

## TRANSPORTATION TECHNOLOGY 30

### Description

This course is designed to give the student a broad understanding of the theory, servicing, operation and repair of today's automotive systems and components. Alternative energy resources and vehicles along with associated vehicle design and construction will be addressed. Emphasis is placed on ignition systems, drive train components, brake systems, computer systems, electronics, structural design, and overall vehicle maintenance. Related hands-on lab work on automotive vehicles and components, along with scale models are integrated into the course.

### Course Overview

#### Course Objectives

Students should be able to:

- understand and apply practical technological methods to a hands-on approach to problem-solving.
- use safely and efficiently, the resources, processes, concepts, and tools of transportation technology.
- develop the ability to analyze and resolve problems through practical experiences.
- combine math and science concepts to solve practical mechanical problems.
- explore principles of mechanical and automotive design concepts.
- gain an appreciation for mechanical and automotive systems and their relationships to various technological systems.
- explore how advanced computer technology is affecting vehicle performance.
- effectively communicate using mechanical and automotive technical terminology.

#### Essential Questions

- What knowledge, skills, tools and safety practices are required to apply practical technological methods to various automotive systems?
- How do safety procedures, different automotive materials and engineering design principals play a role in vehicle design?
- How do electronics and computer systems play a role in the efficiency and maintenance of a modern automobile?

#### Assessments

- Tests and Quizzes per Unit
- **Project 1:** Design and Build Vehicle considering frame structure and body survivability in a crash (Vehicle Safety and Crumple zones)
- **Project 2:** Engineering Design Project using simple machines in tandem to gain torque, speed, and distance traveled. (Rat Trap Vehicle)
- **Project 3:** Circuit board component soldering (Soldering project to create a working circuit board)
- **Project 4:** Disassembly/Reassembly of Automotive Engine. Requires type written manual (term paper)
- on all detailed aspects of the project
- **Actual Hands-on Vehicle Maintenance:** Oil changes, Tune-ups, Troubleshooting/Repairs of Electrical and Mechanical Systems, Brakes, Exhaust Systems, etc.

#### Content Outline

- I. [Unit 1](#) - The Basic Automobile & Basic Hand Tools, Safety
- II. [Unit 2](#) - Engine Fundamentals and Design
- III. [Unit 3](#) - Vehicle Survivability Experience
- IV. [Unit 4](#) - Basic Electricity/Electronics

#### Standards

Connecticut State Technology Education standards have been met in the following areas:

- ***Automotive Technology***
- ***Transportation Technology***
- ***Pre-Engineering***

<ul style="list-style-type: none"> <li>V. <a href="#">Unit 5</a> - Ignition Systems &amp; Computer Systems</li> <li>VI. <a href="#">Unit 6</a> - Charging Systems &amp; Starting Systems</li> <li>VII. <a href="#">Unit 7</a> - Emission Controls</li> <li>VIII. <a href="#">Unit 8</a> - Engineering Design Experience</li> <li>IX. <a href="#">Unit 9</a> - Fuel Injection Systems</li> <li>X. <a href="#">Unit 10</a> - Cooling Systems &amp; Lubrication</li> <li>XI. <a href="#">Unit 11</a> – Brakes, Anti-Lock Brakes, Traction and Stability Control</li> <li>XII. <a href="#">Unit 12</a> - Clutches &amp; Manual Transmissions</li> <li>XIII. <a href="#">Unit 13</a> - Automatic Transmissions, Differentials, Transfer Cases, Transaxles</li> <li>XIV. <a href="#">Unit 14</a> - Engine Disassembly/Reassembly</li> </ul>		
---	--	--

