



# **Computer Aided Design III - Intermediate CAD for 3D Animation (Special Effects), Architecture, and Engineering**

**Course Information**

<b>Grade(s):</b>	11-12
<b>Discipline/Course:</b>	Technology Education
<b>Course Title:</b>	Computer Aided Design III - Intermediate CAD for 3D Animation, Architecture, and Engineering.
<b>Prerequisite(s):</b>	Computer Aided Design II - Beginning CAD for 3D Animation, Architecture, and Engineering (Full Year) <i>or</i> Computer Aided Design II - Beginner CAD for 3D Animation, Architecture, and Engineering (Semester) with teacher's permission
<b>Course Description:</b> <i>Program of Studies</i>	This course expands on the focused skills learned in previous courses. Students will learn advanced level application and may concentrate in any of the areas: 3D Animation, Architecture or Engineering. Examples include: fine animation of character's eyes and mouth, computer special effects (such as fire, tornados, and lightsabers), building design portfolios for college, creating architectural detail plans, "Green Building", and engineering products or inventions to solve real world problems. (Software: Inventor, Revit, 3ds Max, Maya, Mudbox, MotionBuilder, iPi Motion Capture)
<b>Course Essential Questions:</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>
<b>Course Enduring Understandings:</b>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of well-being.</li> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong understanding of the principles of 3D modeling and animation.</li> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>

<b>Duration/Credit:</b>	Full year / 1.0 credit
<b>Course Materials/Resources:</b>	Drawing tools, computers, software, projector/screen, 3D printing technology, basic hand tools.
<b>FPS Course Academic Expectation(s):</b>	CI: Conveying Ideas, CC: Creating and Constructing, UCT: Using Communication Tools
<b>Year at a Glance (Units):</b>	Unit 1 – Sketching, Drawing, Schematics and Character Sketching (3-4 weeks) Unit 2 – CAD Tools, 3D Modeling Techniques, & Construction Techniques (2-3 weeks) Unit 3 – CAD Tools, Intermediate Simulations, Texture Mapping & Unwrapping (3-4 weeks) Unit 4 – Construction Methods, Character Rigging and Skinning, Prototyping (6-7 weeks) Unit 5 – Sustainable Architecture and Character Animation Techniques (3-4 weeks) Unit 6 – Final Summative Project and Portfolio Expansion (8-10 weeks)

<b>Unit Number and Title:</b>	Unit 1 - Sketching, Drawing, Schematics, and Character Sketching
<b>Duration:</b>	3 - 4 weeks
<b>Resource(s):</b>	Computers and consumables
<b>Unit Overview:</b>	Students with a basic understanding of sketching will develop their skills further. Students will learn more advanced perspective drawing techniques, shading techniques, and how to sketch different types of buildings, engineered products, characters and miscellaneous detail elements and poses. Students will learn to read and interpret drawings, drawing conventions, engineering schematics, diagrams while creating their own drawings.
<b>Learning Goals</b>	
<b>Standard(s):</b>	CADD.02.01 Apply conventional Computer Aided Drafting and Design processes and procedures accurately, appropriately, and safely CADD.02.04 Describe and demonstrate the use of graphic communication skills through sketching. CADD.02.05 Evaluate and select appropriate methods of communication for a given problem. CADD.02.07 Express a design of an object as a 3D model.
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of well-being.</li> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong</li> </ul>

	<p>understanding of the principles of 3D modeling and animation.</p> <ul style="list-style-type: none"> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>
<p><b>Learning Goal(s):</b>  <i>Students will know and will be able to use their learning to:</i>          (Content/ Skills)</p>	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>● how to identify view projection systems.</li> <li>● standard drawings architects use to convey their designs.</li> <li>● vanishing points in two and three point perspectives create more realistic drawings than simple 2D drawings.</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>● sketch complex architectural forms and spaces using advanced perspective drawing techniques.</li> <li>● create realistic and expressive architectural sketches with a variety of shading techniques.</li> <li>● construct two and three point perspective drawings of three-dimensional objects.</li> <li>● sketch different types of buildings, products or characters.</li> <li>● apply their sketching skills to real-world design projects, such as developing detailed design proposals or creating presentation drawings.</li> </ul>

