**Process Technology I**

We will cover chapters 1 – 8 & 20 - 21 in the Charles E. Thomas, PhD, Introduction to Process Technology book. There will be quizzes on canvas to track students’ progress after every lesson. There will also be a final at the end of the year as well.

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| Chapter #0  Introduction into the Process Technology Profession | 6 days | 9.3.12.C.1  9.3.12.C.2  9.4.12A.2  9.4.12A.3 |
| Introduction of Process Technology  Careers involving process technology  Process Technology skill requirements  Process technology educational requirements  Process technician duties  Pros & cons of being a process technician  The history of the oil industry | | **Essential Questions:**  What is a process technician?  What does a process technician do?  What carriers can one work at if they become a process technician?  How do you become a process technician?  How much do process technicians make?  What is the work schedule for a process technician?  What is the job availability for process technicians?  What is the history of the oil industry?  How is oils made and where does it come from? |

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| Chapter #1  History of the Chemical Processing Industry  1.1 – 1.9 | 11 days | 9.3.12.C.1  9.3.12.C.2  9.3.12.C.5  9.4.12A.2  9.4.12A.3  9.4.12A.7 |
| History of the Chemical Processing Industry  Current Issues & Trends  Working in the Chemical Processing Industry  College Programs for Process Technology  Your Career as a Process Technician  Roles & Responsibilities of a Process Technician  Regulatory Agencies  The Work environment | | **Essential Questions:**  What are the origins of the process technology industry?  What are any current issues or trends going on with in the CPI?  What is it like working in the chemical processing industry?  What are Middlesex County College & the ACE programs like?  How would a career progress as a process technician?  What types of jobs are available if you have a ptech degree?  What are the roles & responsibilities of a process technician?  What are OSHA, the EPA, and the DOT & what do they regulate?  What is the work environment like for a process technician?  What is shiftwork and how does it affect individuals? |

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| Building machines that use gears or pullies to operate. | 4 days | 9.4.12A.2  9.4.12A.3  9.4.12A.7 |

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| Chapter #2  Introduction to Process Technology  Classes  2.1 – 2.11 | 8 days | 9.3.12.C.1  9.3.12.C.2  9.3.12.C.5  9.4.12A.2  9.4.12A.3  9.4.12A.7 |
| Introduction to Process Technology  Safety, Health & the Environment  The Principles of Quality Control  Instrumentation & Process Control  Process Equipment  Process Systems  Process Operations  Troubleshooting  Applied General Chemistry & Physics  College Math  Process Internship | | Essential Questions:  What is process technology?  What is the importance of safety in the process industry?  What are the 7 main principles of quality control?  How is instrumentation & process control related to the industry?  What are some different equipment used in the process industry?  What are some different systems used in the process industry?  What are some different operations performed in the industry?  How do technicians troubleshoot problems in the industry?  What chemistry and physics are required?  What type of math knowledge is necessary to be a technician?  What internship positions are available to college students? |
| Career Research PowerPoint & Digital Poster | 4 days | 9.3.12.C.1  9.3.12.C.2  9.3.12.C.5 |

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| Chapter #20  Chemical Processing Industry Overview  20.1 – 20.9 | 25 Days | 9.3.12.C.1  9.3.12.C.2  9.3.12.C.5 |
| Industrial processes  Chemical Manufacturing & Petroleum Refining  Land Exploration and Production  Ocean Exploration and Production  Power Generation  Water & Wastewater Treatment  Mining & Mineral Processing  Food & Beverage Processing  Pharmaceutical Manufacturing  Pulp & Paper Manufacturing | | **Essential Questions:**  What are the different industrial processes?  How does the chemical manufacturing industry work?  How is petroleum refined?  How is crude oil extracted from land?  How is crude oil extracted from the ocean?  How is power generated?  How is clean water brought to consumers?  What happens to wastewater?  How are minerals mined?  How are foods & beverages processed & packed?  How are pharmaceuticals manufactured?  How is pulp created?  How is paper made from pulp? |

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| Safety Disaster PowerPoint & Digital Poster | 4 days | 9.4.12A.37  9.4.12A.40  9.4.12M.33 |

