



Lesson Plan

All About Engines!

Created: 01/2021 by the National FFA Organization

Description of lesson: This lesson covers all things engines — from researching the different types of engines to labeling the parts of a gas turbine engine to learning about careers similar to a jet mechanic.

STUDENT LEARNING OBJECTIVES:

After completing these activities, students will ...

1. Examine careers similar to a jet mechanic.
2. Identify and explain the various components of a gas turbine engine.
3. Differentiate between types of engines.

TIME REQUIRED: 60 minutes

RESOURCES/REFERENCES:

1. Website: AgExplorer (2019), [Agexplorer.ffa.org](https://agexplorer.ffa.org)
2. Website: Energy Education, https://energyeducation.ca/encyclopedia/Internal_combustion_engine
3. Website: How Car Engine Works, <https://auto.howstuffworks.com/engine.htm#pt9>
4. Website: Gas Turbine Engines-Air Entrance, <https://www.flight-mechanic.com/gas-turbine-engines-air-entrance/>
5. Website: What is the Difference between a Hybrid Car and an Electric Car?, [https://www.carsdirect.com/green-cars/what-is-the-difference-between-a-hybrid-car-and-an-electric-car#:~:text=The%20primary%20difference%20between%20a.%20Demission%20vehicle%20\(ZEV\).](https://www.carsdirect.com/green-cars/what-is-the-difference-between-a-hybrid-car-and-an-electric-car#:~:text=The%20primary%20difference%20between%20a.%20Demission%20vehicle%20(ZEV).)
6. Article: From Shop Class to Fighter Jets, <https://www.ffa.org/ffa-new-horizons/from-shop-class-to-fighter-jets/>

EQUIPMENT AND SUPPLIES NEEDED:

1. A copy of the “Let’s Learn About Engines!” worksheet for each student

STUDENT ACTIVITY SHEETS:

Direct access to student activity sheets without lesson plan or answer key for easy upload to learning management systems or printing for classwork.

<https://ffa.box.com/s/d7kty4fh9i1n53a5ifolw3sdi14ieatb> (Word)

<https://ffa.box.com/s/of04t17pwdqhf3oqd6ulkyunhh0uf7ik> (PDF)

CROSS-CURRICULAR CONNECTIONS:

English/Language Arts	Engineering
Students will identify and correctly label the components of a gas turbine engine.	Students will learn the various components and functions of gas turbine engine.

THESE ACTIVITIES ARE ALIGNED TO THE FOLLOWING STANDARDS:

AFNR Performance Element

- CS.05. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

FFA Precept

- FFA.PL-A.Action: Assume responsibility and take the necessary steps to achieve the desired results, no matter

what the goal or task at hand.

- FFA.PL-C.Vision: Visualize the future and how to get there.
- FFA.PL-E.Awareness: Understand personal vision, mission and goals.
- FFA.PG-J.Mental Growth: Embrace cognitive and intellectual development relative to reasoning, thinking and coping.
- FFA.CS-M.Communication: Effectively interact with others in personal and professional settings.
- FFA.CS-N.Decision Making: Analyze a situation and execute an appropriate course of action.

Common Career Technical Core

- AG5 Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources Career Pathways.

Common Core - Reading- Informational Text

- CCSS.ELA-Literacy.RI.9-10.2 Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
- CCSS.ELA-Literacy.RI.9-10.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).

Common Core - Writing

- CCSS.ELA-Literacy.W.9-10.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Common Core - Speaking and Listening

- CCSS.ELA-LITERACY.SL.9-10.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- CCSS.ELA-LITERACY.SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

Common Core - Literacy in Science & Technical Subjects: Writing

- CCSS.ELA-Literacy.WHST.9.10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCSS.ELA-Literacy.WHST.9.10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

AFNR Career Ready Practices

- CRP.02: Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive.
- CRP.04: Communicate clearly, effectively, and with reason. Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods.
- CRP.06: Demonstrate creativity and innovation. Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization.
- CRP.08: Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem.

