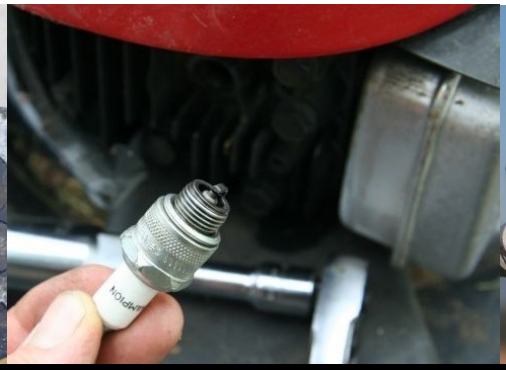
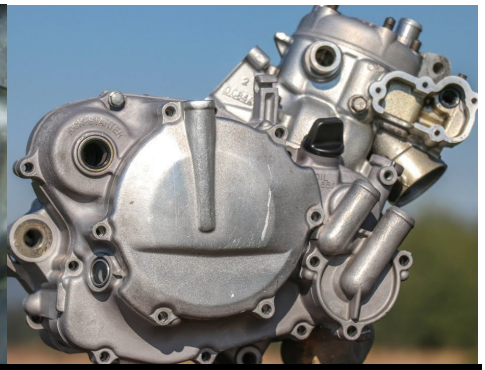




Small Engines

Leader Resource

Name: _____ **Club:** _____ **Age:** _____

The purpose of this project is to help 4-H members learn how to operate an engine on maximum power and efficiency. It will increase their knowledge beyond servicing and operating an engine into major maintenance and repair. It will explain the operating principles of different units such as starters, ignition systems, valves, and lubrication systems. It will also explain when these units are not operating properly and how to repair them.

Project Completion Requirements (PCR)

Small Engines I:

- ☐ Display the small engine you or your group worked on during the year. It must be cleaned and prepared for winter storage.
- ☐ Demonstrate something you have learned:
  - ☐ Safety Tips Change the Oil, Specialty Tools etc...
- ☐ Leaders Test on the Parts of a Two Stoke Engine

Small Engines II:

- ☐ Display the small engine you or your group worked on during the year. It must be cleaned and prepared for winter storage.
- ☐ Demonstration something you learned:
  - ☐ Maintaining the carburetor , Maintaining the starter, Maintaining the generator etc…..
- ☐ Leaders Test on Diagnosing Problems in a Two Stroke Engine

- **Member Booklet** *(with completed member reflection pages)* **are due for all projects**

Please make sure that ALL PCR's are completed and present at the Club Achievement Day.
Resource material (including patterns) is available from the 4-H PEI Office

Exhibition Requirements

SMALL ENGINES - Small engine you and/or your group worked on during the year.
It must be cleaned and prepared for winter storage

Members are strongly encouraged to participate in the 4-H Classes at PEI Fairs & Exhibitions.
Please check with your Project Leader or visit www.pei4h for more Exhibition information.

4-H Year Completion

In order to complete the 4-H year members are required to:

- ☐ Complete the **PCR's (Project Completion Requirements**) as outlined above
- ☐ Complete a **Communication** Project
- ☐ Complete a **Community Service** Activity
- ☐ Complete an **Agriculture Awareness** Activity

Revised 2019

The Project Leader's Job

To begin, thank you for volunteering your time to be a 4-H project leader! We appreciate your time and willingness to teach today's youth a new skill and share your knowledge.

Becoming a project leader can feel overwhelming at first, but we hope that this page will make your "job" clear and offer some tips to help you be successful.

Responsibilities

1. Become a screened leader
   You may have already completed this step, but it is a very important one. The best place to go is to the 4-H PEI website and visit this page: https://www.pei4h.ca/4-h-leaders , to see if you have completed all the necessary requirements. Project meetings cannot begin until you have received a "conditional letter" from the Provincial 4-H Office.
   NOTE: As of July 2019 a new policy has been implemented by 4-H Canada that each project group be accompanied by two screened leaders. ***Insert more information about what National has to say about this policy and why they think it is important for this policy to be in place.***
2. Set Project Meeting Dates
   The amount and length of project meetings is determined by you, the project leader. That being said, you are responsible for covering **five** activities or topics (see project activity ideas pages) with the group. You may decide that you'd like to have five meetings - covering one topic per meeting, or you may decide to spend two 5 hour sessions with your group and cover multiple topics or activities in one meeting. This will also depend on the project you are leading. For instance, if you are leading a quilting project, then the member will be focused on one large item with multiple steps and skills involved. However, a rabbit project may require multiple meetings (and even locations) to cover different activities and topics. Meetings can begin anytime after November 15th. Whatever the case, we highly recommend that Project Leaders **set dates in advance of members signing up for the project.** This method will ensure the members know what they are signing up for, or enable them to make a decision to not sign up if they cannot commit to the dates listed. We also hope that this will avoid a lot frustration for you, because working around multiple schedules is almost impossible!
3. Choose Topics and Activities
   You may choose to work on this step before setting dates for project meetings. Some topics and activities may be able to be covered in one project meeting, while others may need their own meeting. Regardless, we ask that you document your project meetings and topics covered on the next page so that the 4-H Specialist can refer to this information at Achievement Day if necessary.
4. Materials & Supplies
   While you are responsible for determining what materials and supplies are needed, you **are not** responsible for covering these costs. Options to consider:
   A. 4-H Canada has a FCC 4-H Club Fund that all leaders are welcome to apply to. These grants are valued at $500 each. Applications are accepted August through to the end of October.
   B. Asking for supplies. Depending on what project you are leading, just putting a call out for the supplies you need to friends, family, etc. may be successful
   C. Determine an estimate total for the materials and supplies needed and set a "project fee" that all members will pay to help cover the additional costs
5. 4-H Year Completion and Project Completion Requirements
   The project leader **is not** responsible for 4-H Year Completion (these components will be completed at the Club level) though each member **must** complete these components. Project leaders should focus on the Project Completion Requirements, found on the front cover of this guide. These are the items that the 4-H Specialist will expect to see on display at the Club's Achievement Day (typically scheduled for June-July).
6. Club Meetings & Events
   Project leaders are not expected to attend monthly club meetings, but are more than welcome to attend if they'd like to know what is going on at the Club, Provincial or National level of 4-H. Similarly, Club events and activities are open to project leaders, but it is not necessary to attend. Project leaders are encouraged to attend Achievement Day. This is an event that wraps up the Club's 4-H year and a celebration of member success.

The Project Leader's Plan

After reviewing the Project Completion Requirements list on the front of this guide, review the Project Activity Ideas page/s. You can also pull ideas from past experiences, books, social media, online or you can plan to join a took, attend an event or book a guest speaker. The sky is the limit! Regardless of what activities or topics you decide upon, you should choose five in total. It might be a good idea to ask the 4-H members in your project group what they envision before making a concrete plan. In some cases, the project group members may depict what activities or topics based on what project item they have in mind.

Topics and Activities

1. _____

Supplies needed:

_____ _____

_____ _____

_____ _____

2. _____

Supplies needed:

_____ _____

_____ _____

_____ _____

3. _____

Supplies needed:

_____ _____

_____ _____

_____ _____

4. _____

Supplies needed:

_____ _____

_____ _____

_____ _____

5. _____

Supplies needed:

_____ _____

_____ _____

_____ _____

Small Engines

Whether you live in a town or on a farm you will likely use a machine that has a small gasoline engine. From weed whackers and lawn mowers to snow blowers, pumps, chainsaws, generators and grain augers, small engines are an important part of making life more efficient for us. All these machines need care and regular maintenance to ensure they run healthy for a long time. Learning how to operate and maintain small engines is a valuable and useful skill, whether it is just to save you money on servicing your machines, or in preparation for a career as a mechanic.
This project provides the background and basics of how small engines work as well as how to maintain them properly. The information in this project will give you not only practical knowledge on the operation and maintenance of small engines but valuable hands on experience too. Overall, it is an excellent introduction to small engines and a stepping stone towards learning about larger, more complex engines (such as the ones found in cars and trucks).

Retrieved From , Discovering Small Engines: Manitoba

Divisions

Due to the nature of this project it is highly recommended that members begin with the first division—beginner, and then continue to progress into higher divisions upon the discretion of the Project Leader. Divisions do not reflect member age or time in 4-H rather, the skill Level as determined by the Project Leader. Division may also reflect the skill level and comfort of the Project Leaver. Divisions are as follows:

Division I—Small Engines I Division II—Small Engine II

Planning Your Project

- **Review** & **Select** the activities which you want to learn more about based on your division level - *possible topic choices are included on the next page!* Leaders and/or members are also invited to research and create their own project activity.
- **Identify** your goals & time-line for completing chosen project activities

Helpful Resources!

If you are looking for help with one of your project activities, let your 4-H Specialist know, maybe we can help you ! Call 368-4833 or drop by the PEI 4-H Office at 40 Enman Crescent, Charlottetown.

www.small-engines.com
www.hobbytalk.com
www.smallenginesadvisor.com

Remember…

The multiple intelligence theory teaches us that people learn in at least 8 different ways. All individuals will be stronger in some ways of “intelligence” and weaker in others. It follows that the more ways we teach, the more members we will reach. Teaching projects using a broad blend of writing, reading, hands on work, artwork, self evaluation, discussion, and so on, will help increase the learning potential of all members.

Projects are designed to teach many skills. However, the 4-H member is always more important than the subject matter. Stress cooperation in the activities where possible to develop teamwork and cooperation skills. These are valuable skills that will assist them in a number of settings. Ensure the work is completed in a manner that members feel good about themselves and their efforts. This can be done by assigning appropriate tasks or roles based on member’s individual abilities. Modeling and expecting supportive behaviour (i.e. no “put-downs”) amongst members, or by other adults, also contributes to a positive experience.

Small Engines - Safety Guidelines

Safety Tips:

- Keep your work area clean. A dirty work area can lead to dangerous situations .
- Be sure your work area is well ventilated! An exhaust tube will work well if you are indoors. Carbon Monoxide, present in exhaust, can be lethal. It is odorless and invisible!
- Gasoline fumes are highly flammable! Keep all gasoline away from open flames. Also, check your engine for fuel leaks. A leak can lead to an explosion.
- When filling the furl tank on your engine":
    - Fill it only in well ventilated areas
    - Fill only when the engine is cool
    - Check fuel level before you start;
        - Do not overflow the tank. Wipe up any spills promptly and allow the spill to evaporate;
        - Be sure the spout of the gasoline can is in contact with the engine tank. This prevents an explosion caused by static electricity;
        - Never fill the furl tank in the presence of fire and heat.
- Do not wear close clothing near small engines. The rotating parts could catch you and your clothing. Don't wear jewelry (rings, chains, bracelets)
- Tie back long hair to protect yourself from danger
- Engines get hot! Be sure your engine is cooled before you try to work on it.
- There should be no horseplay
- Don't point air hoses at people
- Keep all electrical in good condition
- Use protective equipment at all times (goggles, shields)

Tools Needed for Small Engines:

- Socket wrenches - for small engine work, a 3/8" ratchet and a set of sockets from 1/4" to 1" as well as a special spark plug socket.
- Screwdrivers – a variety (straight and Philips are essential).
- Oil filter wrench
- Pliers - Needle-nose and utility.
- Wire cutters and strippers
- Hammer (ball peen)
- Rubber mallet
- Funnel, drain pan, plastic milk jug for used oil
- Old rags, cotton swabs, paper towels, etc. - for cleaning.
- An old but soft paint brush for getting dust and dirt out of various places.
- Torque wrench – for measuring and controlling the amount of torque or turning force to be exerted on nuts and bolts.
- Feeler gauge - a set of precise thickness strips or wires for setting spark plug and point gaps.
- Carburetor cleaner - this comes in a spray can. It is as flammable as gasoline, toxic, and will eat plastics and painted surfaces. Therefore, use only in a well-ventilated area or outdoors and take precautions.
- A tube of thread-lock - for locking, sealing, and protecting the threads of screws and bolts.
- A tube of anti-seize compound like graphite grease – keeps metal lubricated at high temperatures

Small Engines - Safety Guidelines

Owners Information :

- Every engine built has an accompanying service manual. These manuals are a great help to the mechanic, as they show exactly what to do when servicing an engine. If you do not have the service manual, you can order or purchase that manual from a dealer. It is a good idea to keep all information in a permanent file.

