

DELAWARE VALLEY SCHOOL DISTRICT

# PLANNED INSTRUCTION

**A PLANNED COURSE FOR:**

Mechanical Drawing I / CAD

Curriculum writing committee:

Tom Moran

**Grade Level: 9 - 12**

**Date of Board Approval: July 14, 2022\_\_\_\_\_**

## DELAWARE VALLEY SCHOOL DISTRICT

<b>Participation</b>	<b>10%</b>
<b>Classwork</b>	<b>60%</b>
<b>Projects</b>	<b>30%</b>
<b>Total</b>	<b>100%</b>

## Curriculum Map

**Overview:** Students will learn the basic principles of mechanical drawing using traditional hand drawing techniques and computer aided drafting & design (CADD). This class is ideal for students interested in careers related to drawing and design, including architecture and engineering. Students will also get introductory level experience with machines and software widely used in engineering and design industries. Their level of experience with these machines and software will be further developed in the second level Solid Modeling course.

### Goals:

- Using technical sketching techniques to create sketches
- Creating single stroke gothic letters
- Learning how to read a ruler to 1/16"
- Knowing how to use drafting hand tools to develop mechanical drawings
- Applying the concepts of orthographic drawing to create Multiview drawings
- Create 3 dimensional prototypes using a 3D printer
- Learning how to use the AutoCAD software
- Applying the skills learned in using the CAD software to create Multiview drawings
- Understanding the rules of dimensioning
- Applying dimensions to drawings using the dimensioning rules
- Knowing how to create a section view drawing
- Learn basic Adobe Illustrator tools
- Use the Roland vinyl cutter
- Learn how to create a simple part in Inventor
- Understand the Fablicator MX 3D printer slicer and driver software to build a 3D print

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### **Big Ideas:**

**Big Idea # 1:** The skills, techniques, elements, and principles of the arts can be learned, studied, refined, and practiced

**Big Idea #2:** Artists use tools and resources as well as their own experiences and skills to create art

**Big Idea # 3:** A technological world requires that humans develop capabilities to solve technological challenges and improve products for the way we live

**Big Idea #4:** A technological world requires that humans develop capabilities to solve technological challenges and improve products for the way we live

**Big Idea # 5:** Technology is created, used, and modified by humans

**Big Idea #6:** Technological design is a creative process that anyone can do which may result in new inventions and innovations

**Big Idea #7:** Successful STEM professionals exhibit specific personal and professional characteristics that lend themselves to the creative, collaborative, and solution-driven nature of their profession

**Big Idea #8:** STEM professionals use professional skills and knowledge to pursue opportunities and create sustainable solutions to improve and enhance the quality of life of individuals and society

### **Textbook and Supplemental Resources:**

No textbooks used or print resources

## Curriculum Plan

### UNIT 1: Principles of Sketching

Time Range in Days: 7 Day

**Standards (by number):**

- 9.1.12.A, 9.1.12B

**Anchors:**

- N/A

**Eligible Content:**

- Use hand drawn sketches to effectively communicate your idea.

**Objectives:**

1. Students will sketch lines, angles, circles, arcs, and geometric shapes. (DOK 1)
2. Students will know how to apply the rules and techniques for sketching. (DOK 4)
3. Students will understand the importance of sketching. (DOK 1)
4. Students will be able to apply the proper techniques and steps for sketching geometric shapes. (DOK 4)

**Core Activities and Corresponding Instructional Methods:**

1. Discuss principles of sketching. Rules and techniques used to properly create a sketch of an object.
  - a. Lecture: sketching rules and techniques
  - b. Demonstration: sketching techniques
2. Students will sketch a variety of lines, circles, arcs, ellipses and geometric shapes.
  - a. Hands-on: practice sketching techniques by drawing given objects

**Assessments:**

**Diagnostic:**

- responses to oral questions during lesson discussion

**Formative:**

- practice sketches
- sketching worksheets

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### **Summative:**

-unit examination

**Materials and Resources:** Smart Board, White board, *Exploring Drafting*, drafting paper, pencils, erasers, and desks, and sketching worksheet

# DELAWARE VALLEY SCHOOL DISTRICT

## UNIT 2: Lettering

Time Range in Days: 3 Day

### Standards (by number):

- 9.1.12.A, 9.1.12B

Anchors: N/A

### Eligible Content:

- Create neat hand drawn lettering to develop high quality drawings

### Objectives:

- 1 Students will be able to create the single-stroke gothic alphabet by hand, which is standard lettering used in Mechanical Drawing (DOK 4)
- 2 Students will know how to create proper single stroke gothic numbers (DOK 4)
- 3 Students will demonstrate their ability to create proper text by hand (DOK 4)