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| Chapter #3  Safety, Health & Environment  3.1 – 3.18 | 23 Days | 9.3.12.C.11  9.4.12A.36  9.4.12A.37  9.4.12A.40  9.4.12M.33 |
| Safety, Health & the Environment  Basic safety Principles  Occupational Safety & Health  The PSM Standard  The Hazard Communication Standard  Safe Handling, Storage & Transportation of Hazardous Chemicals  Physical Hazards Associated with Chemicals  Chemical Hazards Associated with Chemicals  Material Safety Data Sheets  Toxicology  Respiratory Protection Program  Personal Protective Equipment  Emergency Response  Plant Permit System  Classification of Fire Extinguishers  HAZWOPPER  Hearing Conservation & Industrial Noise  Department of Transportation | | **Essential Questions:**  What is the importance of safety in the process industry?  What are the basic safety principles?  What are some occupational safety & health issues?  What is the Process Safety Management Standard?  What is HAZCOMM?  How does one safely hand, store & transport hazardous chemicals  What are the physical hazards associated with chemicals?  What are the chemical hazards associated with chemicals?  How do you create & read a material safety data sheet?  What is done when handling toxic chemicals?  What are different respirators, and what are their uses?  Describe various personal protective devices.  What type of emergency response is related to industrial plants?  What is a plant permit system?  What are the different classifications of fire extinguishers?  Describe HAZWOPPER.  What are dangers of industrial noise & how is injury prevented?  How do you read the Department of Transportation placards?  What is the HMIS system?  What is the NFPA diamond? |

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| STEM project on Robots presented by the National Guard | 5 days | 9.4.12A.4  9.4.12A.7  9.4.12A.36 |

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| Chapter #5  Equipment One  5.1 – 5.10 | 20 days  9/16 – 9/30 | 9.4.12A.4  9.4.12A.7  9.4.12A.36 |
| Hand Tools  Valves  Piping  Storage Tanks  Pumps  Compressors  Steam Turbines  Gas Turbines  Electricity  Motors  Equipment Lubrication, Bearings & Seals  Steam Traps | | **Essential Questions:**  What are the different hand tools used in the industry?  What are the different types of valves and their uses?  What are the different types of pipe fittings and their uses?  What are the different types of storage tanks and their uses?  What are the different types of pumps and how do they operate?  What are the different types of compressors & how do they work?  How does a steam turbine operate?  How does a gas turbine operate?  How is electricity created, transported & stepped up/down?  What is the difference between AC & DC electricity?  How do different types of motors operate?  Why is equipment lubricated?  What are the different types of bearings and seals and their uses?  What is a steam trap used for? |

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| Chapter #6  Equipment Two  6.1 – 6.7 | 8 days  9/16 – 9/30 | 9.4.12A.3  9.4.12A.4  9.4.12A.7  9.4.12A.36 |
| Heat Exchangers  Cooling towers  Boilers  Furnaces  Reactors  Distillation  Separators | | **Essential Questions:**  What is a heat exchanger and how does it operate?  What is a cooling tower and how does it operate?  What is a boiler and how does it operate?  What is a furnace and how does it operate?  What is a reactor and how does it operate?  What is a distillation tower and how does it operate?  What is a separator and how does it operate? |

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| Renewable Energy Research PowerPoint & Digital Poster | 4 days | 9.3.12.C.1  9.3.12.C.2  9.3.12.C.5 |

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| Chapter #21  Renewable Energy  21.1 – 2.16 | 10 days | 9.4.12A.3  9.4.12A.4  9.4.12A.7  9.4.12A.36 |
| Solar Photovoltaic Power  Solar Thermal Energy  Geothermal Energy  Hydropower Energy  Marine Energy  Wind Energy  Biomass Energy | | **Essential Questions:**  What is solar photovoltaic power and how is it created?  What is solar thermal energy and how is it created?  What is geothermal energy and how is it created?  What is hydropower energy and how is it created?  What is marine energy and how is it created?  What is wind energy and how is it created?  What is biomass energy and how is it created? |

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| STEM project on renewable energy presented by the National Guard | 5 days | 9.4.12A.4  9.4.12A.7  9.4.12A.36 |

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| Chapter #7  Process Instrumentation One  7.1 – 7.5 | 6 Days | 9.4.12A.3  9.4.12A.4  9.4.12A.7  9.4.12A.36 |
| Introduction to Process Instruments  Symbols & Diagrams  Process Diagrams  Interlocks & Permissives  P & ID Components | | **Essential Questions:**  Are the different types of process instruments?  Identify the different symbols for equipment & instruments.  How do you read a process flow diagram?  What are the different interlocks & permissives?  How is a P & ID drawing read?  How do you create PFDs and P & IDs? |

