BLUE VALLEY DISTRICT CURRICULUM & INSTRUCTION

Engineering

Introduction to Engineering Design

ORGANIZING THEME/TOPIC	FOCUS STANDARDS & SKILLS
Unit 1: Design Process • Design Process • Brainstorming • Prototype testing and Scientific method • Principles and Elements of Design • Portfolio Development Time Frame: 3 weeks	Implement the design process used by professional engineers to create innovative solutions. • KS 21006.02.01 Explain the steps of the design process. • KS 21006.02.02 Assess the value of working as a team and benefits of collaboration. • KS 21006.02.03 Investigate the principles and elements of design and demonstrate their use in the design process. • KS 21006.02.04 Identify career opportunities in design engineering and their job functions. • KS 21006.02.05 Express understanding of the principles and elements of design utilized in products, print media, and art forms. • KS 21006.03.04 Develop a portfolio to organize and display evidence of their work. • KS 21006.06.01 Apply the creative thinking process
Unit 2: Sketching and Visualization • Techniques • Pictorial • Annotated Sketches Time Frame: 2 weeks	Create various technical representations used in visualization, communicating and documenting design ideas. • KS 21006.04.01 Integrate proper sketching techniques and styles in the creation of sketches. • KS 21006.04.02 Demonstrate the ability to produce two-dimensional geometric figures. • KS 21006.04.04 Formulate pictorial sketches to develop ideas, solve problems, and understand relationships during the design process. • KS 21006.04.06 Select a sketching method that is efficient in its use of color, form, and symbols representing abstract data. • KS 21006.04.08 Evaluate and select the necessary views to graphically communicate design solutions. • KS 21006.04.10 Integrate annotated sketches in presentations, portfolio, and documentation processes. • KS 21006.04.11 Develop properly annotated sketches to accurately convey data in design solution.

Unit 3: Measurement and Statistics: • US Customary units • Metric units • Unit Conversion • Precision and accuracy • Linear dimensions • Statistical analysis with spreadsheets Statistics and quality Time Frame: 3 weeks	Utilize precise measurement and accurate statistical analysis in the application of the design process. • KS 21006.02.01 Apply the steps of the design process. o Construct a testable prototype of a problem solution. o Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements. o Use statistics to quantify information, support design decisions and justify problem solutions. o Use a spreadsheet problem to store and manipulate raw date and perform calculations using formulas. • KS 21006.08.15 Set up and integrate the use of a customized common dimensioning standard. • KS 21004.13.02 Design and create tables, charts, and graphs to illustrate data collected.
Unit 4: Modeling Skills • Conceptual models • Graphical models • 3D Computer Models • Physical models • Mathematical models Time Frame: 4 weeks	Apply a variety of modeling methods and formats to represent systems, components, and processes. • KS 21006.06.04 Communicate their idea through written and verbal formats. • KS 21006.06.06 Select and utilize the appropriate graphical format to a problem. • KS 21006.06.07 Analyze and develop graphical representation of given data. • KS 21006.06.08 Demonstrate an understanding of the different physical modeling techniques. • KS 21006.06.09 Present a model with its correct proportions. • KS 21006.06.11 Evaluate a problem using mathematical formulas. • KS 21006.06.12 Analyze a solution to a problem using the correct format of analysis. • KS 21006.06.13 Interpret a sketch using a CAD package. • KS 21006.06.14 Explain the difference between parametric and adaptive designs and be able to specify their uses. • KS 21006.06.15 Draw a two-dimensional sketch using CAD package. • KS 21006.06.17 Demonstrate the ability to generate a three-dimensional model. • KS 21006.06.18 Demonstrate the use of work features and how they are applied while constructing a solid model. • KS 21006.06.19 Recognize the use and need of work planes, axes, and points in the development of a computer model.

