction on video projector

- Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.

Curriculum Development Resources:

- Freehold Regional High School District

Notes/Comments:

Unit 2 Designing/Drawing Basic 2D Objects

Unit Summary:

Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today’s workplace. Students will

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apply concepts of measurement and scale perspective in order to create accurate visual representations of engineered objects.

Interdisciplinary Connections/Content Area Integrations Including Technology:
 All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.

NJSLS Number	NJSLS Content
8.1.12.A.2	Produce and edit a multipage digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
8.1.12.C.1	Develop an innovative solution to a real-world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.2.12.A.1	Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, tradeoffs, and risks, related to the use of the innovation.
8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify tradeoffs and constraints, and document the process through drawings that include data and materials.
8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types, and conditional statements).

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Summative Assessments:

- Portfolios, Self and Peer Assessment
- Performance Assessment
- Midterm/Final Exam
- Projects
- Rubric Assessment

Formative Assessments:

- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

Enduring Understandings:

- Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today's workplace.
- Communicating an engineering design creates accurate visual representations of engineered objects.

Essential Questions:

- How do engineers communicate the elements of their designs?
- How do I know when to use editing commands in engineering drawing?
- How do I use editing commands to change a 2D object into a 3D object?
- Why is it important to understand how software commands work in autocad?

Instructional Outcomes:

- Students will be able to identify drafting icons/commands.
- Students will be able to select the correct command for the task.
- Students will be able to demonstrate proper technique for each command used.
- Students will be able to construct a 2D drawing with correct scale and dimension, and will be able to convert to a 3D object.

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- Students will be able to construct 2D and 3D perspective drawings and apply editing commands like extrude, subtract, union, and shading to drawings.

Suggested Learning Activities:

- Students will copy a 2D image of an engineering gasket, provided by the teacher and using autocad to make a precise 2D scaled drawing.

Suggested Differentiation:

- Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time
- Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts
- Tier 3 Learners: follow basic instruction by following teacher instruction on video projector
- Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.

Curriculum Development Resources:

- Freehold Regional High School District

Notes/Comments:

Unit 3 Designing/Drawing Basic 3D Objects

Unit Summary:

Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today's workplace. Students will apply concepts of 3D perspective and texture rendering in order to create accurate visual representations of engineered objects.

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Interdisciplinary Connections/Content Area Integrations Including Technology:

All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.

NJSLS Number	NJSLS Content
8.1.12.C.1	Develop an innovative solution to a real-world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify tradeoffs and constraints, and document the process through drawings that include data and materials.
8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types, and conditional statements).

Summative Assessments:

- Portfolios, Self and Peer Assessment
- Performance Assessment
- Midterm/Final Exam
- Projects
- Rubric Assessment

Formative Assessments:

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Aligned to the New Jersey Student Learning Standards as Applicable

- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

Enduring Understandings:

- Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today's workplace.
- Application of concepts of 3D perspective and texture rendering will allow for the creation of accurate visual representations of engineered objects.

Essential Questions:

- Why are various artistic techniques applied to engineering drawings?
- Why is it important to understand how software commands work in autocad?
- Why do I have to communicate my design to others?

Instructional Outcomes:

- Students will be able to create accurate and precise isometric 3D images from orthographic projections.
- Students will be able to distinguish between a line and a polyline.
- Students will be able to construct 2D and 3D perspective drawings and apply editing commands like extrude, subtract, union, and shading to drawings.

Suggested Learning Activities:

- Students will draw an orthographic projection of an isometric block by using autocad editing commands and techniques to make a precise scale drawing.

Suggested Differentiation:

- Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time
- Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts

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- Tier 3 Learners: follow basic instruction by following teacher instruction on video projector
- Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.

Curriculum Development Resources:

- Freehold Regional High School District

Notes/Comments:

Unit 4 Creating Multiple Part 3D Objects for Products

Unit Summary:

Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today's workplace. Students will construct unique 3D representations of complex problems utilizing CAD software to create a working design/drawing.

Interdisciplinary Connections/Content Area Integrations Including Technology:

All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.

NJSLS Number	NJSLS Content
8.1.12.A.2	Produce and edit a multipage digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.

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8.1.12.C.1	Develop an innovative solution to a real-world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify tradeoffs and constraints, and document the process through drawings that include data and materials.
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 tradeoffs 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.
8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types, and conditional statements).

Summative Assessments:

- Portfolios, Self and Peer Assessment
- Performance Assessment
- Midterms/Final Exam
- Projects
- Rubric Assessment

Formative Assessments:

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- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

Enduring Understandings:

- Dimensions and rendered 3D CAD creations are used by modern industry to create prototype models of new products.

Essential Questions:

- Why do we build prototypes when we can model them on a computer?
- What is the best way to create a 3D prototype model?
- How are CAD and 3D drawings used in today's workplace?

Instructional Outcomes:

- Students will be able to construct accurate 3D images using CAD software.
- Students will be able to modify CAD images to specific sizes.
- Students will be able to dimension and layout CAD images into proper isometric and orthographic format.

Suggested Learning Activities:

- Students will utilize CAD software to render an object in 3D from a scaled, dimensioned 2D drawing.

Suggested Differentiation:

- Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time
- Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts
- Tier 3 Learners: follow basic instruction by following teacher instruction on video projector

- Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.

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<p>Curriculum Development Resources:</p> <ul style="list-style-type: none"> ● Freehold Regional High School District
<p>Notes/Comments:</p>
<h2 style="margin: 0;">Unit 5 3D Product Design</h2>
<p>Unit Summary:</p> <p>Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today’s workplace. Students will apply concepts of drawing and product design to create a solution within an area of opportunity.</p>
<p>Interdisciplinary Connections/Content Area Integrations Including Technology:</p> <p>All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.</p>

NJSLS Number	NJSLS Content
8.1.12.A.2	Produce and edit a multipage digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
8.1.12.C.1	Develop an innovative solution to a real-world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

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8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify tradeoffs and constraints, and document the process through drawings that include data and materials.
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 tradeoffs 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.
8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types, and conditional statements).

Summative Assessments:

- Portfolios, Self and Peer Assessment
- Performance Assessment
- Midterm/Final Exam
- Projects
- Rubric Assessment

Formative Assessments:

- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

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<p>Enduring Understandings:</p> <ul style="list-style-type: none">● The design/engineering process is a series of steps taken in order to create a product or solve a problem.● Dimensioned and rendered CAD creations are used by modern industry to create prototype models of new products.
<p>Essential Questions:</p> <ul style="list-style-type: none">● Why do we build prototypes when we can model them on a computer?● What is the best way to create a 3D prototype model?
<p>Instructional Outcomes:</p> <ul style="list-style-type: none">● Students will be able to apply concepts of the design process to modify multiple mock-ups to assist in visualization of form and function of a product.● Students will be able to demonstrate proper selection and use of 3D printers, plotters, and color printers machines for use in prototyping designs.
<p>Suggested Learning Activities:</p> <ul style="list-style-type: none">● Students will analyze the design of a current product. Students will modify the design based on their analysis of their new design. Students must compare the functionality of the old design with their modified 3D design.
<p>Suggested Differentiation:</p> <ul style="list-style-type: none">● Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time● Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts● Tier 3 Learners: follow basic instruction by following teacher instruction on video projector ● Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.
<p>Curriculum Development Resources:</p> <ul style="list-style-type: none">● Freehold Regional High School District

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Notes/Comments:

Unit 6 Prototyping and Presentations

Unit Summary:
 Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today’s workplace. Students will create functional and visually realistic 3D prototypes by safely utilizing CNC machines, 3D printers, or laser engravers.

Interdisciplinary Connections/Content Area Integrations Including Technology:
 All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.

NJSLS Number	NJSLS Content
8.2.12.F.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
8.2.12.F.2	Analyze the relationships between internal and external computer components.
8.2.12.F.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).

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Summative Assessments:

- Portfolios, Self and Peer Assessment
- Performance Assessment
- Midterm/Final Exam
- Projects
- Rubric Assessment

Formative Assessments:

- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

Enduring Understandings:

- Dimensioned and rendered CAD creations are used by modern industry to create prototype models of new products.

Essential Questions:

- Why do we build prototypes when we can model them on a computer?
- What is the best way to create 3D prototype models?

Instructional Outcomes:

- Students will be able to identify and select the correct tool/equipment for a task.
- Students will be able to demonstrate proper procedures for color and 3D printing and the plotter.
- Students will be able to apply elements of visual design to a prototype to create a functional 3D prototype with visual and functional properties.

Suggested Learning Activities:

- Students will utilize the 3D printer to create 3D prototype of a practical product that is comprised of more than two different components (e.g., iPhone with earbuds). They will test their design and document their process and results.

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Suggested Differentiation:

- Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time
- Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts
- Tier 3 Learners: follow basic instruction by following teacher instruction on video projector

- Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.

Curriculum Development Resources:

- Freehold Regional High School District

Notes/Comments:

Unit 7 Careers in Engineering

Unit Summary:

Computer-assisted design (CAD) and traditional technical drawing are both important and have varied applications in today's workplace.

Interdisciplinary Connections/Content Area Integrations Including Technology:

All students will use digital media, computers, and autocad software to access, manage, evaluate, and synthesize information in order to solve problems individually, collaborate, and create and communicate knowledge. Printers, plotters, 3D printers, and overhead projectors will also be used by students.

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NJSLS Number	NJSLS Content
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal, and/or social needs.
8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
WHST.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

<p>Summative Assessments:</p> <ul style="list-style-type: none">● Portfolios, Self and Peer Assessment● Performance Assessment● Midterm/Final Exam● Projects● Rubric Assessment
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Formative Assessments:

- Oral Presentations
- Observations (Peer and Teacher)
- Participatory Rubrics

Enduring Understandings:

- Engineering careers have various avenues for employment.

Essential Questions:

- What are the different career paths an engineering degree can lead to?
- What are the different engineering degrees one can receive?

Instructional Outcomes:

- Students will be able to identify several fields of engineering.
- Students will be able to describe differences in the fields of engineering.
- Students will be able to communicate appropriately with clients.

Suggested Learning Activities:

- Students will research college degree programs in the field of engineering.
- Students will research local job sites for related employment in the field of engineering.

Suggested Differentiation:

- Tier 1 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts, and one on one mentoring during the question and answer section of the class time
- Tier 2 Learners: follow basic instruction by following teacher instruction on video projector, use of additional handouts
- Tier 3 Learners: follow basic instruction by following teacher instruction on video projector

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<ul style="list-style-type: none">• Teachers can set expectations for drawings of various difficulty levels, assisting students during discussion and guided practice.
Curriculum Development Resources: <ul style="list-style-type: none">• Freehold Regional High School District
Notes/Comments: