Career and Technical Education (CTE)

6th Grade/STEAM

BOARD APPROVAL DATE: 9/24/19

BOARD ADOPTION OF STATE STANDARDS: 10/1/14

Unit Overview (Standards Coverage)				
Unit	**Standards**	**Unit Focus**	**Skills Overview**	**Suggested Pacing**
Unit 1	**8.2.8.D.1, 8.2.8.C.4, 8.2.8.C.5.a**	**Design Loop and Safety**	**Design Loop, Morphological Chart, Isometric/Orthographic Sketching, Safety**	**1 week**
Unit 2	**8.2.8.A.5, 8.2.8.C.1, 8.2.8.C.2, 8.2.8.C.3, 8.2.8.C.5.a, 8.2.8.D.1, 8.2.8.D.2, 8.2.8.D.3**	**Utilizing the design loop to develop problem solving skills.**	**Design Loop Application, Safe Tool Usage, Identifying Criteria/Constraints, Researching, Brainstorming, Planning, Building, Testing, Improving**	**3-4 weeks**

This document outlines in detail the answers to following four questions:

1. **What do we want our students to know?**
2. **How do we know if they learned it?**
3. **What do we do if they did not learn it?**
4. **What do we do when they did learn it?**

Unit 1 STEAM Principles		
Content & Practice Standards (write in full)	**Interdisciplinary Standards for Practice**	**Critical Knowledge & Skills**
• **8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.** • **8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem.** • **8.2.8.C.5.a Create a technical sketch of a product with materials and measurements labeled.**	• **CRP6. Demonstrate creativity and innovation.** • **CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.**	• **The design loop is a process used to solve a problem consisting of six steps: ask, imagine, plan, create, experiment, improve.** • **A morphological chart is a brainstorming technique created by listing attributes and drawing variables.** • **Isometric sketches (3-d) and orthographic sketches (2-d) are helpful in planning a solution.** • **Safety procedures must be followed when using all tools.**

Unit 1 STEAM Principles	
Stage 1 – Desired Results	
UNIT SUMMARY	**CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)**
Students will learn to follow the design process to create a solution to a problem with given criteria and constraints. Students will learn proper safety procedures, how to use a morphological chart, and isometric and orthographic sketching.	PowerPoints Guided PowerPoints for students to follow along 9 points of personal safety activity 3-d sketch paper 2-d sketch (graph) paper Ruler
UNDERSTANDINGS	
Students will understand that the design loop is a process consisting of six steps that engineers use to create and improve products. Students will understand that both isometric and orthographic sketches are essential when planning a product. Students will understand that morphological charts are a great brainstorming technique to develop variables for specific attributes. Students will understand safety procedures for using hot glue guns, x-acto knives, and mini hacksaws. Students will understand the 9 points of personal safety to dress appropriately for building.	
Students will know…	**Students will be able to…**
Students will know that the six steps of the design loop are ask, imagine, plan, create, experiment, improve. *Students will know that safety glasses and gloves must be used when using anything hot or sharp.* *Students will know that orthographic sketches are 2-dimensional sketches from the front, side, and top view.*	*Students will be able to list and describe the six steps of the engineering design loop.* *Students will be able to pass the safety quiz with a score of 100%.* *Students will be able to draw orthographic sketches of various shapes and objects around the room.* *Students will be able to draw isometric sketches of various shapes and objects around the room* *Students will be able to create a morphological chart for soap, an article of clothing.*

Students will know that isometric sketches are 3-dimensional sketches with lines that are vertical and 30 degrees up from horizontal. *Students will know that a morphological chart is a brainstorming tool to list attributes, draw variables, and circle which attributes they will be choosing.*	

Stage 2 – Assessment Evidence

Performance Tasks: *Isometric sketching* *Orthographic sketching* *Morphological chart for soap* *Safety quiz* *SGO*	Other Evidence **(Alternate Assessments)**: *Teacher observation* *Participation* *Safety re-quiz*

Stage 3 – Learning Plan

• Where is the work headed? Why is it headed there? What are the student's final performance obligations, the anchoring performance assessments? What are the criteria by which student work will be judged for understanding?

- Students will gain foundational knowledge of what STEAM is, how to safely use tools, and how the engineering design loop is utilized. This is important because it sets the foundation for everything taught in STEAM in middle school and the safety procedures for which all projects are built. Students will be graded on participation, drawings, and their safety quiz.

• Hook the student through engaging and provocative entry points: thought-provoking and focusing experiences, issues, oddities, problems, and challenges that point toward essential questions, core ideas, and final performance tasks.