Unit 5: Geometry of Design • Forms and Shapes • Geometric Constraints • Cartesian Coordinate System • Parametric Design Time Frame: 3 weeks	Apply 2 and 3-dimenstional geometric concepts and skills to problem solving and engineering design. • KS 21006.05.01 Define and contrast points, lines and line segments. • KS 21006.05.02 Identify major geometric shapes. • KS 21006.05.03 Using a compass, ruler and triangle, construct geometric shapes. • KS 21006.05.04 Define terminology associated with arcs and circles. • KS 21006.05.06 Distinguish and define geometric constraints. • KS 21006.05.07 Identify geometric constraints in given three dimensional models. • KS 21006.05.08 Apply the right hand rule to identify the X, Y, and Z axes of the Cartesian Coordinate System. • KS 21006.05.09 Apply a combination of absolute, relative, and polar coordinates to construct a three-dimensional model. • KS 21006.05.10 Define the origin planes in the Coordinate System. • KS 21006.06.16 Apply geometrical and dimensional constraints to a sketch.
Unit 6 Reverse Engineering • Visual, functional and structural aspects of design • Functional analysis • Strengths and weaknesses of product and manufacturing process Time Frame: 3 weeks	Disassemble and analyze a product or system in order to understand and document the visual, functional, and/or structural aspects of its design. • KS 21006.08.01 Students will demonstrate how to extract data from solid models. o Evaluate and compare the impact of materials and fastener choices on product design cost, performance, marketability, environment and service life. o Accurately measure linear distances and mass. o Create sketches and orthographic projections of an object to fully detail parts. o Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views.
Unit 7 Documentation • Working Drawings • Dimensioning • Annotation • Dimensional tolerances • 3D Computer models Time Frame: 5 weeks	Create engineering working drawings that document measurements collected during reverse engineering process and to propose new designs. • KS 21006.08.02 Evaluate the accuracy of mass properties calculations. • KS 21006.08.03 Describe how analysis data can be used to update parametric models. • KS 21006.08.04 Generate an isometric view from orthographic drawing views. • KS 21006.08.05 Determine the correct application for the various section views. • KS 21006.08.07 Create the appropriate section view for a specified view. • KS 21006.08.08 Create a detail view that corresponds to appropriate orthographic view. • KS 21006.08.09 Create an auxiliary view to show the detail on an inclined surface. • KS 21006.08.11 Apply common dimensioning systems, rules and practices. • KS 21006.08.13 Apply size and location dimensions to annotated drawings. • KS 21006.08.17 Solve tolerance problems. • KS 21006.08.19 Formulate general and proprietary specifications to further communicate information relating to product design.

Unit 8: Advanced Computer Modeling • Adding Components • Assembly Constraints • Part Libraries • Sub-Assemblies • Driving Constraints • Adaptive Design • Mass Properties • Mathematical functions Time Frame: 3 weeks	Utilize 3D computer modeling skills to create exploded and animated assembly views of multi-part products. • KS 21006.07.01 Demonstrate assembly modeling skills to solve design problems. • KS 21006.07.03 Create components effectively in the assembly modeling environment. • KS 21006.07.05 Replace components with modified external parts. • KS 21006.07.06 Perform part manipulation during the creation of an assembly model. • KS 21006.07.07 Demonstrate assembly modeling skills to solve design problems. • KS 21006.07.09 Apply assembly constraints to successfully construct a multi-part object. • KS 21006.07.10 Utilize part libraries effectively during the assembly modeling process. • KS 21006.07.12 Employ sub-assemblies during the production of assemblies. • KS 21006.07.14 Apply drive constraints to simulate the motion of parts in assemblies. • KS 21006.07.16 Apply adaptive design concepts during development of sketches, features, parts and assemblies.
Unit 9: Design Team and Design Challenge • Collaborative teamwork • Virtual communication • Shared decision-making • Ethical responsibilities • Diversity and cultural competence. • Societal and environmental impacts • Engineering design process • Scientific method • Mathematical models Time Frame: 9 weeks	Apply the concepts and skills of engineering to create and test a solution for a real-world problem. • KS 140101.13.09 Develop and use mathematical models to represent and justify mathematical relationships found in a variety of situations. • KS 140101.04 Apply scientific methods in qualitative and quantitative analysis, data gathering, direct and indirect observation, predictions, and problem identification. • KS 140101.18 Apply leadership, teamwork and effective communication to achieve a common goal. o Apply appropriate technology to support collaboration in the design process. o Develop and utilize a decision matrix based on accepted outcome criteria and constraints. o Justify and validate a selected solution path. o Document design process using technical drawings and design journal. o Incorporate visual elements and principles of design in the engineered product. o Justify and present problem solution.