### Enduring Understandings / Big Ideas:

Invention and Innovation are creative ways of turning ideas into real things.

### Essential Questions:

How have inventors turned their ideas into realities? Can anyone be an inventor or innovator?

### Learning Competencies - What the students will know and be able to do upon completion of the unit

<table>
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<tr>
<th>Supporting Learning Activities</th>
<th>Assessments</th>
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<th>PDE Academic Standards</th>
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</table>
| **Teaching Strategies** - Large Group Demos  
  Large Group Instruction  
  Small Group Instruction  
  Individualized Instruction  
  Multimedia Presentations  
  Journal Writing  
  Hands-On Activities  
  Cooperative Learning | **Formative:** Check for understanding questions will be utilized during large group instruction.  
  Students will be asked open-ended questions during small group and individualized instruction to check for understanding.  
  Students will demonstrate proper use of tools and design concepts while completing design challenges.  
  Students will complete journal entries. Electronic and paper journal entries will be evaluated and assessed.* | **Teacher Resources:**  
  Engineering by Design Curriculum: Invention and Innovation  
  Teacher generated instructional materials  
  Tech lab equipment, tools and materials.  
  Software Applications:  
  - Microsoft Office  
  - Adobe Acrobat  
  - Auto CAD  
  - Google Sketchup  
  **Student Resources:**  
  - Tech Lab Tools and Equipment  
  - Computer Network  
  - Student workstations  
  - MS Software  
  - Design Tools  
  - Calculators  
  - Internet Access  
  - Research  
  - Instructor’s Website  
  **Supplemental Resources:** | **Science Technology Engineering**  
  3.2.7.B1  
  3.2.7.B2  
  3.4.7.A1  
  3.4.7.A2  
  3.4.7.A3  
  3.4.7.B1  
  3.4.7.B2  
  3.4.7.B3  
  3.4.7.B4  
  3.4.7.C1  
  3.4.7.C2  
  3.4.7.D1  
  3.4.7.D2  
  3.4.7.E3  
  3.4.7.E5  
  **Mathematics**  
  2.1.7 B  
  2.1.7 C  
  2.2.7 B  
  2.2.7 C  
  2.3.7.A  
  2.3.7.C  
  2.3.7.E  
  2.3.7.F |

### Supportive Learning Activities

- **Teaching Strategies**
  - Large Group Demos  
  - Large Group Instruction  
  - Small Group Instruction  
  - Individualized Instruction  
  - Multimedia Presentations  
  - Journal Writing  
  - Hands-On Activities  
  - Cooperative Learning

- **Learning Activities – Journal Entries**
  - Students will complete Engineering Journal Entries.
  - Electronic journals will be utilized during lessons and design activities.*

- **Design Challenges**
  - Students will complete the Jellybean Dispenser Design Challenge.
  - Students will complete the Hovercraft Design Challenge.
<table>
<thead>
<tr>
<th>Students will conduct research for scientific, mathematic and historic information relevant to inventions and innovations of the past and their design challenges.</th>
<th>Students will complete final Jellybean Dispenser drawings using Auto CAD.* Students will complete final Hovercraft drawings using Auto CAD.*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Career Exploration</strong> Students will review, reflect, and write about careers related to engineering and transportation technology systems.</td>
<td><strong>Summative:</strong> Students will complete the Jellybean Dispenser Design Challenge for final evaluation. Students will complete the Hovercraft Design Challenge for final evaluation. Students will complete a set of drawings for each design challenge.</td>
</tr>
<tr>
<td><strong>Test</strong> Students will complete a post test.</td>
<td><strong>Self Evaluation</strong> Students will complete a self evaluation form at the end of the unit.</td>
</tr>
</tbody>
</table>
| [All activities are structured to work within each student’s “zone of proximal development” in English Language Acquisition] | **Reading, Writing, Speaking, Listening**
| 1.1.8D 1.1.8F 1.1.8G 1.2.8A 1.3.8F 1.4.8B 1.5.8F 1.6.8A 1.6.8C 1.6.8D 1.6.8E 1.6.8F 1.8.8B |
| **ELL:**
http://www.cal.org/siop: Fifty Strategies for Teaching; English Language Learners, 2nd edition; Adrienne Herrell, Michael Jordan; (Merrill/Prentice Hall, 2003) | **Career Education**
1.3.1.8A 1.3.1.8B |
| **Common Core Standards**
<p>| ELA 1.2.7.L ELA 1.4.7.F ELA 1.4.7.L ELA 1.4.7.R ELA1.4.7.U ELA 1.4.7.V ELA 1.4.7.X ELA 1.5.7.A |</p>
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<tr>
<th>ELA 1.5.7.F</th>
<th>Student Interpersonal Skills</th>
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<td>16.1.8.B</td>
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<td>16.1.8.C</td>
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<td>16.1.8.D</td>
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<td>16.2.8.C</td>
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<td>16.2.8.D</td>
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<td></td>
<td>16.3.8.A</td>
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<td></td>
<td>16.3.8.C</td>
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</tbody>
</table>

**Every Teacher Teaches ESL**

ELP Standard 1: English Language Learners communicate in English for social and instructional purposes within the school setting.

