DELAWARE VALLEY SCHOOL DISTRICT

PLANNED INSTRUCTION

A PLANNED COURSE FOR:

Design and Modeling

Grade Level: 7 & 8

Date of Board Approval: _____2017_____

DELAWARE VALLEY SCHOOL DISTRICT

Planned Instruction

Title of Planned Instruction: Design and Modeling

Subject Area: Technology Education Middle School Grade(s): 7 & 8

Course Description: In Unit 1 Introduction to Design, students discover the design process and develop an understanding of the influence of creativity and innovation in their lives. They will also be learning about different types of measurement and applying them to drawings. In Unit 2 Modeling and Statistical Analysis, students use the Autodesk Inventor 3D modeling software to create a virtual image of their designs and produce a portfolio to showcase their creative solutions. In Unit 3 Design Challenge, students are then challenged and empowered to use and apply what they've learned throughout the class to design a therapeutic toy for a child who has cerebral palsy.

Time/Credit for the Course: 9 weeks, daily, 46 minutes = 34.5 hours

Curriculum Writing Committee: Anthony Comunale

Curriculum Map

1. <u>Marking Period One</u>: 45 days

Goals:
Unit #1: Introduction to Design

- Students will participate in an instant design challenge to create an optimal solution to a given problem and apply what they learn to understand the importance of using the design process.
- Students will learn thumbnail, perspective, isometric, and multi-view sketching as methods for communicating design ideas effectively without the use of technology.
- Students will calculate conversions between two measurement systems.
- Students will apply measurement skills while dimensioning sketches.

Unit #2: Modeling and Statistical Analysis

- Students will apply the design process to create a puzzle cube.
- Students will apply a mathematical model to study a situation.
- Students will design shapes in a coordinate system.
- Students will transfer a two-dimensional representation to a three-dimensional solid model using technology.
- Students will construct basic geometric shapes and use combinations of geometric primitives to form more complex shapes.
- Students will create a solid model using Autodesk Inventor software.
- Students will fabricate and test their design solution.

Unit #3: Design Challenge

- Students will apply the design process and create all the necessary documentation in each of the steps of the design process.
- Students will create sketches for your design ideas.
- Students will create a 3D design using Autodesk Inventor.
- Students will assess your solution and analyze the test data using a data analysis application.

Understanding of:

- Recall that the goal of any engineering design process is to create solutions and opportunities for people and society.
- Construct a prototype based on design documentation.
- Recognize perspective, thumbnail, isometric, and multi-view sketches.
- Summarize the reasoning for using sketching as a communication tool.
- Differentiate between two-dimensional and three-dimensional models.
- Interpret multi-view drawings, specifications, dimensions and annotations.
- Compare and contrast the various types of models used when designing a solution.
- Apply geometric and dimensional constraints to solid model designs.
- Identify the proper tool to use to measure and dimension with accuracy and precision.

Curriculum Plan

Unit #1: **Introduction to Design** **Time Range in Days:** **18**

Standard(s):
Science and Technology and Engineering Education

- 3.4.7.A1, 3.4.7.A2, 3.4.7.B3, 3.4.7.B4, 3.4.7.C1, 3.4.7.C2, 3.4.7.C3, 3.4.8.C1, 3.4.8.C3, 3.4.7.D1, 3.4.7.D2, 3.4.7.D3, 3.4.7.E1
- http://www.pdesas.org/Standard/View#

Anchor(s):

- S7.A.1, S7.A.2, S7.A.3, S8.A.2
- http://www.pdesas.org/Standard/View#

Overview: Students discover the design process as they complete an instant design challenge to create an ankle foot orthosis. They learn thumbnail, orthographic, isometric, and perspective sketching as methods for communicating design ideas effectively without the use of technology.

Focus Question(s):

1. How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity?
2. Why is communication of design ideas with teams and with stakeholders important throughout the design process?
3. What role do team norms play in making a collaborative team more successful?