Pacing Guide							
1st Marking Period				2nd Marking Period			
September		October		November		December	January
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
<a href="#">Basic Auto, Hand Tools, Safety</a>	<a href="#">Engine Fund. and Design</a>	<a href="#">Vehicle Survival Experience</a>	<a href="#">Basic Electricity, Electronics</a>	<a href="#">Ignition Systems, Computer Systems</a>	<a href="#">Charging Systems, Starting Systems</a>	<a href="#">Emission Controls</a>	<a href="#">Engineering Design Experience</a>
2 weeks	2.5weeks	2.5 weeks	2 weeks	3 weeks	2 weeks	2 weeks	3 weeks

Pacing Guide						
3rd Marking Period			4th Marking Period			
February		March		April	May	June
Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	
<a href="#">Fuel Systems</a>	<a href="#">Cooling Systems, Lubrication</a>	<a href="#">Brake Systems</a>	<a href="#">Clutches &amp; Manual Transmissions</a>	<a href="#">Automatic Transmission, Differentials, Transfer Cases, Transaxles</a>	<a href="#">Engine Disassembly/Reassembly</a>	
2 weeks	2 weeks	3 weeks	2 weeks	2 weeks	6 weeks	

**Unit 1 – The Basic Automobile, Basic Hand Tools, Safety, 2 weeks [top](#)**

**Standards**

***Automotive Technology***

**AUTO.01 Students demonstrate the value and necessity of practicing personal and occupational safety and protecting the environment by using materials and processes in accordance with manufacturer and industry standards.**

AUTO.01.01, AUTO.01.02, AUTO.01.03, AUTO.01.04, AUTO.01.05,

**Unit Objectives**

Students will be able to:

- develop an understanding of the basic automobile and its major components.
- describe the purpose of the fundamental automotive systems.
- describe major automobile design variations.
- use appropriate personal protective equipment and safety practices.

**Essential Questions**

- Why is it important to be an advocate for safe work practices?
- Why is it important to understand relationships between systems which function together?

**Focus Questions**

- What is an automotive system?
- What are the major automotive systems?
- What are the different automotive design variations?
- What are the various types of automotive hand tools?
- What are the most important ways to prevent shop accidents?

**Assessments**

- Shop Safety Quiz
- The Automobile
- Basic Hand Tools

**Skill Objectives**

Students will:

- use hand tools safely.
- use common hand tools while following all shop safety rules.
- identify and locate the most important parts of the vehicle.
- identify common automotive hand tools.
- describe safety rules for the auto shop.

**Unit 2 – Engine Fundamentals and Design, 2.5 weeks [top](#)**

**Standards**

*Automotive Technology*

**AUTO.03 Explain scientific principles in relation to chemical, mechanical, and physical functions for various engine and vehicle systems.**

AUTO.03.01, AUTO.03.02, AUTO.03.03, AUTO.03.08

**Unit Objectives**

Students will be able to:

- describe the operating principles of internal and external combustion engines.
- develop an understanding of the basic engine parts and their function.
- explain the basic function of the major parts of an automotive engine.

**Essential Question**

- What is the impact of the internal combustion engine on our society?

**Focus Questions**

- What does TDC and BDC mean?
- How do the specific moving parts relate to the 4 stroke cycle?
- What are the ways to classify engine design?
- How do Overhead Valve engines differ from conventional engines?

**Assessments**

- Engine Fundamentals
- Engine Design Classifications

**Skill Objectives**

Students will:

- design different engine design classifications.
- identify the major parts of a typical automotive engine.
- describe the four stroke cycle.
- identify different types of engine design.

**Unit 3 – Vehicle Survivability Experience, 2.5 weeks [top](#)**

**Standards**

***Pre-Engineering Technology***

**ENG.01 Identify the roles, responsibilities and requirements of engineering.**

ENG.01.01, ENG.01.02

**ENG.02 Use the design process to solve problems by creating and refining prototypes.**

ENG.02.01, ENG.02.02, ENG.02.03, ENG.02.05, ENG.02.06, ENG.02.07, ENG.02.08, ENG.02.09, ENG.02.10, ENG.02.11, ENG.02.12, ENG.02.13

**ENG.04 Design using the appropriate materials in engineering by identifying, comparing, selecting and testing.**

ENG.04.01

**ENG.11 Demonstrate the application of science and math principles to the mechanical engineering process.**

ENG.11.01, ENG.11.02, ENG.11.03

**Unit Objectives**

Students will be able to:

- describe the steps of the design process.
- use the design process to solve problems by creating and refining prototypes.
- describe automotive design related to safety considerations.
- build a prototype from plans.
- test a prototype.