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| Simtronics Heat Exchanger Inside operator computer simulations with workbook. | 10 days | 9.4.12A.4  9.4.12A.7  9.4.12A.36 |

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| Chapter #8  Process Instrumentation Two  8.1 – 8.6 | 7 Days | 9.4.12A.3  9.4.12A.4  9.4.12A.7  9.4.12A.36 |
| Basic Elements of a Control Loop  Process Variables & Control Loops  Primary Elements & Sensors  Transmitters & Control Loops  Controllers & Control Modes  Final Control Elements & Control Loops | | **Essential Questions:**  What are the basic elements of a control loop  What are the process variables in control loops?  What are the primary elements & sensors in the industry?  How are transmitters related to process control loops?  What are the controller and control modes in control loops?  What are the final control elements within control loops? |

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| Designing then building various process instruments & equipment with aide of 3-d printer. | 5 days | 9.4.12A.4  9.4.12A.7  9.4.12A.36 |

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| Final Exam | 1day | All |

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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Process Technology Overview** |
| **Target Course/Grade Levels: Ptech 11/12 Grades** |
| **Unit Summary: The lifeblood of modern society is found in petroleum products. Almost all modern day machines and manufacturing systems require petroleum products to operate.**  **Interdisciplinary Connections: Chemistry, Physics, Earth Science, Biology, and Mathematics.**  **21st Century Themes:**  Standard 9.4 Career and Technical Education: All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements: All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.2 | Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
| 9.4.12A.7 | Evaluate and use information resources to accomplish specific occupational tasks. |
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| **Unit Essential Questions:**  What do process industries do?  What is Process technology?  What does a Process Technician do?  What are the working conditions in process industries? | | **Unit Enduring Understandings:**  Process industries take raw materials and create a product or feedstock for other operations.  Process technology is the study of the equipment, operation, design, and maintenance within this industry.  The Process Technician responsibility is to master and understand all aspects of the steps involved in making a product.  Working conditions vary, but usually are 12 hour shifts and outdoor activities and light maintenance activities. |
| **Unit Learning Targets**  *Student will be able to identify the roles and responsibilities of a Process Technician, their work environment, and various equipment and operation procedures for these industries.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  Through various class discussions, Q&A, outside readings, internet research, students will demonstrate their grasp of the subject matter being studied. | | |
| **Summative Assessment:**  Textbook Unit summary questions, vocabulary quizzes, classroom Q&A. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Introduction to Process Technology | Five class periods | |
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| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Overview of Process Technology** | | |
| **Timeframe: Five class periods** | | |
| **Goals/Objectives:**   * **Understand what is a Process Industry** * **What is the role and responsibility of a Process Technician** * What are the working conditions, training, and salaries | | |
| **Learning Activities/Instructional Strategies:**   * **Instructor lecture, and power point** * **Internet videos from various colleges describing their program** * **Student internet research on various process industries emphasis on NJ based.** | | |
| **Equipment/Resources Needed:**   * **Computers, power point** * **textbooks** | | |
| **Lesson Assessment: Class quizzes, Q&A, Chapter review questions** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Introduction to Career Paths for Process Technicians** |
| **Target Course/Grade Levels: PTEC 11/12** |
| **Unit Summary: The Associates degree in Process Technology qualifies an individual for employment in eight general industries for employment. They are Exploration and Production, Power Generation, Water and Wastewater Treatment, Mining and Mineral Processing, Food and Beverage Processing, Pharmaceutical Manufacturing, Pulp and Paper Processing, and Chemical and Refining Operations.**  **Interdisciplinary Connections: Physics, Chemistry, Earth Science, Mathematics**  **21st Century Themes:**  Standard 9.3 Career Awareness, Exploration & Preparation  All students will apply knowledge about and engage in the process of career awareness, exploration and preparation in order to navigate the globally competitive work environment of the information age. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements: All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.3.12.C.1 | Assess and modify Personalized Student Learning Plans to support declared career goals. |
| 9..3.12.C.2 | Characterize education and skills need to achieve career goal, and take steps to prepare for postsecondary options, including making course selections, preparing for and taking assessments, and participating in extra-curricular activities. |
| 9.3.12.C.5 | Identify transferable skills in career choices and design alternative career plans based on those skills. |
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| **Unit Essential Questions:**  What are the career paths available for individuals with a Process Technology degree?  What are the similarities found in the eight career process industries? | | **Unit Enduring Understandings:**  Exploration, Chemical, Pharmaceutical, Power, Food and Beverage, Wastewater, Mining, Paper.  Similar equipment: furnaces, pipes, valves, tanks, instruments, work day, and conduct. |
| **Unit Learning Targets**  *Student will understand the multiple choices for employment that a Process Technology degree provides* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Class discussions, Q&A, internet research, industry video, textbook readings.** | | |
| **Summative Assessment:**  **Chapter review questions, quizzes, research paper, student power point, current event presentations.** | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Career Paths for Process Technicians | 40 class periods | |
| **Teacher Notes:**  Five class periods for each of the eight identified process industries with emphasis on NJ based opportunities. | | |
| **Lesson Plans** | | |
| **Lesson Title: Career Paths for Process technicians** | | |
| **Timeframe: Forty class periods** | | |
| **Goals/Objectives:**   * **Discuss each of the eight process industry career paths.** * **Discuss pros and cons for each.** * Discuss potential growth opportunities. | | |
| **Learning Activities/Instructional Strategies:**   * **Videos, internet research** * **Student power points** * **Field Trips / guest speakers** * **Textbook readings** * **Class discussions and Q&A** | | |
| **Equipment/Resources Needed:**   * **Computers** * **Textbooks** * **Chart paper, markers, art supplies** | | |
| **Lesson Assessment: Student presentations, Textbook Chapter review questions, Class discussions.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Safety, Health, and Environment** |
| **Target Course/Grade Levels: 11/12 PTEC** |
| **Unit Summary: Safety programs have a rich tradition inside the chemical processing industry. Process technicians play an important part by adopting and observing sound safety principles and government regulations.**  **Interdisciplinary Connections: Chemistry, Physics, Biology, Anatomy, and Mathematics**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**    **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.3.12.C.11 | Evaluate the responsibilities of employers and employees for maintaining workplace safety, and explain health rights related to a particular occupation/career. |
| 9.4.12A.36 | Demonstrate knowledge of personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments. |
| 9.4.12A.37 | Demonstrate knowledge of employee rights and responsibilities and employers obligations to maintain workplace safety and health. |
| 9.4.12A.40 | Explain health, safety, and environmental management systems in organizations and their importance to organizational performance and compliance. |
| 9.4.12M.33 | Demonstrate knowledge of personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments. |

