Unit Overview

Introduction to the Unit:

Unit 3 encourages **innovation** and helps students to lead **entrepreneurial** projects. Students will develop **innovative** solutions to real-world problems and market products for a specific field. The performance task asks students to investigate **innovation** in a specific career field, conduct research on innovation currently occurring in the market, and develop ideas and plans based on a defined audience and target market.

Lessons and materials for this unit were adapted from the CTE Online: Design and Create a Food Truck PBL Project.

Students Will Know and Be Able To…

- understand and apply **creativity** and the habits of effective **innovators** and **entrepreneurs.**
- identify and compare major **innovators** and **entrepreneurs** throughout American history.
- understand how **creative** qualities can be applied to achieve personal and career goals.
- understand and apply the **engineering design process** to develop a client-facing product and **business plan.**
- understand the purpose and major components of a **Request for Proposal (RFP).**
- understand, create and use a **project schedule.**
- create and present a **business plan** to a group of stakeholders.
- use the project evaluation template to reflect on the effectiveness of teams' implementation of the team contract and project schedule.

The following vocabulary words are used throughout the unit. All vocabulary definitions are from *Merriam Webster* unless indicated otherwise.

- **business plan:** a document that defines a business's objectives and strategies which usually includes a business summary, market research, and plan for execution (created definition) *(Unit Plan, PT 3.1, PT 3.1 Rubric, Teacher Guide)*
- **creativity:** the use of imagination or original ideas or an individual's ability to create (created definition) *(Unit Plan, PT 3.1, PT 3.1 Rubric, Teacher Guide)*
- **engineering design process:** a series of steps that engineers or innovators can apply to develop a solution to a problem; for this unit we will use a five-step engineering process or Ask, Imagine, Plan, Create, Improve (created definition) *(Unit Plan, PT 3.1, Teacher Guide)*
- **entrepreneur:** one who organizes, manages, and assumes the risks of a business or enterprise *(Unit Plan PT 3.1, Teacher Guide)*
- **innovation:** the introduction of something new *(Unit Plan, PT 3.1, Teacher Guide)*
- **invention:** something that has been produced for the first time through the use of the imagination or of ingenious thinking and experiment the ability to create something new or the act of develop a new process, product, or service *(Unit Plan, PT 3.1, Teacher Guide)*
- **market research:** the activity of gathering information to understand the needs of your customer; this research helps to identify the value of the product that is being offered (created definition) *(Unit Plan, Teacher Guide)*
- **patent:** a writing securing for a term of years the right to exclude others from making, using, or selling an invention *(Unit Plan, Teacher Guide)*
- **prototype:** a first full-scale and usually functional form of a new design of an invention *(Unit Plan, PT*

3.1, PT 3.1 Rubric, Teacher Guide)

- **phase:** a distinguishable part in a course, development, or cycle *(Unit Plan, Teacher Guide)*
- **project evaluation:** an assessment of if the goals of the project were accomplished *(Unit Plan, PT 3.1, Teacher Guide)*
- **project schedule:** a listing of the project's timelines, activities, and deliverables *(Unit Plan, PT 3.1, Teacher Guide)*
- **Request for Proposal (RFP)**: a legal document that is used to request proposals for a contract or service (created definition) *(Unit Plan, Teacher Guide)*

Introducing, reinforcing, and using academic vocabulary with students is an important part of a student's comprehension of the subject matter. As explained by Robert Marzano and Debra Pickering in *Building Academic Vocabulary: Teacher Manual*, there is a six-step process for direct instruction in subject-area vocabulary (2005):

1. Teacher provides a description, explanation, or example of the new vocabulary word.
2. Students restate explanation of the new vocabulary word in their own words.
3. Students create a picture or image representing the vocabulary word.
4. Students periodically do activities that help add to the knowledge of vocabulary words.
5. Students are asked to discuss the vocabulary word with another student.
6. Students periodically participate in games that allow them to play with the vocabulary words.

Many teachers incorporate this process into their bell ringers at the beginning of class or have students complete a Frayer model or K-W-L chart to build their knowledge of academic vocabulary. Some teachers also use a word-wall to provide students with high-frequency words. Most essential to effective vocabulary learning is the opportunity for students to experience new words, multiple times, and in a range of contexts—for them to hear, read, and use new words and concepts authentically. Teachers are therefore encouraged to plan for how they will introduce new words and terms, the examples they will offer and/or solicit from students, and when and how they will frequently model their own use of new words and encourage students to use new vocabulary in their own writing, discussions, and presentations. (Of note, more traditional approaches to word learning, such as having students research and/or copy definitions, complete flash card "drills," and complete work sheets or quizzes generally "teach" vocabulary in isolation and show little positive, lasting effect on student learning.)

Throughout the unit, different vocabulary words will be introduced in each lesson. Teachers can use the above strategies and process, or leverage the strategies linked below that have other ideas for interactive strategies and activities that can be incorporated into the six-step process to help students build and utilize academic vocabulary:

- Internalization of Vocabulary Through the Use of a Word Map
- Grades 3-8 EngageNY ELA Appendix
- 15 Vocabulary Strategies in 15 Minutes
- 12 Vocabulary Activities and Mini-Lessons for High School Students
- 5 Brain-Based Vocabulary Activities for the Secondary Classroom

Lesson One: Innovation and Entrepreneurship

Day 1: Students will discuss the concepts of **invention**, **innovation**, **entrepreneurship and creativity**. Students will learn about the **engineering design process** and use an engineering design journal to record ideas and responses to class discussions.

Tip: *Teacher should review the notes and talking points before Day 1. These notes also have visual examples of the* ***engineering design process****, which can be used with students. (See Appendix A.)*

1. Introduce students to the unit and explain that **innovative** thinking is the key to becoming a successful **entrepreneur**. Whether they invent a new product or process or develop an **innovation**, students will use their **creativity,** learn how to think like an **inventor,** and find a better way to do something.

2. Explain that students will learn about the characteristics of **invention**, **innovation**, and **entrepreneurship** to research successful **entrepreneurs** and work in teams to develop products and services. In this unit students will learn about the culinary and hospitality industry and design their own food truck as an independent **entrepreneur**.

3. Explain to students that they will practice using the **engineering design process** to build a tower. Briefly introduce students to the five stages of the **engineering design process.** For resources to help introduce the process, see:
   - A STEM Project Just in Time for Earth Day
   - Engineering Is Elementary

Tip: *Teacher may wish to provide more structure to the engineering design journals for students by using the sample journals below.*

4. Introduce students to their engineering design journal. Explain to students that they will use this journal to record their thinking during each phase of the **engineering design process** when they build a tower during tomorrow's lesson. Talk through the process of building the tower that they will do on day 2 and the type of information they would need to include in their journals.
   For sample student journals see:
   - Design Journals
   - Keep a Great Science or Engineering Project Laboratory Notebook
   - Engineering on a Dime: 3 STEM Challenges You Can Do Today

Formative Assessment will be captured through class discussion. Additionally, have students complete an exit ticket where they list the five steps of the engineering design process.

Accessibility Tip:
For students that need more scaffolding, the teacher can provide guided notes for student journals. Teachers may also allow some students to use illustrations.

Day 2: Students will complete an activity to practice the **engineering design process**. Students will record each step of the process in their engineering journal.

1. Briefly review the five stages of the **engineering design process**. Explain that today they will practice using these steps in a Build a Tower activity. Teachers may want to use the **engineering design process** graphic organizer provided with PT 3.1 Student Resources.

2. Have ready activity materials, a copy of the constraints for the project, and the expectations for journal recordings for each phase of the design process for each group.

3. As the groups work through the activity, the teacher will need to circulate and ensure all groups are recording each part of a phase before moving on to the next phase.

Activity: Build a Tower

Time Frame: 45 minutes
Class Configuration: groups of two
Materials: plastic or paper cups and tape or other common classroom materials as the teacher sees fit. Engineering on a Dime: 3 STEM Challenges You Can Do Today
Description: Students work in teams to see who can build the tallest tower using the engineering design process.

Tip: *Teacher may wish to provide a graphic organizer to help students apply the* ***engineering design process****.*

1. Group students in teams of two and inform them that they will record the process for building the tower in their engineering journal.

2. Show the selected materials to the class and announce that teams will be using **the engineering design process** to create the tallest tower. Provide constraints for the project (e.g., students may only use the provided materials, only 20 minutes will be provided to develop the tower, all activities should be recorded in each student's engineering journal). Once the time is up, the class will determine which team created the tallest tower.

3. During the "Ask" phase (of the design process), ensure that student groups are able to define the problem as well as any constraints. The problem definition and constraints should be recorded in their journals.

4. During the "Imagine" phase, ensure that student groups are able to brainstorm solutions. All ideas should be recorded in their journals with both text and visual depictions.

5. During the "Plan" phase, ensure that student groups are able to determine how they will create the tower. The project plan should be recorded by students in their journal. Students should not move to the next phase until this part of the process is complete.

6. During the "Create" phase, ensure that student groups are working to create the tower. Feedback and iteration should be recorded in their journals including whether their design changed during

construction, whether they applied ideas from other groups, and ongoing discussion about how their proposed solution is functioning.

7. After the "Create" phase is complete, determine with the class which student group had the tallest tower. Teams should ensure that all notes during the prior phases are recorded in their journals.

8. During the "Improve" phase, ensure that student groups are reflecting on their design. Reflection should be recorded in journals. The following questions may be used to prompt reflection:
    - Was the team design functional? Why or why not?
    - What would the team change about the design?
    - How closely did the team follow the planning process?
    - How did the team use ongoing feedback during the "create" phase of the project?

Formative assessment will be captured through class discussion and completion of the tower activity. All written research and information should be captured in the students' engineering design journals.

Accessibility Tip: *For students that need more scaffolding, the teacher can provide a more complete copy of the engineering design process. Teachers may also allow some students to use illustrations.*

Day 3: Students will use their experience from the tower activity to develop team norms and create their team contract and project schedule.

Activity: Creating a Team Contract

Time Frame: 25 minutes
Class Configuration: Project Teams
Materials: Student Engineering Journal, PT 3.1 Student Resource
Description: Students will work in teams to complete their team contract

1. Introduce PT 3.1 and distribute 3.1 PT Student Resource. Leave time for students to ask questions about the project.

2. Do a think aloud about the successes and the problems that their team encountered in the previous activities. Have students also consider what work well and what did not in their contracts from the previous unit. This is the second time in the course that they will have used the team contract.

3. Allow students to volunteer to lead an example of a think aloud.

4. Lead a brainstorming session and make an anchor chart of norms each team could develop to make group work more successful.

5. Divide the class into teams of four or five that will remain together for the rest of the project. Make sure groups are heterogeneously divided so that no one group has an advantage. Students who will need help reading or writing from text need to be divided into separate groups. Students who are introverts might need to be grouped together so that they have to participate. Students

with another primary home language should be grouped with fluent speakers in both languages if possible.

6. Students will work in teams to develop team norms and complete their team contract.

7. Each group will then share their team contract with the class. Class members will listen to the agreements from the other team contracts and record new ideas in their engineering design journals.

8. Give students time to reflect and adjust their agreements.

9. Students will write a statement in their engineering design journals that explains why teams need group norms or agreements.

Tip: *Brainstorming is a technique that is used to generate multiple ideas about a question. The following steps are important for the brainstorming process:*

- *Make sure the question is clear*
- *Make sure all participants are in a circle*
- *Follow the order of the circle*
- *Set a time limit*
- *Record all thoughts*
- *Always remain neutral*
- *Encourage the unusual*

Here are some resources on brainstorming:

- *How can I Facilitate Brainstorming in the Classroom?*
- *10 Tips for Effective Creative Brainstorming*
- *Brainstorming*

Activity: Developing a Project Schedule

Time Frame: 20 minutes
Class Configuration: Project Teams
Materials: Student Engineering Journal, PT 3.1
Description: Students will work in teams to complete their project schedule for preparing for a semester test and then will complete their draft project schedule for the food truck project.

1. Describe the purpose of a project schedule. The following resources can be used by the teacher to help prepare for this lesson.
   - Overview of Project Management
   - Project-Management-Schedule

   The stages in the engineering design process are very similar to the stages of project management. Both are tools to ensure successful projects.

2. Model a project schedule for preparing for a semester test. During the model, the teacher will have students share what steps need to be done in order for the student to be prepared for the test at the end of the semester such as reviewing at certain times, developing flash cards, etc.

3. Help students brainstorm a list of things that have to be complete for their food truck project (PT 3.1 Student Resource). The teacher will reinforce that this is just a draft, and that tasks may have to be reviewed and revised as they work.

4. Student teams will use the rest of the class to complete their draft project schedule for the project.

Formative Assessment will be gathered through class discussion and completed documents.

Lesson Two: Innovators Past and Present

Day 1 and 2: Students will conduct research to learn about past and present **inventors** and **entrepreneurs.** Students will select one **inventor** or **entrepreneur** and develop a narrative description. Students will describe the personal and career goals that the selected **inventor** likely had/has and the leadership that made him/her successful. Students will develop a list of issues or problems the selected **inventor** likely overcame in order to be successful. Students will reflect on what impact the **inventor** or **entrepreneur** had in their lives in their engineering design journal.

Tip: The teacher may wish to develop a list or consult *Appendix B* for a generated list of **inventors** and **entrepreneurs** prior to having students conduct research. This list includes inventors of different socio-economic groups, races, and genders.

Activity: Researching an Inventor or Entrepreneur

Time Frame: 50 minutes
Class Configuration: individual
Materials: computer (one per student); internet access
Description: In this activity, students will research the story of an **inventor** and/or **entrepreneur** of their choice and prepare a report on that person.

1. Begin this lesson by reminding students of the list of values and the elevator pitch they developed for unit 1. Have each student write their top 3 values and their elevator pitch in their engineering design journal.

2. Have students list the characteristics/values necessary for the students to achieve their goals. Make sure students use personal examples they previously identified in their personal values and personalities.

3. Students will prepare a report to share with the class that identifies the **inventor** or **entrepreneur** and what characteristics made the individual successful. Students will explain the personal and career goals that the selected **inventor** or **entrepreneur** likely had/has and the leadership characteristics that made him/her successful.

4. Post the following questions for students to use when writing their report:
    - Did I identify my innovator or entrepreneur?
    - Did I identify the characteristics that made my innovator successful?

- Did I identify the personal and career goals of my innovator?
- Did I include the characteristics of leadership that made him/her successful?
- Did I share a list of obstacles my inventor likely overcame to be successful?

5. Students will also develop a list of issues or problems the selected **inventor** likely overcame in order to be successful. Students may use the following websites to research an **inventor** and/or **entrepreneur.**
    - Inc. Magazine
    - Black Enterprise Magazine
    - Success Magazine
    - Entrepreneur Magazine

Tip: *The teacher may post the questions students will answer in their reports.*
Accessibility Tip: *The teacher may want to provide students with shorter articles that have specific points from questions in step four highlighted.*

Formative assessment will be captured through the written research captured in the engineering design journal. All written research and information should be captured in the engineering design journal.

Day 3
Students will learn about past and present **inventors** or **entrepreneurs** by listening to student presentations. Students will discuss common characteristics (and potential differences) these **inventors** or **entrepreneurs** possess. Students will reflect on personal leadership strengths/characteristics and identify how they can use their strengths to accomplish their personal career goal.

1. Model a presentation of an **inventor** or **entrepreneur** After the presentation the teacher will ask:
    - Did I identify my inventor or entrepreneur?
    - Did I identify the characteristics that made my innovator successful?
    - Did I identify the personal and career goals of my innovator?
    - Did I include the characteristics of leadership that made him/her successful?
    - Did I share a list of obstacles my inventor or entrepreneur likely overcame to be successful?

2. Students will give their presentations and the listeners will record common characteristics of all innovators in their engineering design journal.

3. Lead a discussion on what characteristics the innovators had in common (and potential differences) and what obstacles they overcame to be successful.

4. Students will answer the following questions in their engineering design journal:
    - What are my leadership strengths/ characteristics, and how can I use those strengths to accomplish my personal career goal?
    - How are these characteristics like those of the **inventors** or **entrepreneurs** discussed?
    - What obstacles will I have to overcome to achieve my goals?

Formative assessment will be captured through class discussion, presentation of the research activity, and

reflection statements. All presentation notes and information should be captured in the engineering design journal.

Day 4: Students will discuss how **entrepreneurs** develop business concepts and create plans to deploy products and services. Students will use the engineering design process and think about how they could become an **inventor** or **entrepreneur**. Students will work in groups to develop an invention.

Activity: Questions, Questions, Questions!

Time Frame: 50 minutes class
Class Size: Groups of three
Materials: student's engineering design journals
Description: Students review the **engineering design process** and think about how they could become an **inventor** and **entrepreneur**. Students work in groups to develop an **invention**.

1. Provide a graphic organizer to help students apply the **engineering design process**. The graphic organizer is found in PT 3.1 Student Resources. Remind students that they used the same graphic organizer when they did the Build a Tower activity. (5 Min)

2. Have a student review what happens during the "Ask" phase. Then release students to define a problem that they would like to design an invention to solve as well as any possible constraints. Students should record the problem definition and constraints in their journals. (15 min)

3. When a few of the students seem to have a good problem, stop the group and ask groups to share. Remind them of the time remaining and try to keep groups on track. Have a student share what should happen during the "Imagine" phase so that they will be ready to continue. (5 Min)

4. Circulate and make sure the problem statement is clear before releasing student teams to start brainstorming solutions in the "Imagine" phase. **Remind students that all ideas are good ideas.**

5. During the "Imagine" phase, ensure that student groups are able to brainstorm solutions. Students should record textual and visual representations of ideas in their journals. (10 min)

6. During the "Plan" phase, ensure that student groups are able to determine how they will solve the problem. Students should brainstorm all of the steps they will need to take in order to solve their problem. Student groups should document the steps they would take to develop a solution to the problem. (15 min)

Tip: *This is an open-ended problem, which means there are limited constraints; two suggested constraints are that the product must be a new idea and must be something the student groups are interested in developing.*

Day 5: Students will develop a feedback model to vet their ideas through a list of questions and **market research.** Students will use feedback to improve the invention.

1. To begin the class, have some of the students share their progress. Review the five phases of the **engineering design process**. (5 min)

***Tip*:** *Teacher may wish to display a graphic organizer with the five phases of the engineering design process*

2. Students will take the list of steps and apply those to make sure they have addressed the five phases of the **engineering design process**. Remind students to make sure they have addressed each phase and recorded them in their student engineering journal. (15 min)

3. During the "Create" phase, ensure that student groups are working to identify what types of feedback student teams would need to ensure their problem and stated solution could be operational. Student teams should develop a list of questions they would need to ask potential clients to further improve the idea and take their product to market. (5 min) Asking potential clients questions to further improve an idea or produce is **market research.**

   The focus of this phase is questioning. Students will think about what information they would need from potential clients to make the **invention** better or produce the product. Remind sudents that the types of questions they develop will help to refine and create a new idea. The questions may not pop up immediately, but persistence in defining the right questions is important.

   Students will also discuss how they would collect answers to their stated questions to improve their **invention** and successful business ideas. Questions that could be in the **market research** include the following:

   - How could this product be improved?
   - In what ways are you (my customer) not being served?
   - Would this **invention** be useful to you? Why or why not?
   - Would you pay extra for this **invention?** How much?
   - How is the industry changing?

   Tip: *The teacher may wish to post the questions for students.*

4. During the "Improve" phase, pair student groups together to present their ideas and ask the stated questions. Student teams will take turns presenting their ideas and asking their questions. Student teams should record feedback in their engineering design journal. When complete, student teams will reconvene to reflect on the provided feedback. Student teams should document how their **invention** could be improved and revised. (25 min)

Formative assessment will be captured through class discussion and completion of the question activity. All written ideas and feedback should be captured in the students' engineering design journals.

Lesson Three: Solving Problems through Creativity

Day 1: Students will develop **creativity** skills and discuss ways in which **innovators** have used **creativity** to develop **innovations and inventions**. Students will work in teams of four to develop examples of possible innovations.

1. Introduce the lesson by sharing with students how problems can be solved simply by using common materials and a little **creativity**.

2. Have students share examples of everyday problems that have been solved using creativity. If students struggle, have them think about commercials for new products, improvements to travel, improvements to technology, improvements to food, etc.

