

Curriculum Framework

A Reference Guide for the Automotive Career Pathway

**Albuquerque Public Schools
Career Technical Education
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CAREER AND TECHNICAL EDUCATION

Career and Technical Education (CTE), a formal part of American education since the first federal vocational education law was passed in 1917, is proactively responding to an educational reform agenda and to a changing national and global economy. CTE now is increasingly linked to high academic standards as well as particularly responsive to our nation's need for a labor force prepared with the diverse skills required for our knowledge-based economy. CTE provides relevant experiences and enhances opportunities for learning, careers, and further education.

PURPOSE OF THIS GUIDE

The goal of this guide is to provide an integrated curriculum framework that blends the learning and performance expectations in the Automotive Career Pathway with New Mexico core academic standards and expected workforce skills.

This guide contains:

- **Course descriptions** for each course offered within the Automotive Pathway
- **Foundation Standards**, that include critical academic content standards necessary for all courses offered in the Automotive Pathway; and
- **Pathway Standards** and **Assessment Illustrations** specific to each course.

AUTOMOTIVE CAREER PATHWAY

Small Engine Mechanics and Automotive Technology

The Automotive Career Pathway is designed to provide a foundation in small engine repair and automotive technology for students in the Albuquerque Public Schools. The pathways emphasize real-world, occupationally relevant experiences of significant scope and depth in Small Engine Mechanics and Automotive Technology. The standards are designed to integrate academic and technical preparation with a focus on career awareness, career exploration, and skill preparation in two pathways. Integral components include: classroom, laboratory, contextual learning, and project- and work-based instruction, as well as: internship, community classroom, cooperative career technical education, and leadership development. The Small Engine Mechanics and Automotive Technology Pathway will prepare students for postsecondary education and employment in the transportation industry, which includes but is not limited to motor vehicles, marine applications, and outdoor power equipment. The courses include:

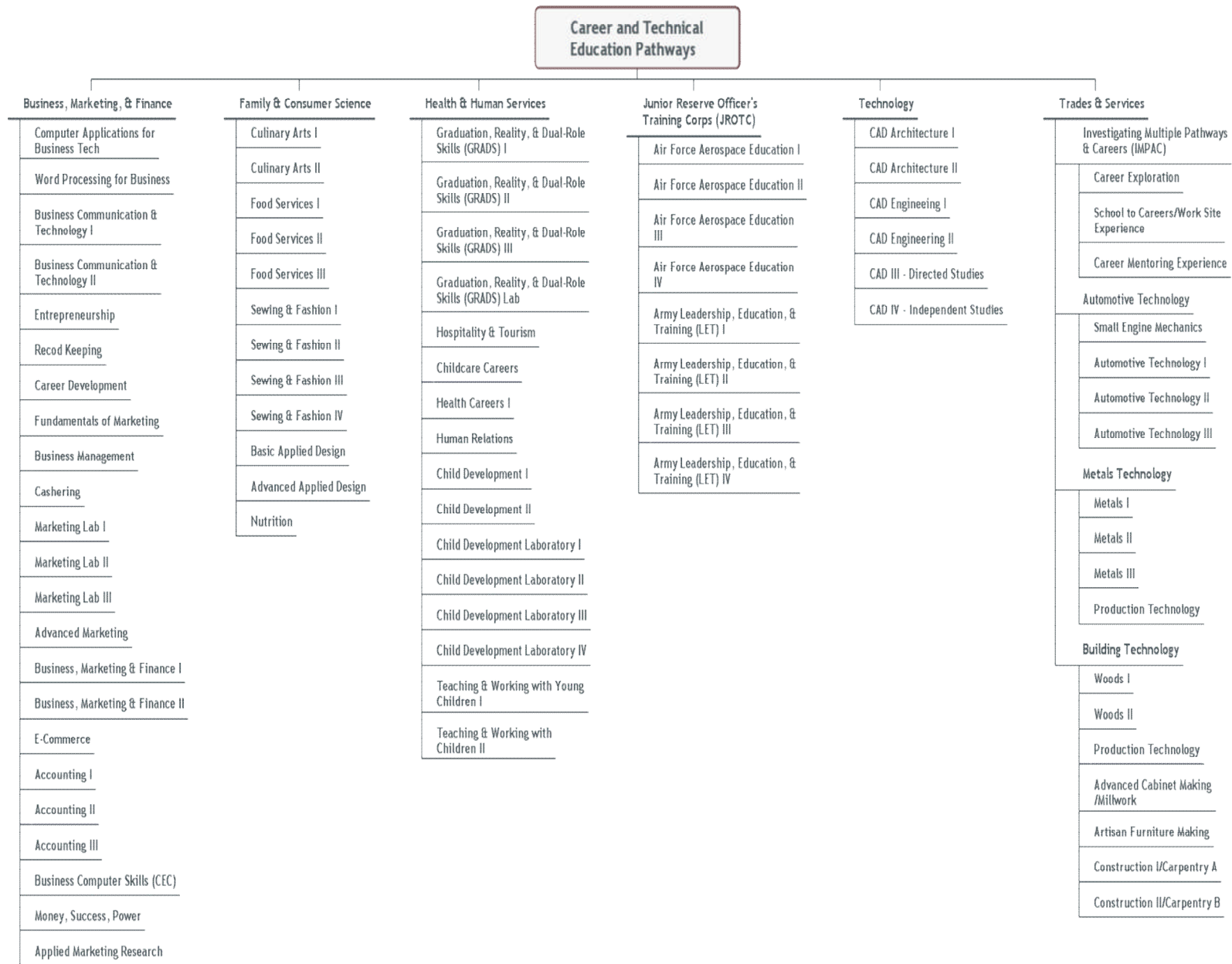
Small Engine Mechanics is designed for the student to gain knowledge of the function, diagnosis, and service of the systems and components of internal combustion engines.

Automotive Technology I is designed for the student to learn how to maintain his personal automobile.

Automotive Technology II enhances the application of the knowledge and skills learned in Automotive Technology I. This course is designed to prepare students with the fundamentals needed to study, diagnose, and repair automotive mechanical and electrical systems.

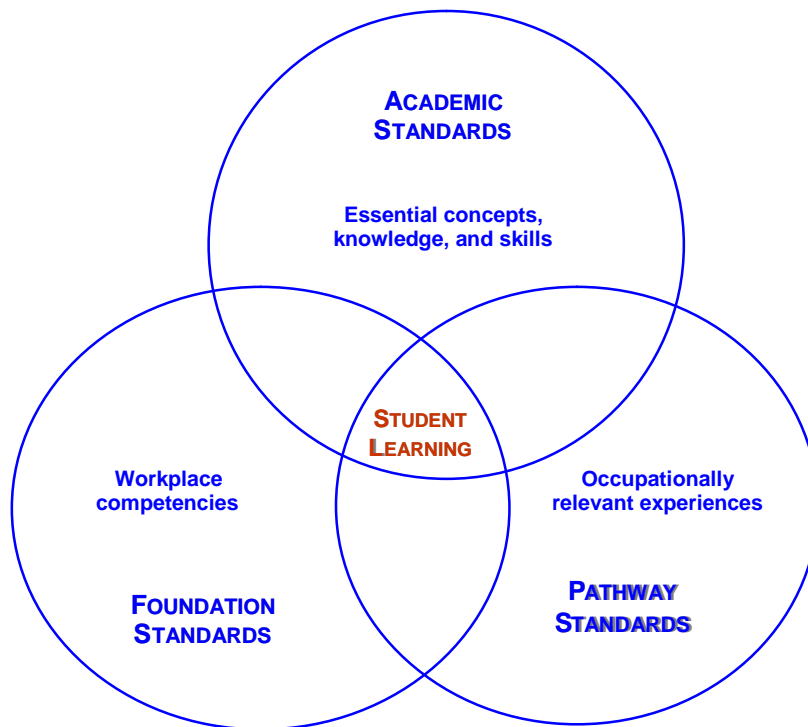
Automotive Technology III enhances the application of the knowledge and skills learned in Automotive Technology II. This course is designed as an automotive laboratory course that deals with the diagnosis and repair of common automotive problems.

The laboratory components of the courses include activities that follow guidelines of the National Automotive Technicians Education Foundation (NATEF) and the National Institute of Automotive Services (ASE).



Automotive Career Pathway Framework

Career and Technical Education (CTE) students need to master certain workplace skills. The Secretary's Commission on Achieving Necessary Skills (SCANS) calls these essentials "foundation skills" because they prepare students to master workplace competencies both within the curriculum and in the workplace. These foundation standards are common to all of the Albuquerque Public Schools' CTE clusters.



The Automotive Career Pathway Foundation Standards include the New Mexico Academic Content Standards.

The following three tabs contain these academic standards, and are labeled:

- Mathematics Content Standards,
- Science Content Standards, and
- Language Arts Content Standards.

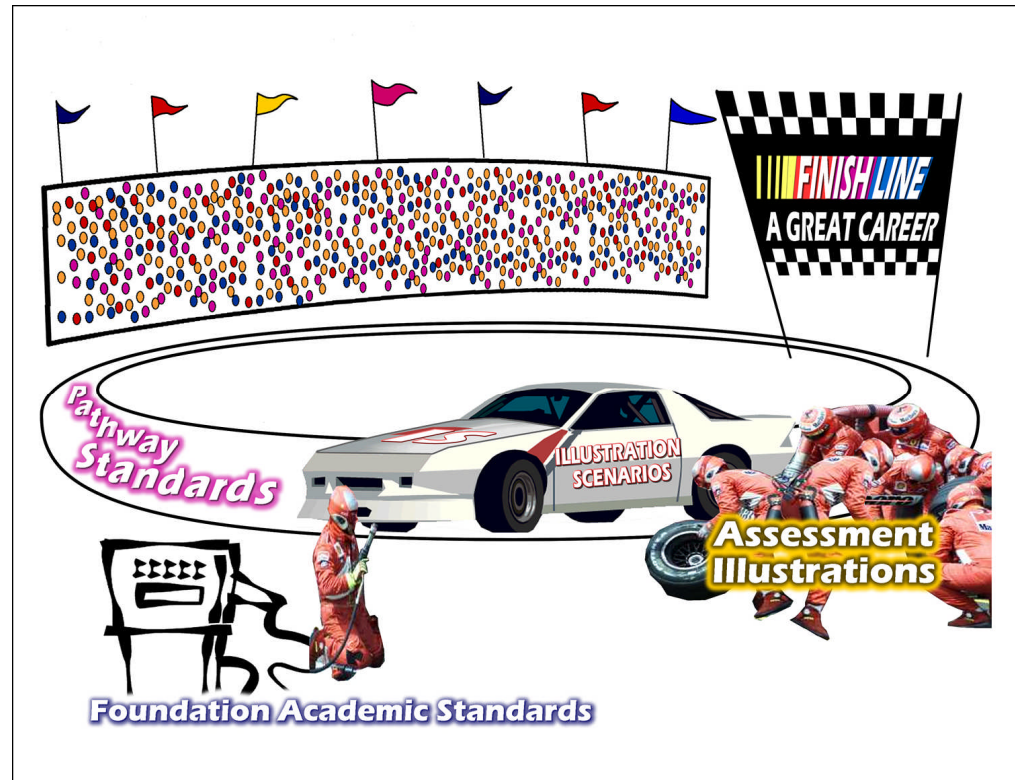
The remaining nationally recognized Foundation Standards are found under the Workforce Skills tab.

The Foundation Standards include workplace competencies. The Core Academic Standards articulate essential concepts, knowledge, and skills. The Pathway Standards contain occupationally relevant materials. When integrated, these three components intersect, creating relevant and successful student learning.

The Relationship Between Foundation Standards, Pathway Standards Assessment Illustrations, and Integration Scenarios

In understanding how these components relate to each other, consider this:

- The **pathway standards** are the track, or super-highway, providing the most direct route between where a student currently is (in school) and their ultimate destination (an engaging and productive career).
- The **illustration scenarios** (or lessons) are the vehicle that moves the student along the track, or highway, and gives students hands on experience in their chosen program of study.
- The **assessment illustrations** are the diagnostics, and instructors use the assessments provided, augmented by their own understanding and any assessment tools they create, to determine where a student is on the track and how ably and quickly they are moving toward the finish line.



- Most importantly, the **foundation standards** are the fuel. The foundation standards, which include the core academic standards, enable students to be successful in their chosen program of study.

Mathematics Academic Content Standards

1.0 Academics

Students understand the academic content required for entry into postsecondary education and employment within the automotive industry.