- 9 points of personal safety with Scooby Doo characters, detailed sketches shown, discussion of importance of design loop in real-world engineering

• Explore and Equip. 21st Century Learning and Interdisciplinary connections. Engage students in learning experiences that allow them to explore the big ideas and essential questions; that cause them to pursue leads or hunches, research and test ideas, try things out. Equip students for the final performances through guided instruction and coaching on needed skill and knowledge. Have them experience the ideas to make them real.

- Students will explore real-world engineering sketches, real-world applications of the design loop, and real-world engineering solutions.
- Students will collaborate when brainstorming and sketching.

•Organize and sequence the learning for maximal engagement and effectiveness, given the desired results.

- Students will learn about the difference between science, technology, engineering, art and math through a guided PowerPoint during which they will take notes.
- Students will be guided through the six steps of the design loop, given real-world applications, and take notes of what each step is and how each step contributes to the overall design of the product.
- Students will do a 9 points of personal safety activity and take notes through a guided safety PowerPoint and teacher demonstration of tools.
- Students will take a safety quiz on safety procedures. *Students will take a re-quiz if they do not get 100%.
- Students will view examples of isometric sketches, define isometric sketches, and make isometric sketches of cube, rectangular prism, tissue box with tissue, cylinder, sphere, and various items around the room.
- Students will view examples of orthographic sketches, define orthographic sketches, take notes of rules for orthographic sketches, and make orthographic sketches of tissue box, soup can, roll of paper towels, and various items around the room.

What pre-assessments will you use to check students' prior knowledge, skill levels, and potential misconceptions?

- Students will be given pre-test in beginning of marking period.
- Students will be asked to make sketches before taught proper sketching techniques.

- Students will be asked to brainstorm ideas before being taught morphological chart.

PROGRESS MONITORING

How will you monitor students' progress toward acquisition, meaning-making, and transfer, during lesson events?

- Teacher will circulate while students are taking notes, making sketches, and making morphological charts.
- Students will first watch teacher sketch, then sketch with guided help, and finally sketch objects of their choice on their own.

What are potential rough spots and student misunderstandings?

- Students may not get 100 on quiz on first take.
- Students may think that the design loop must be followed in the same order each time it is used.
- Students may have difficulty processing 2-dimensional and 3-dimensional drawings.

How will students get the feedback they need?

- Teacher will circulate the room.
- Teacher will give quiz back and go over answers.
- Teacher will provide frequent feedback and answer student questions.

What supports are needed for students to be successful?

- Reteaching, small group instruction, one-on-one teacher conference, safety re-quiz, modified assignments, quiz read aloud.

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students

• Rethink and revise. Dig deeper into ideas at issue (through the faces of understanding). Revise, rehearse, and refine, as needed. Guide students in self-assessment and self-adjustment, based on feedback from inquiry, results, and discussion.

• Evaluate understandings. Reveal what has been understood through final performances and products. Involve students in a final self-assessment to identify remaining questions, set future goals, and point toward new units and lessons.

•Tailor (personalize) the work to ensure maximum interest and achievement. Differentiate the approaches used and provide sufficient options and variety (without compromising goals) to make it most likely that all students will be engaged and effective.

Gifted & Talented: Students will draw isometric and orthographic sketches of various objects around the room. Students will be encouraged to choose more difficult objects to draw. Students will be encouraged to teach struggling classmates.

Tier I: Students may choose alternate objects to sketch. Students may sketch without grid lines on paper.

Tier II: Students will receive quiz back and be given opportunity to ask questions before requiz. Students will be taught sketching at a slower pace while other students are practicing sketches.

Tier III: Students will be pulled to table to reteach sketching at a slower pace. Students will have one-on-one conference with teacher to discuss questions incorrect on re-quiz. Students will be given copies of notes.

ELL: Students have access to Google translate. Depending on English literacy proficiency, students may have assignments and assessments printed in their native language. Students may take safety quiz with ELL teacher.
504s: Accommodations will be provided according to 504 plan. Examples: preferential seating, extra time to complete assignments and quiz, read quiz aloud, copy of notes.
SPED: Accommodations will be provided according to IEP. Examples: preferential seating, extra time to complete assignments and quiz, read quiz aloud, copy of notes.