### Core Activities and Corresponding Instructional Methods:

- 1 Discuss principles of sketching. Rules and techniques used to properly create a sketch of an object.
  - Lecture: sketching rules and techniques
  - Demonstration: sketching techniques
- 2 Students will sketch a variety of lines, circles, arcs, ellipses and geometric shapes.
  - Hands-on: practice sketching techniques by drawing given objects

### Assessments:

#### Diagnostic:

-responses to oral questions during lesson discussion

#### Formative:

-lettering worksheets

#### Summative:

-lettering on hand drawings

### Materials and Resources:

Smart Board, Whiteboard, drafting tables, pencils, and worksheets

# DELAWARE VALLEY SCHOOL DISTRICT

## UNIT 3: Measuring

Time Range in Days: 3 Day

### Standards (by number):

- 2.3.8.F

### Anchors:

- N/A

### Eligible Content:

- Students will be able to use a ruler to measure to  $1/16''$

### Objectives:

1. Students will know how to use a ruler to measure and create lines accurately to  $1/16$  of an inch (DOK 1)
2. Students will learn how to reduce fractions (DOK 1)
3. Students will increase their speed and accuracy of taking measurements using a ruler (DOK 1)

### Core Activities and Corresponding Instructional Methods:

1. Reading a ruler to  $1/16''$ :
  - a. Discussion/demonstration
2. Using a ruler to take and make measurements on measuring worksheets
  - a. Demonstration
  - b. Hands-on

### Assessments:

#### Diagnostic:

-responses to oral questions during lesson discussion

#### Formative:

-measuring worksheets

#### Summative:

-measuring and accurately creating drawings

### Materials and Resources:

Smart Board, Whiteboard, drafting tables, pencils, and worksheets

# DELAWARE VALLEY SCHOOL DISTRICT

## UNIT 4: Line Structure

Time Range in Days: 8 days

### Standards (by number):

- 9.1.12.A, 9.1.12B

Anchors: N/A

### Eligible Content:

- Use hand tools to create proper lines with high quality line structure

### Objectives:

1. Students will know how to use all the hand tools to draw. (DOK 1)
2. Students will be able to create lines neatly and consistently, and shapes (single-view drawings). (DOK 4)
3. Students will learn how to use proper mechanical drawing techniques. (DOK 1)
4. Students will demonstrate the proper techniques to holding a pencil. (DOK 2)
5. Students will demonstrate their ability to create proper line structure. (DOK 4)

### Core Activities and Corresponding Instructional Methods:

1. Students will develop their ability to create proper line structure through hands-on activities.
  - a. Discuss and demonstrate line structure and the use of hand tools.
  - b. Hands-on activities: line and single-view drawings.
2. Students will use hand tools to draw single-view drawings.
  - a. Demonstrate line structure and the use of hand tools.
  - b. Hands-on activities: line and single-view drawings.

### Assessments:

#### Diagnostic:

-responses to oral questions during lesson discussion

#### Formative:

-drawing assignments

#### Summative:

-line structure on drawings

### Materials and Resources:

Smart Board, Hand tools, drawing paper, computers and Netop software, drawing tables.



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## UNIT 5: Orthographic Drawing

**Standards (by number):**

**Time Range in Days:** 15 days

- 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

**Anchor(s):**

- S11.A.2.1, S11.A.3.1

**Eligible Content:**

- Develop high quality orthographic (Multiview) drawings

**Objectives:**

1. Students will apply theories of orthographic projection in the development of Multiview drawings. (DOK 4)
2. Students will also reinforce and assess their ability to create proper line structure. (DOK 3)
3. Students will be able to center Multiview drawings using the centering formula. (DOK 1)
4. Students will know how to use the transfer method to project dimensions for the side and top views. (DOK 1)
5. Students will use proper darkening methods. (DOK 1)

**Core Activities and Corresponding Instructional Methods:**

1. Discuss the theories and benefits of orthographic projection
  - a. Lecture
2. Draw 6 Multiview drawings. These drawings will progress in difficulty
  - a. Demonstration: Process for creating an orthographic drawing
    - i. Each drawing will demonstrate the use of a different drawing technique such as: translating an isometric drawing into an orthographic, and drawing arcs and angles and centering formulas
  - b. Hands-on: Use process to create Multiview drawings

**Assessments:**

**Diagnostic:**

-responses to oral questions during lesson discussion

**Formative:**

-Multiview drawings

**Summative:**

-line structure, ability to create a Multiview drawing using the theories of orthographic projection

**Materials and Resources**

Smart Board, *Exploring Drafting*, white board, computers, Netop, drafting tables, drawing paper, and hand tools

## **UNIT 6: Introduction to Adobe Illustrator and Vinyl Cutting**

**Standards (by number):**

**Time Range in Days: 7 days**

- 3.4.10.C1, 3.4.10.C2, 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

**Anchor(s):**

- S11.A.2.1, S11.A.3.1

**Eligible Content:**

- Learn and use basic Adobe Illustrator tools to create an image with a cut contour to be printed and cut on the Roland SG-540 vinyl cutter.