The **critical mathematics standards** that build a foundation under the Automotive Career Pathway are:

- CMS 1: **Perform conversions with multiple terms between metric and US standard measurement systems.**
(Reference: Mathematics, Grade 8, Strand "Measurement," Standard "Understand measurement..." Benchmark "Apply appropriate techniques..." Performance Standard 5)
- CMS 2: **Demonstrate understanding of the relationships between ratios, proportions, and percents and solve for a missing term in a proportion.** (Reference: Mathematics, Grade 8, Strand "Algebra," Standard "Algebraic concepts and applications..." Performance Standard 4)
- CMS 3: **Use graphs, tables, and algebraic representations to make predictions and solve problems that involve change.**
(Reference: Mathematics, Grade 8, Strand "Algebra," Standard "Analyze changes in various contexts" Performance Standard 1)
- CMS 4: **Model real-world phenomena using linear and quadratic equations and linear inequalities (e.g. apply algebraic techniques to solve rate problems, work problems, and percent mixture problems).**
(Reference: Mathematics, Grade 9-12, Strand "Algebra, Functions, and Graphs", Standard: "Use mathematical models to represent and understand quantitative relationships", Performance Standard 1.)
- CMS 4: **Generate an algebraic sentence to model real-life situations.**
(Reference: Mathematics, Grade 9-12, Strand "Algebra, Functions, and Graphs", Standard: "Use mathematical models to represent and understand quantitative relationships", Performance Standard 9.)
- CMS 5: **Calculate the percentage increase and decrease of a quantity.**
(Reference: Mathematics, Grade 9-12, Strand "Algebra, Functions, and Graphs", Standard: "Analyze changes in various contexts", Performance Standard 3.)
- CMS 6: **Evaluate the estimated rate of change in the context of the problem.**
(Reference: Mathematics, Grade 9-12, Strand "Algebra, Functions, and Graphs", Standard: "Analyze changes in various contexts", Performance Standard 6.)
- CMS 7: **Understand the differences between the various methods of data collection.**
(Reference: Mathematics, Grade 9-12, Strand "Data Analysis and Probability", Standard: "Formulate questions, analyze data, and determine probabilities", Performance Standard 1).
- CMS 8: **Understand the meaning of measurement data and categorical data, and the term 'variable'.**
(Reference: Mathematics, Grade 9-12, Strand "Data Analysis and Probability", Standard: "Select and use appropriate statistical methods to analyze data", Performance Standard 1).

Science Academic Content Standards

1.0 Academics

Students understand the academic content required for entry into postsecondary education and employment within the automotive industry.

The **critical science standards** (CSS) that build a foundation under the Automotive Career Pathway are in grades 9-12 and are in three categories: energy, forces, and chemistry:

ENERGY:

CSS 1: **Identify different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic.**

CSS 2: **Understand that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and know that energy is conserved in these changes.**

CSS 3: **Understand that the ability of energy to do something useful (work) tends to decrease (and never increases) as energy is converted from one form to another.**

(Reference: Science, Grade 9-12, Strand II, Standard I, Benchmark II, Performance Standard 1, 3, & 6)

FORCES:

CSS 4: **Apply Newton's Laws to describe and analyze the behavior of moving objects.**

CSS 5: **Understand the relationship between force and pressure, and how the pressure of a volume of gas depends on the temperature and the amount of gas.**

(Reference: Science, Grade 9-12, Strand II, Standard I, Benchmark III, Performance Standard 4 & 8)

CHEMISTRY:

CSS 6: **Know that chemical reactions involve the rearrangement of atoms, and that they occur on many timescales (e.g., picoseconds to millennia).**

CSS 7: **Understand types of chemical reactions (e.g., synthesis, decomposition, combustion, redox, neutralization) and identify them as exothermic or endothermic.**

CSS 8: **Know how to express chemical reactions with balanced equations that show conservation of mass and products of common reactions.**

CSS 9: **Describe how the rate of chemical reactions depends on many factors that include temperature, concentration, and the presence of catalysts.**

(Reference: Science, Grade 9-12, Strand II, Standard I, Benchmark I, Performance Standards 12, 13, 14, & 15)

Language Arts Academic Content Standards

2.0 Communication

Students understand the principles of effective oral, written, and multimedia communication in a variety of formats and contents.

The **critical language arts standards** (CLAS) that build a foundation under the Automotive Career Pathway are:

CLAS 1: **Respond to informational texts by using a variety of strategies for preparation, engagement, and reflection, including: paraphrasing main ideas and supporting details.**

(Reference: Strand: Reading & Listening for Comprehension: Standard I, Benchmark IA: Listen to, react to, and analyze information, Grade 11 Performance Standard 3.)

CLAS 2: **Demonstrate proficiency in accessing and sending information electronically.**

(Reference: Strand: Reading & Listening for Comprehension: Standard I, Benchmark IB: Synthesize and evaluate information to solve problems across the curriculum, Grade 11, Performance Standard 4.)

CLAS 3: **Accurately interpret information from and detect inconsistencies in a variety of informational, literary, and technical texts.**

CLAS 4: **Accurately interpret information presented in a technical format (e.g. charts, diagrams, tables.)**

(Reference: Reading & Listening for Comprehension: Standard I, Benchmark ID: Apply knowledge of reading process to evaluate print, non-print, and technology-based information. Grades 9, 11: Performance Standards: 3 and 5)

CLAS 5: **Make well-informed and well-organized formal presentations with a clear main point, adjusting the message, wording, and delivery to the particular audience and context.**

(Reference: Strand: Writing and Speaking for Expression: Standard: II, Benchmark II-A, Communicate information in a coherent and persuasive manner using verbal and non-verbal language. Grade 10: Performance Standard 2)

Workforce Skills Foundation Standards

The **critical workforce skills** that build a foundation for the Automotive Career Pathway are:

3.0 Career Planning and Management

Students understand how to make effective decisions, use career information, and manage personal career plans, and:

- 3.1 Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers.
- 3.2 Understand the scope of career opportunities and know the requirements for education, training, and licensure.
- 3.3 Develop a career plan that is designed to reflect career interests, pathways, and postsecondary education.
- 3.4 Understand the role and function of professional organizations, industry associations, and organized labor in a productive society.
- 3.5 Understand the past, present, and future trends that affect careers, such as technological developments and societal trends, and the resulting need for life-long learning.
- 3.6 Know key strategies for self-promotion in the hiring process, such as job applications, résumé writing, interviewing skills, and portfolio preparation.

4.0 Technology

Students know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments, and:

- 4.1 Understand the influence of current and emerging technologies as they relate to the small engine and the automotive industry.
- 4.2 Understand the use of technological resources to access, manipulate, and produce information, products, and services.
- 4.3 Understand the influence of current and emerging technologies on selected segments of the economy.
- 4.4 Understand the role and function of state-of-the art tools, equipment, and machines in use in the industry.
- 4.5 Know key aspects of the current economy and labor market, including the type of good and services produced, the type of skills workers need, the effects of rapid technological change, and the impact of international competition.

5.0 Problem Solving and Critical Thinking

Students understand how to create alternative solutions by using critical and creative thinking skills, such as logical reasoning, analytical thinking, and problem-solving techniques, and:

- 5.1 Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks.
- 5.2 Understand the systematic problem-solving models that incorporate input, process, outcome, and feedback components.
- 5.3 Use critical thinking skills to make information decisions and solve problems.
- 5.4 Apply troubleshooting strategies, including failure analysis procedures, to issues as they arise.
- 5.5 Understand and demonstrate the ability to plan and solve problems in a systematic manner and apply the learned skill to real-world problems.

6.0 Health and Safety

Students understand health and safety policies, procedures, regulations, and practices, including equipment and hazardous material handling, and:

- 6.1 Know policies, procedures, and regulations regarding health and safety in the workplace, including employers' and employees' responsibilities.
- 6.2 Understand critical elements for health and safety practices related to storing cleaning, and maintaining tools, equipment, and supplies.

- 6.3 Use tools, equipment, and machinery safely and appropriately.
- 6.4 Know local, state, and federal laws, and the requirements of regulatory agencies, that affect the small engine and automotive industry.

7.0 Responsibility and Flexibility

Students know the behaviors associated with the demonstration of responsibility and flexibility in personal, workplace, and community settings, and:

- 7.1 Understand the qualities and behaviors that constitute a positive and professional work demeanor.
- 7.2 Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.
- 7.3 Understand the need to adapt to varied roles and responsibilities.
- 7.4 Understand that individual actions can affect the larger community.

8.0 Ethics and Legal Responsibilities

Students understand professional, ethical, and legal behavior consistent with applicable laws, regulations, and organizational norms, and:

- 8.1 Know major local, district, state, and federal regulatory agencies and entities that affect industry and how they enforce laws and regulations.
- 8.2 Understand the concept and application of ethical and legal behavior consistent with workplace standards.
- 8.3 Understand the role of personal integrity and ethical behavior in the workplace.

9.0 Leadership and Teamwork

Students understand effective leadership styles, key concepts of group dynamics, team and individual decision making, the benefits of workforce diversity, and conflict resolution, and:

- 9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.
- 9.2 Understand the ways in which pre-professional associations and competitive career development activities enhance academic skills, promote career choices, and contribute to employability.
- 9.3 Understand how to organize and structure work individually and in teams for effective performance and attainment of goals.
- 9.4 Know multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace.
- 9.5 Understand how to interact with others in ways that demonstrate respect for a variety of situations in the workplace.
- 9.6 Participate as a member of a team and contribute to a group effort.

10.0 Technical Knowledge and Skills

Students understand the essential knowledge and skills common to all pathways in the Trades and Services sector, and:

- 10.1 Understand how to use and maintain small engine and automotive technological products and systems.
- 10.2 Understand the applications of transportation technology to land, water, and air/space.
- 10.3 Understand the resources used to transport people and goods.
- 10.4 Operate, maintain, and troubleshoot equipment.
- 10.5 Understand how to select and use information and communication technologies.
- 10.6 Understand the need to participate in sector-related professional improvement activities related to career pathway specialization.
- 10.7 Understand the need to obtain and maintain industry –standard, technical certifications significant to an industry sector.

11.0 Demonstration and Application

Students demonstrate and apply the concepts contained in the foundation and pathway standards.

Small Engine Mechanics: Pathway Standards

Small Engine Mechanics is designed for the student to gain knowledge of the function, diagnosis, and service of the systems and components of internal combustion engines. The student disassembles and reassembles school- or personally-owned engines to gain experience in hand tool use and proper engine repair and evaluation procedures.

Course components include critical NM mathematics (CMS), science, (CSS), and language arts (CLAS) academic content standards. The laboratory component of the course includes various activities that follow the guidelines of the National Automotive Technicians Education Foundation (NATEF) and the National Institute for Automotive Service Excellence (ASE), and includes critical NM mathematics (CMS), science (CSS) and language arts (CLAS) academic content standards. This course is designed for students with no previous industry experiences.

STRAND I: OCCUPATIONAL SAFETY

CONTENT STANDARD: *The student understands occupational safety issues including the avoidance of physical and environmental hazards in the work environment.*

- A. The student identifies, selects, and uses correct safety rules in the shop.
 - 1. Operates and uses equipment and tools in the shop safely and efficiently (ASE-WS-I 2, 4).
 - 2. Identifies and demonstrates individual responsibilities and personal traits of safe work habits (ASE-WS-I 2, 4).
 - 3. Identifies and uses personal protective equipment required in each shop (ASE-WS-I 2, 4).
 - 4. Uses graphs and tables (CMS 3) to develop a list of environmental hazards and can identify ways of dealing with health and safety concerns (ASE-WS-I 4).
 - 5. Accesses electronic information (CLAS 2), collects data, interprets technical information (CLAS 4), and identifies ways to effectively secure work areas (CMS 8) (ASE-WS-I 1, 2).
 - 6. Uses information text (CLAS 1) and follows shop rules and OSHA/EPA guidelines for personal safety (ASE-WS-I 1, 2).
 - 7. Follows manufacture's recommendation for equipment (ASE-WS-I 1, 2).
 - 8. Follows shop rules and EPA guidelines for disposal/recycling of used oil, antifreeze, refrigerants, and wastes (ASE-WS-I 1, 2).
 - 9. Understands forces, pressure, and chemical hazards (CSS 4, 5, 6, 7) and applies industry specific hazardous communications and material regulations to the workplace situation (ASE-WS-I 1, 3).
 - 10. Practices fire prevention and fire safety procedures (ASE-WS-I 1, 3).
 - 11. Identifies and demonstrates responsible behavior related to safety issues (ASE-WS-I 6).
 - 12. Uses measurement data to understand health hazards related to work in the shop (CMS 9)(ASE-WS-I 2, 3).

STRAND II: SMALL ENGINE REPAIR

CONTENT STANDARD: *The student understands the basic theory, design, and operation of automotive engines.*

- B. The student performs engine mechanical maintenance, adjustment, or repair.
 - 1. Uses charts, diagrams, and tables (CLAS 4) to identify the types of small engines (ASE-A1).
 - 2. Uses graphs, tables (CMS 3), and informational text (CLAS 1) to explain the function of small engines and their components (ASE-A1).
 - 3. Understands the ability of energy to do useful work (CSS 3) and how force relates to the behavior of moving objects (CSS 4).
 - 4. Understands the relationship between force and pressure and how pressure of a gas depends on temperature and the amount of gas (CSS 5).

5. Troubleshoots and repairs small engines ASE-A5).
6. Performs preventative maintenance on small engines ASE-A1).
7. Disassembles and assembles engines using proper procedures ASE-C1).
8. Creates models (CMS 4) to analyze malfunctions and removes, repairs, and replaces automotive engine components ASE-A1).
9. Identifies different forms of energy (CSS 1) and their transformations (CSS 2) in an internal combustion engine.
10. Utilizes electronic information (CLAS 1, 2) to perform a thorough engine inspection, including appropriate engine specifications (ASE-A1).
11. Uses measurement data (CMS 9) and demonstrates competence in locating and utilizing appropriate engine specifications (ASE-A1).
12. Demonstrates knowledge of new and emerging technologies that may affect the service of small engines (ASE-A1).