Partnership for 21st Century Skills

- Critical Thinking and Problem Solving
- Flexibility and Adaptability
- Initiative and Self-Direction
- Leadership and Responsibility

LESSON PLAN:

1. **Bell Ringer:** There are multiple types of engines. Identify as many as you can in 30 seconds.
2. **Introduction:** Today, you are going to read an article about a former FFA member who is now a fighter jet mechanic in the military. We will learn about her story and then dive deeper into various types of engines and their components.
3. **Activity:** Each student needs a copy of the worksheet "Let's Learn About Engines!"
 - a. Part 1: Have students read the article "From Shop Class to Fighter Jets" (<https://www.ffa.org/ffa-new-horizons/from-shop-class-to-fighter-jets/>) and answer the questions pertaining to the article. Next, students will go to AgExplorer.ffa.org to research and identify three careers similar to a jet mechanic. Students will record their findings in the appropriate spaces.
 - b. Part 2: Students will identify and label parts of a gas turbine engine. They will color code and label each component of the engine using this website: https://energyeducation.ca/encyclopedia/Internal_combustion_engine. (For virtual learning, students can type the component name next to the correct piece.)
 - c. Part 3: Students will differentiate between types of engines — 4-cylinder and V6 engines and gas, diesel, hybrid and electric — by researching the differences between the types of engines.
4. **Follow-up:** Have students share with their seat partner one new fact that they learned and how it will impact them in the future. For virtual learning environments, have students submit this via email or the learning management system.
5. **Optional – Extended Learning Opportunities (Not factored into time requirement):**
 - a. Have a local mechanic speak to the class (in-person or virtually) about his or her career. The mechanic could talk about the educational requirements, responsibilities and daily duties associated with his or her career.
6. **Exit Ticket:** How will the knowledge that you learned from this lesson have an impact on your future?

Name: _____

Aligned to the following standards:
FFA.PL-A; FFA.PL-C; FFA.PL-E; FFA.PG-J; FFA.CS-M; FFA.CS-N; AG5; CCSS.RI.9-10.2;
CCSS.RI.9-10.4; CCSS.ELA.W.9-10.2; CCSS.ELA.W.9-10.4; CCSS.SL.9-10.2; CCSS.SL.9-10.4; CRP.02; CRP.04; CRP.06; CRP.08; CCSS.WHST.9.10.4; CCSS.WHST.9.10.6

Let's Learn About Engines!

Part 1

DIRECTIONS:

Read the article "From Shop Class to Fighter Jets" found at <https://www.ffa.org/ffa-new-horizons/from-shop-class-to-fighter-jets/> and complete the following activities.

1. Who is the article about, and what chapter is she from?

Color the state she is from:



2. How did she get started with FFA?

3. What did she do for her SAE?

4. Why did she join the military?

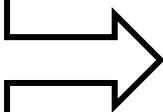
5. Where is she currently stationed, and what is her role within the Air Force? *Color the state where she is currently stationed:*



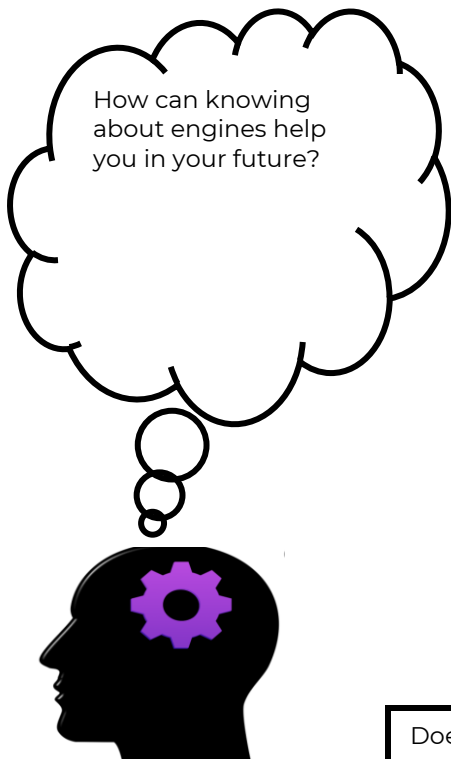
6. What were her favorite classes in high school, and how do the skills learned from the class benefit her now?