ELP Standard 2: English Language Learners communicate information, ideas, and concepts necessary for academic success in the content area of Language Arts.
Addendum

* Activity requires the purchase of computers and software.

Science and Technology and Engineering Standards
3.2.7.B1 Describe how unbalanced forces acting on an object change its velocity. Analyze how observations of displacement, velocity, and acceleration provide necessary and sufficient evidence for the existence of forces.
3.2.7.B2 Describe how energy can be changed from one form to another (transformed) as it moves through a system or transferred from one system to another system.
3.4.7.A1 Explain how technology is closely linked to creativity, which has resulted in innovation and invention.
3.4.7.A2 Explain how different technologies involve different sets of processes.
3.4.7.A3 Explain how knowledge gained from other fields of study has a direct effect on the development of technological products and systems.
3.4.7.B1 Explain how the use of technology can have consequences that affect humans in many ways.
3.4.7.B2 Explain how decisions to develop and use technologies may be influenced by environmental and economic concerns.
3.4.7.B3 Describe how invention and innovation lead to changes in society and the creation of new needs and wants.
3.4.7.B4 Explain how many inventions and innovations have evolved by using deliberate and methodical processes of tests and refinements.
3.4.7.C1 Describe how design, as a creative planning process, leads to useful products and systems.
3.4.7.C2 Explain how modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
3.4.7.D1 Identify and collect information about everyday problems that can be solved by technology and generate ideas and requirements for solving a problem.
3.4.7.D2 Select and safely use appropriate tools, products and systems for specific tasks.
3.4.7.E3 Examine the efficiency of energy use in our environment
3.4.7.E5 Explain how processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing and communicating are necessary for the entire system to operate efficiently.

Mathematics
2.1.7 B Represent and use numbers in equivalent forms (e.g. integers, fractions, decimals, percents, exponents, powers, roots, absolute values).
2.1.7 C Use ratio and proportion to model relationships between quantities.
2.2.7 B  Add, subtract, multiply, and divide whole numbers, decimals, fractions, mixed numbers, or integers.

2.2.7 C  Use the order of operations to evaluate numerical expressions.

2.3.7.A  Demonstrate an understanding of measurable attributes and the units, systems, and processes of measurement.

2.3.7.C  Use measurement formulas to calculate volume, area, and perimeter and to calculate circumference and area of circles.

2.3.7.E  Select and/or use an appropriate scale for creating enlarged or reduced representations.

2.3.7 F  Estimate and verify measurements of length, perimeter, area, volume, capacity, temperature, time, weight, and angles.

**Reading, Writing, Speaking and Listening**

1.1.8D  Identify basic facts and ideas in text using specific strategies (e.g., recall genre characteristics, set a purpose for reading, generate essential questions as aids to comprehension and clarify understanding through rereading and discussion).

1.1.8F  Understand the meaning of and apply key vocabulary across the various subject areas.

1.1.8G  Demonstrate after reading understanding and interpretation of both fiction and nonfiction text, including public documents.

- Make, and support with evidence, assertions about texts.
- Compare and contrast texts using themes, settings, characters and ideas.
- Make extensions to related ideas, topics or information.
- Describe the context of a document.
- Analyze the positions, arguments and evidence in public documents.

1.2.8A  Read and understand essential content of informational texts and documents in all academic areas.

- Differentiate fact from opinion utilizing resources that go beyond traditional text (e.g., newspapers, magazines and periodicals) to electronic media.
- Distinguish between essential and nonessential information across texts and going beyond texts to a variety of media; identify bias and propaganda where present.
- Draw inferences based on a variety of information sources.
- Evaluate text organization and content to determine the author’s purpose and effectiveness according to the author’s theses, accuracy and thoroughness.

1.3.8F  Read and respond to nonfiction and fiction including poetry and drama.
1.4.8B Write multi-paragraph informational pieces (e.g., letters, descriptions, reports, instructions, essays, articles, interviews).
   • Include cause and effect.
   • Develop a problem and solution when appropriate to the topic.
   • Use relevant graphics (e.g., maps, charts, graphs, tables, illustrations, photographs).
   • Use primary and secondary sources.

1.5.8F Edit writing using the conventions of language.
   • Spell common, frequently used words correctly.
   • Use capital letters correctly.
   • Punctuate correctly (periods, exclamation points, question marks, commas, quotation marks, apostrophes, colons, semicolons, parentheses).
   • Use nouns, pronouns, verbs, adjectives, adverbs, conjunctions, prepositions and interjections properly.
   • Use complete sentences (simple, compound, complex, declarative, interrogative, exclamatory and imperative).