Unit 2 Applying the Engineering Design Loop		
Content & Practice Standards	**Interdisciplinary Standards for Practice**	**Critical Knowledge & Skills**
• **8.2.8.A.5 Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system.** • **8.2.8.C.1 Explain how different teams/groups can contribute to the overall design of a product.** • **8.2.8.C.2 Explain the need for optimization in a design process.** • **8.2.8.C.3 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.** • **8.2.8.C.5.a Create a technical sketch of a product with materials and measurements labeled.** • **8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.** • **8.2.8.D.2 Identify the design constraints and trade-offs involved in designing a prototype (e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook.** • **8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.**	• **CRP4. Communicate clearly and effectively and with reason.** • **CRP6. Demonstrate creativity and innovation.** • **CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.** • **CRP11. Use technology to enhance productivity.** • **CRP12. Work productively in teams while using cultural global competence.**	• **The design loop is a process used to solve a problem consisting of six steps: ask, imagine, plan, create, experiment, improve.** • **The six simple machines are the lever, pulley, inclined plane, wedge, screw, and wheel and axle.** • **Safety procedures must be followed when using all tools.** • **Simple machines are useful in daily life to make work easier for the user.**

Unit 2 Applying the Engineering Design Loop

Stage 1 – Desired Results

UNIT SUMMARY	CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)
Students will apply the engineering design process to solve given problems with given criteria and constraints. Students will focus on learning the six types of simple machines and applying their knowledge of simple machines in the creation of their solutions to the problems provided.	Recycled materials, foam board, cardboard, plastic, fabric, pencil, paper, markers, ruler, batteries, popsicle sticks, PVC rods, magnets, levers, wheel and axles, pulley devices, 3-d printer, ping pong balls, electric fan, cups, scissors, skewers, string, tape, hot glue, clothes line, bike tube, velcro, paint, wooden dowels, saws, craft knives, hot glue guns.

UNDERSTANDINGS

Students will understand that simple machines are basic mechanical devices that help make work easier.
Students will understand that the six simple machines are the lever, pulley, inclined plane, wedge, screw, and wheel and axle.

Students will understand that the engineering design loop helps to create the best solution to a problem.
Students will understand that the steps of the engineering design loop do not always have to be followed in a strict order.
Students will understand that safety procedures must be followed at all times when tools are being utilized.

Students will know…	**Students will be able to…**
Students will know that the six types of simple machines are the lever, pulley, inclined plane, wedge, screw, and wheel and axle. *Students will know that the engineering design process is helpful in creating a solution to a problem.* *Students will know that isometric sketches are 3-dimensional sketches and orthographic sketches are 2-dimensional sketches from the front, side, and top views.* *Students will know that improving their solution is a very important part of creating a solution to a problem.* *Students will know that criteria are requirements and constraints are limitations.*	*Students will be able to use multiple simple machines when building solutions to the problems given.* *Students will be able to utilize the steps of the design loop to solve the best solution to a given problem with given criteria and constraints.* *Students will be able to communicate their ideas to their groups and present their ideas to their classmates.* *Students will be able to create isometric and orthographic drawings with measurements* *Students will be able to create a morphological chart in the planning phase of creating their solution to a given problem..* *Students will be able to create a solution to a given problem within the given criteria and constraints.*

Stage 2 – Assessment Evidence

Performance Tasks:	Other Evidence **(Alternate Assessments)**:
Physical solution created *Design loop documentation* *Engineering design notebook* *Invention crusade* *Trash transformation* *Kite project* *Mechanical motion* *Toying with technology* *Gadget creation* *ID holder* *Physical disability* *Manufacturing* *Solar oven*	*Teacher observation* *Participation* *Group discussion*

Stage 3 – Learning Plan

• Where is the work headed? Why is it headed there? What are the student's final performance obligations, the anchoring performance assessments? What are the criteria by which student work will be judged for understanding?

- Students will apply their knowledge of the engineering design loop to solve given problems with given criteria and constraints. They will follow the steps of the design loop to understand the problem, research, brainstorm solutions using a morphological chart, plan their solution through isometric and orthographic sketches, build their solution following safety procedures, test out their solution with other students and teachers, improve their solution to make it look and work better, and present their final solution to their classmates. This is important because this process is what all engineers follow when creating solutions. This process develops students' problem solving skills, communication skills, perseverance, and improves their real-world thinking and 21st century skills. Students will be graded on their documentation of the design

loop, their final solution, and their participation. They will be graded through rubrics created for each project based on the criteria and constraints, and the problem presented.

• Hook the student through engaging and provocative entry points: thought-provoking and focusing experiences, issues, oddities, problems, and challenges that point toward essential questions, core ideas, and final performance tasks.

- Students will be solving real-world problems with personal connections, with a focus on helping others, such as people who are younger/older/have a disability.
- All design briefs include applicable background information, problem definition, criteria, constraints, materials, and tools.
- When possible, brief video clips are shown pertaining to the topic that peak student interest.