7. What is her encouragement to FFA members?

What career pathway would a jet mechanic fit?



How can knowing about engines help you in your future?



Find and research three similarly related careers to jet mechanic/mechanics and describe those careers. Record the information below. Utilize [AgExplorer.ffa.org](https://www.agexplorer.org) to help with your research.

Career Title: _____

Responsibilities:

Career Title: _____

Responsibilities:

Career Title: _____

Responsibilities:

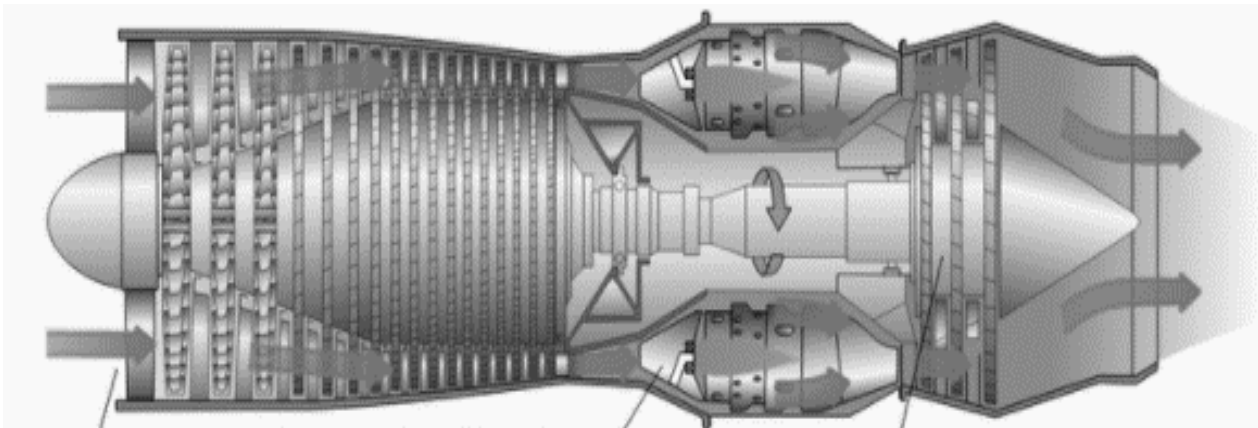
Does one of these careers interest you? Explain why or why not.

Part 2

DIRECTIONS:

On the diagram of the gas turbine engine below, color-code the parts. For example, color the engine turbine purple and record that purple = engine turbine in the legend (beneath the first box). Use this website to help with your research: https://energyeducation.ca/encyclopedia/Internal_combustion_engine.

Engine picture from https://energyeducation.ca/encyclopedia/Internal_combustion_engine



Legend:



What is the purpose of the parts identified in the diagram above? Use these websites to help with research: <https://www.britannica.com/technology/gas-turbine-engine/Major-components-of-gas-turbine-engines>, https://energyeducation.ca/encyclopedia/Internal_combustion_engine

Part: _____ Purpose: _____

Part: _____ Purpose: _____

Part: _____ Purpose: _____

Part: _____ Purpose: _____

Part: _____ Purpose: _____

Part 3

DIRECTIONS:

Answer the questions below to learn more about different types of engines.

What is the difference between 4-cylinder and V6 engines?

<https://auto.howstuffworks.com/engine.htm#pt2>

What is your “dream” car/SUV/truck?

What type of engine does it have?

Describe in your own words the difference between gasoline and diesel engines: <https://auto.howstuffworks.com/engine.htm#pt9>



Describe in your own words the difference in hybrid and electric engines:

[https://www.carsdirect.com/green-cars/what-is-the-difference-between-a-hybrid-car-and-an-electric-car#:~:text=The%20primary%20difference%20between%20a,%2Dmission%20vehicle%20\(ZEV\).](https://www.carsdirect.com/green-cars/what-is-the-difference-between-a-hybrid-car-and-an-electric-car#:~:text=The%20primary%20difference%20between%20a,%2Dmission%20vehicle%20(ZEV).)



