Wayne
Township Public Schools

Applied Technology
Grades 9 - 12
Computer Aided Design I
6/3/2022
Patrick Slater/Alina Duran

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Applied Technology** **Grades 9-11** **Computer Aided Design I**
Unit Plan Title:	**Fundamentals of Architecture**
Time Frame	**12 Weeks**

Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Standard 9.4 Life Literacies and Key Skills. This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

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Unit Overview

During this unit the students will acquire a basic understanding of architectural design using a BIM system. The students will assume the role of an architect. They will be guided through the process of designing a simple residential building. The importance of architectural standards will be stressed during the entire process. Zoning regulations and building codes will be introduced as important considerations that architects must take into account.

Standard Number(s) * i.e: Math: 3.NBT.1 i.e.: RL 8.1

Progress Indicators- Reading and Writing Standards Grades 9-10
Progress Indicators- Reading and Writing Grades 11-12

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a)

9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).

Intended Outcomes - {Essential Questions}

- What is meant by BIM (Building Information Management)?
- How are floor plans used in building design?
- How are bubble diagrams used to plan/design living space?
- What are some of the considerations that should be taken into account before a building is designed?
- What are Architectural Standards and why are they important to the design process?
- What is meant by roof pitch and how is it calculated ?
- Why is proper roof pitch important to the overall design?
- How do architectural and engineering drawings differ?
- What are elevations and how are they named?
- How do sectional views in architecture differ from those produced in engineering?

Enduring Understandings

- Architects have a responsibility to develop designs that are safe, functional and aesthetically pleasing.
- The interior building space must be properly planned out prior to the production any models or formal drawings.
- Design decisions are dictated by Architectural Standards and sound moral and ethical practices.
- An architectural floor plan is a type of sectional drawing.
- Using BIM (Building Information Management) systems have a distinct advantage for architectural design over conventional CAD systems.

- Architectural drawings must include dimensions, annotations and symbols that conform to architectural standards.
- BIM elements can be edited to meet the needs of a specific design.
- BIM systems allow all of the drawing views and models to be generated at the same time.

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In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**	
	Global Awareness	E	**Creativity and Innovation**
X	**Environmental Literacy**	T	**Critical Thinking and Problem Solving**
	Health Literacy	T	**Communication**
	Civic Literacy	T	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Describe a work of architecture in terms of its plans, sections and elevations.
- Understand how architects lead design teams in the design and planning of a building.
- Understand the correlation between building plans, sections and elevations to multi view and sectional drawings.
- Manipulate the properties of BIM elements.
- Develop an understanding of the architectural design process.
- Understand the basic function of a BIM system.
- Develop architectural drawings in compliance with architectural standards.
- Develop an awareness of the considerations that must be taken into account during the design process.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

- **Pre-assessments**
- **Formative assessments**
  - Group discussion
  - Individual conference
  - Verify understanding during guided activities
  - Peer assessment

- Self assessment
- Reflection and goal-setting

- **Summative assessments**
  - Quizzes
  - Performance tasks

Teaching and Learning Activities	
Activities	**Introduction to Architectural Design** ● Pre-design considerations ● Architectural standards ● Bubble diagrams ● Design intent ● Building Codes ● Land use regulations ● Floor plans **Introduction to BIM (Building Information Management)** ● User interface introduction ● Datum levels/planes ● Wall elements ● Drawing wall elements ● Editing wall element structure ● Modify tools **Doors/Windows** ● Hosting requirements ● Proper placement ● Architectural standards ● Family library ● Loading families ● Configurations **Ceilings and Floors** ● Floor placement ● Editing floor element type ● Ceiling placement ● Editing ceiling element type **Roofs** ● Roof types

	● Roof pitch ● Roof element placement ● Editing roof element configuration **Topographic Surfaces** ● Creating a topographic surface ● Editing a topographic surface ● Point elevations ● Building pads **Sheets/Drawings** ● Floor plans ● Elevations ● Sectional views ● Schedules **CGI/Rendering** ● Material editing and application ● Rendering camera settings ● Autodesk 360 Cloud Services
Differentiation Strategies	**Tiered performance tasks:** ○ **Capstone:** ● Students use CAD technology and their knowledge of 2D and 3D geometric constructions to produce digital drawings and models based on a set of provided reference materials. ○ **Extension:** ● Students are given variant problems that reflect a higher degree of difficulty. The problems may be less numerous, but contain more layers of information to dissect and model. ○ **Accommodation:** ● The initial descriptions of the problems may be simplified into step-by-step instructions. The problem, desired results, and required constraints may be simplified according to the needs of the student.
Windows	

Resources	
• CAD workstation/software • BYOD resources • Sketching materials • Internet • Google Classroom • Projection system • Student monitoring system • Classroom Reference materials/Architectural Standards references • Readings and problem sets	

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Applied Technology** **Grades 9-11** **Computer Aided Design I**
Unit Plan Title:	**Introduction to 3D Modeling and Engineering**
Time Frame	**12 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Standard 9.4 Life Literacies and Key Skills. This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Overview

During this unit of study the students will learn parametric modeling techniques. Many of the modeling practices that will be applied are used in today's engineering and industrial applications. The students will create simple to complex models by starting with a base feature. The students will gain an understanding of how design intent is applied to the modeling process. As the 3D models are completed 2D multi-view drawings will be generated and annotated in accordance with current drafting practices. Assemblies will also be created using parts modeled by the students.The students will also have the opportunity to prepare and 3D print one of their models. CGI procedures using the 3D modeling software will also be explored.