<b>Unit Number and Title:</b>	Unit 2 - CAD Tools, 3D Modeling Techniques, & Construction Technique
<b>Duration:</b>	2 - 3 weeks
<b>Resource(s):</b>	Computers and consumables
<b>Unit Overview:</b>	In this unit, students will learn about the design and construction of commercial buildings while exploring the unique challenges and opportunities of commercial architecture, including the need to balance functionality, aesthetics, and cost. Students learn advanced 3D modeling techniques for hard surface models, such as vehicles and props, as well as organic models, such as characters and animals. This course will introduce students to more advanced CAD tools and construction techniques. Students will learn how to create complex 2D sketches and 3D models, and use advanced editing commands.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<p>CADD.02.01 Apply conventional Computer Aided Drafting and Design processes and procedures accurately, appropriately, and safely</p> <p>CADD.02.07 Express a design of an object as a 3D model.</p> <p>CADD.02.08 Export and import images/files in a variety of file formats.</p> <p>CADD.02.09 Evaluate the choice and placement of dimensions, notes and annotations to clearly communicate design intent.</p> <p>CADD.02.10 Revise a design and update finished drawings appropriately.</p> <p>CADD.02.11 Identify basic geometric elements (e.g., line, circle, rectangle, sphere, and cube)</p>
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>

<p><b>Enduring Understanding(s):</b></p>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of well-being.</li> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong understanding of the principles of 3D modeling and animation.</li> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>
<p><b>Learning Goal(s):</b> <i>Students will know and will be able to use their learning to:</i> (Content/ Skills)</p>	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>● major design styles that have been used for buildings, products and public spaces over the centuries.</li> <li>● factors influencing design, such as climate, budget, and the needs of the users or audience.</li> <li>● multiple methods for creating the same shape.</li> <li>● polygon modeling, spline modeling, edge loop modeling and other 3D models.</li> <li>● how to modify 3D shapes using basic modifiers.</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>● define and explain the different types of commercial buildings.</li> <li>● explain how the factors such as climate, budget, and the needs of the end-user influenced their design decisions.</li> <li>● apply the principles of design, such as balance, proportion, and unity, and how to apply them to commercial or public spaces and design.</li> <li>● utilize CAD tools in increasingly creative ways to create more complex shapes and interesting designs.</li> <li>● accurately express their creative visions by creating their own custom shapes and components.</li> </ul>

<b>Unit Number and Title:</b>	Unit 3 - CAD Tools, Intermediate Simulations, Texture Mapping & Unwrapping
<b>Duration:</b>	3 - 4 weeks
<b>Resource(s):</b>	Computers and consumables
<b>Unit Overview:</b>	This unit will introduce students to intermediate level CAD architecture tools and techniques. Students will learn how to use CAD software to create detailed 3d models and drawings of buildings and other structures, including floor plans, elevations, sections, and details. They will also learn basics of texture mapping and unwrapping, how to use CAD to create detailed landforms for use in site plans, how to create and manipulate CAD models of physical systems, and then use these models to predict the behavior of the systems under different conditions.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<p>CADD.06.04 Generate/modify geometric components on construction planes.</p> <p>CADD.06.05 Create a 2-D drawing from a 3-D model.</p> <p>CADD.06.06 Create a 3-D model from a 2-D drawing.</p> <p>ENG.01 Identify the roles, responsibilities and requirements of engineering</p> <p>ENG.02.01 Identify the components of the design process: define the problem, brainstorm, research, develop solutions, prototype, test/evaluate, and communicate results</p> <p>ENG.02.09 Build a prototype from working drawings using appropriate materials.</p> <p>ENG.02.10 Test prototype to defined criteria.</p> <p>ENG.02.11 Redesign prototypes.</p>
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>