3. Tell students that **creativity is** a skill that can be developed with practice and dedication. It's about solving problems and refusing to take no for an answer. The most **creative** people ignore what's widely accepted in favor of the unconventional. Some of the best ideas—cellphones, for example—were once considered too far-fetched to be considered seriously.

4. Explain to students that exercising their **creativity** should not be a chore. Sitting alone in a room, forcing oneself to come up with new ideas is unproductive. Remind students to let themselves be inspired and stimulated by the world around them. When students are in this phase, it is important not to limit their thinking to what they think is possible. To inspire new ideas, many innovators force themselves to think outside the box.

5. Divide students into groups of four and lead them through developing examples from each of the following categories: Each category should take about ten minutes. Students are to write their ideas in the engineering design journal.

    - Mix and Match
        - Can you think of any two products that could be brought together for the first time to create a new one?
        - Don't be afraid to get unconventional. Walk down the aisle of your favorite store and ideas abound. For example, the decision to combine a flashlight and a screwdriver was ingenious because the innovation made it possible to work in dark areas without a flashlight. Just think what our cell phones would be like without a camera?
    - Solve It
        - Tune into the world around you and question everything. How could things be better?
        - Listen to the complaints of your friends and family. What difficulties do they encounter in daily life? What annoys you in your daily life? Identify problems and start brainstorming solutions. Many **entrepreneurs** and **inventors** work this way.
    - What If?
        - What if you could listen to music while swimming? What if you could throw a

football three times the length you can now?
- Don't be afraid to let your mind wander and dream. What do you really wish were possible? For example: "What if I could track how and when children grow?" Instead of pencil markings on a wall, the student designed a magnetic height chart for the fridge.

6. Have each group share their most creative idea.

7. Tell students the more they exercise **creativity**, the easier it will be to regularly create new products and services that improve people's lives. Introduce the catapult activity.

Formative assessment will be captured through class discussion. All written research and information should be captured in the students' engineering design journals.

Day 2: Students will apply the **engineering design process** to develop an **invention** or **innovation** that solves a problem and will work in teams to apply **creativity** and peer iteration to the solution. Students will document the **engineering design process** in their engineering design journal and develop reflection statements on the experience.

Take 5 minutes to introduce the lesson and tell students that they will practice their creativity skills while using the engineering design process to develop a catapult. Briefly have students name the steps in the **engineering design process**. Remind them that the best solutions come from using their creativity.

Tip: *Teacher may wish to establish one or more ways that catapults can be successful (e.g., distance, accuracy). This may be discussed as a class prior to the start of the project so that students may help define the problem.*

Activity: Build a Catapult

Time Frame: 45 minutes
Class Size: groups of two
Materials: pompom ball, paper towel rolls, rubber bands, spoons, tape, cardboard (can be adapted using common classroom resources as the teacher sees fit—craft sticks and tape, binder clips, etc.)
Description: Students will work in teams to build a catapult using the steps of the engineering design process. This activity was adapted from Engineering on a Dime: 3 STEM Challenges You Can Do Today

1. Group students into teams of two. Tell students they will record the process in their engineering journals.

2. Show the selected materials to the class and announce that teams will be using the **engineering design process** to create a catapult. Explain constraints to the project (students may only use the provided materials, only 20 minutes will be provided to design the initial catapult, all activities should be recorded in each student's engineering design journal). Let them know that the class will determine which team created the best catapult at the end of the activity. Provide a graphic organizer to help

students apply the **engineering design process**.

3. During the "Ask" phase, ensure that student groups are able to define the problem as well as any constraints. Students should record the problem definition and constraints in their journals.

4. During the "Imagine" phase, ensure that student groups are able to brainstorm solutions. Both text and visuals should be recorded in journals.

5. During the "Plan" phase, ensure that student groups are able to determine how they will create the catapult and recording the project plans in their journals. This phase of the process must be completed before students begin work on the next phase.

6. During the "Create" phase, ensure that student groups are working to create the catapult and recording feedback and iterations in their journals. (Did their design change during construction? Any ongoing discussion about how their proposed solution is functioning?)

7. After the "Create" phase is complete, student groups will determine how they will test the catapult. Each team should develop criteria for the evaluation and how information will be captured to improve their catapult design. This phase of the process must be complete before students begin to test their catapults.

8. During the "Improve" phase, ensure that student groups are testing their design and reflecting on it. The catapult should be improved during this phase. Students should record reflections in their journals and whether the group improved their design or generated new ideas.

9. After the "Improve" phase is complete, student groups should reflect on the following questions:
    - Was the team design functional? Why or why not?
    - What would the team change about the design?
    - How closely did the team follow the planning process?
    - How did the team use ongoing feedback during the "create" phase of the project?

Formative assessment will be captured through class discussion and completion of the catapult activity. All written research and information should be captured in the students' engineering design journals.

Lesson Four: Innovation and Entrepreneurship at Work

Day 1: Students will be introduced again to the performance task and provided time to ask clarifying questions. Students will form groups to discuss the project guidelines and the performance task rubric. After they determine roles and responsibilities, groups will review the team contract that they previously created in the unit. Students will conduct research on careers in culinary and hospitality management and learn about **entrepreneurs** in this occupational sector. Students will be able to identify three or more possible careers in the culinary and hospitality industry and discuss the skills necessary for these careers.

Begin the class by telling students that for the next few weeks they will be using the tools they have learned to design a food truck. To begin to build background knowledge, show the video "History of Food Trucks" by the History Channel and or review the History of Food Trucks PowerPoint.

Activity: History of Food Trucks

Time Frame: 45 minutes
Class Size: small groups, individual
Materials: History of Food Trucks Venn diagram activity sheet
Description: Students will use the information they gained from the video and PowerPoint to compare Food Trucks then and now.

1. Have students complete the Venn diagram activity on the History of Food Trucks and compare answers with a peer. Explain that they will share responses with the class and discuss what motivated changes (technology, etc.) and why some things remained the same. (10 min)

2. Review the PT 3.1 Student Resource task overview page 1 and rubric and provide time for students to ask questions.

3. Have students meet with their teams and review their team contract that they previously established.

4. Have students research the culinary and hospitality industry independently by reviewing various company and organization websites. Students will identify three or more occupations in the culinary and hospitality industry and provide the skills necessary to be successful in that occupation. Students should record the following information in their engineering design journal.
    - Company profiles: including the name of the company, specific products, and target audience.
    - Occupations and details: including training required, job outlook, potential entry salary, and growth options for the profession.

5. The teacher should circulate and find one or two common websites and lead the class in brainstorming a list of jobs that might be available at that company and the skills they require.

6. Students should present occupational research to the class and discuss potential career pathways that are available for students who are interested in pursuing a career in the culinary or hospitality field.

To formatively assess whether students are aware of career in the culinary and hospitality industry, have each student complete an exit ticket with the following statements: Three occupations in the culinary and hospitality industry are 1_____, 2 _____, and 3. _____Provide one/two sentences about each career and the occupation skills of its employees.

Day 2: Students will review and discuss the **business plan** template in PT 3.1. Student teams will apply the **engineering design process** to identify the stated problem and constraints. Student teams will imagine and brainstorm solutions to a problem and conduct research on restaurants and hospitality groups in their local

or regional communities and use a decision matrix to evaluate ideas.

1. Review the decision matrix and talk about how they used it in Unit 2 of *Quest for Success* to select a company website to review and redesign.

2. Review PT 3.1 and discuss the **business plan** template. Review the **engineering design process** to help frame PT 3.1 and students' roles and responsibilities. Explain that student teams will apply the **engineering design process** to complete PT 3.1.

3. Have teams review PT 3.1 to identify the stated problem and constraints. Student teams will record information in their engineering design journal.

4. Have teams imagine and brainstorm solutions to the problem.

5. Student teams will conduct research on restaurants in their local or regional communities. Teams will review menus and promotion concepts from local businesses on sites such as Yelp. Students will record promotion concepts and menu ideas they might want to use for their food truck.

6. Students may use a decision matrix (used in *Quest for Success* Unit 2) to evaluate their food truck ideas. Student teams will record information in their engineering design journal.

7. Provide assistance to student teams as needed. During group work, check to ensure student ideas and reflections are captured in the journal.

As a formative assessment measure, students will document the **engineering design process** in their engineering journal and develop reflection statements for the act and imagine phases.

Day 3: Students will reflect on a video and discuss progress made on PT 3.1. Teams will begin to develop their food truck project and **business plan**. Student teams will update the **project schedule** template for the food truck project schedule to ensure that all team members have active roles and responsibilities to execute the project.

1. Show The Great Food Truck Race and ask students to reflect on the video and review their work on the act and imagine phases of the **engineering design process** with their teams.
   The following questions may be used for student reflection:
   - What made the food trucks successful or not successful?
   - What factors influenced the success of the food truck team?
   - What factors influenced customer satisfaction with the food truck?
   - How was success determined for each food truck?

2. Have teams review the list of expectations for PT 3.1 and the **business plan** template. Student teams will begin to develop their food truck project and **business plan**.

3. Ask teams to update **project schedules** for the food truck project to ensure that all team members have active roles and responsibilities to execute the project. Remind students of available tools to help with developing a project schedule.

The teacher will provide assistance to student teams as needed. During group work the teacher should check to ensure student ideas and reflections are captured in the journal.

As a formative assessment measure, students will document the **engineering design process** in their engineering journal. Students will reflect and answer how can my team use the plan phase of the engineering design process to ensure successful project completion?

Day 4: Student teams will meet to review their **project schedule** for the food truck project. Student teams should discuss how they know that they are on-track for project completion by the deadline. Student teams will use the remaining class time to finalize their plan for the food truck project and begin to develop the food truck concept and menu. The teacher should provide support to student teams. Students will document the **engineering design process** in their engineering journal and develop reflection statements for the create phase.

1. Teacher should tell student teams to meet and review their **project schedule** template for the food truck project. Direct teams to discuss how they are ensuring that they are on-track for project completion by the deadline.

2. The teacher should remind students to discuss how they will work together to make sure the team is on-track to complete the project. The teacher may want to have students review their team contract.

3. Student teams will use the remaining class time to finalize their plan for the food truck project and begin to develop the food truck concept and menu (i.e. create phase).

The teacher will provide assistance to student teams as needed. During group work the teacher should check to ensure student ideas and reflections are captured in the journal.

As a formative assessment measure, students will document the **engineering design process** in their engineering journal and develop reflection statements for the create phase.

Days 5: The teacher should review **project schedules** and remind student teams may choose to continue to refine their project tools. Student teams should use a **project schedule** to manage group time and execute tasks associated with the project.

Student teams will complete their food truck concept, menu, and **prototype.** Students will design their food truck menu on a computer.

Activity: Menu

Time Frame: 40 minutes
Class Size: Food truck teams
Materials: 8 X 11 paper, computers,
Description: Students will develop a menu for their food truck. Students will give and receive feedback on menu designs.

1. To encourage students to thinking creatively, share the Unique Food Truck Menu PowerPoint showing pictures of food truck menus (15 minutes). As you review the PowerPoint, have students name what is unique about each menu. Students will develop a list similar to the list below.

Food Truck Menu Tricks & Tips

- *The menu is main way you have to market your Food Tuck/ The menu tells your customers who you are and is one of the major ways you show your personality.*
- *Your menu should highlight your best-selling or most unique items. Make sure your eyes are drawn to these items on your menu.*
- *To draw in customers, make sure to add color, images, labels and logos to your menu.*
- *Use attractive, creative descriptions of the ingredients to the dishes. This will make customers want to try your items.*
- *Make sure your food is affordable. What kind of food truck are you going to have? What is the name? What details make sense for food items? Does the menu do more than just name your food items? What kinds of names are used? What colors belong on the menu? How do the colors relate to the other parts of the menu?*

2. Give students the following guidelines for their menu:
    - 4-8 menu items (does not include drinks etc.)
    - Include prices
    - Create appealing, short descriptions of each dish
    - Does your menu have a name?
    - Provide pictures

4. Circulate and encourage student teams to be creative and uses the Tricks and Tips to ask teams questions about their menu.

5. Ask student teams to print and post their menus around the room for inspiration and motivation for other student groups.

6. Organize a gallery walk of student menus for other student teams to provide feedback to groups.

7. Students will record feedback on post-it notes for other student teams.

If students complete their menu, they may work in their teams to begin the design of their food truck and its interior design.

As a formative assessment measure, the teacher should review student menus and feedback.

Day 6: Student teams will complete their food truck concept and prototype. The teacher should provide support to student teams. Students will document the engineering design process in their engineering journal and develop reflection statements for the create phase.

Activity: Food Truck Concept

Time Frame: 50 minutes
Class Size: Food truck teams
Materials: 8x11 piece of paper for each team**,** Inside a Food Truck PPT
Description: Students will create a list of appliances they will need in their food truck. Students will then design the inside of a 16x30 foot food truck on an 8x11 sheet of paper.

1. Teacher will begin the class by showing this 2 minute video from History Channel "Inside a Food Truck"

2. Go through the Inside a Food Truck PowerPoint slides, showing pictures of the inside of a food truck and floor plans.
    - With each slide, have a discussion about what types of appliances are inside the food truck.

3. Give students three minutes to do their best to think of everything they would need inside their food truck. Examples of things to consider:
    - Placement of the food service window?
    - What type of food will be served?
    - What appliances are needed? An oven? Freezer? Refrigerator?
    - How much area is needed for food preparation?

4. Students will record their thinking in their engineering design journal. Students will begin to understand the design of the interior is directly linked to the food they are serving.