**Objectives:**

1. Students will learn how to create an image in Adobe Illustrator
2. Students will know how to draw a cut contour in Adobe Illustrator
3. Students will understand how to use the VersaWorks software to set up and drive the Roland vinyl printer/cutter
4. Students will be able to operate the Roland vinyl cutter

**Core Activities and Corresponding Instructional Methods:**

1. Create an image with a cut contour in Adobe Illustrator that will be printed and cut out in sticker/decal format on the Roland vinyl cutter
  - a. Lecture on the software procedures
  - b. Demonstration of the software tools
  - c. Hands-on creation of the image
2. Setup the graphic made in Adobe Illustrator in VersaWorks so it can be made by the vinyl cutter
  - a. Lecture on the software procedures
  - b. Demonstration of the software tools
  - c. Hands-on creation of the graphic
3. Use the Roland vinyl cutter to make the sticker/decal
  - a. Demonstration of the machine's functions
  - b. Hands-on printing of the project

**Assessments:**

**Diagnostic:**

-oral response during the lectures and demonstrations

**Formative:**

-student artwork on Adobe Illustrator

**Summative:**

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-printed and cut sticker/decals from the vinyl cutter

### **Materials and Resources**

Adobe Illustrator, Roland VersaWorks, Roland SG-540 vinyl printer/cutter, vinyl roll, computers.

## UNIT 7: Introduction to Computer Aided Drawing

Time Range in Days: 8 days

**Standards (by number):**

- 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

**Anchor(s):**

- S11.A.2.1, S11.A.3.1

**Eligible Content:**

- Students will know how to use CAD software to create working drawings.

**Objectives:**

1. Students will be able to effectively use CAD software. (DOK 1)
2. Students will develop their knowledge of the electronic tools and functions such as: drawing setup, saving, and opening, using line, circle, polygon and all other essential drawing tools and printing. (DOK 4)

**Core Activities and Corresponding Instructional Methods:**

1. Practice problems will be used to reinforce the proper use of the software
  - a. Lecture & Demonstration: use of the CAD software.
    - i. Students will take notes as specific tools are being demonstrated.
  - b. Hands-on: practice tools through various activities and drawings.

**Assessments:**

**Diagnostic:**

-responses to oral questions during lesson discussion

**Formative:**

-practice problem

**Summative:**

-use of CAD software

**Materials and Resources**

-*Exploring Drafting*, Smart board, computers, Netop, Autodesk CADD software (latest release), composition notebooks.

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### UNIT 8: Applied Computer Aided Drawing

**Standards (by number):**

**Time Range in Days:** 20 days

- 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

**Anchor(s):**

- S11.A.2.1, S11.A.3.1

**Eligible Content:**

- Students will be able to use CAD software at mastery level.

**Objectives:**

1. Students will know how to effectively use electronic devices and CAD software to effectively create orthographic drawings (DOK 1)
2. Students will learn how to efficiently edit drawings (DOK 2)
3. Students will be able to use all the basic tools in the latest versions of AutoCAD (DOK 1)
4. Students will know how to set up a drawing to print (DOK 1)
5. Students will produce CAD drawings using the HP Design Jet 800 plotter (DOK 1)

**Core Activities and Corresponding Instructional Methods:**

1. Reinforce orthographic drawing techniques and CAD tools through the development of Multiview drawings. Students will translate isometric drawings problems from the *Exploring Drafting* text into orthographic drawings on the computer. These drawings will progress in difficulty to challenge the students' ability to think and solve problems. Each drawing will teach a new aspect of drawing and the computer program.
  - a. Demonstration: use of the computer program and drawing techniques through drawing problems
  - b. Hands-on: learning proper completion of CAD drawing

**Assessments:**

**Diagnostic:**

-responses to oral questions during lesson discussion

**Formative:**

-orthographic drawings

**Summative:**

-use of CAD software

**Materials and Resources**

-*Exploring Drafting*, white board, computers, Netop, Autodesk CAD software (latest release), composition notebooks.

## UNIT 9: Dimensioning

Time Range in Days: 5 days

**Standards (by number):**

- 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

**Anchor(s):**

- S11.A.2.1, S11.A.3.1

**Eligible Content:**

- Students will be able to correctly dimension mechanical drawings.