1.6.8A Listen to others.
   • Ask probing questions.
   • Analyze information, ideas and opinions to determine relevancy.
   • Take notes when needed.

1.6.8C Speak using skills appropriate to formal speech situations.
   • Use complete sentences.
   • Pronounce words correctly.
   • Adjust volume to purpose and audience.
   • Adjust pace to convey meaning.
   • Add stress (emphasis) and inflection to enhance meaning.

1.6.8D Contribute to discussions.
   • Ask relevant, probing questions.
   • Respond with relevant information, ideas or reasons in support of opinions expressed.
   • Listen to and acknowledge the contributions of others.
   • Adjust tone and involvement to encourage equitable participation.
   • Clarify, illustrate or expand on a response when asked.
   • Present support for opinions.
Grade: 7  Subject: Technology and Engineering Education  Course: Invention and Innovation
Unit: Engineering Design
Time Frame for Completion: (23) 43 minutes classes

- Paraphrase and summarize, when prompted.

1.6.8E  Participate in small and large group discussions and presentations.
- Initiate everyday conversation.
- Select a topic and present an oral reading.
- Conduct interviews as part of the research process.
- Organize and participate in informal debates.

1.6.8F  Use media for learning purposes.
- Describe how the media provides information that is sometimes accurate, sometimes biased based on a point of view or by the opinion or beliefs of the presenter.
- Analyze the role of advertising in the media.
- Create a multimedia (e.g., film, music, computer-graphic) presentation for display or transmission.

1.8.8B  Locate information using appropriate sources and strategies.
- Determine valid resources for researching the topic, including primary and secondary sources.
- Evaluate the importance and quality of the sources.
- Select essential sources (e.g., dictionaries, encyclopedias, other reference materials, interviews, observations, computer databases).
- Use tables of contents, indices, key words, cross-references and appendices.
- Use traditional and electronic search tools.

Career Education
1.3.1.8A  Relate careers to individual interests, abilities, and aptitudes.
1.3.1.8B  Relate careers to personal interests, abilities and aptitudes.

Common Core Standards
RST 3.5.6-8.C  Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
RST 3.5.6-8.D  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
RST 3.5.6-8.G Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

WST 3.6.6-8.B Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
- Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
- Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
- Use precise language and domain-specific vocabulary to inform about or explain the topic.
- Establish and maintain a formal style and objective tone.
- Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

WST 3.6.6-8.C Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WST 3.6.6-8.E Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

WST 3.6.6-8.F Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

WST 3.6.6-8J.I Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

ELA 1.2.7.L Read and comprehend literary non-fiction and informational text on grade level, reading independently and proficiently.

ELA 1.4.7.F Demonstrate a grade appropriate command of the conventions of standard English grammar, usage, capitalization, punctuation, and spelling.

ELA 1.4.7.L Demonstrate a grade appropriate command of the conventions of standard English grammar, usage, capitalization, punctuation and spelling.

ELA 1.4.7.R Demonstrate a grade appropriate command of the conventions of standard English grammar, usage, capitalization, punctuation, and spelling.
Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources.

Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Engage effectively in a range of collaborative discussions, on grade level topics, texts, and issues, building on others’ ideas and expressing their own clearly.

Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.
*Zone of Proximal Development:* That area between what the student is capable of at the moment and the point you want the student to reach next (Vygotsky, 1978)

**Stages of Second Language Acquisition:** (Hill, J., Flynn, K., 2006)

<table>
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<tr>
<th>Stage</th>
<th>Characteristics</th>
<th>Approximate Time Frame</th>
<th>Teacher Prompts</th>
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</thead>
</table>
| Preproduction PDE: Entering | The student  
• Has minimal comprehension  
• Does not verbalize  
• Nods “yes” and “no”  
• Draws and points | 0-6 months          | • Show me…  
• Circle the…  
• Where is…?  
• Who has…? |
| Early Production PDE: Beginning | The student  
• Has limited comprehension  
• Produces one- or two-word responses  
• Participates using key words and familiar phrases  
• Uses present-tense verbs | 6 months to 1 year | • Yes/no questions  
• Either/or questions  
• One-or two-word answers  
• Lists  
• Labels |
| Speech Emergence PDE: Developing | The student  
• Has good comprehension  
• Can produce simple sentences  
• Makes grammar and pronunciation errors  
• Frequently misunderstands jokes | 1-3 years          | • Why…?  
• How…?  
• Explain…  
• Phrase or short-sentence answers |
| Intermediate Fluency PDE: Expanding | The student  
• Has excellent comprehension  
• Makes few grammatical errors | 3-5 years          | • What would happen if…?  
• Why do you think…? |
| Advanced Fluency: PDE: Bridging | The student has a near native level of speech. | 5-7 years          | • Decide if…  
• Retell… |