5. Students will use the menu they designed, along with the equipment list needed to serve the food. Students will write down each piece of equipment they need to include on their future truck. This could include a refrigerator, deep fryer, freezer, heat lamp, and storage space to list a few of the basics.

6. After the list of equipment is created, the next part will be to determine how much space is needed. Students will need to research the specifics of each piece of equipment they want to put into the truck and design a layout of where each piece of equipment is to be placed. (Like the floor plans from the PowerPoint.) An average food truck is around 16 feet long but could be up to 30 feet long. It all depends on what size truck.

    Interior Design Tricks and Tips
    - Ergonomics (people's efficiency in the working space) is the number one consideration in the design of kitchen space.
    - The kitchen should be designed for maximum labor efficiency, safety, and functionality.
    - Ensure that there is enough room to move around when carrying supplies and dishes.
    - When the set up helps your employees to decrease extra movement and not waste time, efficiency is increased, and fatigue and workplace injuries are reduced.

7. Students will use the piece of 8x11 paper and design the inside of their food truck.

As a formative assessment teachers will review lists of equipment from their engineering design journal. Teachers should also review floor plan.

Day 7: Students will understand the use of a **Request for Proposal (RFP)** when operating a food truck and will design a **prototype** of their food truck using common classroom/household materials.

The teacher will explain that there is a legal document that is used to purchase or procure goods or services from potential vendors called a **Request for Proposal (RFP).** An entrepreneur would potentially respond to an RFP to operate the food truck in a certain location or for a certain festival or event. Sample food truck RFPs can be found here:

- Scenic Hudson Food Truck RFP
- City of Langley Food Truck RFP
- Greenway Conservancy Food Truck RFP
- Tangletown Neighborhood Food Truck RFP

As the samples demonstrate, the RFP usually contain an overview of the project, timeline for completion, deadline for submission, available funding, and budget period. The teacher will review one of the sample RFPs with the class. Have the students identify the overview, deadline for submission, costs, and evaluation process in the RFP. Ask the students that if they were to submit an application for the RFP what aspects (costs, variety, etc.) of their food truck would they include or highlight in their proposal.

Activity: Food Truck Prototype

Time Frame: 45 minutes
Class Size: Any size
Materials: Creative and Unique Food Trucks PPT, The Great Food Truck Race, cereal boxes, shoe boxes, soda bottles, Styrofoam cups, construction paper, glue, tape, scissors.
Description: Students will view and discuss Creative and Unique Food Trucks. Students will then use ordinary household items to build a prototype of their food truck.

1. Share with students the Creative and Unique Food Trucks PPT, ask them to vote for their favorite food truck, and explain why their selection is their favorite.

2. Student teams will begin to think about the design of their own food truck. Student teams may chose to re-watch The Great Food Truck Race video clip or research food truck concepts and models to think about the design of their **prototype**.

3. Have the students brainstorm on how they would design their own food truck. Students will work with their team to design a model of their food truck. Remind students to be **creative**! Provide a variety of materials for students to work with to develop their **prototypes**. Examples include the following:
    - Cereal boxes
    - Shoe boxes
    - Soda bottles
    - Styrofoam cups
    - Construction paper

- Glue
- Tape

4. Provide assistance to student teams as needed. During group work, check to ensure student ideas and reflections are captured in the engineering design journal.

As a formative assessment measure, students will document the **engineering design process** in their engineering journal and develop reflection statements for the create phase.

Days 8 and 9: Student teams will read and discuss the LinkedIn article How Entrepreneurs are Making Big Bucks with Food Trucks. The teacher and students should review their **project schedules**. Student teams may choose to review and revise their **project schedule**. Student teams will complete their food truck concept, menu, and **prototype** as well as the **business plan** template. As the **business plan** template is complete, student teams should be vetting the food truck concept and menu with their potential clients (their classmates), conducting **market research,** and iterating on the idea and concept (i.e. improve phase of the **engineering design process**). The teacher should provide support to student teams. Students will document the **engineering design process** in their engineering journal and develop reflection statements for the create and improve phases.

Activity: Say Something

Time Frame: 40 minutes
Class Size: Groups of three-four/whole class discussion
Materials: How Entrepreneurs are Making Big Bucks with Food Trucks.
Description: Students will use the *Say Something Protocol* to discuss the article *How Entrepreneurs are Making Big Bucks with Food Trucks*.

1. To introduce the next two days, students will read and discuss the article, *How Entrepreneurs are Making Big Bucks with Food Trucks* by using the Say Something Protocol in order to prepare for developing their business plan.

2. Follow the steps of the protocol as outlined in the linked document.

3. To focus the group interactions, or to stimulate a specific type of thinking, the teacher may want to provide a stem for completion. (For example, "a question that comes to mind when I read this is…")

Tip: *It is effective for the teacher to post a public timer displaying the full-time allotment for the discussion, so teams can determine how long to converse, and how quickly to move on to the next section of the reading.*

Activity: Creating a Business Plan

Time Frame: 50 minutes
Class Size: varies
Materials: computers to create the business plan
Description: Students will work with their teams to research and create a **business plan** which should include the following. These details are also found in PT 3.1 Student Resource.

1. Cover Page: includes company name and logo

2. Introduction/Overview (half page): includes an introduction to your company and idea, what products you sell, target audience/market, and the location of your food truck

3. Company vision and mission statement (two paragraphs/sentences): includes a targeted mission statement and vision statement (could include reason why people will shop at your food truck, e.g. fresh food, best smoothies, etc.

4. Company goals and objectives (two paragraphs): lists your company's short- and long-term goals and strategies to accomplish your goals

5. Financial Overview (half page): discusses your company's menu, types of products and services (catering, delivery, retail, etc.), price of products and services, and expected daily, monthly, and annual revenue

6. Marketing Overview (half page) discusses how you will market your products and services (e.g. flyers, social media, etc.), promotional ideas (e.g. coupons, specials, etc.), and defines your marketing strategy (e.g. specific food, location, gimmick, etc.)

7. Operational Overview (half page): discusses any legal or government issues in your city or state, policies for customers, hours of operation and schedule, and location pattern for clients

8. Conclusion Statement (two paragraphs): paraphrases why your food truck and company will be successful and identifies the strengths of your company

Note: Lesson adapted from CTE Online: Project Planner
https://www.cteonline.org/curriculum/project/design-and-create-a-food-truck-pbl-project/7PJ2wk#node/1

The teacher will provide assistance to student teams as needed. During group work, the teacher should check to ensure student ideas and reflections are captured in the journal.

As a formative assessment measure, students will document the **engineering design process** in their engineering journal and develop reflection statements for the improve phase.

Day 10: Student teams will complete their food truck concept, menu, and the **business plan**. Student teams will develop a group presentation that presents their **business plan** and related products. Student teams will complete their group presentation and determine roles and responsibilities for giving the presentation.

1. Student teams will complete their food truck project and the **business plan**.

2. Student teams will develop their team presentation outlining their **business plan** and associated documents and/or evidence in each section, e.g. food truck concept, menu, and prototype.