Owners Manual

General Information:

- Name of Equipment (on which engine is mounted): _____
- Name and Address of Equipment Manufacturer :_____
    - *Vertical :* _____
    - *Horizontal :* _____
    - *Multi-person :* _____
- Engine Cycle :
    - *2– cycle :* _____
    - *4– cycle :* _____
- Model Number: _____
- Serial Number: _____
- Specification Number: _____
- Type Number: _____
- Horse Power: _____

Types of Accessories and Major Units:

- Carburetor Air Cleaner:
    - Oil Bath ; Oiled Filter ; Dry Filter
- Fuel Strainer:
    - Combination screen and sediment bowl; Screen inside the fuel tank
- Crankcase Breather:
    - Reed valve; floating disk valve
- Starter
    - Rope– wind; Wind– up; Electric; Electric AC; Electric DC
- Ignition System:
    - Flywheel magneto ; External magnet
- Fuel Pump:
    - Mechanically Driven; Differential Pressure Driven
- Carburetor:
    - Float ; Suction Lift ; Diaphragm
- Governor:
    - Air Vane; Centrifugal

Service and Maintenance Specifications:

- Oil:
    - SAE 5W; 5W –20; 5W—30 ; 10W –30 ; 10W-40 ; Classications SC or SD ; SE; CC ; 2 Cycle
- Type of Spark Plug:
    - Gap setting: 0.5 mm; 0.6 mm
- Ignition Breaker– Point Gap:
    - 0.3 mm ; 0.4 mm; other

Small Engines - Safety Guidelines

Preparing for Starting your Engine:

1. Open the fuel shut—off valve if your engine has one. Open valve all the way to prevent leakage
2. Close the choke valve or prime the carburetor.
    - Chocking or priming accomplishes the same purpose. More fuel is made available for vaporization. If your engine has a furl pump and a choke, but no primer, crank it a few turns with the ignition switch off. This action allow the furl pump to fill the furl lines and to supply extra fuel to the carburetor. A warm engine usually does not require choking or priming.
    - The choke helps to increase furl richness by letting less air in. Only vaporized fuel will ignite.
    - There is a wide variety or choke– control designs, but, no matter what the design, they work in the same way. Usually the choke control is marked. The direction for closing the valve is also marked. If you are in doubt as to whether the valve is closing or not remove the air cleaner and look into the carburetor to enrich the fuel-air mixture. Usually one or two strokes are sufficient.
3. Set throttle at position recommended for your engine (halfway open). If your choke and throttle lever are combined, move lever to choke position for starting. Then when engine starts, move it to the run position. This operation is not necessary on engines with automatic chokes.
4. Turn on the ignition switch if engine has one. Engines equipped with magneto ignitions have some type of grounding switch. The switch is on when the grounding switch is open—not grounded. To stop the engine the switch is closed. This provides another path, a short circuit, for the spark current. On some engines when the throttle is opened, the grounding switch is open.
5. Crank the engine.
    - ***Rope-Wind Starter:*** wind rope around flywheel pulley. Crank engine slowly until it reaches the compression stroke it becomes harder to pull. Rewind rope until you have a short section left. Pull rope all the way, straight and evenly.
    - ***Rope rewind Starter:*** Pull rope to crank engine slowly until it comes to compression stroke. Slacken rope and allow it to rewind. Pull rope briskly and firmly but not all the way. The end of the rope is anchored to the started pulley, and there is a danger of breaking the rope. Hold to the rope handle and allow the rope to rewind. This action prevents damage to the starter spring and avoids binding of the rope.
    - **Wind– Up Starter:** place the release lever in wind up position. Wind starter, turn handle in direction indicated on your engine. Fold wind-up handle to retracted position. Move release lever to “run” position.
    - ***Electric Starter:*** engage the starter switch for not more than 10 seconds and release. Electric starters may be operated by means of the ignition key, by a push button or by a pull knob. The starter switch automatically returns to the “off” position when released. Open the choke valve part of all the ay when the engine starts. Some choke valve snap completely open. Others are designed for partial opening until the engine warms up. Adjust the throttle for warm-up, set for a fast idle. Repeat if the engine does not start.

To Stop the Engine:

1. Remove load from engine so that the shock or stopping does not cause your engine to stall.
2. Reduce engine speed to idle and allow engine to cool
3. Turn of the ignition switch.
4. Close the fuel tank shut off valve if the engine has one. This stakes the pressure off the carburetor diaphragms and/or float and prevents fuel leaks.
5. Store the engine in a dry, protected area. If you do not plan to use your engine within 30 days, drain the fuel tank and carburetor. Then, just prior to using it, fill the tank with clean, fresh, regular—grade gasoline.

Project Activity Ideas - Small Engines Division I

Activity 1 -
Parts & How it works - discovery how each part plays a role in the function and use on an engine.

Activity 2 -
Storage Procedure—A project requirement is to demonstrate the storage of an engine. In this Activity you will learn how.

Activity 3 -
Servicing Your Small engine— a basic part of maintenance is to service an engine. Learn those steps in this activity.

Activity 4 -
Checking and Changing Oil - an engine cannot run without oil, and clean oil works best! This activity will show you how to achieve a well run engine.

Activity 5 -
Cleaning the Crankcase and Cylinder Fins - even the smallest parts play key roles in an engine. Learn why in this activity.

Activity 6 -
Cleaning the Air Filter - even an engine needs air to breath. This is one of the most important parts of the engine, learn why in this activity.

Activity 7 -
Carburetor Adjustments - small adjustments can make a huge difference in an engine. This activity will show case why.

Activity 8 -
Idle Stop Screw and High Speed Valve Adjustments - even the smallest parts play key roles in an engine. Learn why in this activity.

Activity 9 -
The Spark Plug - the combustion engine cannot run without a spark. Take the lessons you learned from previous activities to watch an engine run!

Activity 10 -
2 - Stroke and 4– Stroke Engines - the two types of engines we deal with in this project differ in important ways, learn why in this activity.

New Format. New activities. New ideas.

- In its first year of the new project format, the 4-H staff welcome any feedback, questions or concerns about the Small Engines Project. Please do not hesitate to get in touch. Further instructions are provided in the Leader Guide.
- If you have an idea or topic in mind for a project activity that relates to blacksmithing, be sure to talk to your project leader! The new project format allows you to review, discuss and select activities that interest you and your fellow 4-H project members. If you don't see something that you are interested in, suggest a new idea! Have fun with it!

Project Activity Idea #1 - Parts

How your Small Engine Works:

- Combustion means “burning” and this is what a small engine does to produce power. The combustion used in a small engine is called “Internal Combustion”. Energy for driving the crankshaft is generated inside the engine itself. Power is produced by a series or “controlled explosions” inside the combustion area, or cylinder. There are three things necessary for this process to happen; fuel, oxygen and heat.

Parts:

- **Cylinder:** where the fuel—air mixture goes to be burned.
-
- **Stroke:** the full length up and down that a piston can move. One movement of the piston the full length of the cylinder.

- **Crankshaft:** Has two levels. The small shaft in the middle connects to the connecting rod. There are counterweights opposite the small shaft to balance it. The end of the crankshaft protrudes form the engine and is where we connect blades, pulleys, etc.
    - **The Connecting Rod:** connects the piston to the crankshaft.

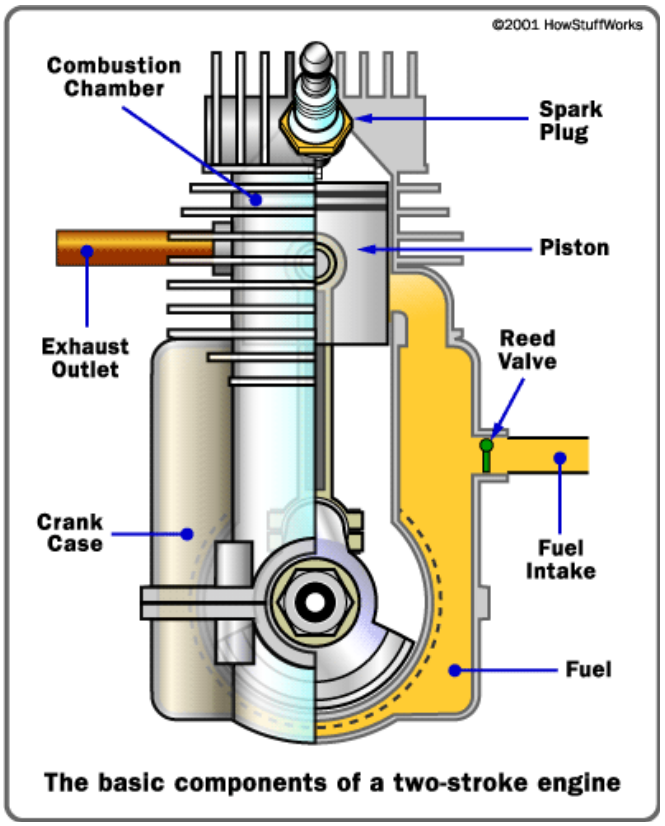
- **Piston** – a cast cylindrical piece of metal that fits in the cylinder of the engine and moves up and down.
    - **Piston Rings:** used to seal the combustion chamber , usually 2 or 3
    - **Piston Pins:** holds the connecting rod to the piston.
    - **Flywheel:** keeps the piston going smoothly on the stoke in a 4 - cycle engine.

- **Exhaust Valve:** the larger one, held together by valve springs, the valves seat ona rung around them. Opened when pushed by the camshaft , which is in turn pushed by the crankshaft via gears. Where waste exits the engine.

- **Reed valve** - allows fresh air/fuel to be drawn into the crankcase from the carburetor and trap it. They act like a check valve. Air-fuel mixture enters the crankcase and is trapped there by the one-way reed valve.

- **Spark plug** – a device designed to let a spark jump across a small gap to ignite fuel.

- **Combustion chamber** – the area in the cylinder where the fuel/air is compressed, and burnt; As the piston moves up and down, the size of the Combustion chamber changes.



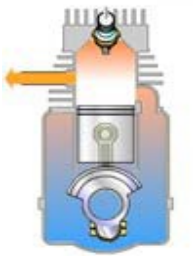
The basic components of a two-stroke engine

- **Cooling fins** - Most small two-stroke engines are air-cooled, air flows over cooling fins around the outside of the combustion chamber.

Project Activity Idea #1 - Parts

- In small engines, the combustion material is gasoline, oxygen is present from the atmosphere, and heat is produced from the spark of the spark plug. For the engine to run continuously, four things have to happen over and over again.: Intake, Compression, Power: and Exhaust.
- The completion of these four steps is called a “cycle”. When the first cycle is completed, the second cycle starts, and so as long as the engine is kept running.

Intake - Step One



- **2– Stroke Engine:** Spark plug fires; explosion occurs. This causes the piston to move downward from pressure. Piston head moves below level of exhaust port; burnt gases exit through port. Piston head moves below level of intake port; fresh fuel air mixture enters. Cylinder. There is a build-up of pressure caused by the downward movement of the piston. The fuel air mixture is forced into the combustion chamber by this pressure.
- **4– Stroke Engine:** Piston moves downward and intake valve opens; fuel air mixture is sucked into cylinder at bottom of stroke, intake valve closes.

Compression - Step Two

- **2 - Stroke & 4 - Stroke Engine:** piston moves upward and seals off intake and exhaust ports. Pressure builds in cylinder as compression occurs at top of stroke. Spark Plug Fires (cycle starts again in 2 - Stroke Engine.)