**Essential Question**

- How does the application of science and math principles contribute to the engineering process?

**Focus Questions**

- What geometric shapes are the strongest?
- How do I use the geometric shapes to build crumple zones for survivability?
- Is a framed body structurally stronger than a unitized body?

**Assessments**

- Design drawings
- Building and testing a model vehicle

**Skill Objectives**

Students will:

- design and Build and Test a model vehicle that will survive a crash based upon structural design.
- compare a unitized body vs. a frame body vehicle.

**Unit 4 – Basic Electricity/Electronics, 2 weeks [top](#)**

**Standards**

***Automotive Technology***

**AUTO.06 Demonstrate the function, principles, and operation of electrical and electronic systems using manufacturer and industry standards.**

AUTO.06.01

***Pre-Engineering Technology***

**ENG.08 Demonstrate the application of science and math principles to the electrical engineering process.**

ENG.08.02, ENG.08.03, ENG.08.04, ENG.08.05, ENG.08.06, ENG.08.07, ENG.08.08, ENG.08.09

**Unit Objectives**

Students will be able to:

- develop an understanding as to how electricity functions in electronic components in a vehicle.
- describe the process of building simple electronic components for specific applications.

**Essential Question**

- How does an understanding of electricity facilitate problem solving with electrical/electronic systems?

**Focus Questions**

- What is the different between a conductor and an insulator?
- How does voltage, current and resistance relate to each other?
- How does a simple electrical circuit and it components function?

**Assessments**

- Basic Electricity and Electronics
- Construction and testing of simple circuit board

**Skill Objectives**

Students will:

- build a simple electronic circuit board.
- compare voltage, current and resistance.
- explain the principles of electricity.
- describe the action of basic electric circuits.
- describe the principles of magnetism and magnetic fields.
- identify basic electric and electronic terms and components.

**Unit 5 – Ignition Systems, Computer Systems, 3 weeks [top](#)**

**Standards**

*Automotive Technology*

**AUTO.07 Engine Performance: Describe the components and functions of the various systems that are related to engine performance.**

AUTO.07.01, AUTO.07.04

**Unit Objectives**

Students will be able to:

- explain the operating principles of an automotive ignition system.
- describe the function of major ignition system components.
- explain how a computer uses sensor inputs to determine correct outputs.
- gain an understanding of how electronics, ignition systems and computers operate to efficiently control an automobile.
- explain the use of scan tools to simplify reading of trouble codes.

**Essential Question**

- How have new technologies impacted diagnosis and repair of operational systems?

**Focus Questions**

- How does the primary circuit compare to the secondary circuit?
- How would you explain the major parts of the ignition systems and how they operate?
- What are the types of computer systems are containing in a vehicle and how do they operate?
- What is the difference between a sensor and an actuator?
- How can on-board diagnostics help a technician in troubleshooting a problem?

**Assessments**

- Ignition System Fundamentals
- Computer System Fundamentals
- On-Board Diagnostics and Scan Tools

**Skill Objectives**

Students will:

- use a scan tool to trouble shoot, analyze, and repair a vehicle engine or electrical problem.
- activate on-board diagnostics and read trouble codes with a scan tool.
- compare contact point, electronic, and computer-controlled ignition systems.
- describe the input, processing, and output sections and operation.



