BABY YOU CAN FIX MY CAR!

BEEP BEEP

STOP CHILDREN, WHAT'S THAT SOUND?

SOMETHING SEEMS TO BE FALLING DOWN...

IS IT YOUR ENGINE OR YOUR TRANSMISSION?

AN INTEGRATED GRADE 9-12 STUDENT GUIDE TO THE CARE AND FEEDING OF THE INTERNAL COMBUSITON ENGINE

By:
Jon Van de Car
Jon.vandecar@merrimack.k12.nh.us

Susan Ruggeri
susan.ruggeri@merrimack.k12.nh.us

Merrimack High School
Merrimack NH
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Unit Title:
Baby, You Can Fix My Car; Stop Children What's that Sound?
Something Seems to be Falling Down - Is it your engine or your transmission?

OVERVIEW

I. **CONTENT**:
Automotive technology has been evolving for years, with changes and improvements made with each model year; however, the basic technology behind the automobile remains the same – the Internal Combustion Engine. This curriculum is the basic theory behind how the internal combustion engine works. Without a basic understanding of how the engine works, you cannot diagnosis what is wrong with it. The skills the students will learn by mastering this curriculum will be lifelong skills.

II. **PROCESS:**
Students will gain knowledge of the workings of the internal combustion engine and apply higher order thinking skills through the use of demonstration, hands-on experiences, brainstorming and research – either by themselves or through group work.

III. **PRODUCT:**
Students will have an understanding of the scientific theory behind the four stroke engine cycle, the theory of carburetion, engine lubrication and the automobile electrical system. They will develop the ability to use higher order thinking skills to troubleshoot and diagnose engine malfunctions.

Unit Overview: Alignment with
National / State / District Pupil Performance Standards

Overarching Benchmarks / Standards / Goals for COMPLETE unit of study:

Goal 1: Comprehension of the theory behind the four-stroke engine

Goal 2: Comprehension of the theory of fuel injection

Goal 3: Comprehension of the automotive electrical system

Goal 4: Comprehension of the theory of lubrication system

I–SEARCH INDEPENDENT RESEARCH PROJECTS FOR GIFTED AND TALENTED STUDENTS: PROJECT BASED LEARNING FOR MULTIPLE INTELLIGENCES

1. **PARADOXES:**

People usually believe that higher-octane fuel burns at a higher speed, but the opposite is true. Research the types of additives that can be added to lower-octane fuel to allow it to burn more efficiently and demonstrate with experimental design how pinging and pre-detonation takes place in a lower quality fuel.

2. **ATTRIBUTES:**

Automobiles are considered the main source of transportation in America – but is that really true? What about the rest of the world? Research modes of transportation in various parts of the United States as well as in other countries and create a bulletin board of the major forms of transportation around the world.

3. **ANALOGIES:**
How is the Internal Combustion Engine like the engine in the Space Shuttle? Create an illustration that shows the ways they are alike and the ways they are different.

4. **DISCREPANCIES:**
The Federal Government gave tax breaks to consumers who bought gas-guzzling SUV's and pick-up trucks. Create a political cartoon that shows that the tax credits came at the expense of the environment.

5. **PROVOCATIVE QUESTIONS:**
Even though we know there is a finite amount of fossil fuel available on earth, America has been very slow to research alternative fuel sources. Write a letter to your Senator outlining the reasons why we need the federal government to mandate and fund this research.

6. **EXAMPLES OF CHANGE:**
Create an illustrated timeline to show the changes the automobile has undergone from the Model T to the Hybrid car.

7. **EXAMPLES OF HABIT:**
Create a PowerPoint presentation depicting common driving habits and alternative habits that could be safer and increase fuel efficiency.

8. **ORGANIZED RANDOM SEARCH:**
Create a "family tree" for the Hybrid Ford Free Spirit, tracing it back to its ancestral roots in the Model T.

9. **SKILLS OF SEARCH:**
Create a postage stamp depicting the four stages of the evolution of machining car parts – from hand manufacturing to Laser manufacturing.

10. **TOLERANCE FOR AMBIGUITY:**
In the old television cartoon show, The Jetsons, cars did not drive on roads, but through the air on "freeways" above the roads. What can we do to utilize today's highways to improve traffic flow, and reduce fuel consumption and accidents?

11. **INTUITIVE EXPRESSION:**
Create a poster that shows the use of each of the five senses in the understanding of the four stokes of the four-stroke cycle.

12. **ADJUSTMENT TO DEVELOPMENT:**
Research the Tucker automobile- considered to be one of the most innovative and advanced automobiles of its time, yet a failure in production. You are a reporter for the National Public Radio show, "All things Considered". Conduct an interview with Preston Tucker, asking him to explain his innovations and speculating as to why it was such a failure.

13. **STUDY CREATIVE PEOPLE AND PROCESS:**
Compare Henry Ford to Bill Gates. Are they alike in the ways they think, develop new ideas or solve problems? Create a Venn diagram showing ways they are different and ways they are alike.

14. **EVALUATE SITUATIONS:**
Create a comic strip where the main character assembles his engine incorrectly. Show what he does wrong and what the end result would be.

15. **CREATIVE READING SKILL:**
Create a mnemonic devise to remember which side the cotter pin is bent to install it correctly. Create another one to remember how to loosen and tighten bolts.

16. **CREATIVE LISTENING SKILL:**
Create a radio jingle urging NH residents to carpool for energy conservation.

17. **CREATIVE WRITING SKILL**:
Write an instructional manual that explains how to start a cold engine.

18. **VISUALIZATION SKILL:**
Create a video that explains and demonstrates one of the stokes of the four-stoke engine.

ACADEMIC / CRITICAL THINKING SKILLS
ANALYZING HUMAN ACTIVITIES! (AHA!)

ESSENTIAL QUESTION: How does the Universal Theme of **Producing, Exchanging and Distributing** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **Essential Question: What are the costs, obvious and hidden, involved in owning a car?**

1. **Producing, Exchanging and Distributing**

KNOWLEDGE:
Video: Getting More Miles (medialink.com)
Students will: Brainstorm costs involved in owning and repairing an automobile.

COMPREHENSION:
Students will explain what can be one to improve fuel economy and what kind of vehicles should be used for various activities (for example, does someone who lives in LA and drives on a freeway really need an all-wheel drive SUV?)

APPLICATION:
Anchoring Activity / Anticipatory Set: Film clip: The Money Pit
Students will create a (class / team product): Students will predict the average cost of auto repair in one year.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video: Can You Name These 1959 Automobiles? (donpugh.dynds.org)
Students will: Compare costs of older cars to new cars
Class/team/individual product: Students will predict the average cost of auto repair in one year.

INDIVIDUAL JOURNAL ASSIGNMENT:
Keep a journal of "car issues" for one month and cost to repair. Include year and make of car as well as mileage of car.

HOMELINK:
Interview parents and other adults as to annual costs of car repair/maintenance

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ESSENTIAL QUESTION: How does the Universal Theme of **Transportation** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach.
Essential Question: **How can a well maintained and designed engine provide transportation in the most cost effective manner?**

2. **TRANSPORTATION**

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Song: I Get Around by the Beach Boys
There is a direct link between how well an engine runs and the cost of operation in miles per gallon. Students will brainstorm ways that a poorly running engine can cost more money at the pump

COMPREHENSION:

Students can explain how a well-maintained and designed engine can save them money. Students can explain the various engine designs.

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: Mustang Sally – John Lee Hooker
Students will create a (class / team product): Students will prepare a chart that compares and contrasts engine system designs and functions for fuel efficiency.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video clip: Electronic Ignition System - theory
Students will: demonstrate the ability to adjust systems to maintain efficiency and an understanding of computerized systems.

INDIVIDUAL JOURNAL ASSIGNMENT:
Research and summarize methods for troubleshooting system malfunctions

HOMELINK:
Poll parents as to the significance of the check engine light.

ESSENTIAL QUESTION: How does the Universal Theme of **Communications** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach.
Essential Question: **How does a technician communicate with the engine?**

3. **COMMUNICATIONS**

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Song: Silver Thunderbird – Marc Cohen
Students will: Students will discuss methods that a technician has to communicate with the engine.

COMPREHENSION:
Students will understand how to use the scan tool to diagnose problems in the engine and how to use the laptop programs.

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: Another Glitch in the Call (www.poppyfields.net/filks/00020.html)
Students will create a (class / team product): Students will hook up scantron tool to automobile, read codes and diagnose problems.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video: Pit Run over by Michael Andretti (AOL Video)
Students will: locate components on the vehicle that were identified as problematic

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ESSENTIAL QUESTION: How does the Universal Theme of **Protecting and Conserving** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **Essential Question**:
What prevents the engine from self-destruction while it is running?

4. **PROTECTING AND CONSERVING**

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Song: Eve of Destruction – Barry McGuire
If the engine is turning at 4000rpm, there are 2000 explosions per minute. Students should discuss what keeps the engine from self-destructing.

COMPREHENSION:
Students will explain the relationship between mechanical and electrical timing and lubrication systems.

APPLICATION:
Anchoring Activity / Anticipatory Set: Video Clip: Drag Car blowing up
Students will create a (class / team product): Disassemble a 2 hp 4-stroke engine and re-ssemble it in working order

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video clip: 3 Stooges hitting a car with sledge hammer
Class/team/individual product:
Students will: troubleshoot non-functioning or poorly functioning engines to determine cause and solutions

INDIVIDUAL JOURNAL ASSIGNMENT:
Students will record process, what was done incorrectly and corrective actions.