Power - Step Three

- **4– Stroke Engine:** spark plug ignites fuel –air mixture; piston is forces downward by explosion. This stroke gives the crankshaft enough momentum to carry through all other strokes.

Exhaust - Step Four

- **4 - Stroke Engine:** piston begins to rise, exhaust valve opens; all burned gases are vented out. Exhaust closes at top of stroke; intake valve opens. Cycle is completed in 4 - Stroke Engine.

Pictures from (http://www.alansmodels.co.uk/engines/how_engine_two.htm)

An excellent website that shows the movement is: http://Science.howstuffworks.com/two-stroke.htm

The two-stroke engine uses the crankcase to hold the next mixture of gases for the combustion chamber instead of using this location as an oil reservoir, because of this you have to mix oil into the gas. This mixture is called the gas to oil ratio, and must follow the manufacturers instructions.

Project Activity Idea #2 - Storage Procedure

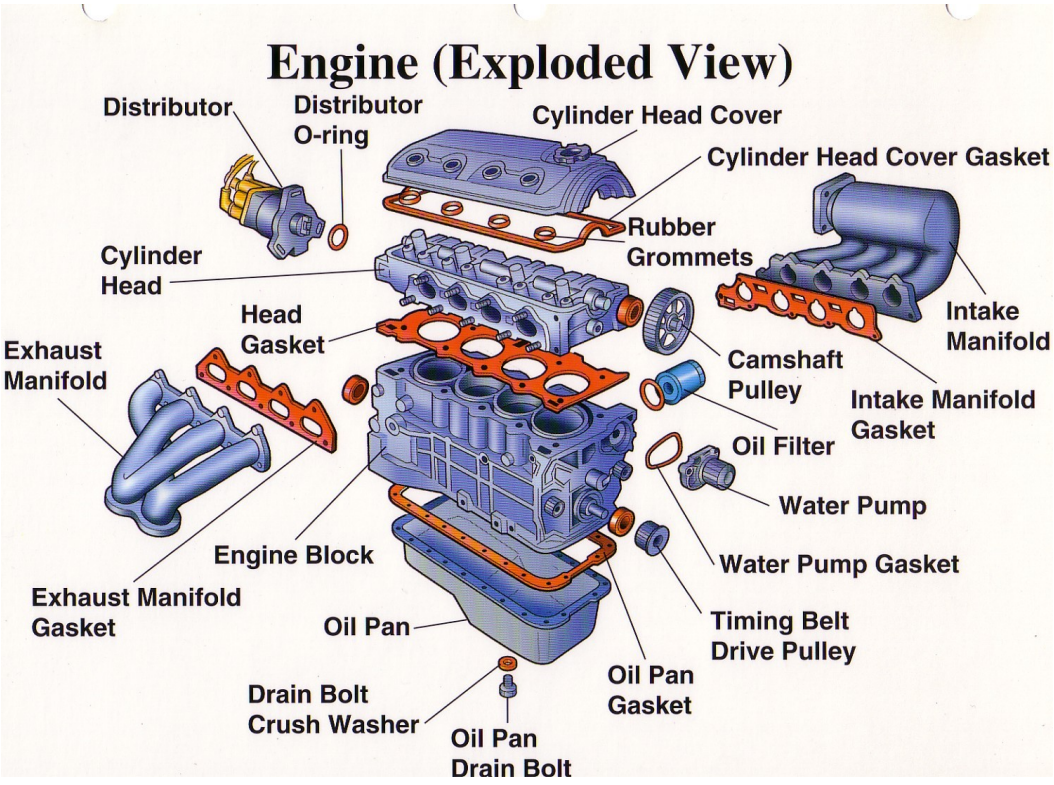
Storage is an important lesson to learn for this project. It will keep your engine from becoming dirty while it is not in use and keeps parts from wearing down. The following steps are how to properly ensure your engine is stored correctly:

Storage Procedure:

1. Either use a fuel stabilizer product added to the gas tank or pour out unused fuel from the gas tank, then run the engine until it stops. This process drains the gas tank and carburetor.
2. Clean the engine by removing dirt and dust from the cooling fins and outside of the engine.
3. Check and clean (or replace) the air filter
4. Check the spark plug and clean (or replace) if needed
5. Coat the inside of the engine using either:
   A. an engine fogging oil that is sprayed into the engine intake or carburetor while engine is running (follow manufacturer's directions) …OR...
   B. Pouring one or two ounces (30 or 60 ml) of engine oil into the spark plug hole then manually rotating the engine a few times to distribute the oil …OR….
   C. After engine has been coated turn it over until the piston is at the top of the compression stroke to seal off the combustion chamber (both the intake and exhaust valves are closed)
6. Store engine in a garage or shed to keep it dry

Now your engine can be put away for another season.

Information on disassembling a lawnmower engine:
http://www.repairfaq.org/samnew/lmfaq/lmeoverp.htm



Project Activity Idea #3 - Servicing Your Engine

Refueling the Engine:

- The fuel system consists of the fuel tank and tube or pipe leading to the carburetor. The fuel tank and tube must not leak, or fired or explosions could occur. There is usually a shut– off valve in the fuel line to stop gasoline form flowing into the carburetor when you are working on the engine. There is also a fuel strainer to clean any dirt form the fuel before it gets to the carburetor. The fuel strainer should be serviced regularly.

How to proceed:

1. Be sure the engine is cooled down ; remember that fuel and heat do not mix!
2. Secure engine ; so it cannot tip over and spill fuel
3. Clean fuel tank and surrounding area
4. Remove gas cap ; set it in a clean place
5. Place funnel in fuel tank
6. Pour fuel into tank ; manual will tell you what type of gas to use for your engine
7. Fill tank ; leave about 1/4 inches at top of the tank for expansion
8. Replace gas cap ; screw on tightly.
9. Clean up spills and set the gasoline away

Oil must look after your engine in five ways:

- *Lubricate* - reduces friction and wear on the moving engine parts. It is very important to have correct viscosity of oil (viscosity means thickness).
- *Cool engine parts* - keeping piston, connecting rods, and bearings at safe working temperatures.
- *Seal* - forms a seal between the piston rings and the cylinder wall to prevent exhaust gases from entering the crankcase.
- *Absorbs* shock and reduces engine noise.
- *Cleans* - provides a cleaning agent to keep soot and varnish from forming during combustion.

When the oil is changed, these particles are drained from the engine. About one gallon of water is produced for every gallon of gasoline burned. When an engine operates normally at temperature, this water escapes as steam. When the engine is cold, some water is trapped in the oil, and helps to form sludge. When the engine operates too hot this causes the oils to form deposits on parts, which is the main cause of sticky rings and intake valves.

Checking and Changing the Oil:

Since oil keeps the engine running smoothly, it is crucial to your engine's performance that the oil be kept clean and at proper level. If the parts inside the crank case were not lubricated, the engine would "seize up".

1. Check Oil Level: check your engine's oil level every time you fill up with fuel (every 2 to 4 hours).
2. Locate the oil plug or cap
3. Clean the filler plug and area around it
4. Remove the plug
5. Check oil level ; remove the dipstick, and check oil level. Oil level should be between "add" and "full" level. If you do not have a dipstick, oil should come to top of fillet plug.
6. Check oil condition ; do not overfill.
7. Add or change oil
8. Replace Oil plug ; tighten snugly

Project Activity Idea #4 - Checking and Changing the Oil

Checking and Changing the Oil:

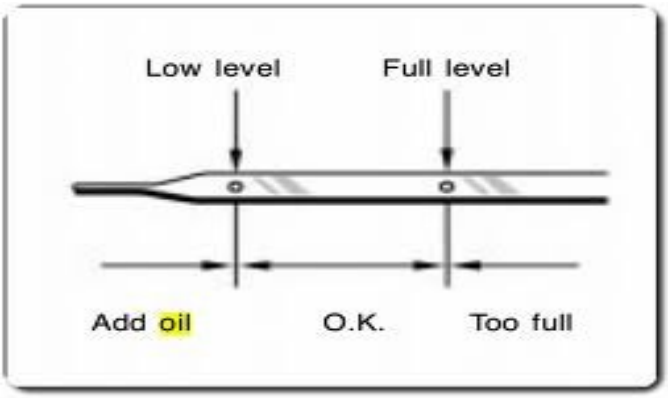
Since oil keeps the engine running smoothly, it is crucial to your engine's performance that the oil be kept clean and at proper level. Since 2 - stroke engines have mixed oil and fuel, changing and checking oil is impossible. In case of 2 - stroke engines, be sure you use the proper fuel/oil ratio and proper oil
This section deals only with only with 4 - stroke engines and how to check and change the oil.

Tools and Materials you will need:

- Slot head screwdriver
- Combination pliers
- Open end wrenches
- Funnel with flexible spout
- Recommended oil
- Container for old oil
- Clean cloths

Steps to Check and Change Oil:

1. Check Oil Level: check your engine's oil level every time you fill up with fuel (every 2 to 4 hours).
2. Locate the oil plug or cap
3. Clean the filler plug and area around it
4. Remove the plug
5. Check oil level ; remove the dipstick, and check oil level. Oil level should be between "add" and "full" level. If you do not have a dipstick, oil should come to top of fillet plug.
6. Check oil condition ; do not overfill.
7. Add or change oil
8. Replace Oil plug ; tighten snugly



https://www.fork-lift-training.co.uk/trainingcourse/preshift/24-engine-oil.html

Project Activity Idea #5 - Changing and Cleaning the Crankcase

The Crankcase oil :

- Oil should be changed in a small engine every 25 hours (more often in dusty conditions) of operation. Oil is changed for the following reasons:
    - Oil suspends dirt particles which can damage moving parts, oil can only absorb a certain amount of contaminants before it become “loaded” with deposits.
    - The engine will eventually get dirty, which can cause the engine to overheat or parts to break-down.

Cleaning the Crankcase and Cylinder Fins: the engine will eventually get dirty and needs to be cleaned regularly to avoid dirt getting inside the engine, overheating of the engine, parts breaking down and potentially loosening of important parts.

Tools You Will Need:

- Slot head screwdrivers
- Phillips head screwdriver
- Socket set
- Wrenches
- Net drivers
- Wire brush
- Pail (40 1./2 gal. size)
- Wooden scraper and/or small putty knife
- Degreaser (diesel fuel or varsol)
- Old toothbrush
- Plastic bags
- Rubber bands
- Can to keep parts in
- Rags

Cleaning Crankcase and Cylinder Fins :

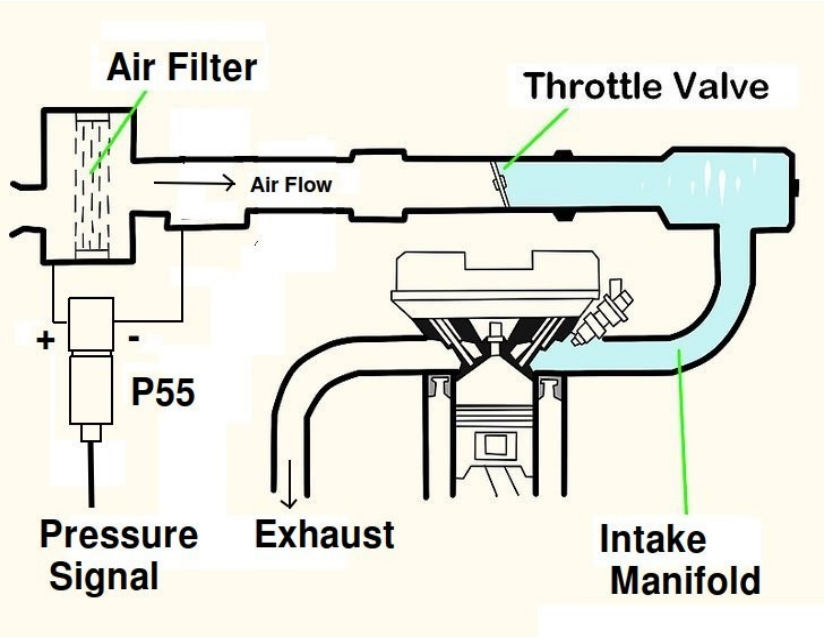
1. Allow the engine to cool ; the dirt and grime will come off easier if the engine is a little warmer, but not too hot.
2. Mount engine securely
3. Remove the spark plug; from spark plug
4. Remove the fuel tank; shut of fthe furl valve, you may not have to remove the fuel tank if it is not in the way. The cover all engine openings with plastic and use rubber band to secure it.
5. Remove the shrouds and baffles; there may be parts attached to these which must be removed. Remember where each piece removed goes.
6. Remove the starter and screen. NOTE: Do not runengine with shroud and baffles removed; the engine will overheat!
7. Clean the inside of shroud and baffles ; use a small bristle brush or putty knife—use degreaser or solvent to make parts clean.
8. Clean dirt and grime from cylinder fins and air intake screen ; use a wood scraper and blow out fins with an air compressor. Be sure you don’t blow dirt into the engine. Wipe cleaner with a rag onto fins.
9. Clean dirt from flywheel fin, use wood scraper and compressed air.
10. Make an inspection; check to see if there are any cracks or broken parts.
11. Replace broken parts; you may have to buy parts for your engine if any are broken
12. Reassemble engine and install the parts in the reverse order in which you took them off. Check all nuts bolts and screws to make sure they are tight
13. Reconnect the spark plug wire and run the engine for 3-5 minutes. This will dry the engine and prevent rusting.

