Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Technology Education
Course: Introduction to CAD
Grade(s): 6 & 7

Course Overview

In this hands-on course, students will be introduced to the fundamentals of computer-aided drafting and 3D design using Tinkercad, a beginner-friendly digital design platform. Through guided exploration and project-based learning, students will develop the skills to create, manipulate, and refine 3D models while gaining an understanding of how digital designs connect to real-world applications such as 3D printing.

Students will learn how to navigate the Tinkercad interface and perform essential functions, such as adding, moving, rotating, and scaling geometric shapes. As their skills progress, they will explore more advanced tools including grouping, alignment, holes, symmetry, and custom 2D-to-3D modeling. They will also learn how to import and modify existing designs, experiment with patterns, and apply design principles to functional objects such as dice, jewelry, sunglasses, or puzzle cubes.

The course emphasizes iterative design, creativity, and problem-solving, encouraging students to plan, test, and refine their work. Students will also gain an introduction to additive manufacturing by learning how digital designs are transformed into physical objects. They will explore 3D printer components, slicing software, and filament types while preparing their own projects for potential printing.

This course provides a foundation in digital design and engineering practices, preparing students for future opportunities in STEM, engineering, and creative fields.

New Jersey State Learning Standards

Summit Public Schools curriculum aligns with the New Jersey Student Learning Standards.

Computer Science and Design Thinking Standards:

- **8.1.8.AP.1:** Design and implement algorithms to solve problems.
- **8.1.8.AP.2:** Develop and use models and simulations to explore and solve problems.
- **8.1.8.AP.3:** Create and refine computational models to represent and simulate complex systems.

- **8.1.8.AP.4:** Analyze the impact of computational solutions on society, culture, and the environment.
- **8.1.8.CS.1:** Describe how hardware and software work together to form a complete computer system.
- **8.1.8.CS.2:** Explain how a computer program works by breaking it down into smaller parts.
- **8.1.8.DA.1:** Develop a computational artifact (e.g., a simple game, an interactive story, a digital model) using a programming language or visual programming environment.
- **8.1.8.DA.2:** Create a digital artifact that represents a design solution.
- **8.1.8.DA.3:** Organize and present data to communicate findings.
- **8.1.8.DA.4:** Analyze and interpret data to make informed decisions.
- **8.1.8.IC.2:** Evaluate the impact of digital tools and resources on the creation, consumption, and dissemination of information.
- **8.2.8.ED.1:** Design a product or system to address a real-world problem.
- **8.2.8.ED.2:** Develop a prototype of a product or system that addresses a real-world problem and refine it based on testing and feedback.
- **8.2.8.ED.3:** Evaluate the effectiveness of a design solution and propose improvements.
- **8.2.8.ED.4:** Design and develop a product or system to address a real-world problem and present the solution to an audience.
- **8.2.8.ETW.1:** Analyze the impact of different types of technologies on the environment.

Interdisciplinary Standards:

- **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-3:** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- **MS-PS1-4:** Develop a model that describes how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
- **MS-PS3-5:** Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.
- **6.3.8.CivicsDP.1:** Analyze the role of innovation and technology in shaping the economy and society.
- **6.3.8.CivicsPR.1:** Analyze the historical, geographic, and economic factors that influenced the development of various forms of government and their impact on citizens.
- **6.3.8.CivicsPR.4:** Evaluate the role of technology in a democratic society.
- **6.3.8.EconET.1:** Using quantitative data, evaluate the opportunity cost of a proposed economic action, and take a position and support it (e.g., healthcare, education, transportation).
- **6.3.8.EconGE.1:** Explain how the availability of resources affects economic decisions.
- **6.3.8.EconGE.2:** Explain how the availability of resources and technology affects the production and distribution of goods and services.
- **6.3.8.EconGE.3:** Analyze the impact of globalization on local and national economies.
- **6.3.8.HistoryUP.2:** Use evidence to analyze the impact of technological innovations on the

development of societies.