**Objectives:**

1. Students will know all the general rules for dimensioning. (DOK 1)
2. Students will learn how to set up dimension styles. (DOK 1)
3. Students will utilize the rules for dimensioning and the dimensioning tools in AutoCAD to apply dimensions to a drawing. (DOK 2)

**Core Activities and Corresponding Instructional Methods:**

1. Properly apply dimensions to orthographic drawings.
  - a. Lecture Unit 10 *Exploring Drafting* text Dimensioning
  - b. Demonstration: application of dimensions
  - c. Hands-on: apply dimensions to orthographic drawing assignments

**Assessments:**

**Diagnostic:**

-responses to oral questions during lesson discussion

**Formative:**

-orthographic drawings

**Summative:**

-dimensions on drawings

**Materials and Resources**

-*Exploring Drafting*, white board, computers, Netop, Autodesk CADD software (latest release), composition notebooks.

## **UNIT 10: Introduction to Rapid Prototyping / 3D Printing**

Time Range in Days: 7 days

### **Standards (by number):**

- 3.4.10.C1, 3.4.10.C2, 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

### **Anchor(s) or Adopted Anchor(s):**

- S11.A.2.1, S11.A.3.1

### **Eligible Content:**

- Rapid prototyping is the process of using computer driven machines (3D printer) to create a working prototype in a fraction of the time compared to more traditional methods. Rapid prototyping is a key element in production today. Students will learn the basics of using a 3D printer to create a prototype.

### **Objectives:**

1. Students will know how to use the Cura and Fablicator software to create a toolpath for their part. (DOK 2)
2. Students will learn how to use the Fablicator 3D printer. (DOK 2)

### **Core Activities and Corresponding Instructional Methods:**

1. Discuss the safest and most efficient process for using the 3D printer
2. Use basic Inventor skills learned in middle school Technology Education classes to create a simple part
  - a. Hands-on: Make part in Inventor
3. Create path in printer and build part
  - a. Demonstration: Cura and Fablicator software
  - b. Hands-on: create toolpath
4. Remove support material and clean part to be graded
  - a. Demonstration: 3D printer operation
  - b. Hands-on: create prototype

### **Assessments:**

#### **Diagnostic:**

-observation of oral response during demonstration of slicer software and 3D printer

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### **Formative:**

-digital image and toolpath of Christmas tree ornament.

### **Summative:**

-prototype of ornament

### **Materials and Resources:**

Smart board, Computer, Inventor software, Cura and Fablictor software, Fablicator 3D printer, consumable materials (model and support material)



## UNIT 11: Section Views

Time Range in Days: 7 days

### Standards (by number):

- 3.4.12.C2, 3.4.12.D2, 3.4.10.E7

### Anchor(s):

- S11.A.2.1, S11.A.3.1

### Eligible Content:

- Section views are extremely important in the understanding of the interior of more complex objects. Students will be able to properly draw a section view.

### Objectives:

1. Students will know the basic theory of section views. (DOK 1)
2. Students will learn the AutoCAD tools used to create section views. (DOK 1)
3. Students will identify the different types of section views and when they should be utilized. (DOK 4)
4. Students will be able to develop a cross section of an object. (DOK 4)
5. Students will label section views with the proper notation. (DOK 2)

### Core Activities and Corresponding Instructional Methods:

1. Discuss the importance and creation of section views
  - a. Lecture: section views
2. Drawing assignments from the textbook (pgs. 269 & 270)
  - a. Demonstration: section view rules and drawing techniques
  - b. Hands-on: section view drawings to reinforce demonstrations

### Assessments:

#### Diagnostic:

-responses to oral questions during lesson discussion

#### Formative:

-orthographic drawings

#### Summative:

-section Views in drawings

### Materials and Resources

-*Exploring Drafting*, white board, computers, Netop, Autodesk CAD software (latest release), composition notebooks.

## Primary Textbook(s) Used for this Course of Instruction

-There are no primary textbooks used in this class

## Appendix

### STANDARDS:

Standard Area - 9.1: Production, Performance and Exhibition of Dance, Music, Theatre and Visual Arts

Standard - 9.1.12.A Know and use the elements and principles of each art form to create works in the arts and humanities.

Standard - 9.1.12.B Recognize, know, use, and demonstrate a variety of appropriate arts elements and principles to produce, review and revise original works in the arts.

Standard Area: Math: 2.3 Measurement and Estimation

Standards Addressed: 2.3.8.F: Estimate and verify measurements of rate and mass.

3.4. Technology and Engineering Education

3.4.C Technology and Engineering Design

- 3.4.12.C2: Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

3.4.D Abilities for a Technological World

- 3.4.12.D2: Verify that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

3.4.E The Design World

- 3.4.10.E7: Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency.

### ANCHORS:

S11.A.2 Processes, Procedures, and Tools of Scientific Investigations

- **Error! Hyperlink reference not valid.** - Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process.

S11.A.3 Systems, Models, and Patterns

- **Error! Hyperlink reference not valid.** – Analyze the parts of a simple system, their roles, and their relationships to the system as a whole.