<p><b>Enduring Understanding(s):</b></p>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of well-being.</li> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong understanding of the principles of 3D modeling and animation.</li> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>
<p><b>Learning Goal(s):</b> <i>Students will know and will be able to use their learning to:</i> (Content/ Skills)</p>	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>● how to build more challenging geometry in structures.</li> <li>● how to build custom components.</li> <li>● know about standard conventions in drawing and what makes a complete design packet.</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>● create detailed drawings of buildings and other structures using CAD software.</li> <li>● create floor plans, elevations, sections, and details using CAD software.</li> <li>● render and animate their designs using CAD software.</li> <li>● demonstrate an understanding of basic architectural principles, such as scale, proportion, and perspective.</li> </ul>

<b>Unit Number and Title:</b>	Unit 4 - Construction Methods, Character Rigging and Skinning, Prototyping
<b>Duration:</b>	6 - 7 weeks
<b>Resource(s):</b>	Computers, projector, paper, pencils, erasers
<b>Unit Overview:</b>	This unit will introduce students to the use of computer-aided design (CAD) software to simulate physical behavior of various mechanisms and methods of construction or production. Students will learn how to create and manipulate CAD models of physical systems, various commercial construction methods and then use these models to predict the behavior of the systems under different conditions. In this unit, students will learn about the importance of building, testing, and analyzing prototypes in the engineering design process. They will gain experience using a variety of simple building materials and tools to create prototypes of their own designs. They will also learn how to test their prototypes to determine whether they meet the design requirements and how to analyze the results of their tests to identify areas for improvement
<b>Learning Goals</b>	
<b>Standard(s):</b>	CADD.02.04 Describe and demonstrate the use of graphic communication skills through sketching. CADD.02.05 Evaluate and select appropriate methods of communication for a given problem.* CADD.02.06 Send and access information through a network CADD.02.07 Express a design of an object as a 3D model. CADD.07.01 Create an assembly in 3-D geometry CADD.05.02 Understand the orthographic projection process for developing multi-view drawings. CADD.05.03 Differentiate the various techniques for viewing objects
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>

<p><b>Enduring Understanding(s):</b></p>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of well-being.</li> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong understanding of the principles of 3D modeling and animation.</li> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>
<p><b>Learning Goal(s):</b> <i>Students will know and will be able to use their learning to:</i> (Content/ Skills)</p>	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>● select, describe and identify the different types of commercial construction methods.</li> <li>● how to export CAD models for 3D printing.</li> <li>● safe use of basic tools.</li> <li>● basic hardware and prototyping materials available for building.</li> <li>● what character rigging is, it's components, and its importance in animation.</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>● design and build a model commercial structure using a variety of construction methods and through prototyping various model iterations.</li> <li>● design, build and analyze physical prototype/model using a variety of tools and materials</li> <li>● use prototypes to test and improve designs.</li> <li>● create a simple character rig using 3D animation software.</li> <li>● create controls for the character's facial expressions and other details and animate the character to produce movement over time.</li> <li>● navigate character structure to alter it.</li> <li>● put “skin” on a character or put an outside envelope on a rig.</li> </ul>

<b>Unit Number and Title:</b>	Unit 5 – Sustainable Architecture and Character Animation Techniques
<b>Duration:</b>	3 - 4 weeks
<b>Resource(s):</b>	Computers and consumables
<b>Unit Overview:</b>	<p>In this unit, students will learn about the principles and practices of sustainable commercial architecture. They will explore how to design and build commercial buildings that are energy-efficient, water-efficient, and use sustainable materials. Students will also learn about the importance of sustainable design for the environment and for human health and well-being.</p> <p>This course will introduce students to the fundamental principles and techniques of character animation. Students will learn how to design and animate characters that are both expressive and believable. They will also learn about the different types of animation software and how to use them to create their own animated short films</p>
<b>Learning Goals</b>	
<b>Standard(s):</b>	<p>CADD.02.05 Evaluate and select appropriate methods of communication for a given problem.</p> <p>CADD.02.09 Evaluate the choice and placement of dimensions, notes and annotations to clearly communicate design intent.</p> <p>CADD.02.10 Revise a design and update finished drawings appropriately.</p> <p>CADD.05.01 Understand the commands and concepts necessary for producing drawings through traditional or computer-aided means.</p> <p>CADD.05.02 Understand the orthographic projection process for developing multi-view drawings.</p> <p>CADD.05.03 Differentiate the various techniques for viewing objects</p>
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> </ul>