Imagine that you own the dream car you identified above. You go out and start it up one morning, but it will not start. What are potential causes of this problem? Explain each cause.

<https://auto.howstuffworks.com/engine.htm#pt8>

Name: _____

Aligned to the following standards:

FFA.PL-A; FFA.PL-C; FFA.PL-E; FFA.PG-J; FFA.CS-M; FFA.CS-N; AG5; CCSS.RI.9-10.2; CCSS.RI.9-10.4; CCSS.ELA.W.9-10.2; CCSS.ELA.W.9-10.4; CCSS.SL.9-10.2; CCSS.SL.9-10.4; CRP.02; CRP.04; CRP.06, CRP.08; CCSS.WHST.9.10.4; CCSS.WHST.9.10.6

KEY: Let's Learn About Engines!

Part 1

DIRECTIONS:

Read the article "From Shop Class to Fighter Jets" found at <https://www.ffa.org/ffa-new-horizons/from-shop-class-to-fighter-jets/> and complete the following activities.

1. Who is the article about, and what chapter is she from?

Cassandra Hyder, Yelm FFA Chapter

2. How did she get started with FFA?

She joined FFA on the heels of her older sister and has earned her American FFA Degree.

3. What did she do for her SAE?

They bred and raised livestock, turning their one-horse family into a small hobby farm of goats, pigs, rabbits, chickens and sheep. She also showed the animals.

4. Why did she join the military?

She wanted to be a vet or join the military. She chose the military after graduating from high school to take advantage of the schooling benefits for veterinary training.

5. Where is she currently stationed, and what is her role within the Air Force? *Color the state where she is currently stationed:*

She is currently stationed in Clearfield, Utah as a fighter jet mechanic after training in Texas and Florida.

6. What were her favorite classes in high school, and how do the skills learned from those classes benefit her now?

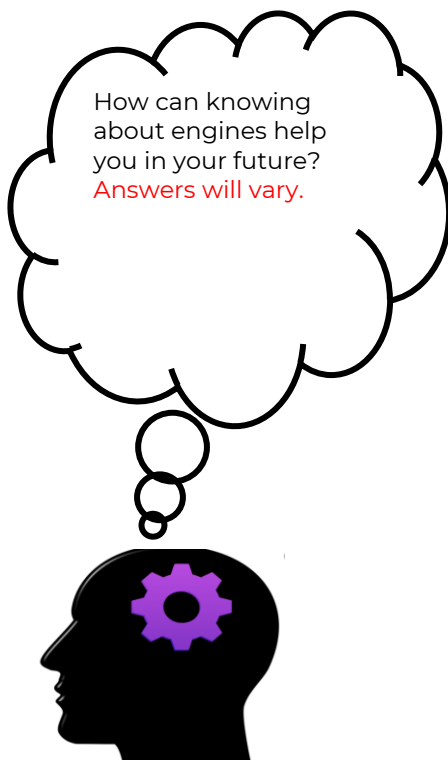
Her favorite classes in high school were shop classes. She always loved fixing things. The skills learned from the shop classes help her in her new career and also put her ahead.

7. What is her encouragement to FFA members?

She encourages current FFA members to seize the opportunities in front of them, such as trying to go to state convention at least once. She also adds to not get discouraged if you don't win an event and that hard work pays off.



What career pathway would a jet mechanic fit?
Power, Structural and Technical Systems



Find and research three similarly related careers to jet mechanic/mechanics and describe those careers. Record the information below. Utilize [AgExplorer.ffa.org](https://www.agexplorer.org) to help with your research. *Answers will vary, but can include:*

Career Title: Hydraulic Technician

Responsibilities: [AgExplorer.ffa.org/career/hydraulic-technician](https://www.agexplorer.org/career/hydraulic-technician)

Can include but is not limited to:

Install, maintain and repair hydraulic systems, read blueprints while diagnosing problems, perform preventative maintenance of hydraulic systems, perform welding, metal fabrication and electrical assembly, etc.