STRAND III: SCIENCE

CONTENT STANDARD: *The student understands scientific principles as they apply to physical and chemical functions in automotive systems.*

- C. The student uses scientific principles to explain how systems function and malfunction.
 1. Analyzes and evaluates waste products from the repair task and disposes of the parts, residue, or trash according to applicable federal, state, and local rules and regulations (ASE-Sc 1).
 2. Converts measurements taken using the English or metric system (CMS 1) to specifications stated in terms of either system (ASE-5c 5).
 3. Explains and demonstrates an understanding of the chemical reaction (CSS 7) that occurs in an automobile regarding the combustion of fuels, catalytic converters, and contamination when introduced into the systems (ASE-5c 6).
 4. Explains the purposes of additives in lubricants (ASE-Sc 7).
 5. Demonstrates an understanding of the kinetic and potential energy relationship (CSS 1) that occur in valve systems, ignition systems, and other stored energy systems, such as springs and fuels, and determine efficiency (ASE-Sc 8).
 6. Explains the relationship of centrifugal and centripetal force (CSS 4) to the failure of rotating systems (ASE-Sc 8).
 7. Demonstrates an understanding of the effect of heat (CSS 9) on automotive systems (ASE-Sc 11).
 8. Demonstrates an understanding of the expansion and contraction (CSS 3) of system parts as a result of heat generated during use and the cooling of the system when not in operation (ASE-Sc 13).
 9. Demonstrates an understanding of the process of acceleration and deceleration (CSS 4) as a function of weight and available power (ASE-Sc 15).
 10. Demonstrates an understanding of the reaction of fluid to the motion (CSS 5) of a valve or piston (ASE-Sc 16).
 11. Demonstrates an understanding of the types of vibrations (CMS 9) caused by out-of-balance or excessively worn systems (ASE-Sc 18).
 12. Explains and demonstrates an understanding of the role of listening to sounds as part of the trouble-shooting process (ASE-Sc 22).
 13. Explains how levers and pulleys (CSS 4) can be used to increase an applied force or distance (ASE-Sc 24).
 14. Identifies the characteristics that define a system that is operating within the manufacturer's specifications (ASE-Sc 25).
 15. Uses precision measuring devices (CMS 9) to determine if wear and adjustments are within the manufacturer's specifications, and to assure that repair or replacement parts meet the manufacturer's specifications (ASE-Sc 26).
 16. Uses tension gauges, such as a torque wrench, to measure the force or tension required to tighten connections (CSS 4) to the

- manufacturer's specification (ASE-Sc 27).
17. Uses pressure measuring tools (CSS 5) to determine pressures in hydraulic or pneumatic systems and compare to the manufacturer's specifications (ASE-Sc 28).
 18. Uses direct and indirect methods to measure system temperatures and then converts to Fahrenheit or Centigrade (CMS 1) as required (ASE-Sc 28).
 19. Uses direct and indirect methods to measure the volume of liquids in a system and compares to the manufacturer's specifications (ASE-Sc 31).
 20. Uses computer databases for information retrieval (CLAS 2) and input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes (ASE-Sc 32).
 21. Explains how an applied force (CSS 5) at one location can be transmitted via fluid pressure to provide a force at a remote location (ASE-Sc 33).
 22. Explains to the customer (CLAS 5) the need for lubrication of adjacent parts to minimize friction as a result of movement at the junction of the parts (ASE-Sc 35).

STRAND IV: MATH

CONTENT STANDARD: *The student understands mathematics principles as they apply to automotive systems.*

- D. The student applies knowledge of mathematics skills that is embedded in the automotive field.
1. Analyzes and solves problems (CMS 3) requiring the use of fractions, decimals, ratios, or percentages (CMS 2) by direct or indirect variation of the numerical elements of the problem (ASE-Math 6).
 2. Determines and interprets place value (e.g., tenths, hundredths, thousandths) when conducting precision measurements (CMS 9) (ASE-Math 8).
 3. Measures and/or tests with tools designed for English or metric measurements, then converts the results (CMS 1) to the manufacturer's system used for specifying the correct measurement or tolerance (ASE-Math 29).
 4. Computes mentally (CMS 5) whether the observed measurement is out of tolerance when comparing the observed measurement to the manufacturer's specifications (ASE-Math 30).
 5. Distinguishes whether a measurement or tolerance is equal or not equal (CMS 9) to the manufacturer's specifications (ASE-Math 31).

STRAND V: LANGUAGE ARTS

CONTENT STANDARD: *The student understands language arts principles as they apply to automotive technology.*

- E. The student uses informational texts, accesses and sends information electronically, accurately interprets technical information, and makes well-informed and well-organized presentations.
1. Requests, collects, comprehends, evaluates, and applies oral and written information (CLAS 1) gathered from customers, associates, and supervisors regarding problem symptoms and potential solutions to problems (ASE-LA 1).
 2. Identifies the purpose of all written and oral communication and then chooses the most effective strategies for listening, reading, speaking, and writing (CLAS 5) to facilitate the communication process (ASE-LA 2).
 3. Adapts a reading strategy for all written materials (e.g., customer's notes, service manuals, shop manuals, technical bulletins) relevant to problem identification, diagnosis, solution, and repair (CLAS 5) (ASE-LA 3).
 4. Attends to verbal and nonverbal cues in discussions with customers, supervisors, and associates to verify, identify, and solve problems (CLAS 5) (ASE-LA 4).

5. Uses study habits and techniques (i.e., previewing, scanning, skimming, taking notes) when reviewing publications (e.g., shop manuals, references, databases, operator's manuals, and text resources) for problem solving (CLAS 1) (ASE-LA 7).
6. Writes clear, concise, complete, and grammatically accurate sentences and paragraphs (CLAS 5) (ASE-LA 7).
7. Follows all oral and written directions that related to the task or system under study ((CLAS 1) ASE-LA 10).

STRAND VI: WORKPLACE SKILLS

The student identifies, demonstrates, and evaluates skills that prepare him/her for success in the workplace.

F. The student achieves proficiency in various skill areas that affect their employability.

1. Personal Skills
 - a. Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings (ASE-WP-F1).
2. Interpersonal Skills
 - a. Identifies roles as a member of a work team (ASE-WP-F4).
 - b. Works cooperatively and accepts supervision (ASE-WP-E2).
3. Thinking and Problem-Solving Skills
 - a. Acquires and evaluates technical and informational texts (CLAS 3) (ASE-WP-D1).
4. Communication Skills
 - a. Communicates both orally and in writing making well-informed and organized presentations (CLAS 5) (ASE-WP-D1, 4).
 - b. Listens attentively and following instructions (ASE-WP-D3).
 - c. Accurately interprets information (CLAS 4) and requests clarification or additional information as needed (WSE-WP-D2).
5. Employment Literacy Skills
 - a. Follows rules, regulations, and policies as established (ASE-WP-D3).
 - b. Assumes responsibility for decisions and actions (ASE-WP-E1).
 - c. Accesses information electronically (CLAS 2) and identifies steps to accomplish a task (ASE-WP-D3).
 - d. Identifies job acquisition skills (ASE-WP-F1).

Small Engine Mechanics: Assessment Illustrations

Note: These assessment illustrations include suggested activities for attaining each performance standard, with at least one key feature to look for while assessing student performance. A check (✓) refers to a key feature to look for while assessing student performance.

STRAND I: OCCUPATIONAL SAFETY

CONTENT STANDARD: *The student understands occupational safety issues including the avoidance of physical and environmental hazards in the work environment.*

- 1, 2, 3, 7, 8. The instructor divides the class into five groups, each representing an area of safety (Attitude, Neatness, Appropriate Dress, Tools and Equipment, Hazardous Materials). Each group brainstorms safe work habits related to their area of safety, offering examples of how the habits identified applies to the course. Findings are presented in a visual aid form, such as a poster, and posted in class. Demonstrated knowledge includes:
- ✓ Appropriate examples of safe work habits
 - ✓ Components of oral presentations and communication skills
 - ✓ Preparation of suitable visual aid
- 1, 5, 6, 10 The instructor and/or safety personnel present topic specific safety tips (many presentations can be scheduled, focusing on various topics relating to safety). After each presentation, students offer demonstrations on the tips presented. Demonstrated knowledge includes:
- ✓ Appropriate understanding of safety rules and practices
 - ✓ Absence of personal injury or damage to property during the demonstration
 - ✓ Achievement of safety standards while completing the job in the allotted ti
 - ✓ Proper use and storage of tools and equipment upon completion of the demonstration
- 4, 9, 11, 12 Students are divided into groups. Each group creates a chart detailing the hazardous materials used in the shop/lab. Each chart should include “The Source” (i.e. the type/style of container that contains the substance), “Important Information” (including an explanation and/or guidelines on how to use the substance), and “What Not to Do” (detailing ways the substance should not be handled). The student groups use various resources (including print material, interviews, and the internet) to research the information contained in the chart, and also present the information contained in their chart to the class. Demonstrated knowledge includes:
- ✓ Appropriate use of technology, reading, and researching abilities to obtain the correct information
 - ✓ Proper use of language and understanding of layout to produce visual aid
 - ✓ Achievement of communication skills for oral presentation

STRAND II: SMALL ENGINE REPAIR

CONTENT STANDARD: *The student understands the basic theory, design, and operation of automotive engines.*

- 1, 2 The instructor provides a variety of diagrams or exploded views of engines and/or engine components. Students label the components shown in each diagram and provide a written explanation of its function. Suggestions for diagrams include: V-6 engine, cylinder, engine block, crankshaft, fuel system, cooling system, and exhaust system. Demonstrated knowledge includes:
- ✓ Correct identification of parts from memory
 - ✓ Accurate explanation of system and its functioning, using correct spelling, grammar, and punctuation

- 3, 4, 5, 6, 7, 8, 9 Students read through a specific tool's instruction manual, including the description of the manufacturer's specifications, and directions for use. The instructor, acting as a customer, explains what is wrong with their car/engine. Students listen to the problem(s), determine a diagnosis(ies), and solution(s). They fill out a job order, including total amount of time needed for the repair, labor costs and parts costs. Findings are presented to the class and/or the instructor for discussion/review. Possible engine problems include: routine maintenance, noise, loss of power, power engine performance failure, increased fuel and oil consumption, or high exhaust emissions. Demonstrated knowledge includes:
- ✓ Successful listening and communication skills
 - ✓ Successful thinking and problem-solving skills
 - ✓ Appropriate understanding of engine function and correct diagnostic assessment
 - ✓ Accurate written completion of work order form
 - ✓ Correct demonstration and completion of repair
 - ✓ Technical skills

STRAND III: SCIENCE

CONTENT STANDARD: *The student understands scientific principles as they apply to physical and chemical functions in automotive systems.*

- 1, 2, 3 Students choose either their garage at home, the school's auto shop, or an auto parts store to use for this task. At one of these locations, students choose a variety of automotive fluids (e.g., brake, coolant, engine oil, transmission, power steering,), placing a spot of each one on a towel or rag. Taking each fluid separately, students analyze the properties of each spot (e.g., what color is it? Does it have an odor? How does it feel?), to find key ways to identify each type of automotive fluid. Once the student feels confident in their knowledge of the properties of each fluid, they conduct a "blind test" by dipping rags into various fluids and identifying as many as they can without looking at the containers. Students then properly discard the rags and clean up the fluids in an appropriate manner. This task can be done by students individually or within groups. Demonstrated knowledge includes:
- ✓ Successful identification of ways fluids differ
 - ✓ Correct matching of spots with fluids
 - ✓ Safe use of cleaning products
 - ✓ Proper disposal methods for rags
- 4 Students read a thermometer that has both Celsius and Fahrenheit readings. Students then put the thermometers away. The instructor hands out worksheets. On one side of the worksheet are the Celsius readings. The other side is blank. Students convert the temperatures, showing the math formulas used to convert the readings. Demonstrated knowledge includes:
- ✓ Critical thinking of correct math formulas to use for conversion
 - ✓ Appropriate knowledge of sequential math steps when converting
- 5, 7 Students are given the automotive problem of low fuel pressure. Using the vehicle manufacturer's service manual, students conduct a fuel pump test. Demonstrated knowledge includes:
- ✓ Problem solving
 - ✓ Reading and technology skills by appropriately reading the diagnostic tree or diagram
 - ✓ Critical thinking by following the proper steps of diagnostic testing

17,18 The instructor, acting as a customer, explains what is wrong with their car/engine. Students listen to the problem(s), determine a diagnosis (ies), and solution(s). They fill out a job order, including total amount of time needed for the repair, labor costs and parts costs. Students describe the tools and protective clothing used during the repair. Findings are presented to the class and/or the instructor for discussion/ review. Possible repair situations include (with the corresponding performance standard):

- ✓ [Performance Standard 5] "The engine keeps stalling."
- ✓ [Performance Standard 6] "I have a leak, but I can't determine from where."
- ✓ [Performance Standards 7, 8] "When I pull up to a stoplight, my car will quite often just quit running, or my engine surges."
- ✓ [Performance Standards 9, 10] "The car is overheating and stalls at stop signs."
- ✓ [Performance Standards 11, 13] "The temperature gauge shows a high reading and the engine has stopped running."
- ✓ [Performance Standards 12, 15, 16] "The car doesn't accelerate well when I am pulling my travel trailer behind my car."
- ✓ [Performance Standards 14, 21] "The engine makes a very loud noise when it is running. It sounds like a tractor."
- ✓ [Performance Standard 19] "The steering is difficult."
- ✓ [Performance Standard 20] "My car needs preventative maintenance."
- ✓ [Performance Standards 21, 22] "My car wont turnover when I start it. It just clicks."