ESSENTIAL QUESTION: How does the Universal Theme of **Providing Education** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **Essential Question**: **What do we need to know to insure that our vehicles pass the annual inspection?**

5. PROVIDING EDUCATION

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Song: I'm in Love with my Car - Queen
Students need to know what components of the auto need to be inspected annually and how to uplink with the computer and access engine management systems for 1996 vehicles and up.

COMPREHENSION:
Students will review and discuss inspection checklist and learn specification for scan tool uplinks.

APPLICATION:
Anchoring Activity / Anticipatory Set: Video Clip – Days of Thunder – NASCAR pit crew using diagnostic computer.
Students will create a (class / team product): Conduct an actual automobile inspection.
Multicultural and/or ESL and/or Bilingual Link: Research automobile inspection standards in other countries – compare them to USA standards. Are we ahead of other nations or behind in ensuring safe, well-functioning and gas efficient vehicles?
School-to-Career/Tech Prep Link: Guest Speaker - service technician to explain changes in automobile inspection and why it has become so expensive

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video Clip: Numbers – using math to solve a problem
Class/team/individual product: **Students will**: demonstrate how to convert a code to an actual activity- what does a code mean and how do you address a problem.

INDIVIDUAL JOURNAL ASSIGNMENT:
Student will research problems common to specific vehicles.

HOMELINK:
Interview parents and other adults about problems they have had with cars.

ESSENTIAL QUESTION: How does the Universal Theme of **Making and Using Tools and/or Technology** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach.

Essential Question: **How have the improvements in On-Board Diagnostics improved our ability to quickly diagnose and repair automobiles?**

6. MAKING AND USING TOOLS AND/OR TECHNOLOGY

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Video: 2001 A Space Odyessy – Clip where HAL shuts down life support systems
Students will identify the first diagnostic computer system OBD I and the second generation system OBD II.

COMPREHENSION:
Students will: compare and contrast OBD I and OBD II diagnostic systems

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: Changes – David Bowie
Students will create a (class / team product): Pull codes from car using OBD I and OBD II

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: video clip: Lost in Space – Danger, Will Robinson, Danger
Class/team/individual product: Disconnect an injector ground wire from each of two vehicles. Divide class into two groups – each group is assigned to diagnosis what is wrong with the vehicle using either the OBD I or OBD II tool. What is the process needed to pinpoint and address the problem.

INDIVIDUAL JOURNAL ASSIGNMENT:
Reflect upon the improvements of OBD I and OBD II

ESSENTIAL QUESTION: How does the Universal Theme of **Providing Recreation** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: How can the automobile be a vehicle of recreation?**

7. PROVIDING RECREATION

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Video Clip: Days of Thunder
Students will: Discuss the phenomena of NASCAR – from its roots in the "good ole boys" from the southeast to a nationwide pastime.

COMPREHENSION:
What does NASCAR stand for and why has it grown into such a national phenomena?

APPLICATION:
Anchoring Activity / Anticipatory Set: Video Clip: Days of Thunder
Students will create a (class / team product): a chart reflecting the socio and economic implications of NASCAR

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video – Tucker Automobile
Class/team/individual product:
Students will: create a visual that explains the process of setting up a NASCAR team; economics, technical support, facilities, transportation

INDIVIDUAL JOURNAL ASSIGNMENT:
Pick a NASCAR driver and follow his progress through a season – economically and championship position.

ESSENTIAL QUESTION: How does the Universal Theme of **Organizing and Governing** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: What changes has the federal government implemented to address emission controls.**

8. ORGANIZING AND GOVERNING

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Video clip – government video – Unsafe At Any Speed
Students will: brainstorm and discuss changes in emission control standards that have been implemented since 1968.

COMPREHENSION:
Students will explain the need for improvements to the emission control standards and the evolution of those changes since the first standards were mandated in 1968.

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: Ragtop Day – Jimmy Buffett
Students will create a (class / team product): physically identify the components of the emission system and test with VOM.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set:
Class/team/individual product: Students will create a timeline from 1968 to present – divided into 5 year increments and naming major changes in each five year block.

INDIVIDUAL JOURNAL ASSIGNMENT:
The biggest change in emission system controls in the last five years is in the fuel management system occurs in the first minute of operation. Explain how this was accomplished.

HOMELINK:
Explain to parents how cars are more fuel efficient and run cleaner than in previous years.

ESSENTIAL QUESTION: How does the Universal Theme of **Moral, Ethical and Spiritual Behavior** create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: Given that the automobile is the least efficient use of energy, why has it taken so long to create a car that is more fuel efficient?**

9. MORAL, ETHICAL AND SPIRITUAL BEHAVIOR

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Video; Who Killed the Electric Car?
Americans have a love affair with the automobile – one of the least efficient uses of energy. Students will brainstorm societal problems caused by the automobile**.**

COMPREHENSION:
Discussion of electric cars, hybrid cars and fuel cell technology

APPLICATION:
Anchoring Activity / Anticipatory Set: Film clip: Click and Clack discuss fuel cell technology (NPR Video)
Students will create a (class / team product): a hydrogen fuel cell car
Multicultural and/or ESL and/or Bilingual Link: Students could research what other countries are doing to address the problem of shrinking natural resources such as solar cars in the Middle East or tropics or solar heating rain water for consumer use.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video clip: - The Jetson's – opening scene – George's car
Class/team/individual product: Students will: research and present comparative data on hybrid cars currently on the market for cost, fuel efficiency and maintenance. Students should choose what they believe the best car to buy and defend their choices.