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| **Unit Essential Questions:**  What is the Process Safety Management Standard?  Describe various personal protective devices.  What is a plant permit system?  Describe HAZWOPER. | | **Unit Enduring Understandings:**  The PMS was developed by OSHA and the EPA to address the accidents within the chemical industry.  PPE includes Hard Hat, Hearing, Face shield /glasses, fire retardant clothing, and radio.  Permit system issues work orders to be performed listing all the safety, materials, and supervisory approval needed to complete the work order.  Hazwoper is a term to describe OSHA’s hazardous waste operations and emergency response standards. |
| **Unit Learning Targets**  *Student will be able to explain the basic principles of safety, health, and environment. Describe the various levels of personal protective equipment. What information is found on a plant permit work order? Describe the components of a HAZWOPER program including MSDS sheets.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations, trying on samples of PPE equipment, Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Vocabulary quizzes, textbook chapter review questions, and student power point presentations. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Basic Safety Principles | One class period | |
| OSHA, EPA, DOT | One class period | |
| PSM & Hazard Communication Program | One class period | |
| HAZCOM / HAZWOPPER | One class period | |
| MSDS sheets / DOT placards | One class period | |
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| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Safety, Health, and Environment** | | |
| **Timeframe: Five class periods** | | |
| **Goals/Objectives:**   * **Introduce students to safety, health, and environment training found in process industries.** * **Students to understand the role of OSHA, EPA, and DOT agencies.** * Students will be familiar with MSDS sheets and a plant permit system. | | |
| **Learning Activities/Instructional Strategies:**   * **Governmental agencies videos. (Chemical Safety Board)** * **Student presentations on various safety topics.** * **Student demonstrating proper use of PPE.** * **Instructor Q&A.** * **Student inspection of the classroom for safety issues.** * **Industry related guest speaker.** | | |
| **Equipment/Resources Needed:**   * **Hard hats, safety glasses, gloves, ear plugs.** * **Computer / Internet connections** * **Chart / Art supplies** | | |
| **Lesson Assessment: Textbook Chapter review questions. Instructor Q&A, Vocabulary quizzes.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Applied Physics for the Process Industries** |
| **Target Course/Grade Levels: 11/12 PTEC** |
| **Unit Summary:**  **Physics plays an important role within the process industries because it deals with matter, energy, motion, and force.**  **Interdisciplinary Connections: Chemistry, Mathematics, Earth Science**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
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| **Unit Essential Questions:**  How are the Principles of Pressure used in the process industry?  Explain how heat, heat transfer, and temperature affect the process industries.  Explain the principle of fluid flow in equipment. | | **Unit Enduring Understandings:**  Pressure increases boiling point, volume, vapor.  Heat increases temperature and volume. Heat transfer is achieved through conduction, convection, and radiation.  Fluid flow affects velocity, viscosity, density, and specific gravity. Classified as turbulent or laminar flow. |
| **Unit Learning Targets**  *Student will be able to describe key terms and principles related to Physics within the process industry.*  *Introduce the students to the basic principles of pressure.*  *Understand the scientific principles of heat, heat transfer, and temperature.*  *Aware of the principles of fluid flow in process equipment.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Vocabulary quizzes, textbook chapter review questions, and student power point presentations. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Principles of pressure, Pascal’s Law, Boyle’s Law | Two class periods | |
| Heat, Heat Transfer, Temperature | Two class periods | |
| Fluid Flow, Bernoulli’s Principle | Two class periods | |
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| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Applied Physics for the Process Industry** | | |
| **Timeframe: Five class periods.** | | |
| **Goals/Objectives:**   * **Understand the principles of pressure and its effects.** * **Familiar with the principles of heat, heat transfer, and temperature.** * Be aware of the principles of fluid flow within equipment. | | |
| **Learning Activities/Instructional Strategies:**   * **Internet Videos** * **Classroom demonstrations** * **Instructor Q&A / lecture** * **Operating multi-level storage tank trainer.** * **Textbook readings.** * **Student research / power point presentation.** | | |
| **Equipment/Resources Needed:**   * **Internet connection / Computers** * **Science lab equipment** * **Textbook** | | |
| **Lesson Assessment: Instructor observation and Q&A, vocabulary quizzes, Textbook review chapter questions.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Fundamental Principles of Chemistry** |
| **Target Course/Grade Levels: 11/12 PTEC** |