Career Title: Assembly Technician

Responsibilities: [AgExplorer.ffa.org/career/assembly-technician](https://www.agexplorer.org/career/assembly-technician)

Can include but is not limited to:

Independently carry out general assembly procedures and work by assembly instruction sheets, assemble and adhere parts to the machine needing maintenance, check and double check work to correct assembly problems, etc.

Career Title: Wind Turbine Technician

Responsibilities: [AgExplorer.ffa.org/career/wind-turbine-technician](https://www.agexplorer.org/career/wind-turbine-technician)

Can include but is not limited to:

Conduct basic cleaning and maintenance of wind turbines, be safety-oriented, maintain fleet vehicles, change filters and perform other scheduled maintenance, etc.

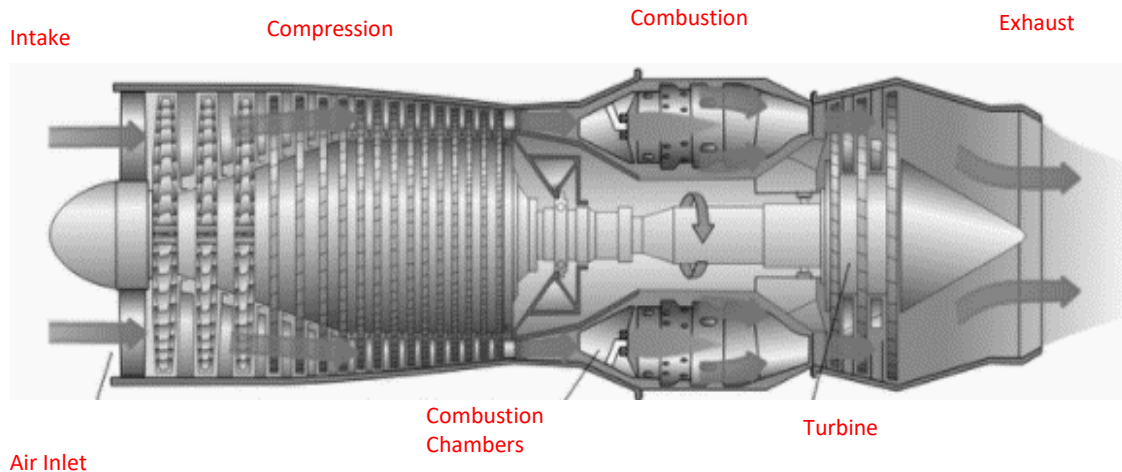
Does one of these careers interest you? Explain why or why not.
Answers may vary.

Part 2

DIRECTIONS:

On the diagram of the gas turbine engine below, color-code the parts. For example, color the engine turbine purple and record that purple = engine turbine in the legend (beneath the first box). Use this website to help with your research: https://energyeducation.ca/encyclopedia/Internal_combustion_engine.

Engine picture from https://energyeducation.ca/encyclopedia/Internal_combustion_engine



Legend: **Color/key will vary.**

What is the purpose of the parts identified in the diagram above? Use these websites to help with research: <https://www.britannica.com/technology/gas-turbine-engine/Major-components-of-gas-turbine-engines>, https://energyeducation.ca/encyclopedia/Internal_combustion_engine

Part: Compressor **Purpose:** The blade passages must exert a tangential force on the fluid with the pressures on one side of the blade higher than on the other. For subsonic flow, an increase in pressure requires the flow area to also increase, thus reducing the flow velocity between the blade passages and diffusing the flow. <https://www.britannica.com/technology/gas-turbine-engine/Major-components-of-gas-turbine-engines#ref45720>

Part: Combustion Chambers **Purpose:** Air leaving the compressor must be slowed down and split into two streams. The smaller stream is fed centrally into a region where atomized fuel is injected and burned with a flame. The larger stream is fed into the chamber through holes along a "combustion liner" to reduce overall temperature. <https://www.britannica.com/technology/gas-turbine-engine/Major-components-of-gas-turbine-engines#ref45721>