3. Student teams will determine the roles and responsibilities of team members during the presentation.

4. Student teams will rehearse their presentation and draw for an order of presentation.

Day 11: Students will present their **business plans** to another class or members of the culinary and hospitality industry.

1. Student teams will give their presentation to another class or to members of the culinary and hospitality industry.

2. Students will reflect on their project and complete the **project evaluation** (PT 3.1 Student Resources).

3. The teacher will complete a teacher rubric for each student.

Website Links Referenced in Unit 3

- http://www.readwritethink.org/classroom-resources/lesson-plans/internalization-vocabulary-through-word-307.html
- https://www.engageny.org/resource/grades-3-8-ela-curriculum-appendix-1-protocols-and-resources
- http://learningtasks.weebly.com/vocabulary-strategies.html
- https://k12.thoughtfullearning.com/blogpost/12-vocabulary-activities-high-school
- http://www.readingrockets.org/content/pdfs/World_Walls_A_Support_for_Literacy_in_Secondary_School_Classrooms.pdf
- https://www.readingandwritinghaven.com/5-brain-based-vocabulary-activities-for-the-secondary-classroom/
- http://neatsweetandhardtobeat.blogspot.com/2015/04/stem-earth-day.html
- https://www.cteonline.org/curriculum/project/design-and-create-a-food-truck-pbl-project/7PJ2wk#home
- https://www.eie.org/overview/engineering-design-process
- https://deseng.ryerson.ca/dokuwiki/design:design_journal
- https://www.sciencebuddies.org/science-fair-projects/science-fair/laboratory-notebooks-stem
- https://minds-in-bloom.com/engineering-on-dime-3-stem-challenges/
- https://www.nyu.edu/faculty/teaching-and-learning-resources/strategies-for-teaching-with-tech/best-practices-active-learning/active-learning-techniques/techniques-1.html
- https://designshack.net/articles/business-articles/10-tips-for-effective-creative-brainstorming/
- https://k12teacherstaffdevelopment.com/tlb/how-can-i-facilitate-brainstorming-in-the-classroom/
- https://opentextbc.ca/projectmanagement/chapter/chapter-8-overview-of-project-planning-project-management/
- https://www.projectmanager.com/blog/create-project-management-schedule
- https://www.inc.com/magazine
- https://www.blackenterprise.com/
- https://www.success.com/
- https://www.entrepreneur.com/
- https://www.cteonline.org/resources/view/71986
- https://www.cteonline.org/resources/view/71860
- https://www.cteonline.org/resources/view/71860
- https://www.cteonline.org/resources/view/72046
- https://www.history.com/shows/modern-marvels/videos/history-of-food-trucks
- https://www.cteonline.org/resources/view/71415
- https://www.foodnetwork.com/shows/the-great-food-truck-race/videos/season-3-highlights#item-0193983
- https://www.linkedin.com/pulse/how-entrepreneurs-making-big-bucks-food-trucks-richard-santoro/
- https://www.moboces.org/UserFiles/Servers/Server_917767/File/Programs%20&%20Services/Professional%20Development/PBL/22%20Say%20Something.pdf

Appendix A

Notes and discussion points on entrepreneurship

- An **entrepreneur** has many motives, but even if the goal is simply to maximize profits, they benefit society as a whole by
  - developing new and improved products,
  - developing more efficient methods of production,
  - tapping new markets,
  - finding new and improved sources of supply, and
  - discovering better methods of organization.
- In a competitive economy, there are only a few fleeting opportunities to earn high profits. **Entrepreneurs** and businesses will quickly enter markets where profits are high which increases the supply, decreases prices, and drives down profits to the normal rate.
- **Entrepreneurs** markets are dynamic, not static. Entrepreneurs respond to profit opportunities, which continually moves economic resources to their highest value. The competition for workers drives up their wages.
- **Entrepreneurs** often try to stifle competition. Because monopolies are hard to achieve, **entrepreneurs** may ask the government to develop barriers for other to enter and this keeps out potential competitors. Government has historically adopted many policies to encourage competition, but has also undercut these policies in important ways.
- Due to cultural norms and economic incentives, the U.S. economy has a strong record of **entrepreneurship**. Successful **entrepreneurs** are men and women of every race, ethnic group, social and educational background.

Students will understand to become a successful **entrepreneur** they must think like an **inventor**.

Notes and discussion points on thinking like an engineer.

- The **engineering design process** is a series of steps that engineers and/or **innovators** can apply to develop a solution to a problem; the five steps of the engineering process developed by Engineering Is Elementary are 1) Ask, 2) Imagine, 3) Plan, 4) Create, and 5) Improve.
- Ask Phase: Start with the customer or end user
  - The customer is your first and most important **creative** challenge. Listen to your potential customers to better understand their needs, problems, and desires. Pay attention to their point of view.
  - Define clearly the problem and then the customers' stated needs. Define constraints and seek consensus across a variety of stakeholders.
  - Once the problem is defined, determine what special methods or processes are presently used to solve them. Work with the end user or customer.
  - It can be helpful to use fictitious product descriptions to stimulate ideas and discussion.
  - Remember that effective **market research** and sales strategy requires just as much **creativity**, enthusiasm, and perfection as product development.
- Ask Phase: Importance of asking the right question

  - The problem can be difficult to define without understanding what motivates your customer. Persist to define the true problem. Always restate the problem in as many ways as you can to see if the customer changes his or her response. Change the wording and take different viewpoints; using multiple depictions like a sentence or graphic can be helpful to get a variety of responses.
  - Describe the problem to laymen and also to experts in the fields. Stay active in the research and don't let initial feedback or surface-level details influence your work. Make sure you understand the problem and motivation before deciding on an approach.
  - Approach the problem from different directions. Often new insights come from transforming one problem into another or studying the inverse problem.
- Imagine Phase: Getting good ideas from everyone and everywhere
  - Look at all possible sources of good ideas: your customers, your competition, your peers, research, and related **patents** or approaches. Use similar examples others have developed to source new ideas. Examples can help to both to illustrate what you're talking about and encourage improvements to your ideas.
  - **Inventions** and **innovations** are often the result of outside influences. Innovators work with top performers in related field and take the relevant tools.
- Imagine Phase: Search for multiple solutions
  - "Nothing is more dangerous than an idea when it is the only one we have" (Alain). The first solution is usually not the optimum. There is usually more than one acceptable solution.
  - Suspend judgement and criticism when first collecting ideas. Studying multiple problems jointly often generates unique solutions. Look for solutions by using combinations of ideas from different or evolving technologies.
  - Even if you have one optimum solution, it may be necessary to get **patent** coverage for all other effective solutions so as to protect your market.
- Imagine Phase: Brainstorming
  - In the initial phase of a brainstorming session, participants are encouraged to suggest any idea that comes to their minds. During this initial phase it is a firm rule that none of the participants can criticize or react negatively to any of the ideas that are proposed.
  - Although a given idea may not be new to some, it will be new to others and provoke new ideas from the group as a whole. The point is to think of as many new ideas as possible and provoke everyone in the group to think **creatively**.
  - Once brainstorming is complete, tools can be used to help critique ideas—selecting, improving, modifying, and combining them to produce the final working solution. Encourage examination of the problem statement itself.
- Plan Phase: Choosing the right idea
  - One solution is not always the best method to follow. Multiple solutions can be developed simultaneously, and feedback can be sought on more than one idea to develop the final concept.
  - Tools like a decision matrix can be used to select ideas and cross reference ideas with identified criteria and constraints.
- Plan Phase: Developing a project plan
  - A project plan is a way to operationalize and idea. Refer to the five-step project management cycle as a model to help students understand the planning phase.
  - Tools like a project schedule, performance management plan, risk log, and evaluation can influence the plan phase of the engineering design process.