| **Unit Summary: Chemistry is the study of the characteristics or structurenof elements and the changes that take place when they combine to form other substances. Process Technicians play a major role in the production and manufacturing of raw materials into finished products.**  **Interdisciplinary Connections: Physics, Mathematics, Earth Science**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements: :**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
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| **Unit Essential Questions:**  Name fundamental chemistry terms.  Name four chemical reactions.  Describe hydrocarbons.  Name three applied chemical processing concepts. | | **Unit Enduring Understandings:**  Terms: matter, atoms, electrons, Ions, molecules, solutions, mixtures, covalent and ionic bonding.  Reactions: exothermic, endothermic, neutralization, and catalyst.  Hydrocarbons are chemical compounds containing hydrogen and carbon.  Chemical processes: distillation, catalytic cracking, alkylation. |
| **Unit Learning Targets**  *Student will be able to define fundamental chemistry terms and their principles. Understand the basic chemical reactions found in the process industries. Understand the various empirical formulas for common hydrocarbon molecules.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Vocabulary quizzes, textbook chapter review questions, and student power point presentations. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Fundamental Principles of Chemistry | Two class periods | |
| Chemical Reactions / hydrocarbons | One class period | |
| Distillation | Three class periods | |
| Catalytic Cracking / Hydrocracking | Two Class periods | |
| Alkylation | One class period | |
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| **Teacher Notes:** | | |
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| **Lesson Plans** | | |
| **Lesson Title: Fundamental Principles of Chemistry** | | |
| **Timeframe: Eight class periods** | | |
| **Goals/Objectives:**   * **Define fundamental chemistry terms.** * **Understand basic chemical reactions.** * Introduced to various hydrocarbon molecules. | | |
| **Learning Activities/Instructional Strategies:**   * **Internet Videos** * **Classroom demonstrations** * **Instructor Q&A / lecture** * **Operating distillation trainer.** * **Textbook readings.** * **Student research / power point presentation** | | |
| **Equipment/Resources Needed:**   * **Computers / internet connections** * **Distillation Trainer** * **Hands-on molecule builder** | | |
| **Lesson Assessment: Instructor observation and Q&A, vocabulary quizzes, Textbook review chapter questions.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Process Equipment - One** |
| **Target Course/Grade Levels: 11/12- PTEC** |
| **Unit Summary: Process technicians are expected to be able to use basic hand tools to perform minor maintenance tasks dependent on existing union contracts. They are also required to have a working knowledge of the other pieces of equipment used in the process industry.**  **Interdisciplinary Connections: Practical Arts Courses, Physics**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.7 | Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace. |
| 9.4.12A.7 | Evaluate and use information resources to accomplish specific occupational tasks. |
| 9.4.12A.36 | Demonstrate knowledge of personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments. |
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| **Unit Essential Questions:**  Name some of the basic hand tools used in the process industry.  Name three valves found in a process industry.  Name some of the common tank designs used for storage.  Name two types of dynamic pumps.  What is a compressor?  What are steam turbines used for? | | **Unit Enduring Understandings:**  Hand tools: pliers, wrenches, screwdrivers.  Valves: Gate, globe, and ball.  Storage vessels: Dome roof, open top, Floating roof, spheres, bins, and tanks.  Pumps: Centrifugal, Axial.  A compressor is a device that produces clean, dry air or gas for industrial applications.  Steam turbines convert kinetic energy to mechanical energy producing electrical power. |
| **Unit Learning Targets**  *Student will be able to identify basic hand tools, valves, storage vessels ,pumps. Explain the workings of compressors and steam turbines.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Vocabulary quizzes, textbook chapter review questions, and student power point presentations. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Basic Hand Tools | One class period | |
| Valves | Two class periods | |
| Storage tanks and piping | Two class periods | |
| Pumps | One class period | |
| Compressors | One class period | |
| Steam Turbines | Two class periods | |
| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Process Equipment -One** | | |
| **Timeframe: Nine class periods** | | |
| **Goals/Objectives:**   * **Students able to identify hand tools, pumps, valves, storage vessels.** * **Students explain the workings of a compressor and steam turbine.** | | |
| **Learning Activities/Instructional Strategies:**   * **Internet Videos** * **Classroom demonstrations** * **Instructor Q&A / lecture** * **Operating pump, storage container trainer.** * **Textbook readings.** * **Student research / power point presentation** | | |
| **Equipment/Resources Needed:**   * **Pump, piping, valves, storage trainer.** * **Valve cut-aways.** * **Internet videos** | | |