- **MP.1:** Make sense of problems and persevere in solving them.
- **MP.4:** Model with mathematics.
- **MP.5:** Use appropriate tools strategically.
- **MP.6:** Attend to precision.
- **MP.7:** Look for and make use of structure.
- **MP.8:** Look for and express regularity in repeated reasoning.
- **6.G.A.1:** Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
- **6.G.A.2:** Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
- **7.G.A.1:** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
- **8.G.A.1:** Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines.
- **8.G.A.4:** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
- **1.2.8.Cn11a:** Analyze and contrast how media art forms are used to represent, establish, reinforce and reflect group identity and culture.
- **1.2.8.Cn11b:** Analyze and contrast how art forms are used to reflect global issues, including climate change.
- **1.2.8.Cr1a:** Generate a variety of ideas, goals and solutions for media artworks using creative processes such as sketching, brainstorming, improvising, and prototyping with increased proficiency, divergent thinking, and opportunity for student choice.
- **1.2.8.Cr2a:** Organize and design artistic ideas for media arts productions.
- **1.2.8.Cr3a:** Use criteria to examine, reflect on and plan revisions for a range of media artworks.
- **1.2.8.Pr5a:** Demonstrate technical skill and craftsmanship in the use of media, tools and techniques.
- **1.2.8.Pr6a:** Present media artworks and explain how the choices of media, techniques, and processes communicate meaning.
- **1.2.8.Re7a:** Describe how the qualities of a media artwork (e.g., sound, image, motion, time) contribute to its meaning.
- **1.2.8.Re9a:** Evaluate media artworks based on artistic criteria. **1.5.8.Cn10a:** Generate ideas to make art individually or collaboratively to positively reflect a group's identity.
- **1.5.8.Cn11a:** Analyze and contrast how art forms are used to represent, establish, reinforce and reflect group identity and culture.
- **1.5.8.Cr1a:** Generate a variety of ideas, goals and solutions for artworks using creative processes such as sketching, brainstorming, improvising, and prototyping with increased proficiency, divergent thinking, and opportunity for student choice.

- **1.5.8.Cr2a:** Organize and develop artistic ideas for artworks.
- **1.5.8.Cr3a:** Use criteria to examine, reflect on and plan revisions for a range of artworks.
- **1.5.8.Pr5a:** Demonstrate technical skill and craftsmanship in the use of materials, tools and techniques.
- **1.5.8.Pr6a:** Present artworks and explain how the choices of media, techniques, and processes communicate meaning.
- **1.5.8.Re7a:** Describe how the qualities of an artwork (e.g., line, shape, color, texture, form) contribute to its meaning.
- **1.5.8.Re9a:** Examine artistic criteria to determine what makes an effective performance.
- **RI.CI.6.2:** Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
- **RI.CR.6.1:** Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- **RI.MF.6.6:** Synthesize content presented in diverse media and formats (e.g., visually, quantitatively, as well as in words) and explain how the different formats contribute to a topic, text, or issue.
- **RI.TS.6.3:** Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
- **W.AW.6.1:** Write arguments on discipline-specific content... to support claims with clear reasons and relevant evidence.
- **W.IW.6.2:** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
  W.WP.6.4: With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, or trying a new approach.
- **W.RW.6.7:** Engage in independent and task-based writing for both short and extended periods of time, producing written work routinely. .
- **SL.PE.6.1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics and texts, building on others' ideas and expressing their own clearly. .
- **SL.PE.6.4:** Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
- **L.VL.6.4:** Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 6 reading and content, choosing flexibly from a range of strategies. .

Career Readiness, Life Literacies and Key Skills Standards:

- **9.4.8.CT.1:** Identify and define a problem, and then apply computational thinking strategies to develop a solution.
- **9.4.8.CT.2:** Evaluate computational thinking strategies to determine the most efficient and effective way to solve a problem.
- **9.4.8.IML.1:** Analyze how information is presented in different media and formats.
- **9.4.8.IML.2:** Evaluate the credibility and accuracy of information sources.
- **9.4.8.IML.3:** Analyze the impact of media and technology on society.
- **9.4.8.TL.1:** Select and effectively use appropriate digital tools to complete a variety of tasks.
- **9.4.8.TL.2:** Utilize digital tools to create and refine solutions to problems.