• Explore and Equip. 21st Century Learning and Interdisciplinary connections. Engage students in learning experiences that allow them to explore the big ideas and essential questions; that cause them to pursue leads or hunches, research and test ideas, try things out. Equip students for the final performances through guided instruction and coaching on needed skill and knowledge. Have them experience the ideas to make them real.

- Students will explore real-world problems, such as helping others.
- Students will utilize the engineering design loop, which is a real-world application.
- Students will collaborate with a partner to design and develop a solution to a problem.
- Students will present their projects to their peers, and will provide positive and constructive feedback to their peers.

•Organize and sequence the learning for maximal engagement and effectiveness, given the desired results.

- Students will do a brief introductory project, such as the ID holder, to follow all steps of the design loop.
- Students will learn definitions and examples of simple machines through a PowerPoint presentations, teacher-led discussions, and video clips.
- Students will receive design brief, read through it, and participate in teacher led discussion of problem, criteria, and constraints.
- Students will read through rubric and discuss examples of best practice for each category.
- Students will research background information for project through prior knowledge, human interaction, and computer research.
- Students will brainstorm a solution to the problem by creating a morphological chart to list attributes and drawing variables.
- Students will plan their solution by describing it and drawing isometric/orthographic sketches.
- Students will build their solution by following safety procedures, safely using tools, and recording their progress daily.
- Students will test out their solutions and have other students and teachers test out their solutions to see if it works and solves the problem.
- Students will improve their solution to make it look and work better.
- Students will present their solutions to their peers, and provide positive and constructive feedback after presentations.
- Students will reflect on their projects through writing.
- Choices for projects based on student interest, teacher knowledge of class, time available and supplies available:
    - Design Problem/Challenge Activity 1 (Physical Disability): There are students who have difficulty holding a mouse because they have a missing limb (i.e. no arms, or missing fingers on a hand) what design can be made to make the task of operating a computer mouse a reality for students with these physical challenges.
    - Design Problem/Challenge Activity 2 (Toying with Technology) Happyland Toy Company wants to create a new board game with a unique logo that will appeal to younger children. You will design and create a game for the Happyland Toy Company that will sell the most board games to children. The logo and color scheme should relate to the game idea and look inviting for children to want to play. You must also create 3-dimensional game pieces that include the color scheme and logo of the company.
    - Design Problem/Challenge Activity 3 (Manufacturing: The Fudgeville Crisis) Fudgeville makes the most delicious fudge, but they have a problem- the fudge only tastes good in the store! They are unable to ship their product because they do not have containers that will preserve the freshness of their product. Your job is to create a cost-effective container in a shape that is easy to ship and preserves the great taste of the fudge.
    - Design Problem/Challenge Activity 4 (Technological Systems: Creating Mechanical Motion using simple machines.) You will be given a request from a younger student at a neighboring school. This request will include the age of the student and what types of toys the student likes to play with. Your job is to create a toy with simple machines and linkage mechanisms that is fun to play with and really works.(flag pole, Jumping Jack,top,games, toys)
    - Design Problem/Challenge Activity 5 (Kite Project) A number of different items have been used at sporting events to support and promote team and school sprite. For this project you are to develop a kite which could be flown during the event outdoors or held by a fan.

- Design Problem/Challenge Activity 6(Trash Transformation) Here's the challenge: Young inventor Thaddeus found his uncle, world renowned inventor Phineas T. Quirkbotham, contemplating a box of assorted materials on his big reference table. "You know, Thadd," Phineas said, "Thomas Edison said something very important many years ago. He said the first step toward inventing something is to start with a big pile of junk!" With that, Thadd joined his uncle in examining the box, which contained a variety of things like old CDs/DVDs, discarded toothbrushes, popsicle sticks, and a variety of empty sewing thread spools. Phineas decided to challenge Thaddeus—and your students—to apply their creativity to invent something useful that incorporates one or more of these materials. Given a good supply of discarded CDs/DVDs, old toothbrushes, popsicle sticks, and empty sewing thread spools, what might your students create?
- Design Problem/Challenge Activity 7 (Solar Oven) Construct a solar oven that will cook a food item in . All teams will be provided with instructions and materials to build a basic solar oven. All teams are encouraged to modify and expand upon the basic design to construct the most efficient oven possible
- Design Problem/Challenge Activity 8 (Invention crusade) Design and construct a model of a product that will assist a small child in doing a household task. Remember, design the gadget so that people with different physical abilities can use it too.
- Design Problem/Challenge Activity 9 (ID Holder) You are going on a field trip to Spain in order to improve your language skills. You are packed, excited, and ready to go! You arrive at the airport and your teacher asks if you have your ID holder so that your ID can be visible at all times on the trip. You realize that you forgot to get one and the airport does not sell any. You cannot leave for your trip until you are wearing your ID in a holder that can be used each day on your trip. Luckily, there are some recycled supplies in your teacher's carry-on bag that you can use to create your ID holder. Your friend forgot his/hers, too! You need to create an ID holder for your partner that will allow his/her ID to be fully visible and that can be worn each day. The ID holder must be worn for multiple days and must also be able to hold one other item of your partner's choice.
- Design Problem/Challenge Activity 10 (Gadget to help with chore) Samantha visits her grandparents with her younger brother during summer break. During the week, Samantha observes her brother having difficulty with simple household chores. She also notices her elderly grandfather is having difficulty with chores. She wonders how she could help her brother become more independent or help her grandfather remain independent. She could invent a gadget to assist her grandparents and brother in performing a household chore. You need to design and create a working prototype of a gadget that will assist either a small child or an elderly person in completing a household chore that utilizes at least two different types of simple machines.