| **Lesson Assessment: Instructor observation and Q&A, vocabulary quizzes, Textbook review chapter questions.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Hydraulics** |
| **Target Course/Grade Levels: 11/12-PTEC** |
| **Unit Summary: Hydraulics uses fluids under pressure to transmit or control power. Process technicians use hydraulics to open and close vales, lift heavy objects, run motors.**  **Interdisciplinary Connections: Physics, Practical Arts Courses**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
| 9.4.12A.4 | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice. |
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| **Unit Essential Questions:**  What are the four major elements of Hydraulics?  What do Graphic symbols represent?  What are the physical laws that affect hydraulics?  Name some of the common components found in a hydraulic system. | | **Unit Enduring Understandings:**  Elements: input, control, transmission, and output.  Symbols: connections, flow paths, component functions.  Laws: force, volume, pressure, and area.  Components: Flow control valves, check valves, directional valves, cylinders, regulators, pumps. |
| **Unit Learning Targets**  *Student will have an awareness of hydraulic fundamentals, and a working knowledge of hydraulic components and devices.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Instructor observations of student activity with the “Discovery II” trainer. Completion of daily lab activities. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Hydraulic Pre-test & Intro to the trainer. | One class period | |
| Inro to the fundamentals of hydraulics. | One class period | |
| Graphic Communications & Compressibility of fluids | One class period | |
| Hydraulic Physical Laws | One class period | |
| Control valves | One class period | |
| Circuit design and cylinders | One class period | |
| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Hydraulics** | | |
| **Timeframe: Seven class periods** | | |
| **Goals/Objectives:**   * **Provide students with the awareness of fluid power; hydraulics.** * **Provide students with the fundamentals of the theory and physical laws applied to hydraulics.** * Provide students with a hands-on experience discovering the workings of hydraulics. | | |
| **Learning Activities/Instructional Strategies:**   * **Instructor lecture and Q&A.** * **Student daily activity sheets for the Discovery II trainer** | | |
| **Equipment/Resources Needed:**   * **Discovery II trainer** * **Student workbooks** * **Daily activity sheets** | | |
| **Lesson Assessment: Pre-test and post test on hydraulics. Completion of daily activity sheets.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Pneumatics** |
| **Target Course/Grade Levels: 11/12- PTEC** |
| **Unit Summary: Pneumatics describes the mechanics of gases used to produce or control mechanical outputs for useful work. In the process industry, pneumatics is a component of either control elements or control loops operating actuators moving the position of valves.**  **Interdisciplinary Connections: Physics, Practical Arts Courses**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
| 9.4.12A.4 | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice. |
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| **Unit Essential Questions:**  List advantages of Pneumatic power.  List Disadvantages of Pneumatic Power.  What do graphic symbols represent?  What physical laws affect pneumatics? | | **Unit Enduring Understandings:**  Air is free, clean, fast response, quiet.  Expensive, pressure limits, leaks, compressibility.  Connections, flow paths, component functions.  Pascal, Boyle, Bernoulli, and Charles’s Laws. |
| **Unit Learning Targets**  *Student will have an awareness of pneumatic fundamentals, and a working knowledge of pneumatic components and devices.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Instructor observations of student activity with the “Discovery I” trainer. Completion of daily lab activities. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Pre-test and Intro to the Discovery I trainer | One class period | |
| Introduction to pneumatics, graphic communications. | One class period | |
| Characteristics of compressed air and air filters. | One class period | |
| Flow control valves and pressure regulators. | One class period | |
| Flow meters and directional control valves. | One class period | |
| Cylinders, speed control, sequencing | Two class periods | |
| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Pneumatics** | | |
| **Timeframe: Seven class periods** | | |
| **Goals/Objectives:**   * **Provide students with the awareness of fluid power; pneumatics.** * **Provide students with the fundamentals of the theory and physical laws applied to pneumatics.** * Provide students with a hands-on experience discovering the workings of hydraulics. | | |
| **Learning Activities/Instructional Strategies:**   * **Instructor lecture and Q&A.** * **Student daily activity sheets for the Discovery I trainer** | | |
| **Equipment/Resources Needed:**   * **Discovery I trainer** * **Student workbooks** * **Daily activity sheets** | | |
| **Lesson Assessment: Pre-test and post test on pneumatics. Completion of daily activity sheets.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Process Flow and Instrumentation Diagrams** |
| **Target Course/Grade Levels: 11/12-PTEC** |