HOMELINK:
Ask parents if they have considered purchasing a green car or hybrid car. What is preventing them for making that choice?

ESSENTIAL QUESTION: How does the Universal Theme of Aesthetic Needs create mastery learning of essential concepts in this unit? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: Is the car simply a vehicle of transportation or an extension of a person's personality?**

10. AESTHETIC NEEDS

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Slide show of the Ralph Lauren car collection from display at the Boston Museum of Fine Arts (http:www.quia.com/pages/automotives.com)
Students will: discuss the car as art and an expression of a person's personality.

COMPREHENSION:
Class discussion regarding what influences affect consumer decisions when buying a car.

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: Car and Driver – Bill Morrissey
Students will create a (class / team product): Research different celebrities, the cars they drive and what the car says about them.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Song: Me and My Automobile – Jack Willliams
Class/team/individual product:
Students will: Research how aesthetics have affected car sales – is the best looking car always the best choice?

INDIVIDUAL JOURNAL ASSIGNMENT:
What is the car of your dreams and what does it say about you?

HOMELINK:
Interview parents about their first car and their favorite car.

ESSENTIAL QUESTION:

How does the discipline/sub-discipline of INTAKE relate to mastery learning of INTERNAL COMBUSTION? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: How are pressure differentials used in the Intake Stroke to begin the process of internal combustion?**

11. INTAKE STROKE

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Film Clip: Titanic – scene where the Titanic is sinking
Students will: brainstorm and discuss reasons why the Titanic sank

COMPREHENSION:
After viewing PowerPoint presentation on the Intake Stroke, student will explain how pressure differentials move air and fuel into the cylinder. **(http:www.quia.com/pages/automotives.com)**

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: Pressure – Billy Joel
Demonstration: Space Bags – garment bags with air removed to save space
Students will blow up balloons and release to demonstrate that a high pressure area equalizes.
Mathematics/Science Link and/or Humanities Link: Observe the differentials in low and high pressure areas in weather and how they affect each other.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: Video Clip – Formula 1 driving
Students will: Compare the difference between a low compression (6:1) engine to a high compression (10:1) engine calculating how low the psi will be in both scenarios.

INDIVIDUAL JOURNAL ASSIGNMENT:
Monitor barometric pressure in NH for a week, the changes that occur and the connections you can make.

ESSENTIAL QUESTION:
How does the discipline/sub-discipline of Compression relate to mastery learning of Internal Combustion? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: Why is it necessary to compress the air during the compression stroke?**

12. Compression

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Video Clip: volcano erupting
Students will: explain why it is necessary to compress the air and fuel mixture to enhance the potential energy

COMPREHENSION:
After viewing the PowerPoint presentation of the compression stroke, students will explain how the psi in the cylinder increases, mathematically show how much, and be able to explain why this is important.
(http:www.quia.com/pages/automotives.com)

APPLICATION:
Anchoring Activity / Anticipatory Set: film clip: SCUBA diver with air compressed into a tank raising the psi.
Students will take a compression test in their individual engines using a compression tester.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: video clip: movie – Fast and Furious – scene where he misses his shift and his car blows up
Students will: explain how the condition of the rings and valves affect the actual compression created by the engine.

INDIVIDUAL JOURNAL ASSIGNMENT:
Compare the difference between a low compression engine and a high compression engine, calculating how high the psi will be in both scenarios.

ESSENTIAL QUESTION:
How does the discipline/sub-discipline of Power relate to mastery learning of Internal Combustion? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: Why and how do you ignite the fuel and air mixture?**

13. Power Stroke

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Song: Light my fire - Doors
Students will: be able to explain how the fuel mixture is ignited and what happens to the expanding gasses.

COMPREHENSION:
After viewing PowerPoint presentation of the power stroke, students will be able to explain how the force is transferred to the crankcase. **(http:www.quia.com/pages/automotives.com)**

APPLICATION:
Anchoring Activity / Anticipatory Set: Firecracker in a box
Using a one quart and a one gallon can – light two small firecrackers and place one of the cans over each firecracker. The firecracker explodes and the can goes into the air. (Make sure students stand back and wear safety glasses.) Conduct experiment next to a yardstick.
Students will measure the height each can reaches. They will then measure the volume of each can and create a ratio of height reached and volume of can.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: song: Start Me Up – Rolling Stones
Students will:
Class/team/individual product: Students will create a visual describing what happened during the experiment, explaining why the smaller can went higher and relating this to low compression and high compression engines.