Demonstrated knowledge includes:

- ✓ Critical thinking to determine cause, problem, diagnosis and repair solution
- ✓ Appropriate listening skills to hear correct customer cues and explanation of problem
- ✓ Correct technician list of causes, diagnosis, checks/corrections, and explanations
- ✓ Application of safety tips
- ✓ Proper selection and use of tools

STRAND IV: MATH

CONTENT STANDARD: *The student understands mathematics principles as they apply to automotive systems.*

1, 2, 4, 5. The instructor presents students with a problem that applies math relating to a dry compression test for a four cylinder engine: The compression readings in the cylinders are 145 psi, 142 psi, 123 psi, and 105 psi. Are the readings within specification? Student reaches their conclusion by comparing the compression in each cylinder with the manufacturer's specifications in the service manual and converting the readings to metric measurements. Students are then asked to explain the answer they provide for review/ discussion by the instructor and/or class. Demonstrated knowledge includes:

- ✓ Appropriate knowledge of correct mathematical formula
- ✓ Ability to properly use formula to obtain the correct math computation
- ✓ Appropriate oral skills in explaining their answer.

1, 3. The instructor provides a metric/customary measurement conversion chart, and a variety of tools and/or pictures of tools with their exact measurements. Solo or in pairs, students note on paper the type of tool pictured or provided, and the tool's measurement and conversion. This type of activity demonstrates:

- ✓ Appropriate identification of tools
- ✓ Knowledge of mathematical formulas for conversion
- ✓ Critical thinking

STRAND V: LANGUAGE ARTS

CONTENT STANDARD: *The student understands language arts principles as they apply to automotive technology.*

- 1, 6. Students obtain a service bulletin from the shop/lab, their place of employment, and/or a dealership. On a separate sheet of paper, students write down: the topic(s) covered by the service bulletin, and a paragraph explaining why it was important for the manufacturer to inform automotive technicians about the information contained in the bulletin. Demonstrated knowledge includes:
 - ✓ Correct paragraph form
 - ✓ Correct spelling, punctuation, and grammar
 - ✓ Critical thinking and ability to accurately identify information
 - ✓ Ability to explain and support view
2. Students prepare an explanation of how an automotive system functions and the problem a customer is having. Emphasis is on using language the customer will comprehend. Students use a flow chart and/or diagram to assist with their explanation. Students then present their explanation and visual aids to the class. The class and instructor offers evaluative input. Demonstrated knowledge includes:
 - ✓ Translation of technical terms into language the customer can comprehend
 - ✓ Communication skills when explaining to the customer
 - ✓ Appropriate knowledge of systems functions and issues
 - ✓ Accurate drawing
3. Students select a service manual, and look up a procedure of their choice used in car repairs. Student then list the steps, in order, identifying the tools needed for each step of the repair. Students put the list into an instructional format to present to another student. Demonstrated knowledge includes:
 - ✓ Knowledge of appropriate steps in their right sequence for the procedure
 - ✓ Correct tools for use in procedure
 - ✓ Appropriate information format for instruction
- 4, 7. Students pair up for a role play. One student acts as the customer, the other acts as the technician. The “customer” explains the vehicle’s problem(s) to the “technician.” The “technician” responds by asking specific investigative questions relating to: Who, When, Where, and How. The “technician” then explains the diagnosis process they are using to determine the problem, identifies the problem and suggests a solution. The focus is on questions asked by the “technician,” with emphasis on questions that are both open-ended and directive to determine the correct problem and solution. After the role plays the class as a whole discusses questions asked, brainstorming others that would be equally and/or more effective. Demonstrated knowledge includes:
 - ✓ Ability to listen and ask appropriate questions
 - ✓ Ability to put questions in appropriate order for correct diagnosis
 - ✓ Knowledge of vehicles, ability to properly diagnose issue and appropriate course of repair
 - ✓ Communication skills
5. Students form groups of two or more. Each group: lists hazardous materials used in the shop/lab, and creates a chart detailing: “The Source” (i.e. the type/style of container that contains the substance), “Important Information” (including an explanation and/or guidelines on how to use the substance), and “What Not to Do” (detailing ways the substance should not be handled). The student uses various resources, including the internet, to research the information to present to the class. Demonstrated knowledge includes:

- ✓ Appropriate use of technology, reading, and researching abilities to obtain the correct information
- ✓ Proper use of language and understanding of layout to produce visual aid
- ✓ Achievement of communication skills for oral presentation

STRAND VI: WORKPLACE SKILLS

CONTENT STANDARD: *The student identifies, demonstrates, and evaluates skills that prepare him/her for success in the workplace.*

- 1, 2, 3. The instructor divides the class into five groups, each representing an area of safety (Attitude, Neatness, Appropriate Dress, Tools and Equipment, Hazardous Materials). Each group brainstorms safe work habits related to their area of safety, offering examples of how the habits identified applies to the course. Findings are presented in a visual aid form, such as a poster, and posted in class. Demonstrated knowledge includes:
 - ✓ Appropriate examples of safe work habits
 - ✓ Components of oral presentations and communication
 - ✓ Preparation of suitable visual aid
- 4, 8, 9, 10. The instructor and/or safety personnel present topic specific safety tips (many presentations can be scheduled, focusing on various topics relating to safety). After each presentation, students offer demonstrations on the tips presented. Demonstrated knowledge includes:
 - ✓ Appropriate understanding of safety rules and practices
 - ✓ Absence of personal injury or damage to property during the demonstration
 - ✓ Achievement of safety standards while completing the job in the allotted time
 - ✓ Proper use and storage of tools and equipment upon completion of the demonstration
 - ✓ Safety rules and practices at all times regarding the demonstration
- 5, 6, 7. Students form groups of two or more. Each group: lists hazardous materials used in the shop/lab, and creates a chart detailing: "The Source" (i.e. the type/style of container that contains the substance), "Important Information" (including an explanation and/or guidelines on how to use the substance), and "What Not to Do" (detailing ways the substance should not be handled). The student uses various resources, including the internet, to research the information to present to the class. Demonstrated knowledge includes:
 - ✓ Appropriate use of technology, reading, and researching abilities to obtain the correct information
 - ✓ Proper use of language and understanding of layout to produce visual aid
 - ✓ Achievement of communication skills for oral presentation
11. Student decide on a career path in the automotive industry, creating list of job acquisition skills necessary to be successful in the industry. The skills are presented on a poster for completion of portfolio.
 - ✓ Knowledge of complete list of skills appropriate for the chosen career path
 - ✓ Creativity and visual aid skills
 - ✓ Writing skills

Small Engine Mechanics: Integration Scenarios

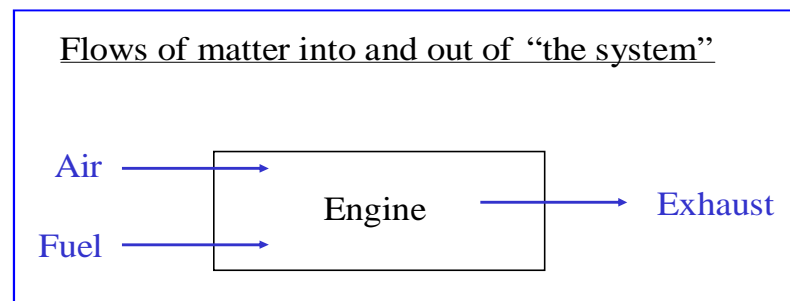
A Science-based Lesson in Small Engine Mechanics

Purpose:

Thinking about something as a “system” having both internal processes and interactions with its surroundings is a very important example of a scientific “model.” (*Science, Grade 7, Strand I, Standard I, Benchmark III, Performance Standard 3: Select and use an appropriate model to examine a phenomenon.*) Examples in science include ecosystems, organ systems, and the solar system. The small engine is an excellent opportunity to reinforce the system-model habit of mind, with increasing sophistication as the course proceeds. The small engine exchanges both matter and energy with its surroundings. Thinking about the engine as a system lets the student appreciate the conservation of matter and energy.

Activity:

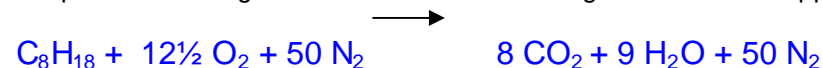
The teacher introduces the activity with a simple “system diagram” of flows of matter into and out of a small engine, like this,



and reminds the students that they can write a balanced chemical reaction to express the conservation of matter in the engine. Air is approximately 80% N₂ and 20% O₂, and fuel is hydrocarbon molecules, mostly C₈H₁₈. So the chemical reaction taking place in the box is



As a cooperative activity, the class can help the teacher figure out what numbers belong where the “??” appears above. The answer is:

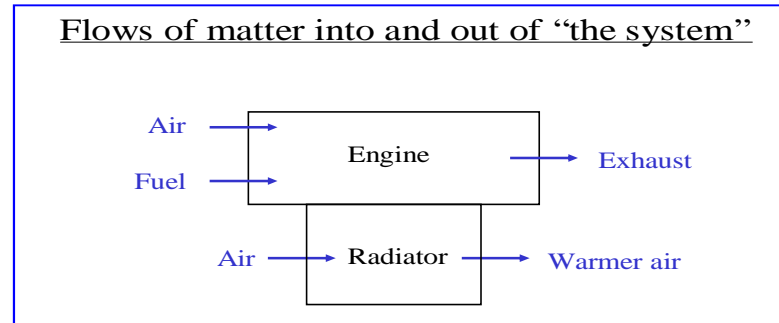


Next the teacher can add a little more sophistication to the diagram, like this:



The first activity for the students to work on is to make a much more sophisticated diagram of the small engine that shows how matter flows into

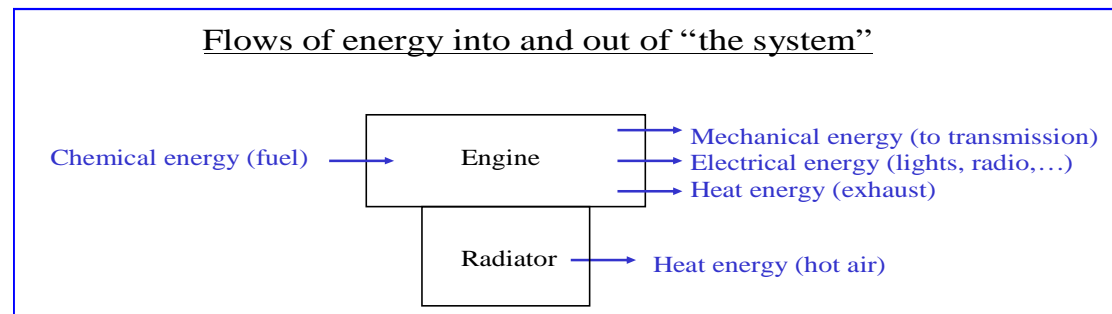
it, through it from subsystem to subsystem, and out of it.



For example, the exhaust manifold, catalytic converter, and muffler could all be shown separately, and some students might even realize that combustion is incomplete in the engine's cylinders and is completed in the catalytic converter. If there has been discussion of old engines with exhaust gas recirculation, some students might choose to draw a diagram of that. Where does piston-ring blowby go? How detailed do you want to be in showing details of water flow? Of oil flow?

After individual students or teams of students have worked with this for a while, it might even be interesting to try to combine everyone's diagrams into a Grand Unified Diagram of All Mass Flows in the Small Engine.

On another day, the teacher could repeat the exercise, but with a focus on energy instead of on matter. The teacher could start with something like this:



and ask the students again to add more details to the diagram, more subsystems either within or just outside of the diagram, focusing on the energy flows through the engine. This is an excellent opportunity to reinforce the students' understanding that energy is neither created nor destroyed; it is only converted from one form to another.

If quantitative estimates of the amounts of power flowing in, through, and out are added, this activity gives the students practice at understanding and interconverting the many different measures of energy—horsepower for mechanical power, Watts for electrical power, calories per second or BTUs per hour for heat energy. The student could estimate what fraction of the chemical energy in the fuel is converted to useful energy. Students could even discuss how much energy is temporarily stored in the engine, for example as kinetic energy of rotation when the engine is revved to high speed or as heat energy when the engine is turned on from a cold start.

Automotive Technology I: Pathway Standards

Automotive Technology I is designed so the student learns how to maintain his personal automobile. Topics range from basic automotive principles to performing preventative maintenance. The laboratory component includes various activities that follow the guidelines of the NATEF and the ASE. This course requires no prior experience with auto mechanics and emphasizes maintenance than can be performed without specialized equipment.

STRAND I: OCCUPATIONAL SAFETY

CONTENT STANDARD: *The student understands occupational safety issues including the avoidance of physical and environmental hazards in the work environment.*

- A. The student identifies, selects, and uses correct safety rules in the shop.
 - 1. Interprets technical information accurately (CLAS 3) and identifies and uses equipment and tools in the shop safely and efficiently (ASE-WS-I 2, 4).
 - 2. Identifies and demonstrates individual responsibility and personal traits of safe work habits (ASE-WS-I 2, 4).
 - 3. Identifies personal protective equipment required in each shop (ASE-WP-I 2).
 - 4. Interprets technical information (CLAS 4) to develop a list of environmental hazards and discusses ways of dealing with health and safety concerns (ASE-WP-I 1, 3).
 - 5. Identifies ways to effectively secure work areas (ASE-WP-I 4).
 - 6. Accesses information electronically (CLAS 2) following shop rules and OSHA/EPA guidelines for personal safety (ASE-WP-I 1, 2).
 - 7. Uses technical information (CLAS 3) to follow manufacturer's recommendations for equipment (ASE-WP-I 1, 2).
 - 8. Follows shop rules and EPA guidelines for disposal and recycling of used oil, antifreeze, refrigerants, and wastes (ASE-WP-I 1, 2).
 - 9. Applies industry specific hazardous communications and material regulations to the workplace situation (CLAS 4)(ASE-WP-I 1, 3).
 - 10. Practices fire prevention and fire safety procedures (ASE-WP-I 1, 3).
 - 11. Identifies and demonstrates responsible behavior related to safety issues (ASE-WP-I 6).
 - 12. Understands health hazards related to work in the shop (ASE-WP-I 2, 3).
 - 13. Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations (ASE/NATEF p 60).

