Career and Technical Education (CTE)

7th 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**	**8 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, and 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 review how to follow the design process to create a solution to a problem with given criteria and constraints. Students will review 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 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 know that orthographic sketches are 2-dimensional sketches from the front, side, and top view. *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.*	*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.*

Stage 2 – Assessment Evidence

Performance Tasks: *Isometric sketching* *Orthographic sketching* *Morphological chart for clothing item* *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 review 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 review the difference between science, technology, engineering, art and math through a guided PowerPoint during which they will take notes.
- Students will review 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 review 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 drawing 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 level, 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. • Safety procedures must be followed when using all tools. • Students will understand the design loop process and get a better understanding of the importance of researching, designing and creating a solution to a problem with great success. • Creating a plan using the design loop steps in order to problem solve any situation; the students can use this process for everyday life.

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 apply their understanding of the differences between series and parallel circuits to create a light source with a parallel circuit and 3 LEDs. Students will use their background knowledge of isometric sketching and knowledge of Tinkercad to create a game board piece on	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, Sphero robot, bridge kits, switch, AA batteries, AA battery holder, wire cutter, electrical tape, soldering kit, LEDs, tablets.

the 3-d printer. Students will code Sphero robots to tell a story they create for elementary school students on a topic of their choice.	

UNDERSTANDINGS

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 understand the differences between series and parallel circuits.
Students will understand how to code Sphero robots.
Students will understand how to create 3-d printed objects on Tinkercad.

Students will know…	**Students will be able to…**
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 know the main differences between parallel and series circuits in terms of practical use and energy usage.* *Students will know how to code Sphero robots to move, speak, change colors, make shapes, and tell a story.* *Students will know how to use Tinkercad to move, reshape, create custom shapes, make holes, resize, and group.*	*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.* *Students will be able to construct a working light source with a parallel circuit and three working LEDs.* *Students will be able to code Sphero to create a square with a loop and tell a story they create.* *Students will be able to create a game board piece in Tinkercad following given criteria and constraints that are to be included.*

Stage 2 – Assessment Evidence

Performance Tasks:	Other Evidence **(Alternate Assessments)**:
Physical solution created *Design loop documentation* *Engineering design notebook* *Light source* *Physical disability* *Candy machine* *Herb kit* *Pin ball game* *Weather center* *Alternative energy challenge*	*Teacher observation* *Participation* *Group discussion*

Innovative phone stand *3-d printed game board piece* *Sphero coded story* *Bridges*	

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 learn background knowledge for each project through teacher led discussion, video clips, and computer research.
- 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 (Light Source) The National Weather Service is calling for major storms the next few days, resulting in residential power blackouts and dangerous conditions out on the roads due to fallen branches. You look for your flashlight so you can be prepared, but it is nowhere to be found! Fortunately, you just learned about simple circuits and LED's, and you have a bunch of recycled materials scattered around the house. If you could design and build your own flashlight from simple materials- instead of buying one from the store- you could create a technological product that meets your exact specifications, and saves you a few bucks in the process!Problem Statement:Your home and the roadways can be dangerous environments when performing emergency tasks in the dark, such as walking up and down stairs or changing a car tire. Storms are on their way, and you don't have an emergency light
- Design Problem/Challenge Activity 3 (Candy Machine) Your aunt Laura, the "the candy connoisseur" and "part-time scientist" has innovated a new way to make candy to taste like many different flavors. For example, she has discovered a way to make jelly beans that taste like chocolate ice cream, hotdogs with ketchup, and PB & J. She would like to share her new candy flavors with the public by offering free samples in stores. She hopes that by offering free samples, people will like them so much that they will go out and buy them by the jars and make her rich and famous. However, she needs someone to "invent" a candy dispenser for her.
- Design Problem/Challenge Activity 4 (Herb Kit) As a product designer for the G&O Product Engineering Company, you are asked to use the design process to create a new product that can be used to grow 2-3 different kinds of herbs.
- Design Problem/Challenge Activity 5 (Pin Ball Game) The Ipad, my trusty computer, just crashed! I can't run the show without it! Even worse, I can't play video games without it! What's a high tech hound gotta do for a little fun around here? I've heard about an ancient game people played before we had computers—a pinball machine. Build one, and let's find out what this primitive contraption can do!
- Design Problem/Challenge Activity 6 (Weather Center) Meteorology is the study of all changes in the atmosphere, i.e. the layers of gases (air) that surround the earth. In order to do this we will need to study current weather conditions and the general climate in your area, and identify which factors most affect your daily temperature. To do this, you must first make a weather station. Begin by designing and building some of the same instruments that meteorologists use.
- Design Problem/Challenge Activity 7 (Alternative Energy Challenge) The Mayor of EHT requests that each home in the community be equipped with an alternative energy source. Each family home in EHT has the ability to meet this request on their property because your home has a stream running through it. You and your team have been employed to respond to his request.
- Design Problem/Challenge Activity 8 (Innovative Phone Stand) The 21st Century has become an environment where the telephone is no longer simply for making phone calls. In many cases, people are rarely using the smartphone for that archaic tradition of making a phone call. Smartphones have solidified themselves as necessities in the lives of human beings from various ages, walks of life, and social groups. Numerous companies have taken this opportunity to jump into the smartphone accessory pool by offering gadgets galore that will make your smartphone a more enjoyable, productive experience. Your two-three person engineering team will innovate the paper phone stand to develop a new and improved prototype targeting a specific demographic of your choosing.
- Design Problem/Challenge Activity 9 (3-D Printed Game Board piece) Today is your first day of your internship with ZompaGames, Inc. There are many unpaid internships available, but the most qualified for the position will be promoted to paid internships. Your primary job as an intern is to create board games, so your first job is to design a game board piece that embodies the theme of your board game. Your boss is looking for your creativity and ability to adhere to criteria and constraints. The best pieces will be chosen to be printed, and those interns will become paid interns to create their game boards. Design and 3-d print a creative game board piece that embodies the theme of your game board.
- Design Problem/Challenge Activity 10 (Sphero coded story) Sphero can talk! Sphero can move! Sphero can change colors! How can you program story to tell a story that you develop through a storyboard? Can Sphero represent more than one character? How can Sphero interact with the setting? Program Sphero to tell a story that elementary school students will enjoy!
- Design Problem/Challenge Activity 11 (Bridges) The college campus has a walking bridge that students traditionally use to cross from the parking lot to their dorm. On move-in day many students have heavy loads including televisions, small dressers, refigerators and other items that they need to bring to their dorms. Many parents and students have complained that it takes hours to bring these items in one at a time. The student counsel would like to propose the use of small motor carts with flatbeds attached to the back to move large, cumbersome furniture across the bridge. Your task is to design a model of a bridge that will be able to hold the extra weight and present your findings to the school decision makers.

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.