INDIVIDUAL JOURNAL ASSIGNMENT:
Explain how the sealing of the rings affects the power transferred from the expanding gasses.

ESSENTIAL QUESTION: How does the discipline/sub-discipline of Exhaust relate to mastery learning of Internal Combustion? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION: What is created by combustion and how do you remove it?**

14. Exhaust Stroke

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Movie clip: Garbage truck hauling trash away
Students will: be able to explain what must be done with the end result of combustion – the exhaust gasses.

COMPREHENSION:
After viewing the PowerPoint presentation on the Exhaust Stroke, students will be able to explain positive displacement. (http:www.quia.com/pages/automotives.com)

APPLICATION:
Anchoring Activity / Anticipatory Set: Film Clip: Exhaust fumes bubbling up from under a boat
Students will start a small engine and restrict the flow of exhaust gasses by 50%. Observe and record what happens to the efficiency, acceleration and responsiveness of the motor. Draw conclusions about horsepower output, emissions and engine efficiency.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anchoring Activity / Anticipatory Set: film clips of chimneys, car exhaust, boat exhaust, and smokestacks.
Students will: inspect various vehicle tailpipes for exhaust residue, explain what they found and propose explanations for possible causes.

INDIVIDUAL JOURNAL ASSIGNMENT:
Explain whether or not design efficiency of exhaust systems affects the engines horsepower or gas mileage

HOMELINK:
Ask parents when the last time they had their cars tuned up and if they saw any improvement in gas mileage.

ESSENTIAL QUESTION:
How does the discipline/sub-discipline of The Fuel System relate to mastery learning of Internal Combustion? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION:**
How does the fuel move from the fuel tank to the cylinder and what is it mixed with?

15. Fuel Systems

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: Demonstration: Atomized water
Fill a gallon can halfway with water. Put a straw into the water about 2 inches deep. Blow air across the top of the straw creating a low pressure area – the water will be pushed up the straw into the air stream creating an atomized mixture.
Students will: After viewing the demonstration students will brainstorm reasons why the water is pushed up the straw into the air stream.

COMPREHENSION:
After viewing the PowerPoint presentation, students will be able to explain how fuel is atomized, the function of each part of the carburetor, and how the ration of fuel to air is adjusted. They will explain why air has to be mixed with fuel and why it has to be at a 15:1 ratio.
(http:www.quia.com/pages/automotives.com)

APPLICATION:
Anchoring Activity / Anticipatory Set: Song: 409 – Beach Boys
Students will disassemble an actual carburetor and label all parts on an exploded view of the carburetor.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: film clip: Fast and Furious – race scene
Students will: discuss the difference between fuel injection and carburetion. Which is better and why?
Class/team/individual product: class debate fuel injection vs. carburetion

INDIVIDUAL JOURNAL ASSIGNMENT:
Why has the carburetor been replaced by fuel injection in all cars currently manufactured?

ESSENTIAL QUESTION:
How does the discipline/sub-discipline of electrical systems relate to mastery learning of Internal Combustion? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION:**
How is the electrical current produced and sent to the individual cylinder?

16. Electrical Systems

KNOWLEDGE:

Anchoring Activity / Anticipatory Set: demonstration: using a spark plug from a car and a transformer – turn on current and have students watch spark – continually widen the gap in the spark plug until there is no longer a spark. Have students note color and size of the spark as the gap is widened.
Students will: discuss reasons why widening the gap affected the flow of electricity.

COMPREHENSION:
After viewing the PowerPoint presentation on the electrical system, students will understand how the magneto system works. (http:www.quia.com/pages/automotives.com)

APPLICATION:
Anchoring Activity / Anticipatory Set: demonstration: using an electro-magnet, instructor will lift a five-pound weight with the magnet
Students will create a (class / team product): an electro-magnet with using both solid and laminated cores and attempt to lift a five-pound weight with it.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: movie clip: Goldfinger – scene where a crushed car filled with gold is lifted with electro-magnet and put in the back of a pick up truck
Students will: explain why the solid core retained the magnetic field and the laminated core did not.

INDIVIDUAL JOURNAL ASSIGNMENT:
Discuss the three ways of producing electricity and give an example of each.

ESSENTIAL QUESTION:
How does the discipline/sub-discipline of Lubrication Systems relate to mastery learning of Internal Combustion? State the essential concept(s) that this specific lesson will teach. **ESSENTIAL QUESTION:**
What is oil viscosity and how is it used to reduce friction in the Internal Combustion Engine?

17. Lubrication Systems

KNOWLEDGE:
Anchoring Activity / Anticipatory Set: demonstration: Three cups each filled with 3 ounces of either water, molasses or tomato juice and three empty cups. Pour the contents of each cup into one of the empty cups. Time and record how long it takes to empty the contents of each cup into the empty one.
Students will: Using the data from the demonstration, students will generate a class definition of the word viscosity.