**Unit 6 – Charging Systems, Starting Systems, 2 weeks [top](#)**

**Standards**

***Automotive Technology***

**AUTO.06 Demonstrate the function, principles, and operation of electrical and electronic systems using manufacturer and industry standards.**

AUTO.06.01, AUTO.06.02, AUTO.06.03, AUTO.06.04

**Unit Objectives**

Students will be able to:

- describe charging system components.
- describe starting system components.
- explain the operation of a charging system.
- explain the operation of a starter system.
- diagnose a problem with a charging system.
- diagnose a problem with a starting system.

**Essential Question**

- What impact have electric motors made on transportation systems?

**Focus Questions**

- How does a charging system replenish the battery voltage?
- What is the difference between DC alternator and an AC generator?
- What is a rectifier circuit?
- How do you diagnosis a problem with the charging system?
- How does starter operation allow the crank to start the engine?

**Assessments**

- Charging System Fundamentals
- Starting System Fundamentals

**Skill Objectives**

Students will:

- list and identify the basic parts of the charging system and starting system.
- describe the construction and operation of a starter motor.
- explain the operation of a starter system.
- troubleshoot problems in a charging system and a starter system.

**Unit 7 – Emission Controls, 2 weeks [top](#)**

**Standards**

***Automotive Technology***

**AUTO.07 Engine Performance: Describe the components and functions of the various systems that are related to engine performance.**

AUTO.07.03, AUTO.07.04

**Unit Objectives**

Students will be able to:

- define the fundamental terms relating to automotive emission control systems.
- explain how a computer or engine control module can be used to operate emission control systems.

**Essential Question**

- Why are emission controls important to our environment?

**Focus Questions**

- What are some causes of air pollution?
- What are the sources of a vehicle's emissions and how are they controlled?
- How does a catalytic converter and an oxygen sensor contribute to low emissions?

**Assessments**

- Emission Control Systems

**Skill Objectives**

Students will:

- identify and explain how sensors and actuators control vehicle emissions through the vehicle's computer system.
- identify and explain how sensors, actuators, the computer control module, and the catalytic converter control vehicle emissions.
- utilize a scanner to detect Diagnostic Trouble Codes.

**Unit 8 – Engineering Design Experience, 3 weeks [top](#)**

**Standards**

*Pre-Engineering Technology*

**ENG.11 Demonstrate the application of science and math principles to the mechanical engineering process.**

ENG.11.01, ENG.11.02, ENG.11.03, ENG.11.05, ENG.11.06, ENG.11.07

*Transportation Technology*

**TRAN.02 Define transportation technology systems.**

TRAN.02.02, TRAN.02.03, TRAN.02.04

**Unit Objectives**

Students will be able to:

- utilize brainstorming and problem solving techniques in the testing and engineering of the vehicle for speed and distance traveled..
- use simple machines to gain mechanical advantage and modify torque requirements.
- solve problems using appropriate units in engineering systems.

**Essential Question**

- How do simple machines still have value in engineering?

**Focus Questions**

- How do you combine various simple machines, a race trap and miscellaneous materials in designing a vehicle that competes in speed and distance traveled?
- How do I use simple machines to gain mechanical advantage?

**Assessments**

- Design drawings, sketches, and journal entries
- Building and testing of rat trap vehicle

**Skill Objectives**

Students will:

- identify the six simple machines and their applications.
- brainstorm, solve problems, design, build, modify, and test a vehicle using engineering design concepts.
- use simple machines to gain mechanical advantage and modify torque requirements.
- design, build and test a vehicle that uses multiple simple machines to apply torque and power.

**Unit 9 – Fuel Injection Systems, 2 weeks [top](#)**

**Standards.**

***Automotive Technology***

**AUTO.07 Engine Performance: Describe the components and functions of the various systems that are related to engine performance.**

AUTO.07.02, AUTO.07.05

**Unit Objectives**

Students will be able to:

- explain the operation of electronic throttle body injection systems.
- develop an understanding of how fuel injection and throttle body systems control the efficiency and environmental impact of a modern automotive engine.

**Essential Question**

- How are modern fuel systems impacting efficiency?