Part: Turbine **Purpose:** The turbine is normally based on the reaction principle with the hot gases expanding through up to eight stages using one- or two-spoiled turbines. <https://www.britannica.com/technology/gas-turbine-engine/Major-components-of-gas-turbine-engines#ref45722>

Part: Air Inlet **Purpose:** Brings air into the system. <https://www.flight-mechanic.com/gas-turbine-engines-air-entrance/>

Part: Exhaust **Purpose:** Removes harmful gas. https://energyeducation.ca/encyclopedia/Internal_combustion_engine



Part 3

DIRECTIONS:

Answer the questions below to learn more about different types of engines.

What is the difference between 4-cylinder and V6 engines? <https://auto.howstuffworks.com/engine.htm#pt9>

Each cylinder contains a piston that pumps inside of it, and those pistons connect to and turn the crankshaft. The more pistons there are pumping, the more combustive events taking place during any given moment. More power can be generated in less time. Four-cylinder engines commonly come in "straight" or "inline" configurations while six-cylinder engines are usually configured in the more compact "V" shape and thus are referred to as V6 engines. V6 engines were the engine of choice for American automakers because they are powerful and quiet. However, turbocharging technologies have made four-cylinder engines more powerful and attractive to buyers.

What is your "dream" car/SUV/truck?

Answers will vary.

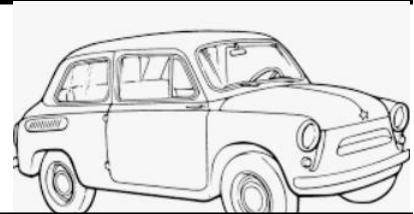
What type of engine does it have?

Answers will vary.

Describe in your own words the difference between gasoline and diesel engines.

<https://auto.howstuffworks.com/engine.htm#pt9>

Diesel engines have no spark plug. Diesel fuel is injected into the cylinder, and the heat and pressure of the compression stroke cause the fuel to ignite. Diesel fuel has a higher energy density than gasoline, so diesel engines get better mileage.



Describe in your own words the difference in hybrid and electric engines:

[https://www.carsdirect.com/green-cars/what-is-the-difference-between-a-hybrid-car-and-an-electric-car#:~:text=The%20primary%20difference%20between%20a,%2Dmission%20vehicle%20\(ZEV\).](https://www.carsdirect.com/green-cars/what-is-the-difference-between-a-hybrid-car-and-an-electric-car#:~:text=The%20primary%20difference%20between%20a,%2Dmission%20vehicle%20(ZEV).)

The main difference is the hybrid derives some of its power from a conventional gasoline engine. The electric car gets all its power from electrical sources and is a completely non-polluting zero-emission vehicle.



Imagine that you own the dream car you identified above. You go out and start it up one morning, but it will not start. What are three potential causes of this problem? Explain each cause.

<https://auto.howstuffworks.com/engine.htm#pt8>

Three main things could potentially be the cause: bad fuel mix, lack of compression or lack of spark.

Bad fuel mix/out of gas/engine is getting air but no fuel: Air intake might be clogged, so there is fuel but not enough air. Fuel system might be supplying too much or too little fuel to the mix, meaning that combustion does not occur properly. There also could be an impurity in the fuel (like water in the gas tank) that prevents the fuel from burning.

Lack of compression: If the charge of air and fuel cannot be compressed properly, the combustion process will not work like it should. Lack of compression might occur for these reasons: piston rings could be worn (allowing air/fuel mix to leak past the piston); intake or exhaust valves are not sealing properly (allowing for leak); or there could be a hole in the cylinder.

Lack of spark: Spark might be nonexistent or weak due to the following:

-Sparkplug or the wire leading to it is worn out, so spark will be weak.

-If the wire is cut or is missing, or if the system that sends a spark down the wire is not working properly, there will be no spark.

-If the spark occurs either too early or too late in the cycle (if ignition timing is off), the fuel will not ignite at the right time.