Goals: Introduce students to the design process and skills essential to design and modeling. The use of a common measurement system is essential for communicating and fabricating designs.

Objectives:

1. Students will participate in an instant design challenge to create an optimal solution to a given problem and apply what they learn to understand the importance of using the design process. (DOK 4)
2. Students will learn thumbnail, perspective, isometric, and multi-view sketching as methods for communicating design ideas effectively without the use of technology. (DOK 2)
3. Students will calculate conversions between two measurement systems. (DOK 1)
4. Students will apply measurement skills while dimensioning sketches. (DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Ankle Foot Orthosis Design
    a. Lecture: Teacher will discuss project requirements
    b. Demonstration: PLTW instructional video
    c. Hands-on: Create foot orthosis prototype
2. Thumbnail, Isometric, and Multi-View Sketching
    a. Lecture: Teacher will discuss the different types of sketches
    b. Hands-on: Practice sketching techniques by drawing given objects
3. Measurement
    a. Lecture: Teacher will discuss the different types of measurement
    b. Hands-on: Practice measuring objects
4. Dimensioning
    a. Lecture: Teacher will discuss the proper dimensioning techniques
    b. Demonstrate: Show how to properly dimension an orthographic sketch
5. Surface Area and Volume
    a. Demonstration: Teacher will discuss how to calculate area and volume
    b. Hands-on: Students will surface area and volume of different objects

Assessments:

Diagnostic:

- Oral response to determine student comprehension

Formative:

- Daily teacher review of engineering notebook
- Foot orthosis challenge
- Sketching activities
- Measurement activities

Summative:

- Engineering Notebook

Extensions:

Students that have mastered the basic sketching and measurement principles will be given more challenging activities.

Correctives:

Individual instruction and demonstrations will be given to students having difficulty.

Materials and Resources:

SmartBoard, whiteboard, engineering notebooks, worksheets, ankle foot orthosis supplies, PLTW videos

Curriculum Plan

Unit #2: **Modeling and Statistical Analysis** **Time Range in Days:** **15**

Standard(s):
Science and Technology and Engineering Education

- 3.4.7.A1, 3.4.7.A2, 3.4.7.B3, 3.4.7.B4, 3.4.7.C1, 3.4.7.C2, 3.4.7.C3, 3.4.8.C1, 3.4.8.C3, 3.4.7.D1, 3.4.7.D2, 3.4.7.D3
- http://www.pdesas.org/Standard/View#

Anchor(s):

- S7.A.1, S7.A.2, S7.A.3, S8.A.2
- http://www.pdesas.org/Standard/View#

Overview: In this unit, students transfer a two-dimensional representation to a three-dimensional solid model with technology. During the design project, students work in teams and apply the design process to create a puzzle cube. Students create a solid model using Autodesk Inventor to fabricate their design solution for testing.

Focus Question(s):

1. Why is it important for an engineer to be aware of the criteria and constraints when designing a project?
2. How do coordinate systems help engineers with their modeling?
3. How has the evolution of rapid prototyping tools impacted design fabrication?

Goals: Develop students' design and modeling skills and introduce them to various types of modeling techniques used by engineers and scientists.

Objectives:

1. Students will apply the design process to create a puzzle cube. (DOK 4)
2. Students will apply a mathematical model to study a situation. (DOK 4)
3. Students will design shapes in a coordinate system. (DOK 4)
4. Students will transfer a two-dimensional representation to a three-dimensional solid model using technology. (DOK 3)
5. Students will construct basic geometric shapes and use combinations of geometric primitives to form more complex shapes. (DOK 3)
6. Students will create a solid model using Autodesk Inventor software. (DOK 4)
7. Students will fabricate and test their design solution. (DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Building Blocks Challenge
    a. Lecture: Teacher will discuss project requirements
    b. Demonstration: Teacher will build an example project
    c. Hands-on: Create building blocks project
2. 2D Coordinate Plane
    a. Lecture: Teacher will discuss 2D coordinate plane system
    b. Hands-on: Practice worksheets on 2D coordinate plane system
3. 3D Coordinate Plane
    a. Lecture: Teacher will discuss the 3D coordinate plane system
    b. Hands-on: Practice worksheets on 3D coordinate plane system
4. Puzzle Cube Design Challenge
    a. Lecture: Teacher will discuss project requirements
    b. Demonstrate: Introduce Autodesk Inventor software
    c. Hands-on: Practice using Autodesk Inventor
    d. Hands-on: Create a puzzle cube in Autodesk Inventor