COMPREHENSION:
After viewing the educational video, Lubrication Systems, and teacher explanation of the need to reduce friction and dissipate heat, students will be able to explain the importance of engine lubrication.

APPLICATION:
Anchoring Activity / Anticipatory Set: clip – TV show – Petticoat Junction – clip of railroad pump car

Students will disassemble two different types of oil pumps – rotor type and gear type and observe how they function, check for wear, inspect the relieve valve and explain how it works.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):
Anchoring Activity / Anticipatory Set: demo of oil pick up screens
Students will: define oil sludge, name three things found in it, and determine the best way to prevent sludge from building up.

INDIVIDUAL JOURNAL ASSIGNMENT:
List and explain the five properties of oil and select the correct oil for a particular engine and explain why they chose that oil.

HOMELINK:
Ask parents how often they change their engine oil.

MORAL / ETHICAL / SPIRITUAL
REASONING AND DILEMMAS
FOR CHARACTER EDUCATION

TEN ETHICAL DILEMMAS

(Must be set in context of unit, but must also relate to the lives of today's students)

ESSENTIAL QUESTION: How does the content of this unit reflect **character education** through Moral and Ethical dilemmas?

1. **Producing, Exchanging, and Distributing** [Economics]

ESSENTIAL QUESTION: How does the **Human Activity** of **Producing, Exchanging and Distributing** create moral/ethical dilemmas?
DILEMMA: The world is running out of fossil fuel, and America continues to have a love affair with the automobile. Why do we continue to buy large, expensive fuel-inefficient vehicles when smaller, more efficient hybrid cars are better for our environment?

2. **Transportation**

ESSENTIAL QUESTION: How does the **Human Activity** of **Transportation** create moral/ethical dilemmas?
DILEMMA: Given the shortage of fossil fuels, why has the federal government dragged its feet in repairing and upgrading the railroad system – including the rail beds, rails and trains?

3. **Communications**

ESSENTIAL QUESTION: How does the **Human Activity** of **Communications** create moral/ethical dilemmas?
DILEMMA:
Why has the federal government allowed large automobile corporations to institute proprietary information such as automobile repair codes, effectively tying the consumer to the dealer and substantially limiting the capabilities of the independent repair shops unless they are willing and able to expend enormous sums of money to the manufactures?

4. **Protecting and Conserving**

ESSENTIAL QUESTION: How does the **Human Activity** of **Protecting and Conserving** create moral/ethical dilemmas?
DILEMMA: The federal government gave tax credits to consumers who bought SUV's and pick-up trucks in order to stimulate the American Automotive Industry. Given the fuel inefficiency of these vehicles, this economic stimulation was done at a cost to the environment. What could the federal government have done to both stimulate the automotive industry as well as protect our environment and natural resources?

5. **Providing Education**

ESSENTIAL QUESTION: How does the **Human Activity** of **Providing Education** create moral/ethical dilemmas?
DILEMMA: The federal government has mandated emission standards, but there are some engine management systems that actually reduce fuel economy, but meet the federal emission standards. Some cars can meet the emission standards without using the mandated catalytic converter. Your car is one of these. Taking off the catalytic converter will improve your gas mileage by two miles per gallon. Are you breaking the law by removing your catalytic converter or are you doing your part to conserve fuel?

6. **Making and Using Tools and/or Technology**

ESSENTIAL QUESTION: How does the **Human Activity** of **Making and Using Tools and/or Technology** create moral/ethical dilemmas?

DILEMMA: Does quality or cost per unit, the bottom line, count? You have designed an engine part that works efficiently and has longevity. Your boss has told you to reduce the production cost even if it severely cuts quality. Do you do it or do you quit your job?

7. Providing Recreation

ESSENTIAL QUESTION: How does the **Human Activity** of **Providing Recreation** create moral/ethical dilemmas?
DILEMMA: Auto racing is beginning to replace baseball as our national pastime. Thousands of gallons of fuel are expended each weekend by racing. Should the federal government mandate that race cars become more fuel efficient, even if that will cut back on the speeds the cars can achieve during the race, and possibly making the racing less exciting?

8. Organizing and Governing

ESSENTIAL QUESTION: How does the **Human Activity** of **Organizing and Governing** create moral/ethical dilemmas?
DILEMMA: Do we pass laws that will create an environment where state inspections can only be done at state inspection centers vs. allowing independent service facilities to conduct safety inspections? Are we sacrificing free enterprise for government controlled emission testing?

9. Moral, Ethical and Spiritual Behavior

ESSENTIAL QUESTION: How does the **Human Activity** of **Moral, Ethical and Spiritual Behavior** create moral/ethical dilemmas?
DILEMMA: Your friend will get you a "lick and stick" inspection sticker for your car that will not pass inspection. Do you take it and run the risk of getting both you and your friend in trouble if you get caught, as well as risking driving an unsafe car, or do you spend the $1000 dollars needed to repair your car and make it safe?

