Unit 3: Thoughtful Product Design 22

Content Area: **Science**
Course(s): **Generic Course**
Time Period: **Semester 2**
Length: **10 weeks**
Status: **Published**

Standards

CS.9-12.8.1.12.AP.4	Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.
CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.9-12.8.1.12.AP.6	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
CS.9-12.8.1.12.AP.7	Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.
CS.9-12.8.1.12.AP.9	Collaboratively document and present design decisions in the development of complex programs.
CS.9-12.8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
CS.9-12.8.2.12.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.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
CS.9-12.8.2.12.ED.6	Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
	Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences.

Enduring Understandings

Students will understand that …

- **U1 –** Geometric shapes and forms are described and differentiated by their characteristic features.
- **U2 –** Physical properties of objects are used to describe and model objects and can be used to define design requirements, as a means to compare potential solutions to a problem, and as a tool to specify final solutions.
- **U3 –** Computer aided design (CAD) and drafting software packages incorporate the application of a variety of geometric and dimensional constraints and model features to accurately represent objects.

Essential Questions

- **EQ1 –** What advantage(s) do Computer Aided Design (CAD) and Drafting provide over traditional paper and pencil design? What advantages does paper and pencil design provide over CAD?
- **EQ2 –** Which high school math topic/course, Algebra or Geometry, is more closely related to engineering? Justify your answer.
- **EQ3 –** How does the material chosen for a product impact the design of the product?

Knowledge and Skills

KNOWLEDGE: Students will …

- **K1 –** Identify types of polygons including a square, rectangle, pentagon, hexagon, and octagon.
- **K2 –** Differentiate between inscribed and circumscribed shapes.
- **K3 –** Identify and differentiate geometric constructions and constraints (such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles) and the results when applied to sketch features within a 3D solid modeling environment.
- **K4 –** Distinguish between the meanings of the terms weight and mass.
- **K5 –** Define the term "physical property" and identify the properties of length, volume, mass, weight, density, and surface area as physical properties.
- **K6 –** Identify three-dimensional objects generated by rotations of two-dimensional shapes and vice-versa.

SKILLS: Students will …

- **S1 –** Solve real world and mathematical problems involving area and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, right prisms, cylinders, and spheres. U1, U2
- **S2 –** Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints and model features. U1, U3
- **S3 –** Measure mass with accuracy using a scale and report the measurement using an appropriate level of precision. U2
- **S4 –** Measure volume with accuracy and report the measurement with an appropriate level of precision. U2
- **S5 –** Calculate a physical property indirectly using available data or perform appropriate measurements to gather the necessary data (e.g., determine area or volume using linear measurements or determine density using mass and volume measurements). U2
- **S6 –** Solve volume problems using volume formulas for rectangular solids, cylinders, pyramids, cones, and spheres. U2
- **S7 –** Use physical properties to solve design problems (e.g., design an object or structure to satisfy physical constraints or minimize cost). U2

- **S8 –** Assign a specific material (included in the software library) to a part and use the capabilities of the CAD software to determine the mass, volume, and surface area of an object for which a 3D solid model has been created.
- **S9 –** Assign a density value to a new material (not included in the software library) and apply the material to a 3D solid model within CAD software in order to determine the physical properties of the object.

Resources

5.1.A CalculatingPropertiesShapes.docx
5.1.A GeometricShapesArea.pptx
5.2.a.A Geometric Constraints.docx
5.2.a.A.SR GeometricConstraints.idw
5.2.b.A IntroductionToCADModelingSkills.docx
5.2.A WorkPointsAxesPlanes.pptx
5.2.b.A.SR AutomobloxT9DimDwgs.docx
5.3.A DeterminingDensity.docx
5.3.A.SR DensityUseCommonMaterialsChart.docx
5.3.A.SR DeterminingDensityDelrinBallMcMasterCarr0.pdf
5.3.A.SR DeterminingDensitySteelBallMcMasterCarr02.pdf
5.3.A.SR DeterminingDensityTitaniumMcMasterCarr01.pdf
5.3.A.SR DeterminingDensityWoodDensities.pdf
5.4.A CalculatingPropertiesSolids.docx
5.4.A PropertiesGeometricSolids.pptx
5.5.a.A CADModelFeatures.docx
5.5.A.b CADModelFeatures.docx
5.6.A .PhysicalPropertyAnalysis.docx
5.6.A PhysicalPropertyAnalysis.pptx
5.7.A InstantChallengeChoremaster.docx

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing