Integrated Project-based Learning: Combining PTE Standards and Academic Standards

Use this template for planning and sharing ideas for projects. This template is based on the 6 A’s:

Authenticity\* Academic Rigor\* Applied Learning\* Active Exploration\* Adult Connections\* Assessment

| **Project** | |
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| **Title of Project** | **Pressure & Temperature in your Automobile** |
| **Project Developed by** | Brad Lancaster, Matt Tierney |
| **E-mail Address** | [blancaster@buhlschools.org](mailto:blancaster@buhlschools.org), [mtierney@buhlschools.org](mailto:mtierney@buhlschools.org) |
| **School** | **ARTEC, Buhl High School** |
| **Pathway / Small Learning Community/Academy** |  |
| **Course Title(s)** | **Auto Tec, Science** |
| **Time Frame** | **2 weeks** |

| **Authenticity** | |
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| *Briefly describe your project. Include the key question and provide an overview of what students do and learn. Tell why the question is meaningful to the students and where one might see a similar question tackled by an adult in the workplace.* | |
| **Key Question** | **How is the understanding of the pressure/temperature relationship used to transfer heat. (in automotive systems)** |
| **Overview** | **Students will gain an understanding of the relationship between temperature and pressure**  **Students will have a working knowledge of Boyle’s Law, Charles’ Law, and Gay-Lussac’s Law**  **Students will do a hands-on investigation to the awesome power of pressure. (can crush)**  **Students will work in groups to describe the main components of and automobile AC system.**  **Student groups will design an AC system based on research on each main component.**  **Students will diagnose a poorly working automotive AC system based on their research into the individual components of the system and the system as a whole.** |

| **Vocabulary/Key Terms** | | |
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| ***List vocabulary words and key terms essential to student understanding.*** | | |
|  | **Pressure, Temperature, solid, liquid, gas, phase change, condensation, evaporation, sublimation, deposition, freezing, thawing, compressor, condenser, evaporator, blower, fan, refrigerant, expansion valve, liquid line, accumulator, hydraulic, psi, kPa, mmHg, inHg, atm.**  **Boyle’s Law, Charles’ Law, Gay-Lussac’s Law** | |
| | **Active Exploration \* Applied Learning \* Adult Connections** | | | | --- | --- | --- | | *What classroom-based, community-based, and career-based activities does the project involve? Include a description of the active exploration, applied learning, and adult connections in the project (as needed).* | | | | ***Active Exploration*** *How does the project engage students in real investigations using a variety of methods, media and sources? What field-based work will students perform? How does student learning and service support active career exploration?* Students will examine real models of homes. **SAMPLE:** Math will explain scaled units in architecture. They will have lessons on home construction and the building codes for bids. How knowledge is used in industry? **Applied Learning** How do students apply what they have learned and researched to a complex problem  (e.g. designing a product, improving a system, creating an exhibit, organizing an event)? **SAMPLE:** Lecture on industry usage of this concept i.e. model designs. Application with their own proportions also will be explored along with industry standards. ***Adult Connections*** *Who from the community, workplace, postsecondary and/or industry partnership works with students on the project?* **SAMPLE:** Lecture from local industry and community in home design, job shadow to… | | | | **Classroom Activities** | **Community** **Activities** | **Career** **Activities** | | **Working Temp/press/volume laws equations.**  **Can Crush w/ pressure activity**  **Design an AC System**  **Diagnose a poorly working AC System** |  | **HVAC Technical experience** | | |

