2023 U09 iSTEM 3 - Advanced 3-D Modeling

Content Area: **CTE**
Course(s): **iSTEM**
Time Period: **November**
Length: **10 - 12 weeks**
Status: **Published**

Unit Overview:

In this unit students will learn advanced 3D computer modeling skills. These advanced skills include learning how to use mathematical functions to represent relationships in dimensional properties of a modeled object within the 3D environment. Students will also develop and apply mathematical relationships to enforce appropriate dimensional and motion constraints. After practicing these skills, students will be introduced and practice the mastery of several new functions within the Autodesk Inventor Program, including by not limited to mirror, sweep, pattern, midplane, revolve and creating holes. Students will then expound on these skills with the creation of a pre-dimensioned car, which will lead to their end of unit project of designing and 3-D modeling their own project for 3-D printing. The class will then complete practice tests and practice assignments in the following weeks in order to achieve Certiport's Autodesk Inventor Certified User Certification.

Essential Questions:

- Are working drawings always necessary in order to communicate the design of a consumer product?
- How do geometric constraints allow the user to produce more accurate 2-D sketches for 3-D Models?
- How can 3D animated assembly models of an object or a proposed design be used in the design process?
- What Is Geometric Modeling?
- What Are The Advantages Of Cad?
- What is the difference between symmetry command and mirror command?
- What are the different file formats in Autodesk?
- How do the file formats differ?
- What factors do you need to consider when designing and modeling for a 3-D printed object?

Enduring Understandings:

- 3D modeling parts and assemblies can utilize parameters, such as geometric constraints as well as numeric constraints to determine the shape and size of geometry and models.
- Dimensions can be represented by an equation that mathematically describes the relationship between that dimension and other related dimensions
- Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing.
- Utilize advanced modeling features to create three-dimensional solid models of complex parts and assemblies within CAD, after being given the actual part.
- Using a CAD application, create relationships among part features and dimensions using parametric formulas.
- Create an exploded assembly view of a multi-part product.

- Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.
- Perform a peer review of technical drawings and offer constructive feedback based on standard engineering practices.

Lesson Titles:

- Presentation of Information: Step by Step 3-D modeling features and tools videos

- Geometric Constraints 3-D Modeling Assignments

- Test: Autodesk Inventor Certification

- Mini - Project: Create your Own 3-D Object for Printing

- Mini - Project: Toy Car Modeling and Assembly of a Toy Car

- Project: Design Challenge - Design and create an attachment for the Toy Car

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Direct Instruction: Daily Overviews (Promethean Board, Chromebooks, White Board)
- Direct Instruction: Presentations - Presentations of Information (google slides)
- Instruction: Videos / Links to documents for Industrial Disasters
- Independent Work: Advanced 3-D Modeling Assignments
- Indirect Instruction: Reflective Discussion, Evaluation of Data and Technical Writing - ENB Write Ups, Self Evaluations, Presentation of Projects
- Experiential: Project - Design Challenge: Toy Car Attachment Project
- Experiential:- Mini - Project: Toy Car Modeling and Assembly
- Experiential:- Mini - Project: Create your Own 3-D Object for Printing
- Cooperative: Partner classwork, short projects, projects and ENB entries

Summative Assessment:

- Mini - Project: Create your Own 3-D Object for Printing
- Mini - Project: Toy Car Modeling and Assembly
- Project: Design Challenge - Toy Car Attachment
- Quiz: Create your Own 3-D Object for Printing

- Quiz: Toy Car Assembly
- Quiz: Toy Car Attachment ENB
- Quiz: Toy Car Modeling

Formative Assessment:

- Anticipatory Set - Overview of items for the day, future activities of the unit, and/or review of previous information from the unit
- Classroom / Student Observation - check in on student work during in-class activities / projects
- Closure of Projects - students provide results of their projects, self-evaluate projects for possible improvements that could be made, and evaluate instruction that could be improved
- Closure of Units - students complete a design project that pertains to the unit at hand as well as prior units
- Conferences between the instructor and student at various points in the semester.
- ENB (engineering notebooks) - reviewed periodically during the school year
- In-class activities where students informally present their results.
- Presentation Sample Slides - Students participate in classroom discussion on topic that is being introduced and reviewed
- Q & A session - Student led question and answer session at the start of class for project information as needed
- Question and answer sessions, formal, planned and informal, spontaneous.
- Warm-Up - review information from current topic or previous topics, preview time for current activity, and/or opportunity for clarity on the previous day's work

Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

Alternative Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Standards/Indicators/Student Learning Objectives (SLOs):

9-12.HS-ETS1	Engineering Design
9-12.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
9-12.HS-ETS1-1.1.1	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
9-12.HS-ETS1-4.ETS1.B	Developing Possible Solutions
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
9-12.HS-ETS1-3.ETS1.B.1	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Career Readiness, Life Literacies, & Key Skills:

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.7	Plan education and career paths aligned to personal goals.

Inter-Disciplinary Connections:

MA.G-CO.D	Make geometric constructions
MA.G-GMD.B	Visualize relationships between two-dimensional and three-dimensional objects
MA.G-MG.A	Apply geometric concepts in modeling situations
MA.G-MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
MA.G-MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems

	based on ratios).
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

Technology Materials and Standards

- SmartBoard Presentations
- Chromebooks, Google Drive, Google Applications
- MS Office Software as needed
- Smartphones
- Autodesk Inventor Program

TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
TECH.8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
TECH.8.2.12.D	Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.
TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.CS1	Computational thinking and computer programming as tools used in design and engineering.

Computer Science and Design Thinking Standards

CS.K-12.4.b	Evaluate existing technological functionalities and incorporate them into new designs.
CS.K-12.4.c	Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.
CS.K-12.5.a	Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.
CS.K-12.6.a	Systematically test computational artifacts by considering all scenarios and using test cases.
CS.K-12.6.b	Identify and fix errors using a systematic process.
CS.K-12.6.c	Evaluate and refine a computational artifact, multiple times, to enhance its performance, reliability, usability, and accessibility.

Modifications

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers

- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

Resources & Materials:

- Project Lead the Way, Introduction to Engineering Design Information
- Walker, Exploring Drafting, II: Goodhart-Wilcox, 1996
- Gradwell & Wekch. Technology, Engineering Our World, IL: Goodhart-Wilcox, 2012
- Autodesk Inventor Program