10. Aesthetic Needs

ESSENTIAL QUESTION: How does the **Human Activity** of **Aesthetic Needs** create moral/ethical dilemmas?
DILEMMA: You have a nine-month-old child and need to buy a new car. Which car do you buy? The one you consider to be the safest – or the really good deal on the sporty car and less fuel efficient car of your dreams – even though you know it didn't do well on safety crash tests?

PRODUCTIVE THINKING SKILLS
DIVERGENT / CREATIVE THINKING

1. **BRAINSTORM MODEL**

A. BRAINSTORM ALL OF THE _____.
AHA #1: costs involved in owning an automobile
AHA #2: reasons why a poorly running engine costs extra money
AHA #3: methods a technician uses to diagnosis engine problems
AHA #4: reasons why an engine can malfunction
AHA #5: reasons why a car should be inspected annually
AHA #6: tools that have developed to diagnose engine problems
AHA #7: components necessary to run a NASCAR team

B. BRAINSTORM AS MANY_____AS YOU CAN THINK OF.
AHA #8: automotive developments
AHA #9: reasons why autos should be made more fuel efficient
AHA #10: aesthetically pleasing advancements and their relationship to efficiency
AHA #11: examples of pressure differentials
AHA #12: examples of pressure changes
AHA #13: uses of expanding gasses used in machinery
AHA #14: ways engineers have attempted to solve exhaust pollution problems

C. HOW MANY WAYS CAN YOU COME UP WITH TO _____?

AHA #15: create an atomized mixture
AHA #16: create an electrical current
AHA #17: reduce friction

2. **VIEWPOINT MODEL (Human or Animate) USE CULTURAL LITERACY TERMS**

A. HOW WOULD_____LOOK TO A(N) _____?
AHA #1: a carburetor look to a fuel injection system
AHA #2: an engine look to a horse
AHA #3: an OBD II scantron tool look to Henry Ford
AHA #4: regular engine oil look to synthetic engine oil
AHA #5: a current auto inspection look to a 1950's mechanic
AHA #6: electronic ignition look to Thomas Edison
AHA #7: a NASCAR look to a horse and buggy
AHA #8: a tailpipe look to a driveway

B. WHAT WOULD A _____ MEAN FROM THE VIEWPOINT OF A(N)_____?
AHA #9: fossil fuel …hay
AHA #10: mag wheel …wagon wheel
AHA #11: air pressure …piston
AHA #12: combustion chamber…donkey
AHA #13: spark plug…firecracker
AHA #14: tailpipe…prairie dog
AHA #15: fuel injector…carburetor
AHA #16: magnetic field …credit card strip
AHA #17: dirty oil filter…car engine

C. HOW WOULD Thomas Edison VIEW THIS?
(Use one person from history here)
1: automotive computer
2: fuel injector
3: electronic ignition
4: hybrid car
5: hydrogen cell
6: four wheel drive automobile

3. **INVOLVEMENT MODEL (Personification / Inanimate object brought to life**)
A. HOW WOULD YOU FEEL IF YOU WERE_____?
AHA #1: gasoline in an SUV
AHA #2: a dirty spark plug
AHA #3: a broken wire
AHA #4: dirty oil
AHA #5: a broken muffler
AHA #6: an OBD II scan tool
AHA #7: a racetrack

B. IF YOU WERE A_____, WHAT WOULD YOU (SEE, TASTE, SMELL, FEEL, etc.)?
AHA #8: tailpipe
AHA #9: catalytic converter
AHA #10: Ferrari chassis
AHA #11: intake valve
AHA #12: piston ring
AHA #13: spark plug
AHA #14: exhaust valve

C. YOU ARE A _____. DESCRIBE HOW IT FEELS.
AHA #15: venturi
AHA #16: electrical current
AHA #17: oil filter

4. CONSCIOUS SELF–DECEIT MODEL

A. SUPPOSE_____. WHAT_____.
AHA #1: you were in charge of emission controls…changes would you make
AHA #2: you owned a taxi company…improvements would you make
AHA #3: you were an OBD II scan tool…could you tell us
AHA #4: you are a conservationist…would you monitor on cars
AHA #5: you were a car owner…what can you check to be sure your car passes inspection
AHA #6: you were an OBD I computer…could an OBD II teach you
AHA #7: you could drive 150 mph…safety devices do you need
AHA #8: you are CEO in charge of buying company cars…what vehicles do you buy
AHA #9: you could make a hydrogen cell work…would you do to market it

B. YOU CAN_____. WHAT_____?
AHA #10: have all the technology available…would you do to make a better car
AHA #11: have all the atomized fuel you want…would you do to make a car more efficient
AHA #12: have all the sealing power of a ring…would you do to make a car more efficient
AHA #13: have all the potential energy created gas has…would you do to make the engine more powerful.
AHA #14: have all of the time needed…would you do to remove all exhaust fumes
AHA #15: remove all the heat generated by combustion…would that do to help lubrication
AHA #16: have all the voltage needed…would you do to make gas burn more completely
AHA #17: have all the air needed…would you do to make gas more powerful

