T&E Express
SCSU Mobile Lab Program

Course : Industrial Technology 8

Science Strand and Substrand being addressed *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.*

Science Standard being addressed *MS-ETS1-4*

Overview:

Science Standard and Benchmarks *Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.*

Math Strand and Substrand being addressed *Understand congruence and similarity using physical models, transparencies, or geometry software. Verify experimentally the properties of rotations, reflections, and translations:*

Math Standard being addressed *(8.G.1)*

Overview:

Math Standard and Benchmarks *Draw, construct, and describe geometrical figures and describe the relationships between them.*
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. (7.G.1)

Correlation to AAAS Atlas:
Science - 9.1.2.2 AAAS Atlas Benchmark(s): The Mathematical World (Shapes): The more parts and connections a system has, the more ways it can go wrong. Complex systems usually have components to detect, back up, bypass, or compensate for minor failures. 3B/H5

Math - 9.3.1A AAAS Atlas Benchmark(s): The Nature of Technology (Design & Systems) The Mathematical World (Shapes):The position of any point on a surface can be specified by two numbers. 9C/H3b

Essential Understandings/Big Ideas:
In this unit, students are introduced to and use the design process to solve a design problem. They are given design constraints as well as the necessary criteria for the design. Students will use the Autodesk Inventor 3D modeling software to create a virtual image of their design and produce an actual model of their designed solution. Students will then evaluate their design to determine if it meets the identified need.

What should students know and be able to do [at a mastery level] related to these benchmarks? – *bulleted descriptive list*

- ***Identify criteria within a design problem***
- ***Research what others have done to solve similar problems.***
- ***Brainstorm a number of solutions that could solve the problem and select the best one based on supporting mathematical evidence.***
- ***Design a product that meets the design criteria.***

Misconceptions:

Student Misconceptions:
Students often underestimate or do not appreciate the importance of design constraints. It will be essential to discuss with them the reason for the constraints as well as showing them what may happen to their design if adherence to protocol and procedures are not followed.
Students also struggle to understand the concept of space and distance. It will be necessary to review dimensioning and locating features within a design.

Teacher Resources:

- **Teacher Notes**
- This project is intended to occur after the students have completed a number of assignments that hone their 3D modeling skills.

- The students will have the opportunity to print their design at the conclusion of this design problem. It is important to allow time at the conclusion of the printing for students to refine their design to fully complete the problem solving process.

New Vocabulary

Term	***Definition***
Centerline	*A line type that is used to indicate the axis of symmetry for a part*

	or feature.
Construction Line	*Thin lines that serve as guides while sketching or drawing.*
Depth	*The distance from front to back.*
Diameter	*A straight line passing from side to side through the center of a circle or sphere.*
Dimension	*A measurable extent, such as the three principal dimensions of an object of width, height, and depth.*
Dimension Line	*Thin lines capped with arrowheads, which may be broken along their length to provide space for the dimension numerals.*
Extension Line	*A thin solid line perpendicular to a dimension line, indicating which feature is associated with the dimension.*
Height	*The measurement of someone or something from head to foot or from base to top.*
Hidden Line	*A line type that represents an edge that is not directly visible because it is behind or beneath another surface.*
Isometric	*A form of pictorial drawing in which all three drawing axes form equal angles of 120 degrees with the plane of projection.*
Object Line	*A heavy solid line used on a drawing to represent the outline of an object.*
Radius	*A straight line from the center to the circumference of a circle or sphere.*
Scale	*A proportion between two sets of dimensions used in developing accurate, larger or smaller prototypes, or models of design ideas.*
Size Dimension	*Placed directly on a feature to identify a specific size or may be connected to a feature in the form of a note.*
Sketch	*A rough drawing representing the main features of an object or scene and often made as a preliminary study.*
Three Dimensional (3D)	*Having the dimensions of height, width, and depth.*
Two Dimensional (2D)	*Having the dimensions of height and width, height and depth, or width and depth only.*
Visualize	*To imagine the visual form of an object or situation that one cannot see.*
Width	*The measurement or extent of something from side to side.*

Vignette:

Day(s) 1: Dimensioning

Students will learn the importance of size as it relates to a shape. They will learn how to properly size a part and locate features. This includes height, width, and depth.

Day(s) 2-3: Computer Modeling Fundamentals

Students will use their knowledge of dimensioning to create accurately sized geometric shapes on a computer modeling software. They will know how to sketch two dimensionally as well as the extrusion process. They will learn how to edit both sketches and features.

Day(s) 4-5: Reverse Engineering of a Widget

Provide widget and calipers for students to reverse engineer into 3D CAD. Create a simple object in the woods lab for students to recreate.

Day(s) 6-8: Introduce Design Brief and

Discuss the purpose of the design and discuss the criteria for a successful solution. Allow students to engage in the problem solving process in order to come up with a suitable approach.