STRAND II: BRAKES

CONTENT STANDARD: *The student understands and demonstrates knowledge and understanding of basic automotive systems*

- B. The student applies knowledge of basic brake systems and their functions.
 - 1. Locates and interprets vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).
 - 2. Uses technical information (CLAS 4) to understand how to identify applicable vehicle and service information, such as brake

- system operation, vehicle service history, service precautions, and technical service bulletins.
3. Identified individual brake systems, its components, and its functions (e.g., drum brakes, non anti-lock disc brakes, parking brakes).
 4. Accurately interprets technical information (CLAS 3,4) to identify and interpret hydraulic brake systems, its components, and its function.
 5. Diagnoses and replaces drum brake pads and shoes.
 6. Diagnoses and replaces disc brake pads and shoes.
 7. Selects, handles, stores, and fills brake fluids to proper level.
 8. Uses data and technical information (CMS 3) and accurately interprets data (CLAS 4) to inspect, measure, and replace wheel studs.
 9. General Brake Systems Diagnosis (ASE/NATEF, pg 60)
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
 - b. Identify and interpret brake system concern modeling a real-life situation (CMS 4); determine necessary action to solve the problem (CMS 3).
 - c. Access electronic information (CLAS 2) to research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins.
 - d. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).
 10. Hydraulic System Diagnosis and Repair (ASE/NATEF, pgs 60-61)
 - a. Measure brake pedal height, collect data (CMS 3); determine necessary action to solve problem (CMS 4).
 - b. Understand relationship between force and pressure (CSS 5) to check master cylinder for internal and external leaks and proper operation; determine necessary action.
 - c. Remove, bench bleed, and reinstall master cylinder.
 - d. Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system to model real-life phenomena (CMS 4); determine necessary action.
 - e. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.
 - f. Understand the relationship between force and pressure (CSS 5) to inspect, test, and/or replace metering (hold-off), proportioning (balance) (CMS 2), pressure differential (CSS 5), and combination valves.
 - g. Bleed (manual, pressure, vacuum, or surge) brake system.
 11. Drum Brake Diagnosis and Repair (ASE/NATEF, pg 61)
 - a. Understand the relationship of force on moving parts (CSS 4) to diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine necessary action.
 - b. Remove, clean (using proper safety procedures), inspect, and measure brake drums; use data and information to model problem (CMS 3) and determine necessary action.

- c. Refinish brake drum.
 - d. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates accessing technical information as needed (CLAS 2); lubricate and reassemble.
 - e. Remove, inspect, and install wheel cylinders.
 - f. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.
 - g. Install wheel, torque lug nuts, and make final checks and adjustments and clearly communicate results (CLAS 5).
12. Disk Brake Diagnosis and Repair (ASE/NATEF, pgs 61, 62)
- a. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; use models to accurately depict problem (CMS 4) and determine necessary action.
 - b. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.
 - c. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.
 - d. Remove, clean and inspect pads and retaining hardware; determine necessary action.
 - e. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.
 - f. Clean, inspect, and measure rotor with a dial indicator and a micrometer understanding the meaning of the measurement data (CMS 9); accessing technical information (CLAS 2) and following manufacturer's recommendations in determining need to machine or replace.
 - g. Remove and reinstall rotor.
 - h. Refinish rotor on vehicle.
 - i. Refinish rotor off vehicle.
 - j. Install wheel, torque, lugnuts, and make final checks and adjustments accurately interpreting technical data (CLAS 4).
13. Power Assist Units Diagnosis and Repair (ASE/NATEF, pg 62)
- a. Know how forces impact moving objects (CSS 4) and test pedal free travel with and without engine running; check power assist operation.
 - b. Understand the relationship between force and pressure in an hydraulic system (CSS 5) and inspect and test hydraulically assisted power brake system for leaks and proper operation; determine necessary action.
14. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair (ASE/NATEF, pg 63)
- a. Use data (CMS 3) to diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.
 - b. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.
 - c. Check parking brake operation accessing technical information (CLAS 2,3); determine necessary action.
 - d. Check operation of brake stop light system; using technical information and data to model the problem (CLAS 3, CMS 4) to determine necessary action.
 - e. Inspect and replace wheel studs.

STRAND III: SUSPENSION AND STEERING

CONTENT STANDARD: *The student demonstrates knowledge and understanding of basic automotive systems including: VAT, DMV, DMM, CAN/BUS Ohmmeter, Hybrid (voltage), Conductor tester, Parasitic draw, Soldering electrical wiring.*

C. The student applies knowledge of basis suspension and steering systems and their functions.

1. Identifies the components and function of the suspension system.
2. Identifies the components and function of the steering system (thrust, shimmy, etc.).
3. Identifies and diagnoses tire wear patterns and determines necessary action.
4. General Suspension and Steering Systems Diagnosis (ASE/NATEF, pg 55):
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
 - b. Use data and technical information (CMS 3) to identify and interpret suspension and steering concern; determine necessary action.
 - c. Access electronic information (CLAS 2) to research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins and accurately interpret technical information (CLAS 3).
 - d. Locate and interpret vehicle service history, service precautions, and technical service bulletins (CLAS 2,4).
5. Steering Systems Diagnosis and Repair (ASE/NATEF, pgs 55, 56)
 - a. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.
 - b. Determine proper power steering fluid type; inspect fluid level and condition.
 - c. Diagnose power steering fluid leakage using data and information (CMS 3); model real-world problem (CMS 4) to determine necessary action.
 - d. Remove, inspect, replace, and adjust power steering pump belt.
6. Rear Suspension: Remove, inspect, and install coil springs and spring insulators. (ASE/NATEF, pg 57)
7. Miscellaneous Service (ASE/NATEF, pg 57):
 - a. Inspect, remove, and replace shock absorbers.
 - b. Remove, inspect, and service or replace front and rear wheel bearings.
8. Wheel and Tire Diagnosis and Repair (ASE/NATEF, pg 59)
 - a. Use data and technical information (CMS 3 CLAS 3) to diagnose tire wear patterns; determine necessary action.
 - b. Inspect tires; check and adjust air pressure.
 - c. Rotate tires according to manufacturer's recommendations accessing specifications electronically (CLAS 2).
 - d. Measure wheel, tire, axle, and hub runout and understand the meaning of measurement data (CMS 9) and determine necessary action.
 - e. Balance wheel and tire assembly (static and dynamic).
 - f. Dismount, inspect, and remount tire on wheel.
 - g. Reinstall wheel; torque lug nuts.

- h. Inspect tire and wheel assembly for air loss estimating rates of loss (CMS 7); perform necessary action.
 - i. Repair tire using internal patch.
9. Understand the relationship between forces and moving objects and analyze the behavior of moving objects in automotive systems (CSS 4).

STRAND IV: ELECTRICAL/ELECTRONIC SYSTEMS

CONTENT STANDARD: *The student demonstrates knowledge and understanding of basic automotive systems.*

- D. The student applies knowledge of basic electrical/electronic systems and their functions.
 - 1. Locates and identifies the battery and its function.
 - 2. Locates and identifies the starting system and its function.
 - 3. Locates and identifies the charging system and its function.
 - 4. Locates and identifies the lighting system and its function.
 - 5. Locates and identifies the accessory and safety systems and their functions.
 - 6. General Electrical Systems Diagnosis (ASE/NATEF, pgs 64, 65, 66):
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
 - b. Understand basic concepts of electricity in an automotive system (CSS 1,3) and identify and interpret electrical/electronic system concern; determine necessary action.
 - c. Use data and electronic information (CMS 3, CLAS 2) to research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins.
 - d. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).
 - e. Check continuity and measure resistance in electrical/electronic circuits (CSS 2,3) and components using an ohmmeter; determine necessary action.
 - f. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits understanding how electrical energy functions in automotive circuits (CSS 1,3); determine necessary action.
 - g. Measure and diagnose the cause(s) of excessive key-off battery drain (parasitic draw); use measurement data and information (CMS 9) to determine necessary action.
 - h. Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical /electronic circuits demonstrating principles of electrical conductivity (CSS 3); perform necessary action.
 - i. Remove and replace terminal end from connector.
 - j. Repair connectors and terminal ends.
 - k. Repair wiring harness (including CAN/BUS systems).
 - l. Perform solder repair of electrical wiring.
 - m. Understand how electricity is a form of energy and how the ability of energy to do useful work tends to decrease as the energy is converted in an automotive system (CSS 3).

7. Battery Diagnosis and Service (ASE/NATEF, pg 66)
 - a. Perform battery capacity test (or conductance test) understand measurement data and accurately interpret information (CMS 8 CLAS 4); confirm proper battery capacity for vehicle application; determine necessary action.
 - b. Understand electrical circuits in automotive technology (CSS 2) and maintain or restore electronic memory functions.
 - c. Inspect, clean, fill, and replace battery.
 - d. Perform slow/fast battery charge.
 - e. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.
 - f. Start a vehicle using jumper cables and a battery or auxiliary power supply.
8. Starting System Diagnosis and Repair (ASE/NATEF, pgs 66, 67)
 - a. Perform starter current draw tests; determine necessary action.
 - b. Perform starter circuit voltage drop tests; determine necessary action.
 - c. Understand the principles of electricity in a car battery and the chemical reactions that produce battery power (CSS 7).
9. Charging System Diagnosis and Repair (ASE/NATEF, pg 67)
 - a. Perform charging system output test; use data and information (CMS 3) to determine necessary action.
 - b. Remove, inspect, and install A.C. generator (alternator) and understand principles of electrical motors in automotive systems (CSS 2).
 - c. Perform charging circuit voltage drop tests; determine necessary action.

STRAND V: SCIENCE

CONTENT STANDARD: *The student understands scientific principles as they apply to physical and chemical functions in automotive systems.*

- E. The student uses scientific principles to explain how systems function and malfunction.
 1. Disposes of the parts, residue, or trash according to applicable federal, state, and local rules and regulations (ASE-Sc-1).
 2. Converts measurements taken using the English or metric system to specifications stated in terms of either system (ASE-Sc 5).
 3. Explains the purpose of additives in lubricants (ASE-Sc 7).
 4. Demonstrates an understanding of the kinetic and potential energy relationship (CSS 1) that occur in valve systems, ignition systems, and other stored energy systems, such as springs and fuels, and determines efficiency (ASE-Sc 8).
 5. Explains the relationship of centrifugal and centripetal force to the failure of rotating systems (CSS 4) (ASE-Sc10).
 6. Demonstrates an understanding of the effect of heat on automotive systems (CSS 3) (ASE-Sc 11).
 7. Demonstrates an understanding of the expansion and contraction of system parts as a result of heat generated during use and the cooling of the system when not in operation (ASE-Sc 13).
 8. Demonstrates an understanding of the process of acceleration and deceleration (CSS 4) as a function of weight and available power (ASE-Sc 15).
 9. Demonstrates an understanding of the reaction of fluid to the motion of a valve or piston (CSS 5) (ASE-Sc 16).
 10. Demonstrates an understanding of the types of vibrations caused by out-of-balance or excessively worn systems (CSS 4) (ASE-Sc 18).

11. Explains and demonstrates an understanding of the role of listening to sounds as part of the trouble-shooting process (ASE-Sc 22).
12. Explains how levers and pulleys can be used to increase an applied force or distance (CSS 4) (ASE-Sc 24).
13. Identifies the characteristics that define a system that is operating within the manufacturer's specifications (CLAS 3,4) (ASE-Sc 24).
14. Uses precision measuring devices (CMS 9) to determine if wear and adjustments are within the manufacturer's specifications, and to assure that repair or replacement parts meet the manufacturer's specifications (ASE-Sc 26).
15. Uses tension gauges, such as a torque wrench, to measure the force or tension required to tighten connections to the manufacturer's specifications (ASE-Sc 27).
16. Uses pressure measuring tools to determine pressures in the hydraulic or pneumatic systems (CSS 5) and compare to the manufacturer's specifications (CLAS 3,4) (ASE-Sc 28).
17. Uses direct and indirect methods (CMS 8) to measure system temperatures and then converts to Fahrenheit or Centigrade (CMS 1) as required (ASE-Sc 28).
18. Uses direct and indirect methods (CMS 8) to measure the volume of liquids in a system and compares to the manufacturer's specifications (ASE-Sc 31).
19. Uses computer databases (CLAS 2) for information retrieval and input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes (ASE-Sc 32).
20. Explains how an applied force at one location can be transmitted via fluid pressure (CSS 5) to provide a force at a remote location (ASE-Sc 33).
21. Explains the necessity of knowing that the hardness of a metal determines in part, its function and location in the automobile (ASE-Sc 36).
22. Explains the dynamic control properties of a hydraulic system (CSS 5) (ASE-Sc 37).
23. Explains the surface processes that occur on system seals due to the absorption of the contained materials (ASE-Sc 38).
24. Demonstrates an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force (CSS 4) (ASE-Sc 39).
25. Explains how rotational motion is changed to linear motion (CSS 2) and the need for balance in rotating systems (ASE-Sc 40).
26. The role of the ac generator in maintaining battery and system voltage (CSS 1) (ASE-Sc 46).
27. Explains and demonstrates an understanding of the ignition coil's role generating high voltages (CSS 3) required to fire the sparkplug (ASE-Sc 47).
28. Explains and demonstrates an understanding of the role of a fuse or fusible link (CSS 1) as a protective device in an electrical or electronic circuit (ASE-Sc 49).
29. Explains and demonstrates an understanding of system voltage generation, uses, and characteristics (CSS 2,3)(ASE-Sc 52).
30. Demonstrates an understanding of the ion transfer process (CSS 7) that occurs in an automotive battery (ASE-Sc 53).
31. Explains the conductivity problems in a circuit when connectors corrode due to electrochemical reactions (CSS 3,7) (ASE-Sc 54).
32. Explains the relationship between electrical current in a conductor and the magnetic field produced in a coil such as the starter solenoid (CSS 2) (ASE-Sc 55).