What pre-assessments will you use to check students' prior knowledge, skill levels, and potential misconceptions?

- Students will write their prior knowledge of the information as part of their research portion of their design loop documentation.
- Students will have taken a safety quiz on safety procedures.
- Students' skill levels of using tools is assessed through conferencing with students and close teacher observation.

PROGRESS MONITORING

How will you monitor students' progress toward acquisition, meaning-making, and transfer, during lesson events?

- Teacher will circulate room and check in with students frequently, checking their progress through the design loop documentation.
- Teacher will check in with students after specific checkpoints, such as checking the students' detailed plan and conferencing with them before they start building.
- Teacher will lead class discussion daily about timelines and due dates of specific parts of project.

What are potential rough spots and student misunderstandings?

- Students may not remember to check 9 points of personal safety before beginning to build.
- Students may think that the design loop must be followed in the same order each time it is used.
- Students may have difficulty creating 2-dimensional and 3-dimensional sketches of solutions prior to building.
- Students may have difficulty brainstorming ideas and developing plan for solution.
- Students may not get syllabus signed and may not be permitted to use tools.

How will students get the feedback they need?

- Teacher will circulate the room.
- Teacher will conference with students frequently.
- Teacher will provide frequent feedback and answer student questions.
- Teacher will check the first three steps of design loop documentation before building begins.
- Teacher will test students projects as part of step five: experiment, and provide constructive feedback on how the students can improve their solutions.

What supports are needed for students to be successful?

- Modified assignments, one-on-one teacher conference,conference with teacher to brainstorm and develop plan.

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students

• Rethink and revise. Dig deeper into ideas at issue (through the faces of understanding). Revise, rehearse, and refine, as needed. Guide students in self-assessment and self-adjustment, based on feedback from inquiry, results, and discussion.

• Evaluate understandings. Reveal what has been understood through final performances and products. Involve students in a final self-assessment to identify remaining questions, set future goals, and point toward new units and lessons.

•Tailor (personalize) the work to ensure maximum interest and achievement. Differentiate the approaches used and provide sufficient options and variety (without compromising goals) to make it most likely that all students will be engaged and effective.

Gifted & Talented: Students have a lot of choice within developing a solution, students will be encouraged to plan and create solutions that will be more challenging to create when conferencing with teacher. Students will be encouraged to create a second solution, further improve their solution, or help struggling classmates if they have extra time.

Tier I: Students who are unable to complete projects for disciplinary reasons for improper use of tools will be given alternate research assignment depending on material learned in specific project.

Tier II: Students will receive some additional support through teacher conferencing to aid in development of idea for solution. Students will have additional teacher support in using tools and will be retaught as necessary.

Tier III: Students will receive a lot of additional support through teacher conferencing to aid in development of idea for solution; if necessary, idea will be provided for student. Students will have additional teacher support in using tools and will be retaught as necessary; if necessary, materials will be cut for students.

ELL: Students have access to Google translate. Depending on English literacy proficiency, students may have assignments and assessments printed in their native language. Students may have extra time to work on projects with ELL teacher.

504s: Accommodations will be provided according to 504 plan. Examples: preferential seating, extra time to complete assignments, extra support coming up with plan for solution or idea for solution provided, depending on level. Some students with 504 may be provided with an extra partner who is strong in STEAM to help. Additionally,

SPED: Accommodations will be provided according to IEP. Examples: preferential seating, extra time to complete assignments, extra support coming up with plan for solution or idea for solution provided, depending on level. Some students with IEP may be provided with an extra partner who is strong in STEAM to help.