Project Activity Idea #6 - Air Filter Cleaning

The Air Filter:

- The air cleaner has a very important job. It must make sure all the air entering the engine is dust free and completely pure. An engine without an air cleaner will only run a few hours before it breaks down. This exercise will show you how to service your air cleaner to give your engine a longer, healthier life.

- When do you know to service your engines? Most manufactures recommend servicing the air cleaner every 25 hours if the engine is being operated under ideal conditions. When the engine is operated continuously is extremely dirty or dusty conditions, there may be times when you will need to service the air cleaner more frequently.



http://www.validyne.com/blog/engine-air-filter-pressure-drop/

There are three types of air clearers used on small gasoline engines:

- ***Oil Bath type***—this washes dirt particles from air by forcing it through a bath of oil. Air enters the cleaner under the edge of the cover and this is directed towards the bottom of the oil cup. When the air reaches this point, its path of travel changes abruptly to an upward movement. The oil in the filter is picked up and carried along with the air. This action coats the dirt particles with oil and causes them to lodge in the mesh of the filtering element—a metallic maze. As more dirt and oil collect in the filtering element, it drains back into the outer chamber of the oil cup and the oil is used again to rap more dirt.
    - **How to Service Oil Bath Air Cleaner:**
        1. Disconnect the spark plug to prevent the engine from starting accidentally
        2. Loosen cover and remove the air cleaner; the cover may be held by a wing nut, bolt or bail wire.
        3. Cover the air intake; to keep out dust and debris
        4. Clean the cleaner cup; if the sediment is as much as 9mm deep. If the oil has thickened, if there is water in the cup empty the cup and clean it and the filter in the solvent
        5. Check the air intake pipe for dirt accumulation; clean with a wooden scraper and wet rags id necessary
        6. Refill oil cup to the “oil level” mark. Use recommended crankcase oil.
        7. Remove air intake cover
        8. Reassemble the air cleaner; make sure all parts are in the right places and tighten.
        9. Reconnect the spark plug wire

Project Activity Idea #6 - Air Filter Cleaning

- ***Oiled Filter Type—*** this air cleaner consists of filtering material such as aluminum foil mesh, or maze, or a sponge like polyurethane. Either material is coated with oil before being installed . The filter is designed so the air passes over a large area of oiled surface. Oil on the filter material picks up dust and dirt particles and prevents them from going into the engine.
    - How to Service the Dry Filter Type Oiled Filter Air Cleaner:
        1. Disconnect the spark plug wire.
        2. Clean area from around air cleaner to prevent the loose dirt from getting into the engine.
        3. Remove the element cover, may be a snap on cover or a slotted screw
        4. Remove the air filter element; if the element is in poor condition is should be replaced
        5. Cover the air intake to prevent from entering the engine
        6. Clean filter; wash filter in hot water and detergent or petroleum solvent
        7. Clean filter cover and housing; clean with solvent and dry with rags
        8. Dry the filter element; polyurethane filter—squeeze moisture out and use compressed air to blow dry / Metal mesh filter—swish is through the air or use compresses with solvent.
        9. Clean the carburetor; remove plastic and wipe clean with a rag dampened with solvent
        10. Oil the filter element—be sure all parts of the filter are installed in proper order. Tighten securely
        11. Assemble filter element ; be sure all parts of filter are installed in proper order and tighten
        12. Reconnect spark plug wire.

- ***Dry Filter Air Cleaner—***As this is a dry filter, you cannot oil it. Oil will clog the filers pours, and air will not be able to pass through.
        1. Disconnect the spark plug to prevent the engine from accidently starting
        2. Clean the area around the air cleaner to prevent dirt from getting into the engine.
        3. Remove the filter cover; use the proper tools and as some filters are self– contained, just loosen them and remove them
        4. Cover the air intake with plastic and rubber band
        5. Clean filter element ; paper element—clean by tapping it on a hard surface or blowing compressed air through it from the inside out.; fiber or moss element; clean out by rinsing in soap and water (NOT SOLVENT)
        6. Clean filter cover and air intake with a rag dampened with solvent
        7. Assemble air cleaner; be sure all parts of cleaner are installed in proper order and tighten securely.

Project Activity Idea #8 - Carburetor Adjustments

Carburetor Adjustments:

- The carburetor is the part of the engine that prepares fuel to be burned by mixing with air and breaking it into a mist which readily burns. The carburetor must control the air/ fuel ration as well as the amount of air which enter the combustion chamber.
- There are basically three things which can go wrong with a carburetor.
    - It can make the fuel/ air mixture to lean (not enough fuel, to much air).
    - It can make the fuel/ air mixture to rich (too much fuel, not enough air)
    - It can not delivery any fuel to the carburetor

Adjustments can be made to help correct most basic problems. Most carburetors have these adjustments in the forms of screws which can be turned in or out, opening or closing needle valves:

- High speed valve
- Idling valve (idle—mixture)
- Idle speed stop screw

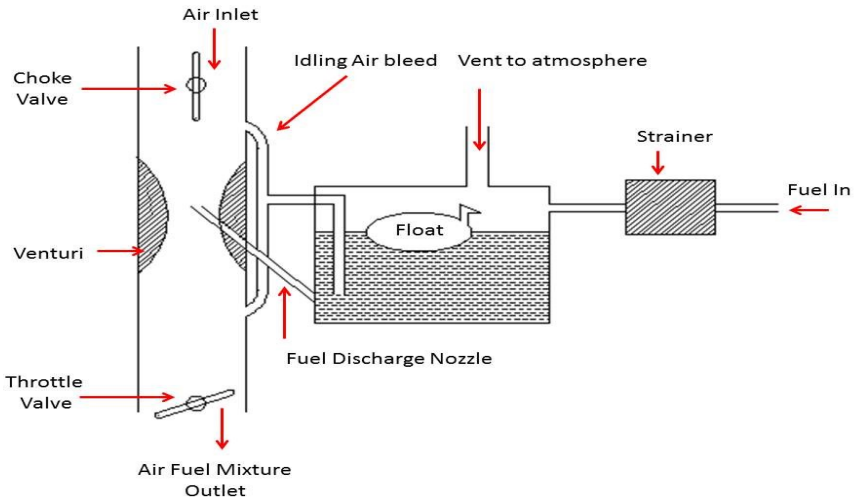
First you must see what is not working properly; there are *four* different tests you can do:

- ***A wet thumb test:***
    1. Remove the spark plug
    2. Place your thumb or finger over the spark plug hole.
    3. Close the choke valve
    4. Crank the engine with the started 3 or 4 times
    5. Remove your finger
        - Your finger will be wet if fuel is being delivered to the cylinder by the carburetor.
        - If your finger is wet, its not the carburetor—unless the engine is flooding
        - If your finger is not wet—no fuel is getting to the engine , you will do the primer test.
- ***A Primer Test:***
    1. Put 5 mL. of gasoline into the combustion chamber. Do this by inserting a soda straw or length of small tubing into the gasoline. When it fills hold your finger over the top of the straw to hold the gasoline until you can insert the straw or tubing into the combustions chamber through the spark-plug hole. The release, do not put too much fuel into the combustion chamber or you will flood the engine and upset the test.
    2. Reinstall Spark plug
    3. Start the engine:
        - If it starts and run for only a short period of time, this means that not enough fuel is getting past the carburetor and that is the trouble.
        - IF your engine does not start at all, its not the carburetor—unless the engine is flooding.
        - Allow the spark plug to dry, adjust and try again .
- ***A Throttle Test:***
    1. Operate the engine at idling speed for warm up (approx. 2000– 3000 rpm.)
    2. Advance the throttle suddenly. The engine should accelerate smoothly and evenly. If it does not, this means that the fuel mixture is too lean. High operating temp indicates that as well.
- ***Exhaust Test:***
    1. Check the exhaust smoke—if it is black then the engine is burning too much fuel and the fuel mixture is rich. Adjust the carburetor Two cycle engines should smoke slightly because of the oil in the fuel.

Project Activity Idea #7 - Carburetor Adjustments

Tools You Will Need:

- Slot head screwdriver
- Phillips screwdriver
- Tachometer
- Open-end wrenches
- Needle nose plers



https://www.mechanicalbooster.com/2017/04/what-is-carburetor-parts-and-working.html

Carburetor Adjustment Preparations:

1. Fill the fuel tank with clean, fresh gasoline. (Properly mixed fuel for 2– cycle engines.)
2. Check the throttle and linkage for mechanical condition and freedom of action.
3. Service the engine before adjusting the carburetor :
    - Check the crankcase oil level
    - Check the fuel tank vent in the fuel-tank cap make sure it is clean. If it is plugged, fuel will not flow to the carburetor. Your engine may start but it will not run very long. Service the air cleaner; a partially clogged air cleaner will tend to choke the engine and cause a richer than normal texture.
4. Check for air leaks in the carburetor manifold; this also includes checking for air leaks in the crankcase of 2– cycle engines. IF you suspect a leak at any poi8nt, put a drop of oil on the suspected area, crank the engine, and see if the oil disappears. If it does, you have an air leak. If you have an air leak, tighten the flanges and recheck; it may be necessary to replace the gasket(s).
5. Check the ignition, poor ignition will give you a false carburetion check. Be sure there is a good spark. Check all wires to make sure there are no shorts.
6. Locate the idle– speed stop screw. If you cannot find the stop screw, operate the throttle control and notice where the linkage is attached to the carburetor. The stop screw limit's the travel of the throttle valve toward the closed position.
7. Locate and identify the fuel—air mixture adjusting screws. There are two of them on most carburetors ; an idle mixture adjustment and a high—speed load– adjusting screw.
    - On most carburetors the idle– mixture adjustment screw is nearer the engine.
    - Id you are not sure, start the engine and operate it at idle speed. Turn the most likely adjusting screw to closed position (clockwise in most cases).
    - If the engine slows down or stops, you have closed the idle-mixture adjusting needle.
    - If there is no noticeable difference in the engine speed, try changing the engine speed to 1/2 to 3/4 throttle.
    - If you get a difference in operation at this speed, then you have closed the high-speed load adjusting needle.
    - A few carburetors have no idle—mixture adjustment. It is fixed by the size of the drilled discharge port in the carburetor. Also , some have no high speed load adjustment.
8. Make initial carburetor adjustment. Turn each of the adjusting needles all the way in by hand (usually clock-wise). Then open the idle speed approximately one turn. This amount varies from 3/4 to 1 1/2 turns on different carburetors. Open the high speed load 1 to 2 1/2 turns. Check your operator's manual for exact specifications.