**Focus Questions**

- What are some advantages of fuel injection systems over carburetor systems?
- How does a throttle body system differ from a system that uses a carburetor?
- How does a fuel injector system operate?

**Assessments**

- Gasoline Injection Fundamentals

**Skill Objectives**

Students will:

- list advantages of gasoline injection.
- compare the various types of gasoline injection systems.
- identify and describe the components of a fuel injection system.

**Unit 10 – Cooling Systems, Lubrication, 2 weeks [top](#)**

**Standards**

***Automotive Technology***

**AUTO.03 Explain scientific principles in relation to chemical, mechanical, and physical functions for various engine and vehicle systems.**

AUTO.03.06

**Unit Objectives**

Students will be able to:

- develop an understanding of how cooling system parts and solutions protect the engine from wear, overheating, and freezing.
- explain the operation and construction of major cooling system components.
- develop an understanding of how lubrication system parts and lubricants protect the engine from wear.

**Essential Questions**

- Why is knowledge of thermal dynamics important in understanding cooling systems?
- Why are oil rating systems used?

**Focus Questions**

- What are the major parts and operation of a cooling system?
- How does anti-freeze coolant work to lower the boiling point and anti-freezing characteristics of the solution?
- Why is the cooling system pressurized?
- What are the main functions of oil?
- What are the major parts of a lubrication system?

**Assessments**

- Cooling System Fundamentals
- Lubrication System Fundamentals

**Skill Objectives**

Students will:

- summarize the functions of a cooling system.
- explain the importance of anti-freeze/coolant.
- list the basic parts of the lubrication system.
- summarize the construction and operation of the lubrication system.
- explain the characteristics and ratings of engine oil.

**Unit 11 – Brakes, Anti-Lock Brakes, Traction and Stability Control, 3 weeks [top](#)**

**Standards**

*Automotive Technology*

**AUTO.09 Demonstrate function and principles of automotive drivetrain, steering and suspension, brake, and tire and wheel components and systems in accordance with portable national industry standards.**

AUTO.09.01, AUTO.09.02, AUTO.09.03, AUTO.09.04, AUTO.09.05, AUTO.09.06

**Unit Objectives**

Students will be able to:

- develop an understanding of brake system parts and how they operation.
- explain how to diagnose and repair a vehicle’s brake system.
- explain the major functions of a brake system.
- develop an understanding how anti-lock brakes, traction control, and stability control help in controlling a modern vehicle.
- explain the hydraulic and mechanical principles of a brake system.

**Essential Question**

- What are the impacts of control systems applied to braking systems?

**Focus Questions**

- What are the differences between disc brakes and drum brakes?
- How do brake systems differ from vehicle to vehicle?
- How does the brake hydraulic system operate?
- What are come brake problems associated with a vehicle?
- What is the proper procedure to replace brakes?
- What is the purpose of anti-lock brakes?
- How do traction control and stability control systems help in the controlling a vehicle?

**Assessments**

- Brake System Fundamentals
- Brake System Diagnosis and Repair
- Anti-Lock Brakes, Traction Control, Stability Control

**Skill Objectives**

Students will:

- explain how to service disc and drum brake systems.
- identify the major parts of an automotive brake system.
- identify the major parts of a typical anti-lock brake system.
- describe the operation of anti-lock brake systems.
- diagnose common brake system problems.
- inspect and maintain a brake system.
- compare disc and drum brakes.
- explain how to service disc and drum brake systems.
- describe the purpose and operation of traction control and stability control systems.

**Unit 12 – Clutches, Manual Transmissions, 2 weeks [top](#)**

**Standards**

*Automotive Technology*

**AUTO.09 Demonstrate function and principles of automotive drivetrain, steering and suspension, brake, and tire and wheel components and systems in accordance with portable national industry standards.**

AUTO.09.07.

**Unit Objectives**

Students will be able to:

- develop an understanding of how clutches and manual transmissions operate to give a vehicle power transmission and movement.
- explain the fundamental operation of a manual transmission.