- **9.4.8.TL.4:** Apply digital tools to design and develop creative products or solutions.
- **9.4.8.TL.5:** Collaborate effectively using digital tools to plan, create, and present projects.
- **9.4.8.TL.6:** Explain the components and functions of a digital technology system.

Career Ready Practices (list if relevant)

CRP 1. Act as a responsible and contributing citizen and employee.
CRP 2. Apply appropriate academic and technical skills.
CRP 3. Attend to personal health and financial well-being.
CRP 4. Communicate clearly and effectively and with reason.
CRP 5. Consider the environmental, social and economic impacts of decisions.
CRP 6. Demonstrate creativity and innovation.
CRP 7. Employ valid and reliable research strategies.
CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP 9. Model integrity, ethical leadership and effective management.
CRP 10. Plan education and career paths aligned to personal goals.
CRP 11. Use technology to enhance productivity.
CRP 12. Work productively in teams while using cultural global competence.

New Jersey Curriculum Mandates: (list only relevant ones)

This curriculum integrates lessons that address the following interdisciplinary New Jersey Curriculum Mandates:

- Diversity and Inclusion (Grades K - 12)
- Climate Change Education (Grades K - 12)

Learning Objectives

Learning objectives are clear, specific statements that define what students should know, understand, and be able to do by the end of a lesson or course.

Students will be able to:

- Successfully log in to Tinkercad and identify all major components of the user interface.
- Add, select, move, rotate, and scale basic geometric shapes on the Workplane.
- Combine multiple shapes using the grouping tool.
- Subtract shapes from solid objects using the "Hole" feature.
- Precisely position and arrange objects using the alignment tool.
- Save and retrieve their Tinkercad designs.
- Use the "Duplicate and Repeat" feature to create patterns and symmetrical designs.
- Use the Workplane tool to build and modify objects on various surfaces.
- Create custom 2D shapes using the "Scribble" tool and extrude them into 3D objects.
- Design a functional dice, accurately placing pips using alignment.
- Access and utilize Tinkercad's Sim Lab to observe the physical properties of their designs.
- Import 2D vector graphics (SVG files) into Tinkercad and extrude them into 3D objects.

- Import existing 3D models (STL files) into Tinkercad for modification or integration.
- Apply a combination of Tinkercad tools and imported assets to solve a multi-part design challenge (e.g., Puzzle Cube).
- Practice iterative design by refining their imported and custom-designed elements.
- Apply precise measurement and alignment techniques to design multi-part jewelry pieces (e.g., watch, earrings, bracelet, necklace).
- Utilize symmetry and curved shapes effectively in their designs, such as when creating sunglasses.
- Demonstrate an understanding of aesthetic principles in 3D design.
- Practice problem-solving and iteration to refine complex designs.
- Conceptualize, plan, design, and refine a custom 3D object of their choice.
- Demonstrate mastery of all previously learned Tinkercad tools and concepts (e.g., grouping, holes, alignment, duplicate/repeat, Workplane, SVG/STL import, Sim Lab) in a complex, self-directed project.
- Communicate their design process, challenges, and solutions through a project proposal and presentation.
- Understand the process of preparing a 3D model for export and potential 3D printing.
- Reflect on their overall learning experience in 3D design.
- Explain the basic concept of additive manufacturing (layer-by-layer building).
- Identify and describe the function of key 3D printer components (e.g., extruder, print bed, nozzle, filament).
- Describe the role of slicing software in preparing a 3D model for printing.
- Identify common types of filament (e.g., PLA, ABS) and their general characteristics.
- Connect their Tinkercad designs to the 3D printing process.

Units of Study

Units of study are organized collections of lessons and learning experiences focused on a specific topic and set of skills within a course. Each unit is guided by a set of essential questions.

Unit 1: Getting Started with Tinkercad (5 Days)

- How do 3D design tools help us create objects that exist in the real world?
- What are the fundamental building blocks of 3D models?
- How can simple shapes be combined or modified to create more complex forms?

Unit 2: Advanced Manipulation and Simulation (5 Days)

- How can we efficiently create repeating patterns or symmetrical designs in 3D?
- Why is it important to be able to build on different surfaces of a 3D object?
- How can simulating physical properties help us refine our designs?