Project Activity Idea #8 -
Idle Stop Screw and High Speed Valve Adjustments

Adjusting the Idle– Speed Stop Screw:

- Adjusting the idle speed is really a throttle stop adjustment. A spring on the throttle valve tends to keep it closed. A set screw called a bumper stop screw", acts as a bumper to the throttle stop lever. It can be adjusted to hold the throttle at the desired engine speed.
- A spring is usually installed on the screw to hold it in place. Aver a period of time, however, this screw will gradually work out. The engine will idle too slowly and it may stop when the speed-control lever is in the closed position. The idle speed may need adjustment when—you change altitude/ you change from cold weather operation to warm weather operation and vice versa.
- The idle speed of a small engine is relatively fast. It varies from 1200 to 3200 rpm. Most operators manuals recommend approximately 1800 rpm or 1/2 maximum operating speed. Do not operate it at a slow idle speed. Small engines are designed to operate at full throttle, and the fuel-air mixture is too rich for slow speed. Unburned fuel will foul the spark plugs.
    1. Operate at about half throttle for 2 minutes for warm-up
    2. Set speed– control lever at almost completely closed position.
    3. Check the idle speed with a tachometer. There are three types:
        - Vibro (measures rate of vibrations_
        - Dial-Type (measures rotation of crankshaft)
        - Dwell– Tachometer (electrical measurements)
    4. Adjust to normal idling speed
        - Turning the adjusting screw clockwise usually increases engine speed.
        - Turning it counterclockwise decreases it
        - Check your operators manual for proper idle position.

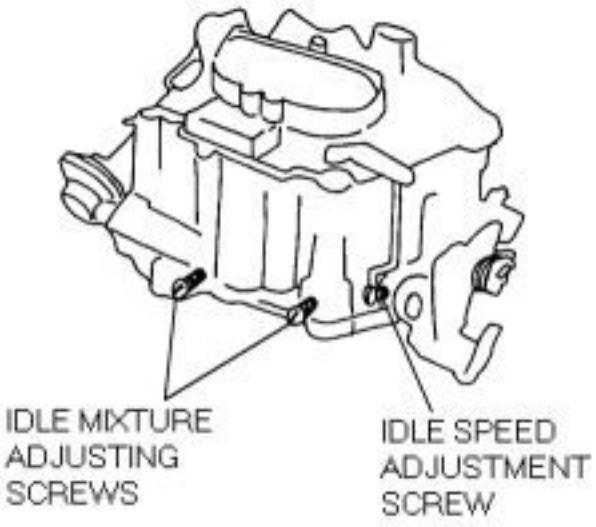
Adjusting the High Speed Load Valve :

- The valve that controls the fuel0slow for full load at high speed is known as "main adjusting needle", "power adjusting needle" and/or "high-speed-load adjustment".
- The engine should be up to full operating temperature when this adjustment is made, or your adjustment will not be satisfactory after the engine reaches normal operating temperature.
    1. Run engine at full throttle, load if possible. If you can provide a constant load without having your equipment in motion—such as by belt power take-off or a dynamometer—you can get a more satisfactory adjustment.
    2. Add load until speed decreases slightly from its high idle speed
    3. Turn load adjusting screw clockwise until engine begins to lost power.
    4. Turn adjusting screw counterclockwise until engine gives off black smoke from exhaust. The adjustment is now providing too rich a furl-air mixture. You may be getting satisfactory horsepower, but the fuel efficiency of your engine is somewhat lower.
    5. Turn screw clockwise until engine runs smoothly and at full speed. Make 1/8 turn on the needle and wait for engine to adjust.
    6. Check carburetor adjustment by accelerating engine quickly while it Is under load.
        - The engine should accelerate quickly when you adjust the speed control lever suddenly if the carburetor is properly adjusted. Backfiring indicated too lean a mixture, and dark coloured smoke indicates too rich a mixture.
        - If your engine will be operating under a heavy load or during cold weather, adjust the fuel-air mixture so it is slightly on the rich side—about 1/16 turn. Do not overdo it. This adjustment is not to take the place of your choke for cold weather starting.

Project Activity Idea #8 -
Idle Stop Screw and High Speed Valve Adjustments

Adjusting the Idling Valve:

- Some manuals indicate an initial setting of 3/4 to 1 1/2 turn open. You should use one that applies to your particular engine. This is used when your engine will not start because of carburetor trouble and when your are repairing the carburetor. A somewhat finer adjustment, however, may be secured by using the procedures that follow.
    1. Warm the engine if it is not already warm
    2. Loosen idle-speed stop screw. Set engine throttle to the recommended idle speed– approximately 1800 rpm.
    3. Tighten idle-mixture screw slowly until engine begins to "roll" or slow down. Use 1/1/8 turn when adjusting the needle valve. After each 1/8 turn, wait a few seconds until the engine has a chance to adjust to the new fuel mixture.
    4. Turn adjusting screw back slowly until engine runs smoothly. If you find that the engine is not affected by one or two complete turns of the adjusting screw, this may indicate trouble—a leaking float valve or diaphragm , too high a fuel level in the float chamber or deposits in the manifold around the throttle valve which are restricting air flow.
    5. Recheck high speed load adjustment; adjusting the idle speed may change the fuel mixture enough to affect the original adjustment.
    6. Recheck idle mixture adjustment.
    7. Check for proper operation. Operate the throttle back and forth a couple of times to see if your engine will accelerate properly from the idle position.



https://www.autozone.com/repairguides/GM-Corvette-1963-1982-Repair-Guide/Tune-up-Procedures/Idle-Speed-and-Mixture/_/P-0900c1528008337d

Project Activity Idea #9 - The Spark Plug

Spark Plug:

- Since the spark plug has the vital job o igniting the fuel in the combustion chamber, its proper operation is very important. The spark plug is usually simple to check and adjust, and is often the problem when an engine is not working properly. Two things which can go wrong with a spark plug:
    - Oil or lead deposits (from fuel or oil) also called fouling,
    - Electrode gap to wide.
- When an engine is new, and the ignition system is in good shape, it will have little trouble producing 10,000 volts or even up to 20,000 volts. But as the ignition system gets older, it may have trouble developing enough voltage to fire a worn plug. This makes spark-plug maintenance all the more important in older engines.
- A plug may reach a stage where it cannot be cleaned and re-gapped properly, it should then be replaced with a new one. A spark plug that does not function properly will cause:
    - An increase in fuel consumption
    - Crankcase oil dilution
    - Excessive deposits in the combustion chamber
    - Hard starting
    - The engine to skip
    - Greatly reduced efficiency of the engine

Tools and materials you will need:

- Spark-plug sockets
- Torque wrench handle—3/8 inch drive
- Wire feeler gage
- Jack knife
- Wire brush
- Small paint brush
- Pan of petroleum solvent (mineral spirits, kerosene , or diesel fuel)

Spark Plug Preparations:

1. Disconnect the spark plug wire from the spark plug. Pull the connector straight up from the plug.
2. Loosen plug one or two turns, and then remove dirt with a wood scraper or an air compressor. Use a spark plug socket wrench that fits the plug. Do not use an open-end or box-end wrench or pliers. There is danger or cracking the porcelain or damaging the inner seal, which may cause server leakage or burning. Hold the socket wrench so the socket is squarely over the plug when turning to protect the porcelain insulator. If plug threads are seized to an aluminum head, apply petroleum solvent and rotate the plug back and forth until it is free. Otherwise, you may strip the threads.
3. Remove the spark plug
4. Remove gasket if it remains on the cylinder head.
5. Reconnect the spark plug wire to the spark plug
6. Ground the spark plug to the engine by setting it by the spark plug hole (not in, through). Lay the spark plug on the cylinder head so the metal part is toughing an unpainted surface of the engine.
7. Crank the engine one or two turns.
8. Observe the spark at the electrode. If the spark plug is good the spark should be a blue– orange colour with multi-lines. There should be a sharp crackling sound. This action indicated the spark plug is good. If there is no spark, or if the spark is weak, move to step 9. The trouble is either in the spark plug or in the ignition system.
9. Disconnect the spark-plug wire from the spark plug.
10. Hold the end of the spark plug wire approximately 6mm from the cylinder head, or use a spark tester.
11. Crank the engine one or two turns,
12. Observe the spark between spark-plug wire and cylinder head. If the spark is a blue orange colour, the ignition system is good. If there is no spark, the trouble is the ignition system.

Project Activity Idea #9 - The Spark Plug

Inspecting and Servicing the Spark Plug:

1. Check the condition of the plug. There are different conditions on plugs that can tell you is something is wrong with your engine. Plugs that are worn should be replaced with new ones of the type and size recommended for your engine. Check your operators' manual or see your dealer to make sure of this.
2. Remove oily deposits from plugs, Put sparks in a pan of solvent, such as kerosene, distillate, or diesel fuel, to remove the oily film from porcelain body. Remove solvent with a clean cloth.
3. Clean threads with a wire brush. This cleaning is important for removing dirt so the plug will not bind when reinstalled. Do not brush the insulator. It will leave a metallic film which may provide an electrical short to ground and damage the engine.
4. Remove deposits from plugs. Use a small bladed knife for removing hard deposits. Watch that you do not damage the insulator around the center electrode.
5. Blow loose materials from plug with compressed air or tap lightly on counter. This is important to get rid of any remaining particles.
6. Bend the ground electrode (not the center electrode). Bend enough to allow for a thin (ignition point) file.
7. File electrodes on plugs until both have flat surfaces.
8. The flat surfaces help assure against misfiring. About 25 to 40 per cent less voltage is required to fire a spark plug with sharp edges on the central electrode than one with a round end. File end of center electrode until it is flat. Follow the same procedure with the eroded surface on the ground electrode. Remove as little material as possible.
9. Bend the ground electrode back into its original position and determine proper spark-gap spacing for your engine.

Installing the Spark Plug:

1. Replace plug (and gasket) and tighten with fingers, Without a gasket a spark plug may extend into the combustion chamber far enough to become damaged. It is best to use a new gasket to ensure proper seating, the old one is only usable if it has not been flattened too much by plug tightening. If you cannot seat the plug in the cylinder head by hand, remove it and wipe the threads in the cylinder head with a clean cloth.
2. Completely tighten the plug with a socket wrench. If you are using a torque wrench be sure to check your owners manual to see how much torque should be applied. If the plug is not tightened properly, heat will build up and cause the plug to overheat. If properly heated, the gasket is compressed enough so that heat will travel readily from the plug to the cooling fins. If the plug is too tight, it will be distorted and the gap between the electrodes will change, which stresses the porcelain.
3. Check condition of connections and insulation on spark-plug wire when reattaching wire to spark plug.
4. Check polarity of spark at spark plug in a battery-ignition system. (Polarity is direction of current.) If ground electrode on spark plug is “cupped”, the polarity is wrong—from 5—45 per cent more voltage may be required to fire the plug. This is because electrons jump more readily from a hot surface to a cool one that from cool to hot. Since the center electrode of the spark plug is hotter than the ground electrode, it is important that the primary circuit to the ignition coil be connected so that spark jumps from the center terminal.

Project Activity Idea #10 -
2 - Stroke vs. 4 - Stroke

How to Identify your Engine:

- The servicing procedures for some jobs on 2– cycle engines are not the same as four 4– cycle engines. It is difficult to tell a 4– cycle and a 2– cycle apart unless you understand the main differences.
    - One way is to check for an oil sump and oil filler plug or cap, if yours has a sump and file plug or cap, it is a 4-cycle engine. There is no oil sump or 2– cycle engines.
    - A second method is to check for the location of the exhaust ports or muffler. On a 4-cycle engine the exhaust muffler connects at the cylinder head end of the engine cylinder. The 2-cycle engine has an exhaust port about midpoint on the cylinder.
    - A third method is to check the information on the name plate or to check your operators instructions. One, or both of them, should mention the oil specifications. If either one gives the crankshaft capacity or a kind of crankcase oil, this applies only to 4-cycle engines. If mixing oil and gasoline is mentioned, this would identify a 2-cycle engine. The name plate is usually located on the blower shrowd or crankcase of the motor.
    - If none of these methods work and you are still unsure about the identification of your engine, use the compression method. Follow these steps.
        1. Disconnect the spark plug to prevent the engine from starting. Make sure the connector is not touching the spark-plug terminal.
        2. Put a chalk mark on the starter flange or pulley.
        3. Crank the engine slowly by hand. If resistance, caused by compression, if felt at only every other revolution, it is a 4-cycle engine. If the resistance, caused by compression , is felt at each revolution, it is a 2-cycle engine.