33. Explains the need for a specific gravity test of battery electrolyte (CSS 9) to determine charge (ASE-Sc 57).

STRAND VI: MATH

CONTENT STANDARD: *The student understands mathematics principles as they apply to automotive systems.*

F. The student applies knowledge of mathematics skills that is embedded in the automotive field.

1. Determines the proper sequence of arithmetic operations (CMS 5) to arrive at a solution than can be compared to other specifications when comparing system measurements to the manufacturer's specifications (ASE-Math 1).
2. Adds two or more whole numbers, fractions, or decimals to determine component conformance of multiple measurements with the manufacturer's specifications (CMS 5) (ASE-Math 2).
3. Subtracts whole numbers, fractions, or decimals to arrive at a difference for comparison with the manufacturer's specifications (ASE-Math 3).
4. Divides decimals to determine measurement conformance with the manufacturer's specifications (ASE-Math 4).
5. Estimates the results of basic arithmetic operations (CMS 7), and accurately round up or down depending on the appropriate rule for the situation (ASE-Math 5).
6. Analyzes and solved problems (CMS 2) requiring the sue of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem (ASE-Math 6).
7. Determines the irrelevant and/or missing data needed to solve a problem (CMS 2) (ASE-Math 7).
8. Determine and interprets place value (e.g., tenth, hundredths, thousandths) when conducting precision measurements (ASE-Math 8).
9. Used Centigrade or Fahrenheit measurement scales (CMS 1) to determine the existing temperature of substances such as a coolant or lubricant (ASE-Math 9).
10. Uses English and metric volume measurement techniques to determine the volume of a system, component, or cylinder (CMS 9) (ASE-Math 10).
11. Uses conventional symbols (E for voltage, etc.) to solve circuit parameter calculations using formulas such as Ohm's Law, $E=IR$ (CMS 5)(ASE-Math 11).

STRAND VII: LANGUAGE ARTS

The student understands language arts principles as they apply to automotive technology.

G. The student applies knowledge of language arts that is embedded in the occupation.

1. Requests, collects, comprehends, evaluates, and applies oral and written information gathered from customers, associates, and supervisors regarding problem symptoms and potential solutions and problems (CLAS 1,2,3,4,5) (ASE-LA 1).
2. Identifies the purpose for all written and oral communication (CLAS 5) and then choose the most effective strategies for listening, reading, speaking, and writing to facilitate the communication process (ASE-LA 2).
3. Adapts a reading strategy for all written materials (e.g., customer's notes, service manuals, shop manuals, technical bulletins) relevant to problem identification, diagnosis, solution, and repair (CLAS 3,4) (ASE-LA 3).
4. Attends to verbal and nonverbal cues in discussions with customers, supervisors, and associates to verify, identify, and solve problems (ASE-LA 4).

5. Uses study habits and techniques (i.e., previewing, scanning, skimming, taking notes) when reviewing publications (e.g., shop manuals, references, databases, operator's manuals, and text resources) (CLAS 1,3,4) for problem solving (ASE-LA 5).
6. Writes clear, concise, complete, and grammatically accurate sentences and paragraphs (CLAS 5) (ASE - LA 7).
7. Follows all oral and written directions that relate to the task or system under study (ASE-LA 10).

STRAND VIII: WORKPLACE SKILLS

CONTENT STANDARD: *The student identifies, demonstrates, and evaluates skills that prepare him/her for success in the workplace.*

H. The student achieves proficiency in various skill areas that affect their employment.

Personal Skills

1. Demonstrates understanding, friendliness, adaptability, and politeness in group settings (ASW-WP-F4).

Interpersonal Skills

2. Identifies roles as a member of a work team (AWS-WP-F1).
3. Works cooperatively and accepts supervision (ASW-WP-E2).

Thinking and Problem-Solving Skills

4. Acquires and evaluates information (CLAS 2) (ASE-WP-D1).

Communication Skills

5. Communicates both orally and in writing (ASE-WP-D1, 4).
6. Listens attentively and follows instruction (ASE-WP-D3).
7. Requests clarification or additional information as needed (ASE-WP-D2).

Employment Literacy Skills

8. Follows rules, regulations, and policies as established (ASE-WP-D3).
9. Assumes responsibility for decisions and actions (ASE-WP-E1).
10. Identifies steps to accomplish a task (ASE-WP-D3).
11. Identifies job employability skills (ASE-WP-F1).

Automotive Technology II: Pathway Standards

Automotive Technology II enhances the application of the knowledge and skills learned in Automotive Technology I. This course is designed to prepare students with the fundamentals needed to study, diagnose, and repair automotive mechanical and electrical systems. Emphasis is placed on automotive systems (brakes, steering and suspension, and electrical/electronic). The laboratory component includes various activities that follow the guidelines of the NATEF and the ASE.

STRAND I: OCCUPATIONAL SAFETY

CONTENT STANDARD: *The student understands occupational safety issues including the avoidance of physical and environmental hazards in the work environment.*

- A. The student identifies, selects, and uses correct safety rules in the shop.
 - 1. Verifies the safety of all personnel before energizing or operating any equipment (ASE-WS-I2, 4, 5).
 - 2. Accesses and interprets technical information (CLAS 2,3) and follows shop rules and OSHA/EPA guidelines for personal safety (ASE-WS-I2, 4).
 - 3. Demonstrates the proper use and care of appropriate personal protective equipment (ASE-WS-I2, 4).
 - 4. Understands and interprets technical information and data (CLAS 3 CMS 3) and follows shop rules and EPA guidelines for disposal/recycling of used oil, antifreezes, refrigerants, and wastes (ASE-WS-I1, 2).
 - 5. Practices fire prevention and fire safety procedures (ASE-WS-I2, 6).
 - 6. Identifies and demonstrates responsible behavior related to safety issues (ASE-WS-I2, 6).
 - 7. Understands electrical, chemical, and mechanical (CSS 1, 4, 7, 9) health hazards related to work in the shop (ASE-WS-I3).
 - 8. Identifies and uses equipment and tools in the shop safely and efficiently (ASE-WS-I 2, 4).
 - 9. Identifies and demonstrates individual responsibility and personal traits of safe work habits (ASE-WS-I 2, 4).
 - 10. Develops a list of environmental hazards and discusses ways of dealing with health and safety concerns (ASE-WP-I 1, 3).
 - 11. Identifies ways to effectively secure work areas (ASE-WP-I 4).
 - 12. Accesses and interprets technical information (CLOAS2,3,4) and follows manufacturer's recommendations for equipment (ASE-WP-I 1, 2).
 - 13. Understands tables, graphs, charts and technical information (CMS 3) and applies industry specific hazardous communications and material regulations to the workplace situation (ASE-WP-I 1, 3).
 - 14. Complies with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations (CLAS 1) (ASE/NATEF, p 60)

STRAND II: BRAKES

CONTENT STANDARD: *The student understands and demonstrates knowledge and understanding of basic automotive systems.*

- B. The student applies knowledge of basic brake systems and their functions.
 - 1. Reviews and interprets brake system components and determines necessary action (ASE-V-A1).

2. Uses technical information and electronic media (CLAS 2) to research applicable vehicle and service information, such as brake system operation, vehicle history, service precautions, and technical service bulletins (ASE-V-A2).
3. Understands the relationship between forces and pressure (CSS 5) to diagnose and repair hydraulic systems (ASE-V-B1).
4. Understands how forces affect moving objects (CSS 4) and diagnoses and repairs drum brakes (ASE-V- C1).
5. Refinishes rotor on disc brakes according to manufacturer's recommendations (ASE-V—E1).
6. Identifies, diagnoses, and repairs power assist units (ASE-V-E1).
7. Identifies, diagnoses, and repairs wheel bearings (ASE-V-F1).
8. Identifies, diagnoses, and repairs parking brakes (ASE-V-F2).
9. General Brake Systems Diagnosis (ASE/NATEF, pg 60)
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction (CLAS 5).
 - b. Identify and interpret brake system concern using and interpreting technical data (CMS 3); model the problem (CMS 4) to determine necessary action.
 - c. Access electronic information (CLAS 2) to research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins.
 - d. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).
10. Hydraulic System Diagnosis and Repair (ASE/NATEF, pgs 60-61)
 - a. Fabricate and/or install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.
 - b. Flush hydraulic system.
11. Power Assist Units Diagnosis and Repair (ASE/NATEF, pg 62)
 - a. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
 - b. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.
 - c. Measure and adjust master cylinder pushrod length, understanding the meaning of measurement data (CMS 9).
12. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, etc.) Diagnosis and Repair (ASE/NATEF, pg 63)
 - a. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, or replace as needed.
 - b. Replace wheel bearing and race.

STRAND III: SUSPENSION AND STEERING

The student demonstrates knowledge and understanding of basic automotive systems.

- C. The student applies knowledge of basic suspension and steering systems and their functions.
 1. Identifies and interprets suspension and steering components, including relationships that involve ratios and proportions (CMS 2) and determines necessary action (ASE-IV-A1).
 2. Researches applicable vehicle and technical service information (CLA 1, 2, 4), such as suspension and steering system

- operation, vehicle service history, service precautions, and technical service bulletins (ASE-VIV-A2).
3. Diagnoses and repairs steering systems, such as: ball joints, for example. (ASE-IV-B1).
 4. Understands the relationship between force and moving objects (CSS 4) and diagnoses and repairs front suspension (ASE-IV-C1).
 5. Understands the relationship between force and moving objects (CSS 4) and diagnoses and repairs rear suspension (ASE-IV-C2).
 6. Removes, inspects, and services or replaces front and rear wheel bearings (ASE-IV-C3.2).
 7. Identifies and describes the concept of wheel alignment repair (ASE-IV-E1).
 8. Diagnoses, adjusts, and repairs wheel alignment, including the: caster, camber, tow, etc. (ASE-IV-E1).
 9. General Suspension and Steering Systems Diagnosis (ASE/NATEF, pg 55):
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
 - b. Identify and interpret suspension and steering concerns using and interpreting measurement data (CMS 9); determine necessary action.
 - c. Access information electronically (CLAS 2) to research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins.
 - d. Locate and interpret vehicle service history, service precautions, and technical service bulletins accurately interpreting technical data and information (CLAS 3, 4).
 10. Steering Systems Diagnosis and Repair (ASE/NATEF, pgs 55, 56)
 - a. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
 - b. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.
 - c. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.
 - d. Flush, fill and bleed power steering system.
 - e. Remove and reinstall power steering pump.
 - f. Inspect and replace power steering hoses and fittings.
 - g. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
 - h. Understand the relationships between force and pressure in automotive steering systems (CSS 5).
 11. Front Suspension (ASE/NATEF, pg 57)
 - a. Use measurement data and technical information (CMS 9) to diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.
 - b. Diagnose strut suspension system noises, body sway, and uneven riding height concerns; model problem (CMS 4) to determine necessary action.
 - c. Remove, inspect and install strut rods (compression/tension) and bushings.
 - d. Remove, inspect, and install upper and/or lower ball joints.
 - e. Remove, inspect, and install steering knuckle assemblies.
 - f. Remove, inspect, and install stabilizer bar bushings, brackets, and links.
 - g. Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
 - h. Lubricate suspension and steering system.

- i. Understand the relationship between force and moving objects as it relates to automotive suspension systems (CSS 4).
- 12. Rear Suspension (ASE/NATEF, pg 57):
 - a. Remove, and use measurement data (CMS 9) to inspect, and install transverse links, control arms, bushings, and mounts.
 - b. Remove, inspect, and install strut cartridge or assembly, strut coil spring, and insulators (silencers).
- 13. Wheel Alignment Diagnosis, Adjustment, and Repair (ASE/NATEF, pgs 58):
 - a. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns using data and technical information (CMS 3, CLAS 1); determine necessary action.
 - b. Perform pre-alignment inspection; perform necessary action.
 - c. Check and adjust front and rear wheel camber; perform necessary action.
 - d. Check and adjust caster; perform necessary action.
 - e. Check and adjust front wheel toe and center steering wheel.
 - f. Check to-out-on-turns (turning radius); determine necessary action.
 - g. Understand the relationship of force and moving objects in wheel alignment systems (CSS 4).
 - h. Check SAI (steering axis inclination) and included angle using mathematical models and relationships (CMS 4); determine necessary action.
 - i. Check and adjust rear wheel toe.
 - j. Check rear wheel thrust angle; determine necessary action.
 - k. Check for front wheel setback; determine necessary action.
 - l. Check front cradle (subframe) alignment; determine necessary action.
- 14. Wheel and Tire Diagnosis and Repair (ASE/NATEF, pg 59)
 - a. Diagnose wheel/tire vibration, shimmy, and noise identifying the relationships between forces and moving objects in an automotive system (CSS 4); determine necessary action.
 - b. Diagnose tire pull (lead) problem (CMS 3); determine necessary action.