**Essential Question**

- What impact do gear ratios have on power applied to motive force?

**Focus Questions**

- How does clutch operation connect and disconnect the engine and manual transmission?
- How do gears and gear ratios combine to change manual transmission torque, power and speed?
- What type of fluid does a manual transmission use?

**Assessments**

- Clutch Fundamentals
- Manual Transmission Fundamentals

**Skill Objectives**

Students will:

- list the basic parts of an automotive clutch.
- explain the operation of a clutch.
- describe the construction of major clutch components.
- describe gear operating principles.
- identify all major parts of a manual transmission.

**Unit 13—Automatic Transmissions, Transfer Cases, Differentials, Transaxles, 2 weeks [top](#)**

**Standards**

*Automotive Technology*

**AUTO.09 Demonstrate function and principles of automotive drivetrain, steering and suspension, brake, and tire and wheel components and systems in accordance with portable national industry standards.**

AUTO.09.07

**Unit Objectives**

Students will be able to:

- develop an understanding of the operation of automatic transmissions, drive shafts, transfer cases, differentials, transaxles and CV axles.
- identify how various combinations of these systems operate in many different vehicles being manufactured today.
- describe the operation of a differential.

**Essential Question**

- How are complex systems integrated to provide motive force?

**Focus Questions**

- How does a automatic transmission use hydraulics to operate output shafts?
- What type of fluid does an automatic transmission use?
- How do drive shafts and transfer case operate in a four wheel drive system?
- How does a transaxle compare to an automatic transmission and differential system?

**Assessments**

- Automatic Transmission Fundamentals
- Drive Shafts and Transfer Cases
- Differentials
- Transaxle and Front Drive Axle Fundamentals

**Skill Objectives**

Students will:

- explain how an automatic transmission shifts gears.
- explain the functions of a drive shaft and universal joint.
- explain the basic operation of a transfer case.
- explain the operation of a manual and automatic transaxle.
- explain how CV Joints operation.
- identify the basic components of and automatic transmission.
- identify the major parts of a transaxle assembly.



**Unit 14 – Engine Disassembly and Reassembly Project, 6 weeks [top](#)**

**Standards**

*Automotive Technology*

**AUTO.03 Explain scientific principles in relation to chemical, mechanical, and physical functions for various engine and vehicle systems.**

AUTO.03.01, AUTO.03.02, AUTO.03.03

**AUTO.05 Diagnosis and repair engines, including but not limited to two- and four-stroke and supporting subsystems**

AUTO.05.01, AUTO.05.02

**AUTO.04 Perform and document maintenance procedures in accordance with the recommendations of the manufacturer.**

AUTO.04.01, AUTO.04.03

*Pre-Engineering Technology*

**ENG.06 Use engineering equipment, laboratory materials and tools appropriately and safely.**

ENG.06.01, ENG.06.02, ENG.06.03

**Unit Objectives**

Students will be able to:

- explain engine block assembly and configurations in modern automobiles.
- develop a manual that references the complete engine simulated overhaul.
- experience disassembly and reassembly of an automotive engine.
- describe the use of precision machining in engine repair.

**Essential Questions**

- How do national standards influence the practice of auto mechanics?

**Focus Questions**

- How should you organize parts to help in the reassembly of the engine?
- Why can the order of the reassembly and the attention to details become critical?
- Can you develop a manual for disassembly/reassembly of a particular automotive engine that anyone could understand and use?

**Assessments**

- Engine Project Analysis Checklist which follows hands-on practical experience.
- Type written manual (project term paper)

**Skill Objectives**

Students will:

- organize and reference parts to the three main sections of the engine.
- list steps involved with disassembling an engine and organizing parts.
- list steps involved with reassembling an automotive engine.
- create a manual that references and complements every aspect of the hands-on experience.
- completely disassemble and reassemble an automotive engine.
- machine specific engine parts.