| **Unit Summary: Process flow diagrams (PFDs) and process instrumentation drawings (P&IDs) are used to outline or explain the complex flows, equipment, instrumentation that exist in a process unit.**  **Interdisciplinary Connections: Practical Arts Courses**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.4 | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice. |
| 9.4.12A.4 | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice. |
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| **Unit Essential Questions:**  What are some of the basic symbols used in process industries representing equipment, instruments, and flow diagrams? | | **Unit Enduring Understandings:**  Level and flow controllers, temperature indicators, valves, piping, pump and tank, and heat exchangers. |
| **Unit Learning Targets**  *Student will be able to identify and draw basic equipment and instrument symbols.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Textbook Unit summary questions, vocabulary quizzes, classroom Q&A. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Process flow diagrams | Three class periods | |
| Process & Instrument Diagram | Three class periods | |
| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Process Flow and Instrument Diagrams** | | |
| **Timeframe: Six class periods** | | |
| **Goals/Objectives:**   * **Students are able to draw a basic process flow diagram.** * **Students are able to draw a basic Process & Instrument diagram.** * Students are able to identify basic symbols for equipment and instruments used in the process industry. | | |
| **Learning Activities/Instructional Strategies:**   * **Textbook readings** * **DVD videos** * **Internet research** * **Student work groups** * **Instructor Q&A** | | |
| **Equipment/Resources Needed:**   * **Art supply and chart paper** * **Examples of equipment for drawing** * **Textbooks** | | |
| **Lesson Assessment: Instructor observation and Q&A, vocabulary quizzes, Textbook review chapter questions.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: Workplace Readiness Skills** |
| **Unit Title: Heat Exchangers** |
| **Target Course/Grade Levels: 11/12-PTEC** |
| **Unit Summary: The transfer of heat from one process to another is typically accomplished with heat exchangers. This transfer of energy is accomplished without the two fluids coming in physical contact with each other.**  **Interdisciplinary Connections: Physics, Practical Arts Courses, Chemistry**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements: All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.4 | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice. |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
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| **Unit Essential Questions:**  What are heat exchangers used for?  What method of heat transfer is utilized by a heat exchanger?  What configuration of heat exchangers is the most common in process industries? | | **Unit Enduring Understandings:**  Heat exchangers are used to heat or cool either liquids or gases without inter mingling both items.  Conduction performs the heat transfer.  Shell and Tube is the most popular. |
| **Unit Learning Targets**  *Student will be able to describe the major components and operation of heat exchangers.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Textbook Unit summary questions, vocabulary quizzes, classroom Q&A. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Heat exchangers | Three class periods | |
| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Heat exchangers** | | |
| **Timeframe: Three class periods** | | |
| **Goals/Objectives:**   * **Describe the purpose and function of heat exchangers.** * **Review the three methods of heat transfer** * Introduce the typical operation of a shell and tube heat exchanger. | | |
| **Learning Activities/Instructional Strategies:**   * **Instructor Q&A** * **Study static model of a tube and shell exchanger** * **View video of heat exchangers being placed in service** | | |
| **Equipment/Resources Needed:**   * **Static Model** * **Heat exchanger video** * **Textbook study guide** | | |
| **Lesson Assessment: Instructor Q&A, Summary questions from video, textbook section review questions.** | | |
| **Teacher Notes:** | | |
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| **Unit Overview** |
| **Content Area: workplace Readiness Skills** |
| **Unit Title: Distillation** |
| **Target Course/Grade Levels: 11/12 - PTEC** |
| **Unit Summary: A distillation column is a series of stills placed one on top of the other. As a mixture is heated to various boiling points, vapor travels up the column and flows concurrently from still ( TRAY) to still. The lightest components travel up to the top where they are condensed and transferred to storage or used back again within the column.**  **Interdisciplinary Connections: Physics, Chemistry**  **21st Century Themes:**  Standard 9.4 Career and Technical Education  All students who complete a career and technical education program will acquire academic and technical skills for careers in emerging and established professions that lead to technical skill proficiency, credentials, certificates, licenses, and/or degrees. |
| **Learning Targets** |
| **Standards:**  S**tandard 8.2 Technology Education, Engineering and Design** |
| **Content Statements:**  **All students will develop and understanding of the nature and impact of technology, engineering, technological design and the designed world as they relate to the individual, global society, and the environment.** |