STRAND IV: ELECTRICAL/ELECTRONIC SYSTEMS

The student demonstrates knowledge and understanding of basic automotive systems.

- D. The student applies knowledge of basic electrical/electronic systems and their functions.
 - 1. Uses measurement data and technical information (CMS 9, CLAS 1) to diagnoses electrical/electronic system components and determines necessary action (ASE-VI-A1).
 - 2. Access electronic data and information (CLAS 2) Researches applicable vehicle and service information, such as electrical/ electronic system operation, vehicle service history, service precautions, and technical service bulletins (ASE-VI-A2).
 - 3. Diagnoses electrical/electronic integrity for series, parallel and series-parallel circuits using principles of electricity (Ohm's Law) (CSS 3) (ASE-IV-A4).
 - 4. Diagnoses and services battery (ASE-IV-B1).
 - 5. Diagnoses and repairs starting system (ASE-IV-C1).
 - 6. Diagnoses and repairs charging system (ASE-IV-D1).
 - 7. Diagnoses and repairs lighting systems (ASE-VI-E1).

8. Understands types of chemical reactions in automotive batteries (CSS 7) and the nature of electrical circuits and systems in automotive technology (CSS 3).
9. Identifies, diagnoses, and repairs gauges, warning devices, and driver information systems (ASE-VI-F1).
10. Identifies and reads on-board diagnostic system (CMS 9) (OBD 1 and OBD 2) (ASE-VI-F3).
11. General Electrical Systems Diagnosis (ASE/NATEF, pgs 64, 65, 66):
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction presenting well-informed and organized information (CLAS 5).
 - b. Identify and interpret electrical/electronic system concern responding to data and technical information (CLAS 1) ; determine necessary action.
 - c. Access information electronically (CLAS 2) to research applicable vehicle and service information, such as electrical/ electronic system operation, vehicle service history, service precautions, and technical service bulletins.
 - d. Locate and accurately interpret (CLAS 3, 4) vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).
 - e. Check electrical circuits with a test light; use data and information to model problem (CMS 4) and determine necessary action.
11. Battery Diagnosis and Service: Identify electronic modules, security systems and/or radios that require reinitialization or code entry following battery disconnect accurately interpreting data and information. (CLAS 3,4). (ASE/NATEF, p 66)
12. Starting System Diagnosis and Repair (ASE/NATEF, pgs 66, 67)
 - a. Inspect and test starter relays and solenoids; model problem (CMS 4) and determine necessary action.
 - b. Remove and install starter in a vehicle.
 - c. Use measurement data and information (CMS 9) to differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.
13. Charging System Diagnosis and Repair: Inspect, adjust, or replace AC generator (alternator) drive belts, pulleys, and tensioners using and interpreting technical data and information (CLAS 1, 3) ; check pulley and belt alignment. (ASE/NATEF, pg 67)
14. Lighting Systems Diagnosis and Repair (ASE/NATEF, pg 67)
 - a. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.
 - b. Inspect, replace, and aim headlights and bulbs.
 - c. Understand electrical circuits and how they produce power in automotive systems (CSS 2, 3).
15. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair: Use technical data and information (CMS 3) to inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action. (ASE/NATEF, pg 67)
16. Horn and Wiper/Washer Diagnosis and Repair: Diagnose incorrect horn operation; perform necessary action.
17. Use technical measurement data (CMS 3,4) to diagnosis and repair Accessories :
 - a. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.
 - b. Diagnose incorrect heated glass, mirror, or seat operation; determine necessary action.
 - c. Remove and reinstall door panel.

STRAND V: SCIENCE

The student understands scientific principles as they apply to physical and chemical functions in automotive systems.

E. The student understands scientific principles to explain how systems function and malfunction.

1. Develops a hypothesis regarding the cause of the problem and tests the hypothesis to determine the solution to the problem (ASE-Sc 4).
 - a. Identify the problem
 - b. Gather information
 - c. Develop hypothesis
 - d. Take action
 - e. Check results
2. Demonstrates an understanding of the role of balanced and unbalanced forces on linear and rotating vehicle assemblies =(CSS 4) (ASE-Sc 9).
3. Explains that dyes added to lubricants fluoresce in ultraviolet light and provides a process for determining the source of leakage (ASE-Sc 14).
4. Demonstrates an understanding of the circular motion of a vehicle as it relates to such events as toe-out on turns and tracking (CSS 4) (ASE-Sc 17).
5. Explains and demonstrates an understanding of how sound generated in one place in the body and engine can be carried to other parts of the engine through metal and other materials (CSS 2) (ASE-Sc 19).
6. Explains the relationship of the frequency of the sound to a normal or abnormally operating system (ASE-Sc 21).
7. Uses direct and indirect methods to measure system temperatures and then convert to Fahrenheit/Centigrade as required (CMS 1)(ASE-Sc 28).
8. Identifies the properties of electricity that impact the lighting, engine management, and other electrical systems in the vehicle (CSS 3) (ASE-Sc 42).
9. Identifies characteristics of a quality electrical ground and explains the problems associated with an inadequate electrical circuit ground (CMS 3) (ASE-Sc 43).
10. Explains voltage and current flow in series and parallel circuits (CSS 1) (ASE-Sc 44).
11. Demonstrates an understanding of the processes used to locate a short circuit in the electrical/electronic system (CMS 3)(ASE-Sc 45).
12. Demonstrates an understanding of the correct procedures used to measure the electrical parameters of voltage, current, resistance, or power (CMS 9) (ASE-Sc 48).
13. Explains and demonstrates an understanding of the use of Ohm's Law in verifying circuit parameters (resistance, voltage, amperage) (CMS 8) (ASE-Sc 50).
14. Explains and demonstrates an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters (CMS 6) (ASE-Sc 51).
15. Uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power (CMS 6) (ASE-Sc 58).
16. Demonstrates an understanding of the role of mechanical transducers in sending electrical control signals (ASE-Sc 59).

STRAND VI: MATH

The student understands mathematics principles as they apply to automotive systems.

F. The student applies knowledge of mathematics skills that is embedded in the automotive field.

1. Understands that if the described problem has certain conditions (symptoms), then a limited number of solutions to the problem apply (CMS 4) (ASE-Math 12).
2. Understands the relationship between the frequency of the occurrence of a problem (symptom) and the possibility of accurately predicting the problem (CMS 3) (ASE-Math 13).
3. Calculates the average (mean) of several measurements to determine the variance from the manufacturer's specifications (CMS 6) (ASE-Math 14).
4. Uses English and metric angle and distance measurements and techniques to determine angle variances from the manufacturer's specifications (CMS 1)(ASE-Math 15).
5. Solves problems that involve determining the relative proportion of desired versus undesired ingredients or elements of a mixture, and determines if that proportion is within the manufacturer's specifications (CMS 2) (ASE-Math 16).
6. Comprehends and uses standard defined by each manufacturer for the system being analyzed (CLAS 2) (ASE-Math 17).
7. Converts test readings that are in decimal or fraction form to a ratio or percent for comparison with the manufacturer's specifications for the sub-systems (CMS 2) (ASE-Math 18).
8. Visually perceives the geometric relationship of systems and sub-systems that require alignment (ASE-Math 20).
9. Used measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle systems requiring geometric alignment (CMS 9) (ASE-Math 22).
10. Uses formulas to indirectly confirm systems that are outside of the manufacturer's specifications (CMS 5) (ASE-Math 23).
11. Verifies that the relationship between parallel lines and angles concurs with the manufacturer's specifications when diagnosing a system's malfunction (ASE-Math 24).
12. Visually formulates a belt (e.g., suspension/drive) angles and verifies conformance to the manufacturer's specified angles (ASE-Math 25).
13. Distinguishes the congruence of the measured tolerances with those specified by the manufacturer (ASE-Math 28).
14. Measures and/or tests with tools designed for English or metric measurements, then converts measurement or tolerance (CMS 1) (ASE-Math 29).
15. Distinguishes whether a measurement or tolerance is equal or not equal to the manufacturer's specifications (CMS 9) (ASE-Math 31).

STRAND VII: LANGUAGE ARTS

The student understands language arts principles as they apply to automotive technology.

G. The student applies knowledge of language arts that is embedded in the occupation.

1. Uses prior knowledge learned from solving similar problems to diagnose and repair specific problems (ASE-LA 6).
2. Writes clear, concise, complete, and grammatically accurate sentences and paragraphs (CLAS 1) (ASE-LA 7).
3. Comprehends and applies industry definitions and specifications to diagnose and solve problems in all automotive systems and components (CLAS 1,2,3) (ASE-LA 9).

4. Comprehends and uses problem-solving techniques and decision trees that are contained in service manuals to determine cause-and-effect relationships (CLAS 1) (ASE-LA 11).
5. Scans service manuals and databases to locate specific information for problem-solving purposes (CLAS 2) (ASE-LA 12).
6. Uses the service manual to identify the manufacturer's specifications for system parameters, operation, and potential malfunction (CLAS 1) (ASE-LA 13).
7. Interprets charts, tables, or graphs to determine the manufacturer's specifications for system operation to identify out-of-tolerance systems and sub-systems (CMS 3) (ASE-LA 14).

STRAND VIII: WORKPLACE SKILLS

The student identifies, demonstrates, and evaluates skills that prepare him/her for success in the workplace.

- H. The student achieved proficiency in various skill areas that affect their employability.

PERSONAL SKILLS

1. Exerts a high level of effort and perseveres towards goal attainment (ASE-WS-J9, M4, 5).

INTERPERSONAL SKILLS

2. Works cooperatively and accepts supervision (ASE-WS-L6, M3).
3. Participates effectively in varied roles as a member of a work team (ASE-WS-M1-5).

THINKING AND PROBLEM-SOLVING SKILLS

4. Explains the conditions under which service maintenance are required for transportation vehicles (ASE-WS-H1–3, 5–6).
5. Recognizes problems and devises and implements plan of action (ASE-WS-H1-10).
6. Uses efficient learning techniques to acquire and apply new knowledge and skills (ASE-WS-J5).

COMMUNICATION SKILLS

7. Communicates both orally and in writing (CLAS 5) (ASE-WS-D1, 4).
8. Listens attentively and follows instructions (ASE-WS-D3).
9. Requests clarification or additional information as needed (ASE-WS-D2).

EMPLOYMENT LITERACY SKILLS

10. Follows rules, regulations, and policies as established (ASE-WS-D3, J1).
11. Assumes responsibility for decisions and actions. (ASE-WS-J2, 4).
12. Identifies, organizes, and, plans to accomplish a task. (ASE-WS-10).
13. Demonstrates job employability skills (ASE-WS-B1-10).

Automotive Technology III: Pathway Standards

Automotive Technology III enhances the application of the knowledge and skills learned in Automotive Technology II. This course is designed as an automotive laboratory course that deals with the diagnosis and repair of common automotive problems. All diagnosis and repair is done under the supervision of the instructor. Service, diagnosis, and repair procedures are performed on personal or school-owned vehicles to simulate working in the industry. Emphasis is placed on particular systems (brakes, steering and suspension, or electrical) as determined by the instructor, parent/guardian, and student. The laboratory component includes various activities that follow the guidelines of the NATEF and the ASE.

STRAND I: OCCUPATIONAL SAFETY

CONTENT STANDARD: *The student understands occupational safety issues including the avoidance of physical and environmental hazards in the work environment.*

- A. The student identifies, selects, and uses correct safety rules in the shop.
 - 1. Operates and uses equipment in the shop safely and efficiently (ASE-WS-I2, 4).
 - 2. Uses properly personal protective equipment required in each shop efficiently (ASE-WS-I1).
 - 3. Accesses technical information (CLAS 2) to identify ways to effectively secure work areas efficiently (ASE-WS-5).
 - 4. Follows shop rules and OSHA/EPA guidelines for personal safety efficiently (ASE-WS-I1).
 - 5. Accurately interprets technical information (CLAS 3,4) and follows manufacturer's recommendations for equipment efficiently (ASE-WS-I1, 2).
 - 6. Understands types of chemical reactions (CSS 7) and analyzes and develops shop rules and EPA guidelines for disposal and recycling of used oil, antifreeze, refrigerants, and wastes efficiently (ASE-WS-I1, 2).
 - 7. Uses technical data and information (CMS 3) to apply industry specific hazardous communications and material regulations to the workplace situation efficiently (ASE-WS-I3).
 - 8. Identifies and uses equipment and tools in the shop safely and efficiently (ASE-WS-I 2, 4).
 - 9. Identifies and demonstrates individual responsibility and personal traits of safe work habits (ASE-WS-I 2, 4).
 - 10. Accesses electronic information (CLAS 2) to develop a list of environmental hazards and discusses ways of dealing with health and safety concerns (ASE-WP-I 1, 3).
 - 11. Identifies ways to effectively secure work areas (ASE-WP-I 4).
 - 12. Accurately interprets technical information (CLAS 4) and follows manufacturer's recommendations for equipment (ASE-WP-I 1, 2).
 - 13. Responds to technical information (CLAS 1) and applies industry specific hazardous communications and material regulations to the workplace situation (ASE-WP-I 1, 3).
 - 14. Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations (ASE/NATEF, p 60).