	<ul style="list-style-type: none"> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of well-being.</li> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong understanding of the principles of 3D modeling and animation.</li> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>
<b>Learning Goal(s):</b> <i>Students will know and will be able to use their learning to:</i> (Content/ Skills)	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>● key principles of sustainable design.</li> <li>● how to identify and define a real-world problem.</li> <li>● how to conduct research and gather evidence to inform their work.</li> <li>● how to analyze and interpret complex information.</li> <li>● how to develop and implement a plan to solve a problem.</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>● apply sustainability principles to the designworld.</li> <li>● evaluate the sustainability of commercial buildings using various rating systems.</li> <li>● apply knowledge and skills from across the curriculum to solve a real-world problem.</li> <li>● conduct independent research and analyze complex information.</li> <li>● alter character movement in a predictable way.</li> <li>● create distinct character motions like: running, standing, jumping.</li> <li>● record animation clips that contain character animation.</li> <li>● design and develop characters with unique personalities and physical characteristics.</li> <li>● animate characters in a variety of poses and movements, including walking, running, jumping, and facial expressions.</li> <li>● use animation software to create their own animated short films.</li> </ul>

<b>Unit Number and Title:</b>	Unit 6 – Final Summative Project and Portfolio Expansion
<b>Duration:</b>	8 - 10 weeks
<b>Resource(s):</b>	Computers and consumables
<b>Unit Overview:</b>	Students will use their knowledge of the design process to create hand sketches of their designs. Using teacher feedback students make any improvements needed to demonstrate learning by designing a final project in the form of a computer model. Students will then put together finished drawings and renderings for use in their portfolios. Students assemble their best work from this and prior years to continue a design portfolio demonstrating their talent and skill. Students will go beyond a basic portfolio to include customized detail content.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<p>ENG.02.06 Analyze and research between alternate solutions</p> <p>ENG.02.09 Build a prototype from working drawings using appropriate materials.</p> <p>ENG.02.10 Test prototype to defined criteria</p> <p>CADD.07 Create assemblies and views in 3-D format.</p> <p>CADD.10 Maintain a portfolio to document knowledge, skills, materials and experience in CAD.</p> <p>CADD.10.01 Gather educational and work highlights to include in portfolio.</p>
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can CAD be used to enhance our quality of life?</li> <li>● How can a more livable and sustainable world be promoted through social and environmental design?</li> <li>● What are the challenges and opportunities of designing for different platforms and purposes?</li> <li>● What is the role of the animator/architect/engineer and technology in the future of society?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>● Design has a significant impact on our lives. The buildings we live in, products we use and entertainment we watch can shape our moods, our productivity, and even our sense of</li> </ul>

	<p>well-being.</p> <ul style="list-style-type: none"> <li>● Design is a creative, problem-solving discipline using knowledge and skills to design and build solutions to complex problems.</li> <li>● 3D artists use a variety of software and tools to create their work, and they must have a strong understanding of the principles of 3D modeling and animation.</li> <li>● A successful design whether in architecture, engineering or animation can be judged according to industry-accepted methods and criteria.</li> </ul>
<p><b>Learning Goal(s):</b>  <i>Students will know and will be able to use their learning to:</i>          (Content/ Skills)</p>	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>● multiple methods of displaying their work from physical portfolios to digital portfolios.</li> <li>● which elements of a design portfolio are the most important.</li> <li>● strategies for effective communication.</li> <li>● how to identify and define a real-world problem.</li> <li>● how to conduct research and gather evidence to inform their work.</li> <li>● how to analyze and interpret complex information.</li> <li>● how to develop and implement a plan to solve a problem.</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>● use a variety of communication tools and strategies to effectively convey their design concepts to an audience.</li> </ul>