Standard Number(s) *** i.e: Math: 3.NBT.1 i.e.: RL 8.1**

Progress Indicators- Reading and Writing Standards Grades 9-10
Progress Indicators- Reading and Writing Grades 11-12

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
8.2.12.NT.2: Redesign an existing product to improve form or function.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a)
9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).

Intended Outcomes - {Essential Questions}

- How does parametric sketching compare to conventional CAD drawing?
- Why is it important to place sketch dimensions?
- Why is it important to understand geometric constraints?
- What is meant by parametric modeling?
- How are multi-view drawings used to create 3D models?
- How can a 2D drawing be created from a 3D model?
- What is the relationship between a 3D model file and its associated 2D drawing file?
- How would you describe the three fundamental 3D modeling operations?
- How do sketched and placed features differ?
- What is meant by design intent?
- What is the relationship between assembly constraints and degree of freedom?
- Describe the function of a base feature?
- How must assembly and drawing files be managed?
- What is meant by software interoperability?
- How are 3D models processed for 3D printing?

Enduring Understandings

- Parametric models are created by understanding their design intent.
- Sketch entities are placed using sketch and geometric constraints.
- Complex models are built by first creating a base feature.
- Sketch dimensions are a vital component of the modeling process.
- 3D models are created prior to the creation of a 2D drawing
- 2D drawing views are directly associated with their corresponding 3D model
- 3D models can be prototyped using 3D printing and CNC technology.
- Sectional views are used to describe the intersection of a plane and an object.

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In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**	
	Global Awareness	E	**Creativity and Innovation**
	Environmental Literacy	T	**Critical Thinking and Problem Solving**
	Health Literacy	T	**Communication**
	Civic Literacy	T	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Apply the proper workflow associated with parametric 3D modeling.
- Generate 3D models derived from single and multi-view 2D and pictorial drawings.
- Understand the importance of proper file management for 2D drawings and assemblies.
- Create and annotate 2D drawings derived from 3D models in compliance with drafting standards.
- Understand how engineers develop economical and safe and economical solutions to practical problems.
- Identify the advantages of using parametric modeling techniques over conventional CAD techniques.
- Create a digital assembly based on individual parts.
- Understand the economical advantages of rapid prototyping has in the design process.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

- **Pre-assessments**
  - Diagnostic tasks
  - Anticipatory sets
- **Formative assessments**

- Group discussion
- Individual conference
- Verify understanding during guided activities
- Peer assessment
- Self assessment
- Reflection and goal-setting

○ **Summative assessments**

- Quizzes
- Performance tasks

Teaching and Learning Activities	
Activities	**Introduction to Parametric Modeling** ● Introduction to parametric modeling technologies ● User interface familiarization ● Comparisons to conventional CAD systems ● File management ● Design intent **Creating parametric sketches** ● Parametric sketching ● Sketch and geometric constraints ● Sketch dimensions ● Editing tools ● Geometric construction ● Sketch reference geometry **Modeling operations** ● Base Features ● Extrude operations ● Revolve operations ● Boolean/cut operations ● Editing features ● Placed and sketched features ● Model reference geometry ● Interoperability **Parametric Drawings** ● File management ● Model views ● Projected views ● Sectional views

	● View scaling **Dimensioning/Annotation** ● Model dimensions ● Notes ● Hole callouts ● Placement ● Configuration **Assemblies** ● File and model management ● Fixed/anchored parts ● Degrees of freedom ● Assembly relations/constraints ● Reference geometry ● Exploded views ● Simulations **Prototyping** ● 3D printing ● Model preparation **CGI/Rendering** ● Materials ● Scene lighting ● Rendering procedures ● File management
Differentiation Strategies	**Tiered performance tasks:** ○ **Capstone:** ● Students use CAD technology and their knowledge of 2D and 3D geometric constructions to produce digital drawings and models based on a set of provided reference materials. They generate a 3D print of some part of the digital model. ○ **Extension:** ● Students are given variant problems that reflect a higher degree of difficulty. The problems may be less numerous, but contain more layers of information to dissect and model. They print more complex forms that require the use of load-bearing

	scaffolds. ○ **Accommodation:** ● The initial descriptions of the problems may be simplified into step-by-step instructions. The problem, desired results, and required constraints may be simplified according to the needs of the student.
Windows	

Resources
• CAD workstation/software • BYOD resources • Sketching materials • Internet • Google Classroom • Projection system • Student monitoring system • Classroom reference materials • Readings and problem sets • Digital fabrication hardware/ proprietary software/consumable

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Applied Technology** **Grades 9-11** **Computer Aided Design I**
Unit Plan Title:	**Digital Drafting and Graphic Communication**
Time Frame	**12 Weeks**

Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

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Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Overview

During this unit, students will acquire the skills necessary to create and annotate their drawings with information that clarifies size, materiality, and fabrication processes. They also learn best practices and standards for formatting and sharing their drawings with others. As the unit progresses, students use increasingly advanced orthographic and paraline drawing techniques. By the end of the unit, students will produce a drawing that can be read by someone else to fabricate a simple object.