Operating position of Crankshafts:

- The crankshaft operating position on engines can be seen easily. Three positions are:
    - Vertical: has its cylinder in a horizontal position. The crankshaft is vertical, which makes it the ideal engine for a lawn mower.
    - Horizontal: may have its cylinder in a vertical, a horizontal or an intermediate position. The horizontal crankshaft engine is well adapted to supplying power to a horizontal transmission shaft. Such engines are often used on small tractors.
    - Multi-positional—will operate in any position. Of course the piston is always at a right angle to the position of the crankshaft. This type of engine is used on chain saws.

Examples of Engines:

4– Stoke:

- Lawnmower
- Snow-blower
- Electric generators
- Gardon tillers
- Small tractors
- go-karts
- Grain augers
- Air compressor
- Golf cart

2– Stroke:

- Lawn mower
- Earth augers
- Mopeds
- Chain saws
- Ice augers
- Grain augers
- Snowmobile
- Sump pump
- Air compressor

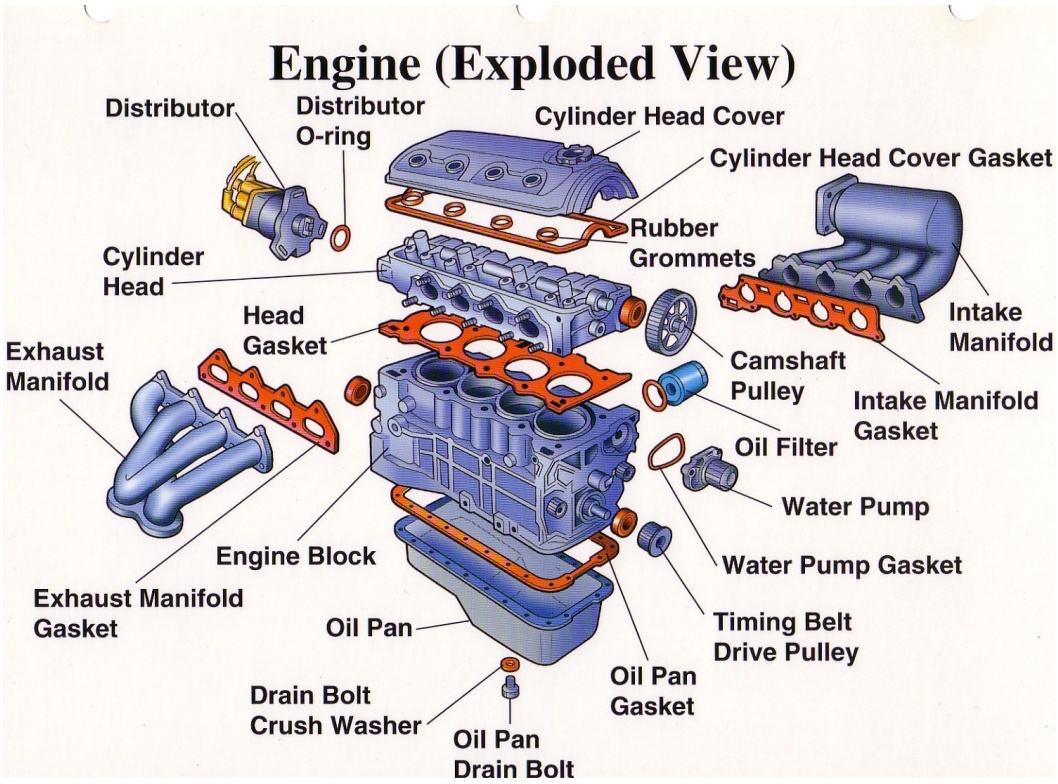
Division II—Small Engines II

The purpose of this project is to help 4-H members learn how to operate an engine on maximum power and efficiency. It will increase their knowledge beyond servicing and operating an engine into major maintenance and repair.

It will explain the operating principles of different units such as starters, ignition systems, valves, and lubrication systems. It will also explain when these units are not operating properly and how to repair them.

Each member will be required to do the following in order to successfully complete his or her project.

1. Select one small engine and work with it throughout the year. The machines or equipment, powered by small engines, that the member selects must be from the following list:
    - Lawn mower
    - Chain saw
    - Snow blower / snowmobile
    - Rotary tiller
    - Power bicycle / motorcycle
    - Sump pump / generator
    - Go-cart / dirt bike
2. Complete Lessons
3. Complete Achievement Day Requirements (see member's guide)
4. Complete a Communications Project
5. Complete a Community Project
6. Complete an Agriculture Awareness Project



Project Activity Ideas - Division II

Activity 1 -

- Review and Maintenance—review what you learned in Small Engines Division I. Division II will build on these concepts.

Activity 2 -

- Repairing Starters - Start Your Engines! This activity will teach a small part of the engines systems.

Activity 3 -

- Repairing Starting and Generating Systems— a generator is in many different machines, learn about its role in the engine in this activity.

Activity 4 -

- Maintaining and Repairing Ignition System - what does magnets and batteries have to do with engines? Find out in this activity.

Activity 5 -

- Repairing fuel systems and repairing generators - Fuels systems and carburetors work together to keep the engine going. Find out why in this activity.

Activity 6 -

- Repairing valves on 4 cycles engine and repairing valves on 2 cycle engine - Sometimes the smallest part of the engine can play the largest role. Learn about valves in this activity.

Activity 7 -

- Repairing cylinders and Piston-and-Rod assemblies— parts need to work together to make an engine run, in this activity you will see why.

Activity 8 -

- Repairing lubricating mechanisms in 4– cycle engines - lubricating systems are key to the maintenance of the engine. This activity will show you why.

Activity 9 -

- Repairing camshaft assemblies in 4-cycle engines - learn the difference between the camshaft and the crankshaft.

Activity 10 -

- Repairing crankshaft assemblies - the final part in the system that will create a smooth running engine. The activity will explain why.

New Format. New activities. New ideas.

- In its first year of the new project format, the 4-H staff welcome any feedback, questions or concerns about the Small Engines Project. Please do not hesitate to get in touch. Further instructions are provided in the Leader Guide.
- If you have an idea or topic in mind for a project activity that relates to blacksmithing, be sure to talk to your project leader! The new project format allows you to review, discuss and select activities that interest you and your fellow 4-H project members. If you don't see something that you are interested in, suggest a new idea! Have fun with it!

Project Activity #1— Review

How to Diagnose Small Engines Problems:

To learn how to deal and fix with common problems and in the future prevent them in the future:

1. Check the fuel delivery if your engine won't start. See whether there's fresh fuel in the tank, examine the fuel tank cap for clogging and make sure the shut off valve isn't closed.
2. Look for carburetor problems next. The carburetor may be blocked, choked too high or poorly adjusted.
3. Turn your attention to the ignition if the engine still has trouble starting. The spark plug mat be dirty, the plug gap may not be correct, the wiring may be damaged or the switch may not be functioning. Always thread a spark plug by hand and tighten no more than one and a half turns with a wrench, this is easily able to destroy the engine. Always remove and replace spark plugs after the engine has cooled.
4. If after installing new plugs, you hear a consistent clicking noise, the spark plug is loose, give it another half turn and restart the engine. Noise should be gone. Never turn the plug over two half (one whole) turns after hand tightening. You will destroy the engine.
5. Check for poor compression—its another common culprit when an engine doesn't start. Parts such as valves and pistons may be damaged or dirty.
6. Learn the probable causes of a knocking sound. Common ones include a loose flywheel, bad spark plug, worn cylinder and carbon that has built up and needs to be cleaned out of the combustion chamber.
7. Check the areas that often cause overheating. Clean your engine, make sure the oil level is sufficient and check the fuel mixture in your carburetor—it may be too lean.

How to Maintain a Small Engine:

Before Each Use:

- Remove debris from the air intake screen, muffler, oil filter, and governor linkage areas with a stiff plastic bristle brush .
- Remove the air intake screen to clean the flywheel fins
- Twice a year (depending on use and manufacturer's recommendations):
- For a four stroke engine, change the oil. Drain the old oil into a container through the drain plug or pour it out through the filler hole and refill with new oil. (Two– stroke engines don't need this step because the oil is in the fuel)
- Apply a small amount of lightweight oil, lithium grease, or silicone lubricant to all exposed control cable and pivot points (clutch and throttle controls)
- Clean or replace and air filter as needed.
    - Remove the cover and lift out the foam filter
    - Clean dirt and grease form the housing interior with a soft cloth and wash the filter with dish detergent and hot water and rinse with clear water
    - Allow the filter to fully dry before reinstalling.

Replace a recoil starter rope:

- Disconnect the spark plug cable for safety
- Disengage the throttle cable from the housing and remove the housing as needed to access the starter
- Remove the handle from the rope, which is often held in place by a knot or retainer pin.
- Unfasten the other end of the rope form the starter using pliers or a cutter as needed.
- Knot the end of replacement rope
- Tighten the pulley counterclockwise all the sway, then back it off two turns and hold it firmly.
- Thread the rope through the housing hole and pull it taut.
- Slowly release the pulley, allowing the rope to wind around the pulley
- Attach the handle and reassemble as needed
- Reconnect the spark plug cable.

Project Activity #2— Repairing Starters

Check your list of tools and materials needed:
Your leader will be covered information on:

- A repairing rope wind –starters
- Repairing rope rewind starters
- Repairing windup starters

Discuss with your members any problems they may have in filling out the Owner's Engine Information Form. It is always a good idea to have a fire extinguisher on hand.

1. **Rope –wind :**
    - Pocket knife or diagonal cutting pliers
    - Replacement rope
    - Matches

2. **Rope –Rewind :**
    - Vice grip pliers or adjustable end– wrench (Depending on your type of starter)
    - Wire Paper Clip
    - Slot –head screwdriver—8"
    - Nut driver 7/16"
    - Phillips head screwdriver
    - Vice—4 "
    - 8—Inch c-clamps (2)
    - 3/4" x 3" x 5" Woodstock
    - Small amount of multi– purpose grease
    - Matches
    - Rope
    - Gloves
    - Petroleum solvent (mineral spirits, kerosene or diesel fuel)

3. **Windup :**
    - Vise 4" jaws
    - 8 inch clamps (2)
    - Slot– head screwdriver 8"
    - Open-end wrenches (7/16", 1/2", 9/16")
    - Needle –nose pliers 7"
    - Combination pliers 7"
    - Multi-purpose grease

Project Activity #3— Repairing Starters

Small engines starters are either recoil or electric, though on rare occasions both systems are used. Your lawnmower, unless it is very large, probably employs a recoil starter. Pulling the starter rope of a small engine with a recoil starter causes the pulley contained the rope to spin rapidly. Centrifugal action causes a pawl within the pulley to extend outward and engage teeth on the interior of the flywheel hub linking the pulley and the flywheel. This action takes place within the first few inches or rope travel; the remainder of the rope pull spins the engine over and starts in. Pulling the rope also winds a spring under the pulley. Releasing the pull handle lets this spring turn the pulley in the reverse direction to rewind the rope. The pawl, which is designed to ratchet when the engine starts, is disengaged at the moment the re-winding starts.