STRAND II: BRAKES

CONTENT STANDARD: *The student understands and demonstrates knowledge and understanding of basic automotive systems.*

B. The student applies knowledge of basic brake systems and their functions.

1. Understands the relationship between force and moving objects (CSS 4) and diagnoses and repairs brake systems ASE-V-A1).
2. Inspects and tests hydro-boost system and accumulator for leaks and proper operation and determines necessary action (ASE-V-E4).
3. Identifies and inspects antilock brake system (ABS) components and models problems (CMS 4) to determine necessary action (ASE-V-G1).
4. General Brake Systems Diagnosis (ASE/NATEF, pg 60)
 - a. Use a well-organized format (CLAS 5) to complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
 - b. Identify and interpret brake system concern; determine necessary action.
 - c. Access electronic information (CLAS 2) to research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins.
 - d. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).
5. Hydraulic System Diagnosis and Repair (ASE/NATEF, pgs 60-61)
 - a. Inspect, test, and adjust height (load) sensing proportioning valve.
 - b. Inspect, test, and/or replace components of brake warning light system.
 - c. Understand the relationship between force and pressure in an automotive hydraulic system (CSS 5).
6. Disc Brake Diagnosis and Repair (ASE/NATEF, pgs 61, 62)
 - a. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.
 - b. Adjust calipers equipped with an integrated parking brake system.
 - c. Understand the relationship between forces and moving parts in an automotive system (CSS 4).
7. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair (ASE/NATEF, pg 63)
 - a. Use technical data and measurement (CMS 3, 9) to check operation of parking brake indicator light system.
 - b. Remove and reinstall sealed wheel bearing assembly.
8. Antilock Brake and Traction Control Systems
 - a. Identify and inspect antilock brake system (ABS) components; determine necessary action.
 - b. Use technical data and measurement (CMS 3,9) to diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the antilock brake system (ABS); determine necessary action.
 - c. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.
 - d. Relate concepts of force and pressure (CSS 5) and depressurize high-pressure components of the antilock brake system (ABS).

- e. Bleed the antilock brake system's (ABS) front and rear hydraulic circuits.
- f. Remove and install antilock brake system (ABS) electrical/electronic and hydraulic components.
- g. Use a variety of measurement data (CMS 9) to test, diagnose and service ABS speed sensors, toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
- h. Diagnose ABS braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).
- i. Identify traction control/vehicle stability control system components.

STRAND III: SUSPENSION AND STEERING

CONTENT STANDARD: *The student demonstrates knowledge and understanding of basic automotive systems.*

C. The student applies knowledge of basic suspension and steering systems and their functions.

1. Understand the relationship between forces and moving objects in automotive systems (CSS 4) and diagnose and repair suspension and steering systems (ASE-IV-A1).
2. Accesses electronic information (CLAS 2) to research applicable vehicle and service information, such as suspension and steering system operations, vehicle service history, service precautions, and technical service bulletins (ASE-IV-A2).
3. Understands measurement data (CMS 9) and tests and diagnoses components of electronically controlled steering systems using a scan tool and determine necessary action (ASE-IV-B 19).
4. Tests and diagnoses components of electronically controlled suspension systems using a scan tool (CMS8,9) and determine necessary action (ASE-IV-C3.4).
5. General Suspension and Steering Systems Diagnosis (ASE/NATEF, pg 55):
 - a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
 - b. Identify and interpret suspension and steering concern; model problem (CMS 4) to determine necessary action.
 - c. Understand the relationship between forces and moving objects in an automotive system (CSS 4).
 - d. Access electronic information (CLAS 2) to research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins.
 - e. Access electronic information (CLAS 2) to locate and interpret vehicle service history, service precautions, and technical service bulletins.
6. Steering Systems Diagnosis and Repair (ASE/NATEF, pgs 55, 56)
 - a. Disable and enable supplemental restraint systems (SRS).
 - b. Use technical data (CMS 3) and measurement (CMS 9) to diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, noise, and fluid leakage concerns; determine necessary action.
 - c. Use various methods of data collection (CMS 8) to diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, noise, and fluid leakage concerns; determine necessary action.
 - d. Understand the relationships between forces and moving objects in an automotive system (CSS 4).
 - e. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.

- f. Use technical data and information (CLAS 4) to adjust manual or power non-rack and pinion worm bearing preload and sector lash.
 - g. Remove and reinstall power steering pump pulley; check pulley and belt alignment.
 - h. Test and diagnose components of electronically controlled steering systems (CMS 3) using a scan tool; determine necessary action.
 - i. Inspect and test non-hydraulic electric power assist steering.
 - j. Identify hybrid vehicle power steering system electrical circuits, service and safety precautions.
- 7. Front Suspension (ASE/NATEF, pg 57).
 - a. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.
 - b. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.
 - c. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.
 - d. Accurately interpret a variety of technical data and information (CLAS 3,4) to service front suspension automotive systems.
- 8. Rear Suspension: Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts. (ASE/NATEF, pg 57).
- 9. Wheel and Tire Diagnosis and Repair (ASE/NATEF, pg 59).
 - a. Dismount, inspect, and remount tire on wheel equipped with tire pressure sensor.
 - b. Use a variety of measurement data (CMS 9) to inspect, diagnose, and calibrate tire pressure monitoring systems.

STRAND IV: ELECTRICAL/ELECTRONIC SYSTEMS

CONTENT STANDARD: *The student demonstrates knowledge and understanding of basic automotive systems.*

- D. The student applies knowledge of basic electrical/electronic systems and their functions.
 - 1. Understands the nature of electrical circuits in an automotive system (CSS 3) and identifies and interprets electrical/electronic system concern and determines necessary action (ASE-VI-A1).
 - 2. Diagnoses electrical/electronic integrity for series, parallel, and series parallel circuits using principals of electricity (Ohm's Law) (CSS 3) (ASE-VI-A4).
 - 3. Maintains or restores electronic memory functions (ASE-VI-B3).
 - 4. Uses a variety of technical measurement data and information (CMS 3,8) to perform starter circuit voltage drop tests and determine necessary action ASE-VI-C2).
 - 5. Diagnoses the cause of incorrect operation of warning devices and other driver information systems and determines necessary action (ASE-VI-F10).
 - 6. Diagnoses and repairs born and wiper/washer (ASE-VI-G1).
 - 7. Performs on-board diagnostics using electronic data and information (CLAS 2) (OBD 1 and OBD 2) (ASE-VI-B6).
 - 8. General Electrical Systems Diagnosis: Use wiring diagrams during diagnosis of electrical circuit problems (CMS 3) (ASE/NATEF, pg 64).
 - 9. Battery Diagnosis and Service (ASE/NATEF, pg 66).
 - a. Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions.
 - b. Identify hybrid vehicle auxiliary (12v) battery service, repair and test procedures.
 - c. Understand types of chemical reactions and how they produce power in a car battery (CSS 7).
 - 10. Lighting Systems Diagnosis and Repair (ASE/NATEF, pg 67).
 - a. Use technical data and information (CMS 3) to inspect and diagnose incorrect turn signal or hazard light operation;

- perform necessary action.
- b. Identify system voltage and safety precautions associated with high intensity discharge headlights.
- 11. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair (ASE/NATEF, pgs 67, 68).
 - a. Accurately interpret technical information (CLAS 3,4) to inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.
 - b. Diagnose the cause of incorrect operation of warning devices and other driver information systems; model problem (CMS4) and determine necessary action.
 - c. Use a variety of measurement data (CMS9) to inspect and test sensors, connectors, and wires of electronic (digital) instrument circuits; determine necessary action.
- 12. Horn and Wiper/Washer Diagnosis and Repair (ASE/NATEF, pgs 68):
 - a. Use technical data and information (CMS3) to diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.
 - b. Diagnose incorrect washer operation; generate a mathematical relationship (CMS 5) and perform necessary action.
- 13. Accessories Diagnosis and Repair (ASE/NATEF, pgs 68, 69).
 - a. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.
 - b. Diagnose incorrect electric lock operation; determine necessary action.
 - c. Diagnose incorrect operation of cruise control systems; determine necessary action.
 - d. Use electronic information and data (CLAS 2) to diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: follow manufacturer's safety procedures to prevent accidental deployment).
 - e. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.
 - f. Diagnose body electronic system circuits using a scan tool (CMS 8); determine necessary action.
 - g. Check for module communication (including CAN/BUS systems) errors using a scan tool.
 - h. Diagnose the cause of false, intermittent, or no operation of anti-theft systems.
 - i. Understand electronic systems in automotive technology (CSS 3).

STRAND V: SCIENCE

CONTENT STANDARD: *The student understands scientific principles as they apply to physical and chemical functions in automotive systems.*

- E. The student uses scientific principles to explain how systems function and malfunction.
 - 1. Explains and demonstrates an understanding of the properties of electricity that impact the lighting, engine management, and other electrical systems in the vehicle (CSS 1, 3) (ASE-Sc 42).
 - 2. Demonstrates an understanding of the characteristics of a quality electrical ground and explains the problems associated with an inadequate electrical circuit ground (CSS 3) (ASE-Sc 43).
 - 3. Demonstrates an understanding of the role of capacitance in time circuits (e.g., RC timers or MAP sensors) where the charging manifold pressure causes two metal discs to act like a capacitor by sending varying voltage to the electronic engine control systems (CSS 2,3) (ASE-Sc 59).

STRAND VI: MATH

CONTENT STANDARD: *The student understands mathematics principles as they apply to automotive systems.*

- F. The student applies knowledge of mathematics skills that is embedded in the automotive field.
 - 1. Uses appropriately an estimated performance value versus an exact value, based on a system being analyzed and repaired (CMS 7) (ASE-Math 19).
 - 2. Measures times or sequenced operating parameters to conform to the manufacturer's specifications (CMS 3) (ASE-Math 26).

STRAND VII: LANGUAGE ARTS

CONTENT STANDARD: *The student understands language arts principles as they apply to automotive technology.*

- G. The student applies knowledge of language arts that is embedded in the occupation.
 - 1. Uses prior knowledge learned from solving similar problems to diagnose and repair specific problems (ASE-LA 6).
 - 2. Writes reports and work orders to include information regarding problem resolution and the results of the work performed for the customer or manufacturer (CLAS 5) (ASE-LA 8).
 - 3. Scans service manuals and databases to locate specific information for problem-solving purposes (CLAS 2,3) (ASE-LA 12).
 - 4. Supplies clarifying information to customers, associates, part suppliers, and supervisors (CLAS 5) (ASE-LA 15).

STRAND VIII: WORKPLACE SKILLS

CONTENT STANDARD: *The student identifies, demonstrates, and evaluates skills that prepare him/her for success in the workplace.*

- H. The student achieves proficiency in various skills areas that affect their employability.

PERSONAL SKILLS

- 1. Assesses self accurately, sets personal goals, monitors progress, and exhibits self control (ASE-WS-H1- 10).
- 2. Chooses ethical courses of action (ASE-WS-J1-11).
- 3. Shares responsibilities and accepts supervision (ASE-WS-J4).

INTERPERSONAL SKILLS

- 4. Participates effectively in leadership roles as a member of a work team (e.g., team leader, mediator, reviewer, coach, facilitator) (ASE-WS-M1-5)
- 5. Demonstrates cooperative working relationships across gender and cultural groups (ASE-WS-L1).
- 6. Teaches others a process, strategy, or skill (ASE-WS-J2).
- 7. Communicates ideas to justify position, persuades or convinces others, responsibly challenges existing procedures and policies (CLAS 5) (ASE-WS-D1, F7)).
- 8. Works well with others from diverse backgrounds (ASE-WS-L1).

THINKING AND PROBLEM SOLVING SKILLS

- 9. Uses various types of information retrieval systems in a systematic approach to determine specifications and repair/service procedures (ASE-WS-H2, 3, 5).
- 10. Performs and documents maintenance procedures in accordance with the recommendations of the manufacturer (ASE-WS-J1).
- 11. Specifies goals and constraints, generates alternatives, considers risks and evaluates and chooses best alternative (ASE-WS-H3, 5, 6, 8, 10).
- 12. Analyzes and evaluates efficient learning techniques to acquire and apply new knowledge and skills (ASE-WS-M5).

COMMUNICATION SKILLS

- 13. Communicates both orally and in writing (ASE-WS-D1, 3, 4).
- 14. Listens attentively and follows instructions (ASE-WS-D3).
- 15. Requests clarification or additional information as needed (ASE-WS-D2).

EMPLOYMENT LITERACY SKILLS

- 16. Follows rules, regulations, and policies as established (ASE-WS-D3).
- 17. Assumes responsibility for decisions and actions (ASE-WS-J4).
- 18. Selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules (ASE-WS-H7, 10).
- 19. Identifies, organizes, plans, and allocates time, money, material, facilities, and human resources to accomplish a task (ASE-WS-H1, 10).
- 20. Acquires, stores, allocates, and uses materials or space efficiently (ASE-WS-I2, 4).
- 21. Analyzes and evaluates job employability (ASE-WS-A1, 6).