Standard Number(s) * i.e: Math: 3.NBT.1 i.e.: RL 8.1

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8.2.12.NT.2: Redesign an existing product to improve form or function.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a
9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Intended Outcomes - {Essential Questions}

- What is CAD?
- What is meant by Graphic Communication?
- What is the Alphabet of Lines?
- How does the Cartesian Coordinate system apply to CAD?
- What are the key components of the CAD interface?
- What is an entity?
- How do we create and edit entities?
- How can entities be precisely placed or moved in a CAD environment?
- What are some industries that make use of CAD technology?
- What conventions are used when annotating a CAD drawing?
- What kinds of attributes can CAD entities have?
- What are some of the symbols and annotations that we have seen in technical drawings?
- How does one prepare a drawing to be printed? Where can we find critical information about a drawing?
- What are the three main views of a multi-view drawing?
- How many views are shown in a complete multi-view drawing?
- Why are multi-view drawings necessary and how are they constructed?
- How do we construct curved and sloped isometric surfaces?
- Are there alternatives to hidden lines for showing the interior of complex objects?

Enduring Understandings

- Most professionals complete tasks using standard or conventional techniques for the sake of productivity, clarity, and compatibility.

- Dimensions and annotations should provide clear and complete instructions for fabrication.
- We work at full scale when we draw in model space.
- Paper or Layout space allows us to adjust the scale of a drawing to fit on a sheet.
- Orthographic drawings may require multiple two dimensional views to communicate the true three-dimensional form of an object.
- Isometric drawing is a useful method for producing a convincing pictorial image.
- Sections are cutaway views.
- A properly executed technical drawing can be used by others to fabricate an object without confusion.

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In this unit plan, the following 21st Century themes and skills are addressed.

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	Global Awareness	**E**	**Creativity and Innovation**
	Environmental Literacy	**A**	**Critical Thinking and Problem Solving**
	Health Literacy	**A**	**Communication**
	Civic Literacy	**E**	**Collaboration**
	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

Students will:

- Review mathematics for linear and angular measurement.
- Learn fundamental CAD drawing techniques for design illustration.
- Construct multi-view drawings with three views.
- Identify, compare, and construct oblique and isometric drawings.
- Apply annotations to a CAD drawing according to drafting standards.
- Learn traditional drafting and visualization techniques.
- Participate in lab exercises that will reinforce key concepts.
- Use appropriate line-types, line-weights and symbols to communicate specific concepts.
- Complete various problems in fundamental geometric construction.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

- **Pre-assessments**

- Diagnostic tasks
- Anticipatory sets

○ **Formative assessments**

- Group discussion
- Individual conference
- Verify understanding during guided activities
- Peer assessment
- Self assessment
- Reflection and goal-setting

○ **Summative assessments**

- Quizzes
- Performance tasks

Teaching and Learning Activities	
Activities	**Introduction to CAD Systems** ● Introduction to the Design Studio ● Introduction to CAD technologies ● CAD system user interface overview ● Cartesian Coordinate System **Creating/Reading Technical Drawings** ● Fundamentals of analytic drawing ● Creating and editing entities ● Linetypes and lineweights ● Dimensions/annotations ● Graphic communication ● Geometric construction **Multi-view Drawings (third angle projection)** ● Orthographic projection ● Sloped surfaces ● Curved surfaces ● Alignment and spacing of views ● Hidden surfaces and features **Isometric drawing techniques** ● Isometric planes ● Isometric geometry ● Constructing ellipses

	● Curved surfaces ● Sloped surfaces **Dimensioning/Annotation** ● Standards ● Size vs. location ● Annotations ● Configuration **Layout** ● Paper space vs Model space ● Title block ● External references **Sections** ● The section plane ● Hatching ● Exploded drawing **Arrays** ● Polar Array vs. Rectangular Array ● Association **Tangency** ● Fillet tool ● Tangent lines ● Tangent curves
Differentiation Strategies	**Tiered performance tasks:** ○ **Capstone:** ● Students use CAD technology and their knowledge of 2D and 3D geometric constructions to produce digital drawings and models based on a set of provided reference materials. They generate a 3D print of some part of the digital model. ○ **Extension:** ● Students are given variant problems that reflect a higher degree of difficulty. The problems may be less numerous, but contain more layers of information to dissect and model.

	○ **Accommodation:** ● The initial descriptions of the problems may be simplified into step-by-step instructions. The problem, desired results, and required constraints may be simplified according to the needs of the student.
Windows	

Resources

- CAD workstation/software
- BYOD resources
- Sketching materials
- Internet
- Google Classroom
- Projection system
- Student monitoring system
- Classroom reference materials
- Readings and problem sets
- Digital fabrication hardware/ proprietary software/consumable