Learning Objective
Students will explain the purpose of an aircraft fuel pump, identify the parts, and draw the fuel system.

Student Activities:
1) Students read the text below ('Student Reading,' take summary notes in their notebooks.
2) Teacher reviews text with students
3) Teacher identifies parts of fuel pump, demonstrates operation of a fuel pump, and diagrams the fuel system. Students take notes on classroom discussion.
4) Students replicate fuel system into their notebooks.
5) Students work in pairs to disassemble a fuel pump, diagram the parts, and record information into their notebooks.

Materials
- Aircraft Fuel Pump
- Student Reading
- Diagram of aircraft fuel system

Student Reading
There are two kinds of fuel systems in piston driven aircraft: carbureted and fuel injected. Each is supplied by a different fuel pump system.

Fuel pumps for carbureted systems
In some carbureted system, there are two fuel pumps, one that is built within the engine, and a second backup pump that runs on the 12 volt systems. Carbureted engines only require 3-5 psi to get enough fuel to the carburetor.
Different types of fuel pumps are used in aircraft. 

**Gear Driven:** One pump design is a set of gears built within the engine itself. As the gears turn, the volume on one side is reduced, creating pressure on the other side, causing fuel to flow in one direction.

**Diaphragm Pump:** The engine driven pump might also be a diaphragm pump activated by a lever that rides on lobe on a cam. As the lever goes up and down, the diaphragm is moved up and down. Inside the pump are one-way check valves that keep the fuel flowing in one direction only. Gaskets prevent leakage.

Disassembled Diaphragm Pump

Lycoming engines are often used in low-wing aircraft. Since the wings, and therefore the tanks, are low, the carburetor is mounted on the bottom of the engine. As long as the aircraft is at stall attitude (16-20 degrees angle of attack), and the tank is above the carburetor, sometimes fuel can still gravity feed to the carburetor. There is a safety advantage in a low carburetor design. If there is any fuel leakage from a flooded carburetor, that fuel drips down away from the hot engine.

Aircraft engines do not have a choke, but instead use a primer pump that squirts fuel directly into each cylinder. The primer is squirted 2-4 times before the engine is turned over.
Fuel injected engines.
In fuel-injected engines, the fuel flow is controlled by the servo, which is directly connected to the throttle. Fuel is constantly being delivered to each cylinder, no matter what stroke the engine is on. If the intake valve is closed, the fuel is sprayed onto that valve until it opens for intake of air/fuel mix. This does several things. This increases vaporization of fuel and also cools the intake valve with the latent heat of vaporization. Fuel injected engines have far fewer problems with icing than carbureted engines.

The fuel is delivered at 24 psi at 2700 rpm. In this system, more fuel is delivered than the engine can use, so it is returned to a header tank or a sump to be re-injected into the system.

In WWII, the Germans used a Bosch fuel injection system, which, like a diesel, was injected at the right instant into the cylinder. However, the pressure in the cylinder when the piston is coming up on the compression stroke is very high, and injected fuel pressure must be greater than that for the fuel to spray into the cylinder, over 200 psi.

Backup pump. Backup pumps run on 12 volt DC power. They are activated when taking off, landing, flying over water, or when changing tanks. Having the backup pump on gives security in case something goes wrong during those critical times. The backup pumps are in series with the existing fuel system.

Before engine startup, a pilot turns on the master switch then the fuel pump. The backup pump should develop 5 psi with the engine off. If the engine were running, it would not be possible to tell which pump was providing the pressure. Once the engine is running and in flight, the backup pump is turned off, and the pressure from the main fuel pump is shown by the gauge.

Water check
Each tank has a water drain, called a curtis valve. In the fuel line there is also a gascolator, a
combination filter and water trap, which also has a curtis valve on the bottom. Before every flight, pilots drain a little fuel from the gascolator and both tanks, looking carefully for water contamination.

Av fuel vs. Auto gas.
Aircraft are only approved for Aviation Fuel. There are basic differences between auto gas and airplane gas. Auto gas can contain up to 10% alcohol, and is much lower in octane than AvGas, which is either 100 or 130 octane.

High octane fuel has more power than low octane fuel. Lower octane auto gas, like 87 octane, can be used with no problem in low compression engines (with the STC). However, higher compression engines require higher octane fuel to develop more horse power. Also, chemicals such as lead are added to the aviation fuel to prevent detonation and pre-ignition. The lead also helps lubricate the valves and valve stems. If the fuel did fire from compression or pre-ignition, there would be tremendous back pressure on the crankshaft, causing damage.

A lower compression aviation engine can be STC’d (government permission) for auto gas, but it is up to the individual to check the fuel for specific gravity. Many people think if the engine is STC’d for auto gas, no further check is necessary, but this is not the case. The individual should do a specific gravity test every time, as the standards for auto gas aren’t nearly as stringent as those for aviation.

Emergency Electric Fuel Pump
Assessment:
Students demonstrate assembly and disassembly of a diaphragm fuel pump. Student notes are reviewed by instructor.
STANDARDS:

**Technology C 1:** A student should use technology to observe, analyze, interpret, and draw conclusions.

**Science A:** A student should understand and be able to apply the processes and applications of scientific inquiry.

**Science E:** A student should understand the relationships among science, technology, and society.