5. **FORCED ASSOCIATION MODEL** **USE CULTURAL LITERACY TERMS HERE**

A. HOW IS _____ LIKE _____?
AHA #1: fuel…food
AHA #2: an engine tune-up…an energy audit
AHA #3: an OBDII tool …a heart monitor
AHA #4: engine oil…blood
AHA #5: annual inspection…a yearly check-up
AHA #6: an exhaust pipe…chimney
AHA #7: a NASCAR …bicycle

B. GET IDEAS FROM _____TO IMPROVE _____.
AHA #8: a power plant…auto emissions
AHA #9: Thomas Edison…fuel efficiency
AHA #10: Picasso…auto design
AHA #11: a rocket ship…ignition
AHA #12: a dam…seals
AHA #13: a volcano…power
AHA #14: toilet…tailpipes

C. I ONLY KNOW ABOUT _____. EXPLAIN _____ TO ME.
AHA #15: fossil fuel…hydrogen cells
AHA #16: AC current…DC current
AHA #17: Engine Heat…oil viscosity

6. **REORGANIZATION / SYNECTICS MODEL**

A. WHAT WOULD HAPPEN IF _____?
AHA #1: cars could be fueled by compressed air
AHA #2: tires could never wear out

AHA #3: cars could tell us what is wrong with them
AHA #4: engines could run as hot as they wanted without damage
AHA #5: we never had to inspect out cars
AHA #6: cars could repair themselves
AHA #7: there were no interstate highways

B. SUPPOSE _____(HAPPENED) WHAT WOULD BE THE CONSEQUENCES?
AHA #8: cars had to burn fuel at 100% efficiency
AHA #9: cars had to get 80 mpg to be allowed on roads
AHA #10: all cars had to have the same design
AHA #11: air pressure did not change
AHA #12: air and fuel would not mix
AHA #13: gasoline was inflammable in the liquid state
AHA #14: cars had no tailpipes

C. WHAT WOULD HAPPEN IF THERE WERE NO _____ ?
AHA #15: local gasoline stations
AHA #16: electrical currents
AHA #17: lubrication in the engine
Random: speed limits
Random: traffic lights
Random: emission controls

CULTURAL LITERACY

1. Dates:

2. Names:
alternator
antifreeze
battery
catalytic converter
electricity
fuel
fuel injector
gasket
hybrid car
hydrogen fuel cell
ions
magnesium wheels
magneto
oil
p.s.i.
pump
relay
rings
seal
spark plugs
thermostat
vernier caliper
volt ohm meter

3. Proper Names:
Preston Tucker OBD I

Thomas Edison
Henry Ford
NASCAR
OBD II
OTTO

4. Ideas:

atomization
bore
carburetion
compression
consumer
exhaust
four-wheel drive
heat exchanges
hydraulics
ignition
inspection
intake
lubrication
power
pressure
schematics
stroke

5. Phrases

cooling system
electro-magnetism
fossil fuel
pressure differentials

RESOURCES

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How a Car is Built – the Ford Mustang
Tecumseh Factory School Training Videos:
- Carburetors
- Ignition Systems

Meridian Educational Corporation – Diesel Engine Operation
The History Channel Videos
- Modern Marvels: Engines
- Modern Marvels: The Manhattan Project
- Automobiles: The Porsche 911

Rebuilding Your Engine
ASE Automobile Series: Brakes A5
Educational Videos – Strut Replacement

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The Money Pit
Can You Name these 1959 Automobiles? (donpugh.dynads.org)
Pit Runover by Michael Andretti (AOL Video)
Days of Thunder
2001: A Space Odyssey
Who Killed the Electric Car? (google video)
NPR Video – Click and Clack Discuss the Hydrogen Fuel Cell
Titanic
Formula 1 Driving (google video)
Volcano Erupting (google video)
Scuba diver (google video)
The Fast and the Furious
The Fast and the Furious 2
The Italian Job
Garbage truck hauling trash away (google video)
Exhaust fumes (google video)
Chimneys (google video)
Boat exhaust (google video)
Smoke stacks (google video)
Goldfinger
Petticoat Junction (TV show)
Drag Car blowing up (google video)
Three Stooges
Numbers (TV show)
Lost In Space (TV show)
Tucker Automobile
Gone in 60 Seconds
Cars

Talladega Lights

V **Music**
I Get Around – Beach Boys
Mustang Sally – John Lee Hooker
Silver Thunderbird – Marc Cohen
Another Glitch in the Call (www.poppyfields.net/filks/00020.html)
Eve of Destruction – Barry McGuire
I'm in Love With My Car – Queen
Changes – David Bowie
Pressure – Billy Joel
Car and Driver – Bill Morrissey
Me and My Automobile – Jack Williams
Light My Fire – Doors
Start me Up – The Rolling Stones
409 – Beach Boys
Ragtop Day – Jimmy Buffett

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