Unit 3: Integrating External Designs (6 Days)

- How can existing 2D images or 3D models be used to enhance our designs?
- What are the benefits of importing external files versus building everything from

scratch?
- How do we ensure imported elements fit seamlessly into our Tinkercad projects?

Unit 4: Creative Design Challenge (5 Days)
- How do design principles like symmetry and proportion contribute to an aesthetically pleasing 3D object?
- What considerations are important when designing wearable objects?
- How can we translate real-world measurements and forms into a digital 3D design?

Unit 5: Culminating Project and Beyond (6 Days)
- How can I use 3D design to solve a problem or express a personal idea?
- What is the design process, and how does it help us create successful projects?
- How can I effectively communicate my design choices and the functionality of my 3D model?
- What are the next steps for bringing a digital 3D design into the physical world?

Unit 6: Introduction to 3D Printing (5 Days)
- What are the fundamental principles behind 3D printing?
- What are the main components of a 3D printer and what do they do?
- How does a digital 3D model become a physical object?
- What materials are used in 3D printing and why?

Instructional Resources and Materials

Instructional resources are the information sources teachers utilize to guide their teaching and assessing. Instructional materials are the texts students read or review. The instructional resources and materials may vary in order to meet the learning needs of students.

Required:
- Tinkercad.com access
- Projector/Interactive Whiteboard
- Teacher-created example designs
- Printed or digital step-by-step guides
- Teacher-created example patterns/structures
- Physical dice
- Sim Lab tutorial videos/guides
- Curated library of simple SVG and STL Files
- Physical puzzle cubes
- Step-by-step import guides
- Rulers and calipers
- Design inspiration images and videos
- Project proposal
- Slicing software

Recommended:
- "Tinkercad for Beginners" YouTube playlist

- Examples of simple 3D printed objects
- Online galleries of Tinkercad designs
- "Physics in 3D" short videos
- Tinkercad "Learn" activities on Workplane and Duplicate & Repeat
- Examples of complex patterns in nature or architecture
- "How to find free 3D models" guide
- Videos on file formats (SVG vs. STL)
- Guest speakers
- Principles of Design resources
- Online jewelry/eyewear design galleries
- Design Thinking for Kids
- Inspirational Videos on 3D Printing

Teacher Resources:

- Tinkercad Learn Tutorials
- Tinkercad Classrooms Feature
- Basic Shape Reference Sheet
- Troubleshooting Common Issues
- Tinkercad Blog/Examples
- Sim Lab Guide
- Pre-made Dice Template
- Free SVG/STL Repositories
- Tinkercad Import Troubleshooting
- Puzzle Cube Solutions/Examples
- Jewelry Design Inspiration
- Sunglasses Templates
- Measurement Tools
- 3D Printing Slicing Software Overview
- Design Thinking Process Posters

Assessment Strategies

Assessment measures a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes and for evaluative purposes. Teachers may choose one or more of the following ideas to assess learners. They may also modify these ideas to make the assessment more responsive to students' interests and needs.

Formative Assessments:

- Teacher Observations
- Quick Checks
- Success Checks
- Progress Checks
- Workplane Application
- Sim Lab Discussion
- Peer Feedback
- Sketches/Plans

Summative Assessments:

- Basic Build Challenge
- Project Completion
- Patterned Object & Simulation
- Modular Design with Import
- Wearable Design Portfolio
- Culminating Custom Design Project & Presentation
- Explain 3D Printing Presentation/Report

Benchmark Assessments:

- Simple Structure Challenge
- Symmetrical Structure & Workplane Test
- Import and Modify Task
- Symmetry & Scale Challenge
- Mid-Project Checkpoint and Tool Inventory
- 3D Printer Component Matching
- Slicing Parameter Identification

Alternative Assessments:

- Tinkercad Tool Tutorial
- Sim Lab Experiment Write-up
- Design Process Explanation
- Design Reflection Journal
- Design Portfolio
- 3D Printer Glossary

Suggested Strategies for Modification & Differentiation

Modifications Chart (update for your content area)