Assessments:

Diagnostic:

- Oral response to determine student comprehension

Formative:

- Puzzle cube design challenge
- Dimensioning activities
- Coordinate plane challenge

Summative:

- Engineering notebook

Extensions:

Students that have mastered dimensioning will be given more challenging activities.

Correctives:

Individual instruction and demonstrations will be given to students having difficulty.

Materials and Resources:

SmartBoard, whiteboard, engineering notebooks, worksheets, linking cubes, Autodesk Inventor, 3D printer, PLTW videos

Curriculum Plan

Unit #3: **Design Challenge** **Time Range in Days:** **12**

Standard(s):
Science and Technology and Engineering Education

- 3.4.7.A1, 3.4.7.A2, 3.4.7.B3, 3.4.7.B4, 3.4.7.C1, 3.4.7.C2, 3.4.7.C3, 3.4.8.C1, 3.4.8.C3, 3.4.7.D1, 3.4.7.D2, 3.4.7.D3, 3.4.7.E1
- http://www.pdesas.org/Standard/View#

Anchor(s):

- S7.A.1, S7.A.2, S7.A.3, S8.A.2
- http://www.pdesas.org/Standard/View#

Overview: Students use a simulation to better understand cerebral palsy prior to beginning their Therapeutic Toy Design Challenge. Within teams, students brainstorm and select a design solution to the problem based on design requirements.

Focus Question(s):

1. Why are teams of people more successful than an individual when solving problems?
2. Why are brainstorming, research, and testing important when creating, modifying, or improving a design solution?

Goals: Apply the knowledge and skills that you have acquired in the Design and Modeling unit, as you design and fabricate a therapeutic toy for children with cerebral palsy.

Objectives:

1. Students will apply the design process and create all the necessary documentation in each of the steps of the design process. (DOK 4)
2. Students will create sketches for your design ideas. (DOK 4)
3. Students will create a 3D design using Autodesk Inventor. (DOK 4)
4. Students will assess your solution and analyze the test data using a data analysis application. (DOK 3)

Core Activities and Corresponding Instructional Methods:

1. Therapeutic Toy Challenge
    a. Lecture: Teacher will discuss project requirements
    b. Demonstration: Teacher will show students various examples
    c. Hands-on: Create therapeutic toy

Assessments:

Diagnostic:

- **Oral response to determine student comprehension**

Formative:

- **Therapeutic toy design challenge**
- **Design process activity**

Summative:

- **Engineering notebook**

Extensions:

Correctives:

Individual instruction and demonstrations will be given to students having difficulty.

Materials and Resources:

Smart Board, whiteboard, engineering notebooks, worksheets, Autodesk Inventor, rulers, dial calipers, 3D printer, PLTW videos

Primary Textbook(s) Used for this Course of Instruction

Name of Textbook: There are no textbooks used for this course.

Checklist to Complete and Submit:

(Scan and email)

_____ Copy of the curriculum using the template entitled "Planned Instruction," available on the district website.

_____ The primary textbook form(s).

_____ The appropriate payment form, in compliance with the maximum curriculum writing hours noted on the first page of this document.

Each principal and/or department chair has a schedule of "First and Second Reviewers." Each Reviewer must sign & date below.

First Reviewer Printed Name_____

First Reviewer Signature_____ Date_____

Second Reviewer Printed Name_____

Second Reviewer Signature _____ Date_____