Electric start engines have a small electric motor, called a starter motor, mounted on the side of the engine. This motor has a device called a Bendix drive, mounted on the threaded output shaft. A Bendix drive is essentially a gear with a one-way clutch that engages only as long as power is applied to it. The starter motor drives the Bendix up the threads on the shaft to engage teeth on the perimeter of the fly-wheel, spinning the engine over. When the engine starts, the flywheel turns faster than the starter causing the one-way clutch to disengage. Shutting off the voltage to the starter motor allows the Bendix to drop back down the shaft thread away from the flywheel.

Check your list of tools and materials needed:

1. 120 V AC starters (plug into a wall)
2. Starting and generating systems

Tools and Materials Needed:

1. 0-24 range DC Voltmeter
2. 0-30 range ammeter
3. 0-50 range AC Voltmeter
4. Slot—head screwdriver 8”
5. Open end wrenches (7/16”, 1/2”, 9/16”)
6. Brush –seating stone or sandpaper (no.00) , a small wooden block with a 1.2 square end
7. A clean cloth
8. Tachometer
9. Petroleum solvent (mineral spirits, kerosene or diesel fuel)

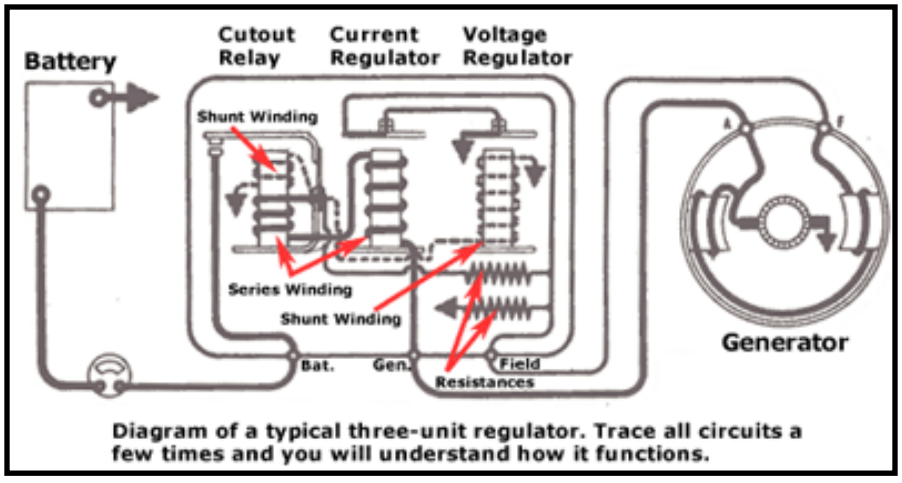


Diagram of a typical three-unit regulator. Trace all circuits a few times and you will understand how it functions.

Project Activity #4 — Maintaining Repairing Ignition Systems

Check your list of tools and materials needed.

1. Material covered in this lesson includes:
    - Magnet and solid state ignition systems
    - Battery ignition systems

Tools and Material Needed:

1. Socket wrench set - 1/4” through 13/16” - 3/6” drive
2. Flywheel puller (3)
3. Openn-end wrenches 1/4” through 1/2”
4. Slot– head screwdriver 6”
5. Phillips head screwdriver 6”
6. Needle nose pliers 7”
7. Tag card stock or postal card for measuring air gap
8. Ignition tools
9. Feeler gage
10. Permeate, for dealing around spark –plug wire at the coil
11. Ohmmeter
12. Flywheel holder
13. Coil tester
14. Continuity test light
15. Neon timing light
16. Clean rags
17. Cleaning solvent, denatured lcohol, mineral spirits, kerosene, or diesel fuel

Project Activity #5 — Fuel Systems

Fuel Tanks: come in various shapes and sizes. They are molded to fir the contour of the engine. The gas cap is usually easily reached for refilling the tank. Fuel tanks are made from aluminum or hi-impact plastic. The fuel tank should be cleaned outside and inside before the engine is reassembled. Use a solvent, and dry the tank thoroughly. The furl line should be removed and cleaned as well. Set the furl line in a container where it will not be punctured, dented, or damaged.

Air Cleaners: should be removed and serviced when overhauling an engine. Use the proper servicing procedure for the type of air cleaner you have. Set all the parts of the air cleaner in a container so they cannot get dusty.

Carburetor and Fuel System:

The carburetor is the part of the small engine where air and fuel are mixed together before they travel through the intake valve to the cylinder. The carburetor uses a fast air flow and a venture to make fuel into a vapor that will explode easily.
The fuel tank is where the gasoline is stored. It is far enough away from the cylinder to stay cool. A hose or pipe carries the fuel to the carburetor, where a valve lets fuel into the carburetor as fuel is needed. The fuel is sucked through a tube called a fuel jet into the stream of air. The speed of the small engine is controlled by the throttle, which controls the amount of fuel-air mixture allowed to enter the cylinder.
The amount of air allowed to enter the carburetor is controlled by the choke. As the name says, it "chokes" the amount of air, making more fuel and less air go into the cylinder. A cold engine needs more fuel to start. This is hwy the choke must be on to start a cold engine. There ar esome adjustments which can be made to a carburetor. The first is the main fuel adjusting needle. This adjustment changes the amount of fuel allowed to enter the fuel jet. The idle speed, or slowest speed, of the engine is controlled by an idle adjusting needle, which only lets in so much furl when the throttle is closed in the idle position).

Types of Carburetors and How They Work:

There are three types of carburetors used on small engines: depending on how fuel is supplies form the tank to the fuel chamber in the carburetor. They are:

A. Float type
B. Suction life type
C. Diaphragm type

- Check your list of tools and materials needed:
- Material covered in this lesson includes:
    - Repairing fuel systems
    - Repairing generators

Tools and Materials Needed:

- Open end wrenches 7/16" through 9/16"
- Slot-head screwdriver 6" regular
- Clean Rags
- Petroleum solvent (mineral spirits, kerosene or diseal fuel
- One foot length of wire—approximately 14 gage
- Fuel container
- Phillips head screwdriver 6"
- Wire brush
- Open—end wrenches 1/4" through 1/2"
- Needle nose pliers 7"
- Combination 7"

Project Activity #6 —
Repairing valves on 4 Cycle Engine and 2 Cycle Engine

Check your list of tools and material needed:

1. Material covered in this lesson:
    - Repairing valves on 4 cycle engine
    - Repairing valves on 2 cycle engine

Tools and Materials Needed:

1. Socket wrenches 1/4” through 9/16”
2. Wire brush
3. Valve spring compressor
4. Valve lapping tool
5. Valve seat insert remover
6. Valve grinder
7. Feeler gage
8. Torque wrench and socket set 3/8” through 9/16”, 3/8” drive and a set 3/4” or 11/16” spark plug socket
9. Slot head screwdriver 6” regular
10. Phillips head screwdriver 6”
11. Air pressure gage—1-100 psi
12. Air operating valve adapter
13. Pocket knife
14. Micrometer 0” to 2” and 0” to 6”
15. Clean rags
16. Emery Cloth
17. Open end wrenches 3/8” to 9/16”
18. Steel ruler
19. Punch 5/16”
20. Carburetor cleaning solvent
21. Wooden Scrapper

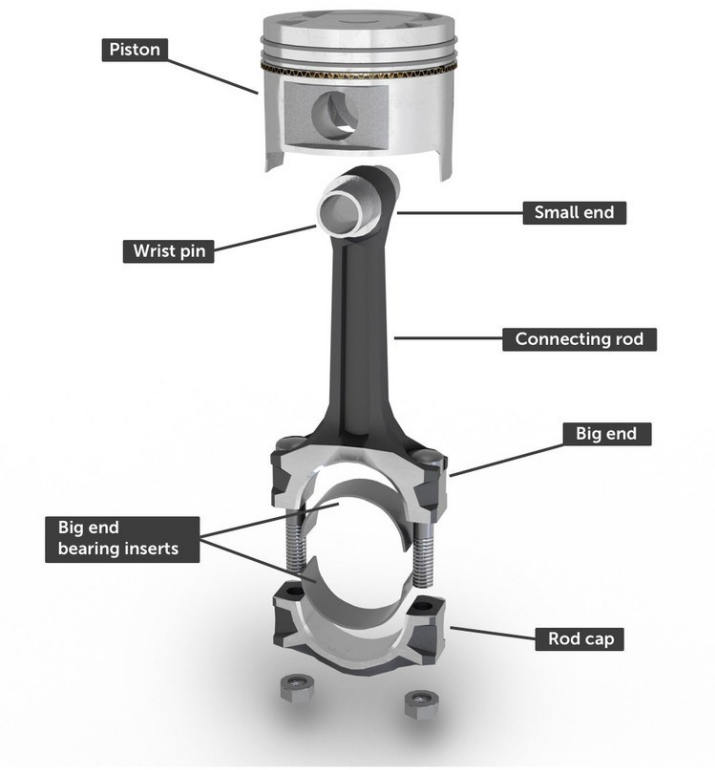
Project Activity #7 —
Repairing Cylinders and Piston and Rod Assembles

Check your list of tools and materials needed

1. Material covered in this lesson:
    - Checking piston and piston—and– rod assembly
    - Repairing pistons, rods and rings
    - Repairing cylinders

Tools and Materials Needed:

1. Long-nose pliers 7”
2. Piston ring expander
3. Reamer for piston pin
4. Micrometer (outside and inside)
5. Ring groove gage
6. Open end wrenches 3/8” through 9/16”, 3/8” drive
7. Brass punch 1/2” x 6”
8. Piston solvent—John Deere, Stoddard or equivalent
9. Clean Rags
10. Crankcase oil
11. Inside micrometer or cylinder gage
12. Home and/ or boring bar (coarse and find honing stones)
13. Cleaning solvent (mineral spirits, kerosene or diesel fuel)
14. Soap and Water
15. Paper and pencil
16. Cutting fluid



https://www.howacarworks.com/pistons

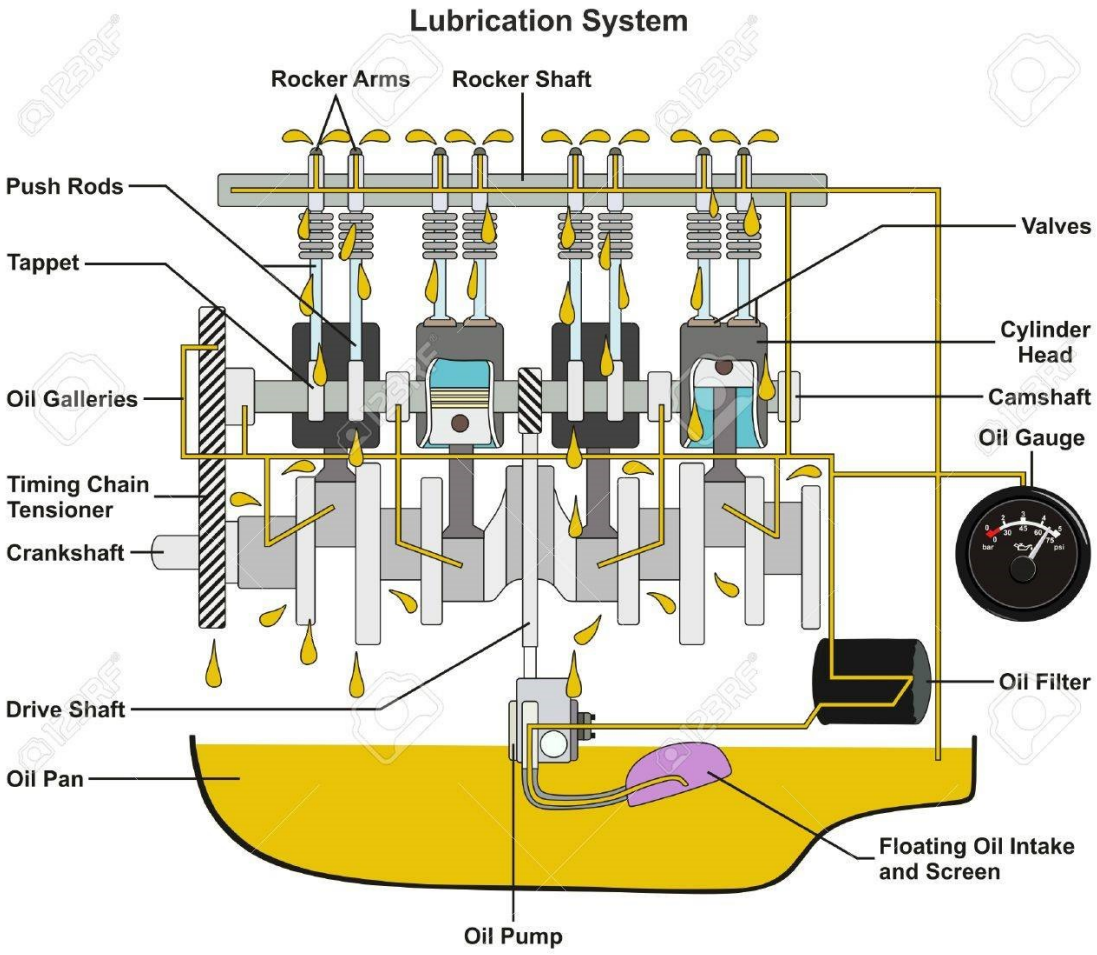
Project Activity #8 —
Repairing Lubricating Mechanisms in 4-Cycle Engines