Days(s) 9-12 3D Printing and Project Assembly

Students will be afforded the opportunity to print their designed solution. They must determine if all design criteria have been met and export their design in the appropriate file type.

Additional Instructional Resources

DESIGN BRIEF:

Introduction:

Have you ever felt like it was difficult to find your locker in the endless line of hallways? Ever feel frustrated about the school rule forbidding the outside of lockers from being decorated? Here is your chance to design a "school approved" locker ID tag!

In this activity you will design a locker ID tag with a theme of your choice. It is important for you to remember what you learned about measuring, sketching, drawing, and using software in previous lessons and activities. You may want to refer back to

your notes in your Engineer's notebook if you need help on an idea or the design process.

Equipment

- ***Engineer's notebook***
- ***Pencil***
- ***Computer with 3D modeling program***
- ***Sketch paper***
- ***Ruler***

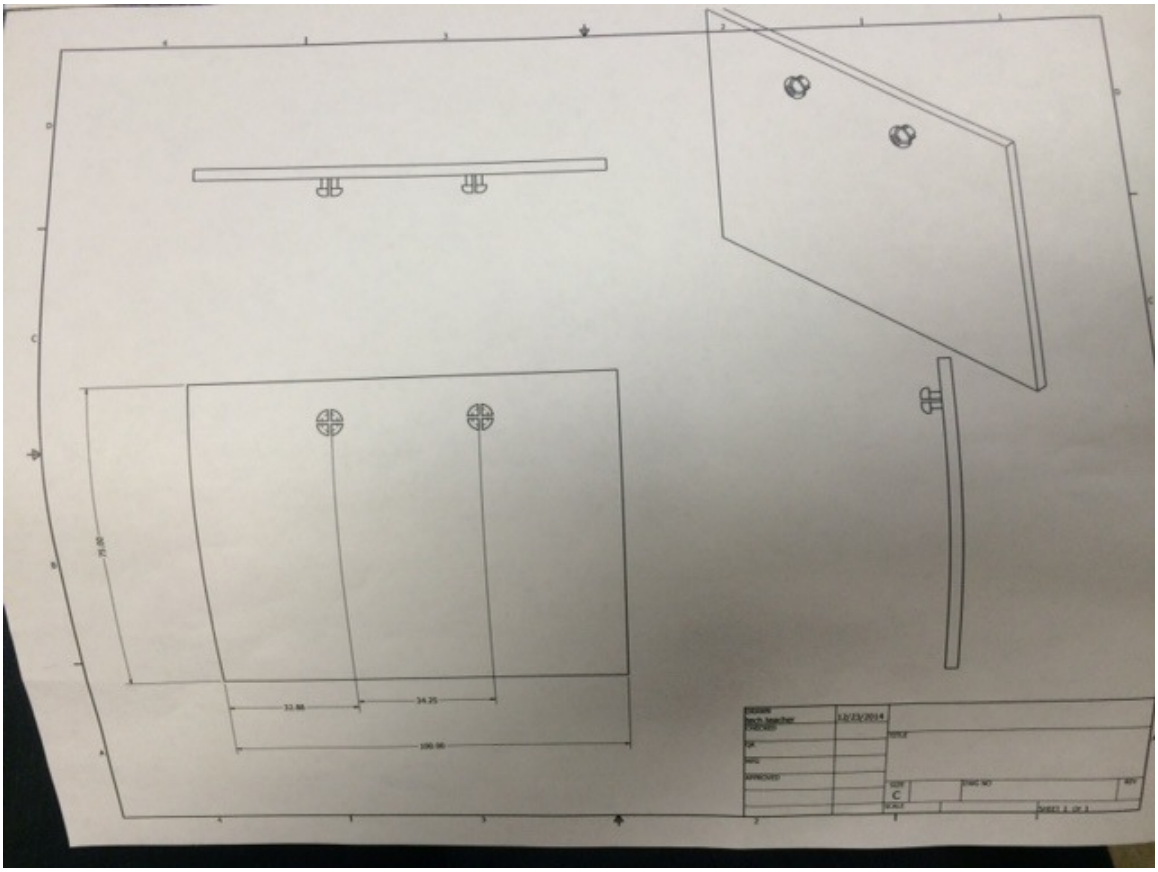
Procedure

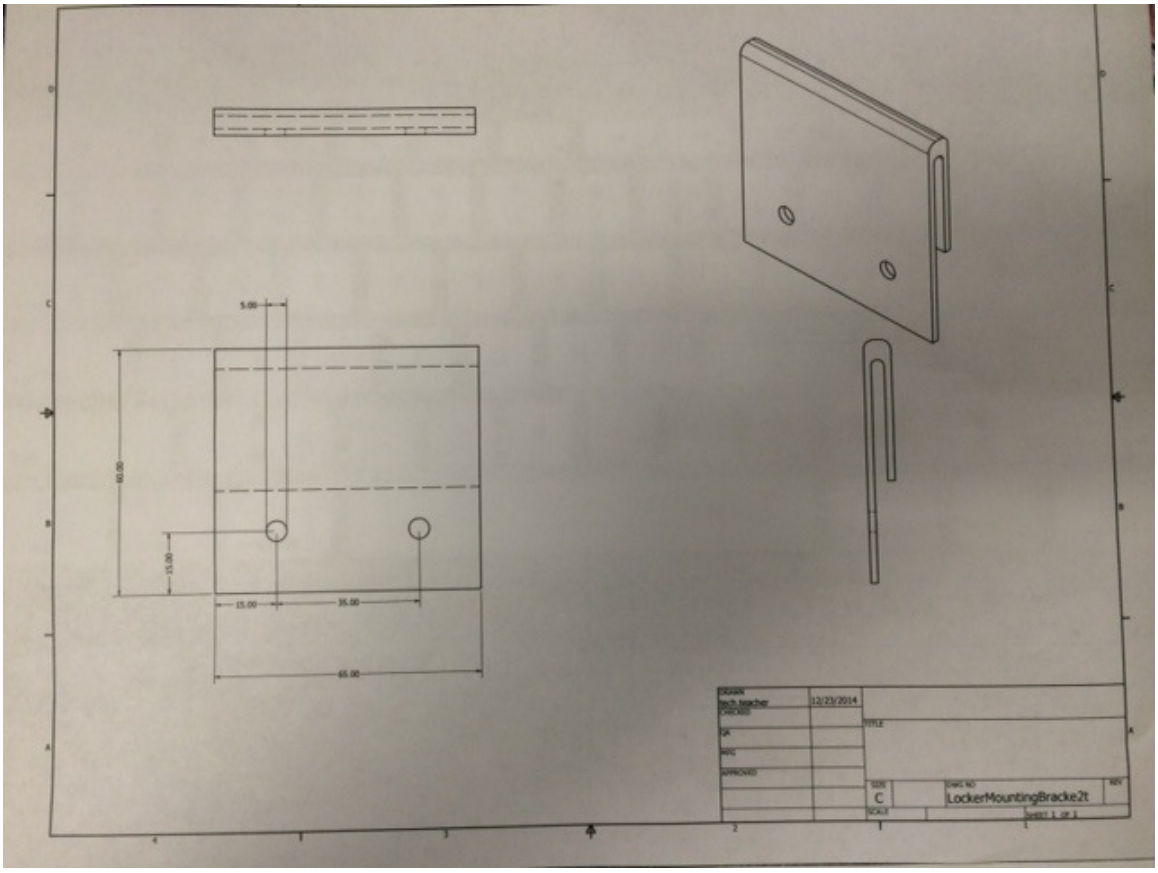
In this activity you will design a locker ID tag that will attach to the ventilation slot on your locker. . You will need to measure the locker opening to determine the necessary material thickness. You will also need to design a snap design to fasten your tag to the mounting bracket.

The design of the Locker Tag must include the following constraints:

- ***At least two holes for hanging that incorporates a snap ring.***
- ***Fillets or chamfers that add to the design***
- ***Rounded edges for safety***
- ***Your name***
- ***An image that helps describe you***
- ***a non distracting background***

The following images are of basic design templates.





Assessment:

Assessment:
Students will print their design and determine if the two parts will assemble appropriately. They will present their solution to the class and will identify where they incorporated all of the design elements into their product.

Differentiation:

Gifted and Talented:
Student will have the opportunity to create increasing complex mathematical representations in the design software. Producing text to follow a geometric shape as well as the inclusion of mirroring functions will allow gifted and talented extension activites.

Special Education:
This activity can be scaled up or down depending on the ability and aspirations of the students. In the case of a special ed student certain measures can be taken to increase the likelihood of an individual's success. This includes providing design templates that reduce the measurement burden on these individuals.

English Language Learners
Much of the vocabulary will be new to all students. Increasing the number of visuals will help all students learn the vocabulary common to design and engineering.

Parents and Administration:

Administrative/Peer Classroom Observation

Students Are: (descriptive list)	**Teachers Are:** (descriptive list)
Sketching & Dimensioning Drawings	Demonstrating industry standards.
Creating engineering drawings	Providing examples of best practice.
Applying geometric constraints and dimensions in 3D CAD	Demonstrating part/assembly interactions and geometric constraining
Engaging in the design process	Reviewing problem solving steps as necessary and providing feedback as designs evolve.

Parent Resources:
http://www.sciencebuddies.org/engineering-design-process/engineering-design-process-steps.shtml

http://pbskids.org/designsquad/parentseducators/workshop/process.html

http://www.autodesk.com/education/free-software/all

References:

http://www.education.state.mn.us/mde/edexc/stancurri/index.html
www.pltw.org