| **Academic/PTE Rigor** |
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| **Standards** *Use the space below to list the state content standards and PTE industry standards addressed by the project. (A list of the content standards is available at* [*http://www.sde.idaho.gov/ContentStandards/default.asp*](http://www.sde.idaho.gov/ContentStandards/default.asp)*. This page, which includes selected high school level standards, is designed to let you easily create a list of standards you are addressing. You may then copy and paste the list into this template.)* |
| **RI: 1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.**  **W: 1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence**   1. **Introduce precise claimis(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.**   **W: 6. Use technology, including the internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.**  **W: 9. Draw evidence from literary or informational text to support analysis, reflection, and research.**  **SL: 4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.**  **Math:**  **F-BF: 1. Write a function that describes a relationship between two quantities.** |
| **School to Career Competencies** *Please check (x) the competencies addressed by the project* |
| [ x] Communicate and understand ideas and information  [ x] Collect, analyze and organize information [ x] Identify and solve problems [x ] Use technology [x] Initiate and complete entire activities [ x ] Act professionally [ x] Interact with others [ ] Understand all aspects of an industry [ x ] Take responsibility for career and life choices |
| **Student Goal(s) Once the project begins, ask students to generate one or two personal goals.** |
| To be able to describe in detail an automotive AC system.  To be able to diagnose likely problems within a poorly working ac system. |
| **Assessment** |
| *How do you and the students know the project is a success? What are your criteria for measuring students' achievement of the disciplinary knowledge and applied learning goals of the project? What evidence do they use to demonstrate their progress? What deliverables do they need to complete prior to the final exhibition? How will students self-assess?* |
| **Students will work in groups of 4. Each student will be responsible for describing the function and location of 1 major component of a vehicles AC system (condenser and fan, compressor, expansion valve and drier, evaporator and blower). Each student will draw a detailed picture their respective component, in addition to a well written description of its function(s). Design must indicate where state changes occur in the system, what state refrigerant is in throughout the system, and label high/low pressure and temperature areas of the system. Groups will combine their pictures and design an entire AC system. A full description of how a system works together will be produced.**  **After labeling, describing, and assembling an AC system, students will work in their same groups to troubleshoot a bugged system. They must go through their knowledge of each component and decide which component(s) could be contributing to the low functioning system as well as which component(s) are not likely to be contributing factors.** |

| **Recommended Resources / Sample Products** | |
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| **Software or Materials Needed** *(Examples*) | **AC pressure gauge, IR thermometer, vehicle w/ AC, soda cans, tongs, burner/hot plate, ice, vacuum chamber, beaker, computer** |
| **Teacher-Developed Materials** *(Examples of materials that can be shared with other classes. Please attach samples.)* |  |
| **Student-Developed Materials** *(Examples of products that can be shared with other classes. Please attach samples.)* |  |
| **Websites Used** *(Examples*) | **www.phet.colorado.edu** |
| **Final Words** (In a sentence or two, highlight your project’s overall value.) | **Students will get an understanding of the problem solving process and practice using their own knowledge to diagnose problems and suggest solutions to fix them.** |
| **Teacher Tips/Extensions** (Use the first person to share a useful idea that helps with implementation and ensures success. Make it chatty, informal.) |  |
| **Extensions** *(List any ideas for students who may want to go deeper into the learning standards.)* |  |

| **Timeline** |
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| ***What sequence of teaching and learning experiences will equip students to develop and demonstrate the PTE standards and the Academic standards?*** |
| **Instruction on Phase Change and phase change diagrams. Phase change vocabulary is to be covered in this section. Demonstration of boiling water at room temperature in a vacuum chamber. (2 days)**  **Charles’ Law, Boyle’s Law, Gay-Lussac’s Law. An investigation into the different relationships that exist with temperature, volume, and pressure. Practice using the equations to calculate temperature, pressure, and volumes. (3 days)**  **Students will engage in a lab activity using pressure (negative pressure) to crush soda cans. (1 day)**  **Students will work in small groups to describe the importance of understanding the pressure temperature relationship in vehicles, citing specific examples of this relationship in vehicle systems. (1 day)**  **Examples of automotive systems where pressure and temperature are important for a vehicle to function properly are given to students. (1 day)**  **Air Cooling system is highlighted. Instructor will demonstrate how to measure temperature and pressure within a working automotive AC System (1day)**  **Students will work in groups of 4. Each student will be responsible for describing the function and location of 1 major component of a vehicles AC system (condenser and fan, compressor, expansion valve and drier, evaporator and blower). Each student will draw a detailed picture their respective component, in addition to a well written description of its function(s). Groups will combine their pictures and design an entire AC system. A full description of how a system works together will be produced (3-4 days)**  **Assessment: After labeling, describing, and assembling an AC system, students will work in their same groups to troubleshoot a bugged system. They must go through their knowledge of each component and decide which component(s) could be contributing to the low functioning system as well as which component(s) are not likely to be contributing factors.** |

(Adapted from the Boston Public Schools Signature Projects.)