- Create Phase: Develop a working model and **prototype**
  - Models can be developed that are mathematical or physical. Mathematical models are representations of a product or the design or a project. A typical mathematical model is a computer generation of an idea. Physical models are actual representations of the solution, but they do not typically function.
  - A **prototype** is a working model of the solution that typically functions and appears like the proposed solution.
- Improve Phase: Value of experimentation and persistence
  - Experimentation is the ability to evaluate the identified solution. This can include testing the physical model or seeking feedback from potential clients using a mathematical model. The ability to design, seek feedback, and iterate on potential solutions is essential to developing **inventions** or **innovations**.
  - Failure may occur as a result of experimentation. The ability to fail frequently will help to refine the problem and develop a solution. If you don't fail frequently you aren't trying hard enough and you may be missing a lot of good opportunities. As Edison said, "genius is one percent inspiration and 99 percent perspiration."
  - Persistence is the ability to continue to solve a problem even after you have failed and/or not received positive feedback. Be stubborn about solving a problem, but be flexible about the definition of the problem and open minded about the form of the solution.
- Improve Phase: Understand the product market
  - Once a final solution has been established, there are additional factors that can be applied to further refine the solution. The cost to develop the product, the value of the product in the market, and the product lifecycle or how durable the product is are things that **inventors** and **entrepreneurs** study once they have a solution to a problem.
  - Remember that **entrepreneurs** are driven by impact and profit. Review potential solutions and products based on how they will influence the market, how they have an impact on the consumer, and how to increase profit margin or how much money a product will likely generate.
- The **engineering design process** is captured as an ongoing process through **patent** and project notebooks, which are sometimes called engineering design journals
  - **Patent** notebooks or engineering design journals can have many useful functions but they are primarily are used to provide legal protection for i**nventions**.
  - Project planning: document of progress towards a solution can serve to record, remind, and document ideas as a means of ensuring project continuity and a way to communicate with yourself and within a project group.
  - Reflection planning: clarity and conformance to legal standards is critical, as is reflecting on ideas and progress. Things that should be recorded for reflection include sources of inspiration, ongoing questions, early successes, and early failures. Reflection should also be ongoing and follow a specific timeline. For this unit students will reflect in their engineering design journal daily following their progress on performance tasks.
- Effective use of notes
  - Notes can include text and graphics (diagrams, flow charts, block diagrams, elementary circuits). Keep notes that are simple and ongoing. Do not erase old ideas, continue to iterate. Write in pen. If an idea or word is incorrect, simply cross out the idea using a single line. It is important that incorrect ideas still be visible. Learning from past mistakes is important throughout the process.
  - Mark ideas and questions in a way that makes them obvious and/or searchable. Remember that using an engineering design journal is about process documentation.

All ideas are good ideas, until they are not. And you can learn from mistakes. Richard Feynman, a Nobel Laureate physicist, believed in getting his hands dirty and doing lots of experiments, saying "to develop working ideas efficiently, I try to fail as fast as I can."

- Visual representations of the **engineering design process**
  - STEM Earth Day
  - Engineering Design Process Worksheet
- Examples of engineering journals
  - Design Journal
  - STEM Lab Notebooks

Appendix B

Inventors and Entrepreneurs

1. Ralph Baer- Inventor of the video game console
2. Dr. Patricia Bath- Inventor of laser eye surgery
3. Alexander Graham Bell- Inventor of the telephone
4. Karl Benz- Inventor of the gas-powered automobile
5. Tim Bernes-Lee- Inventor of the World Wide Web
6. Laszlo Jozsef Biro- Journalist who invented the ball point pen
7. Sarah Blakely- Founder of SPANX
8. Marie Van Brittan Brown- Inventor of the original closed-circuit security system
9. George Washington Carver- Inventor of an important agricultural planting technique and numerous uses for the peanut
10. Ole Kirk Christiansen- Inventor of the Lego
11. Mark Dean- Coinvented the personal computer
12. Leonardo di Vinci- Invented multiple things including the helicopter, tank, and parachute
13. Thomas Edison- Considered by many to be America's greatest inventor
14. Arthur Fry- Inventor of Post-It notes
15. Lori Greiner- Inventor and entrepreneur of many products; current member of Shark Tank panel
16. Johann Gutenberg- Inventor of the printing press
17. Ruth Handler- Entrepreneur and inventor of the Barbie doll
18. Kazuo Hashimoto- Inventor of the answering machine and Caller ID
19. Alec John Jeffreys- Invented and developed the techniques used in DNA fingerprinting and profiling
20. Steve Jobs- Inventor of a range of computer technologies and founder of Apple, Inc. and Pixar
21. Lonnie Johnson- Inventor of the Super Soaker water-gun
22. Whitcomb Judson- Inventor of the zipper
23. Beyonce Knowles- Cofounder of an apparel and accessary company
24. Stephanie Kwolek- Inventor of Kevlar
25. Dr. Domingo Liotta- Invented the first artificial heart to be successfully transplanted into a human
26. Annie Malone- Inventor of African American cosmetic products
27. George de Mestral- Inventor of Velcro
28. Garrett Morgan- Inventor of the first gas mask and three signal traffic-signal
29. James Naismith- Inventor of basketball and the football helmet
30. Alfred Nobel- Inventor of dynamite
31. Julio C. Palmaz- Inventor of the balloon expandable stent used to treat heart disease
32. John Pemberton- Inventor of the recipe for Coca Cola
33. Wilhelm Conrad Rontgen- Inventor of the x-ray machine
34. Percy Spencer- Inventor of the microwave oven
35. Sofia Vergara- Actress and a cofounder of a Latin American talent management and media company
36. Cher Wang- Cofounder of HTC, a manufacturer of smartphones and virtual reality products
37. Madame C.J. Walker- Entrepreneur who invented hair products specially made for African Americans
38. James E. West- Inventor of the compact microphone used in a variety of products
39. Eli Whitney- Inventor of the cotton gin
40. Oprah Winfrey- Actress, media personality and founder of the OWN network