Check your list of tools and material needed

1. Material covered in this lesson
    - Repairing lubricating mechanisms in 4-cycle engines

Tools and Materials Needed:

1. Open end wrenches 3/8” - 9/16”
2. Slot head screwdrivers 6”
3. Phillips head screwdriver 6”
4. Crankcase Oil
5. Squirt Gun
6. Clean Rags
7. Petroleum solvent (mineral spirits, kerosene or diesel fuel)



https://www.123rf.com/photo_87963539_stock-vector-vehicle-lubrication-system-infographic-diagram-showing-cross-section-of-car-engine-with-all-parts-an.html

Project Activity #9 —
Repairing Camshaft Assemblies in 4-cycle engines

The Primary function of the camshaft assembly is to open and close the valves at exactly the right time.

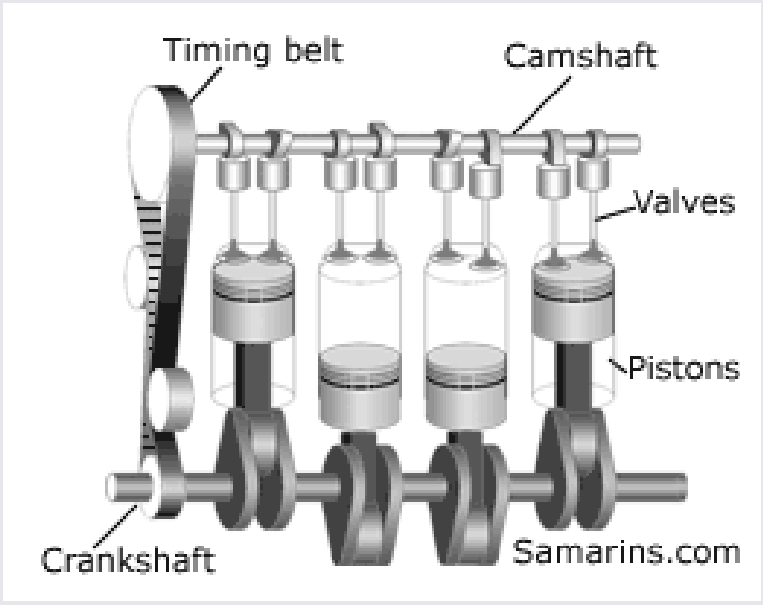
A. Intake Stroke: cam pushed tappet against valve stem and forces the intake valve open. There is no cam action against the exhaust valve tappet in this stroke, it remains closed.
B. Compression Stroke: no cam action against either valve tappet. Both valves are closed.
C. Power Stroke: both valves remain closed,
D. Exhaust Stroke: cam pushed tappet against exhaust valve stem and opens the exhaust valve.

Check your list of tools and materials needed:

1. Cover information on:
    - Repairing camshaft assemblies in 4-cycle engine

Tools and Materials Needed:

1. Open –end wrenches 3/8” through 9/16”
2. Socket wrenches and handle 3/8” through 3/4” - 3/8” drive
3. Slot head screwdriver 6”
4. Phillips head screwdriver 6”
5. Combination pliers 7”
6. Needle nose pliers 7”
7. Micrometer—1/2” to 1”
8. Petroleum solvent (mineral spirits, kerosene or diesel fuel)
9. Clean Rags



http://nonizuka.blogspot.com/2014/05/pengertian-mesin-ohvohcsohcdohc.html

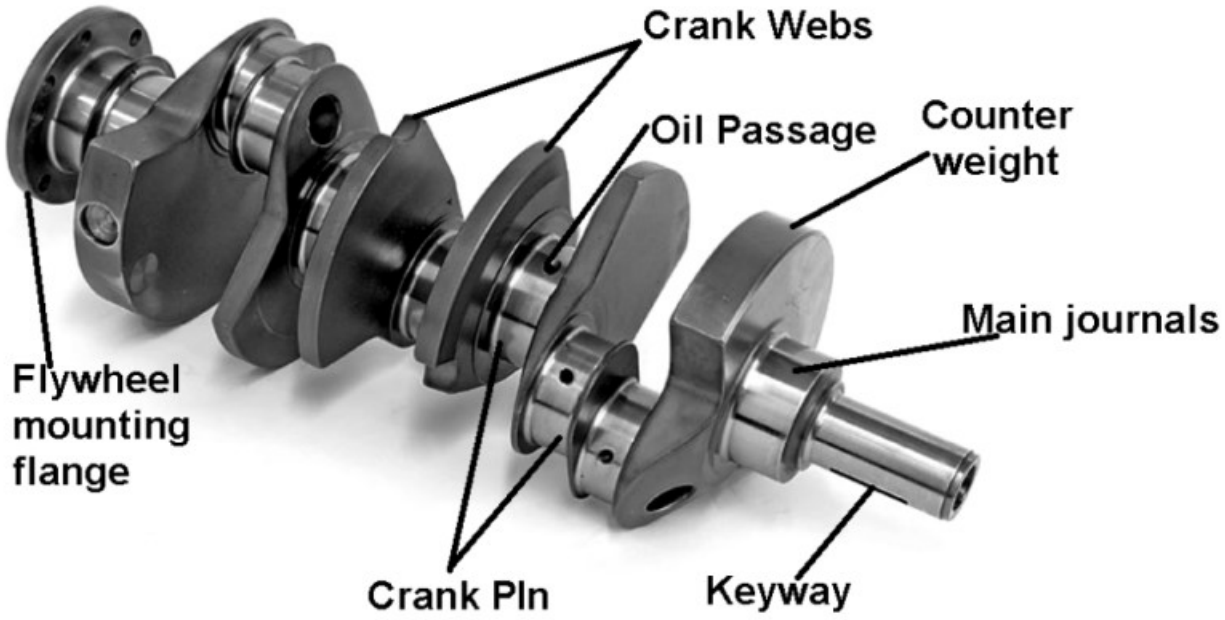
Project Activity #10 —
Repairing Crankshaft Assemblies

Check list of tools and materials needed.

1. Your leader will be covered information on:
    - Repairing crankshaft assemblies

Tools and Materials Needed:

1. Long nose pliers 7”
2. Slot head screwdrivers 8”
3. End wrenches 3/8” through 3/4”
4. Clean Rags
5. Micrometer, inside and outside
6. Arbor Press
7. Bearing Puller
8. Petroleum Solvent
9. Emery Cloth
10. Gasket cement
11. Gaskets



https://www.theengineerspost.com/basic-engine-components-engine-parts/

4-H Judging

Judging is an important skill that you will use in 4-H and beyond. As a 4-H member, judging will help you develop important assessment skills, and with practice, you will learn to carefully **observe, evaluate, make decisions, communicate with confidence.**

Is Judging a requirement for THIS project?

Judging is not a requirement for **ALL** 4-H PEI projects, but you are encouraged participate in the practice whenever possible.

- When Judging is a requirement, it will be listed in the PCR's (Project Completion Requirements) on the front page of this member booklet. Members will need to fill out the score card below showing that the activity has been completed. The judging activity will be arranged by your project leader!
- When Judging is not a requirement, members and leaders may use the information and scorecard below for practice and learning. The skills learned from 4-H judging are used in everyday life situations, so it is always a useful skill to build!

Score Card for Judging

I place this class of: _____ in the order of _____ _____ _____ _____
(Description - specify type of animals or items) *(1st)* *(2nd)* *(3rd)* *(4th)*

I place _____ over _____ because:

Reasons: _____

_____

I place _____ over _____ because:

Reasons: _____

_____

I place _____ over _____ because:

Reasons: _____

_____

I place _____ at the bottom of this class because:

Reasons: _____

_____

For these reasons, I place this class of: _____ in the order of _____ _____ _____ _____
(1st) *(2nd)* *(3rd)* *(4th)*

4-H MEMBER OPPORTUNITY - Provincial 4-H Judging Competition (Annual Event)

This event is open to all members, ages 9-21, and offers a great opportunity to learn more about judging in a competitive atmosphere (Three age categories & cash prizes awarded to top members for their judging abilities). Senior members (17-21) also compete for the chance to join the **Maritime 4-H Judging Team** to compete at **Agribition** (Regina, SK) in November.

- **4-H Canada Learns** is a resource tool providing information on 4-H projects from different provinces. Check out www.4-h-learns.org/resources - keyword "judging" for resource documents that will help with developing and building your judging skills!
- **4-H PEI** is able to provide information to members and leaders on both livestock and non-livestock judging practices. Check with your 4-H Specialist for more information **AND** be sure to check out the 4-H PEI Judging Resource page at www.pei4h.ca/4-h-judging-resources

Member Reflection

As a 4-H member, you are encouraged to "Learn to Do by Doing" through hands-on activities. Keeping a record of your 4-H activities with this **Member Reflection** will provide helpful insight for you, your leader and the 4-H Specialist as to skills you have learned and projects you have completed throughout the 4-H year!

Skill Based Project: You are encouraged to work on skill development and completion of project requirements (with guidance from the project leader) throughout the 4-H year. Not every activity will have a tangible item (for display), but you are asked to share the activities and learnings in which you participate below...

Project Activity: _____

What I did: _____

What I learned: _____

What I liked: _____

Project Activity: _____

What I did: _____

What I learned: _____

What I liked: _____

Project Activity: _____

What I did: _____

What I learned: _____

What I liked: _____

Project Activity: _____

What I did: _____

What I learned: _____

What I liked: _____

Project Activity: _____

What I did: _____

What I learned: _____

What I liked: _____

(feel free to use more space if necessary!)

LEADER COMMENTS (optional): Leader observations can be helpful to you in future years with this and other 4-H projects. Be sure to ask your project leader if they would like to reflect on your 4-H year.

I am most impressed by… _____

I believe that you have learned… _____

In the future I encourage you to...

4-H Year Completion Checklist

In addition to completing a Skill Based 4-H project, members are also required to participate in Communications, at least **ONE** Ag. Awareness Activity and **ONE** Community Service Activity in order to complete the 4-H year.

Use the space provided to reflect on what you have learned through participation in these activities.

If this information has already been completed in another booklet, please indicate where it can be found:

My Communications Activity

☐ Speech ☐ Demonstration (Single) ☐ Demonstration (Team) ☐ Alternate Communications: _____

What I learned: _____

What I can work on: _____

Agriculture Awareness Activity

What did you do to complete this activity this year? (Either on your own or with your 4-H Club)

What area of Agriculture would you like to explore in the future?

Community Service Activity

What did you do to complete this activity this year? (Either on your own or with your 4-H Club)

What will you do in the future to give back to your community?

4-H PEI - Staff Comments (Optional)

Completion Requirements		**Completion Notes**
Skill Based Project		
Communications		
Ag. Awareness Activity		
Community Service Activity		