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| **CPI #** | **Cumulative Progress Indicator (CPI)** |
| 9.4.12A.3 | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities. |
| 9.4.12A.42 | Demonstrate knowledge of safe and healthful working conditions and the environment in the classroom and/or worksites that adhere to employee rights and responsibilities and employer obligations. |
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| **Unit Essential Questions:**  Explain the workings of a distillation column. | | **Unit Enduring Understandings:**  A distillation column is a series of stills placed on top of each other. Knowing the boiling point of components in a mixture, the component can be separated from the remaining mixture. This is accomplished by vaporization within the reboiler. The vapor is turned back into a liquid through condensation. |
| **Unit Learning Targets**  *Student will be able to explain and operate a distillation column.* | | |
| **Evidence of Learning** | | |
| **Formative Assessments:**  **Student workgroups for Q&A, student internet research, mini presentations. Instructor observations of various student activities, videos and discussion sheets.** | | |
| **Summative Assessment:**  Textbook Unit summary questions, vocabulary quizzes, classroom Q&A. | | |
| **Lesson Timeframes** | | |
| **Lesson Title:** | **Timeframe (hours/days)** | |
| Distillation - Intro | Two class periods | |
| Bayport Distillation trainer | Five class periods | |
| EnVision software trainer program | Five class periods | |
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| **Teacher Notes:** | | |
| **Lesson Plans** | | |
| **Lesson Title: Distillation** | | |
| **Timeframe: 12 class periods** | | |
| **Goals/Objectives:**   * **Understand the terms related to distillation.** * **Understand the theory of distillation.** * Successfully operate the Bayport Distillation trainer. | | |
| **Learning Activities/Instructional Strategies:**   * **Instructor Q&A** * **Internet video and student research.** * **Textbook readings.** * **Operation of the Bayport Distillation trainer.** * **Students power point presentations.** | | |
| **Equipment/Resources Needed:**   * **Computer and internet connection.** * **Textbooks / vocabulary sheets/ study guides.** * **Bayport Training model / Bayport static model** | | |
| **Lesson Assessment: Instructor Q&A, Summary questions from video, textbook section review questions.** | | |
| **Teacher Notes:** | | |
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