The 4-H Motto

“Learn To Do By Doing.”

The 4-H Pledge

I pledge

My HEAD to clearer thinking,
My HEART to greater loyalty,
My HANDS to larger service,
My HEALTH to better living,
For my club, my community and my country.

The 4-H Grace

(Tune of Auld Lang Syne)

We thank thee, Lord, for blessings great
On this, our own fair land.
Teach us to serve thee joyfully,
With head, heart, health and hand.

Developed by

Elizabeth Webster, M.Ag.

Published by

4-H Branch
Alberta Agriculture and Rural Development
7000 113 ST RM 200 NW
EDMONTON AB CANADA  T6H 5T6

Check out our web site at: http://www.4h.ab.ca  Email info@4h.ab.ca  Phone 310-0000 (Toll-Free RITE line then) 780-422-4H4H (4444)

No portion of this manual may be reproduced without written permission from the 4-H Branch of Alberta Agriculture and Rural Development.

August 1999/cas
# Table of Contents

## Introduction
- Objectives ................................................................. L-7
- Planning the Club Year ............................................... L-8
- Scheduling the Club Year ............................................. L-9
- Achievement Day Requirements ............................... L-10

## Leader Teaching Resources
- Encouraging Learning ................................................. L-13
- Ideas and Tips From Other Small Engine Clubs .......... L-16
- Project Meeting Ideas .................................................. L-19
- Things To Do With Your club ....................................... L-22
- Small Projects To Do With Your Club ......................... L-25
- Observation: Your Most Important Tool ...................... L-26
- Resources for Learning ............................................... L-28
- Building Skills in the 4-H Member ............................... L-30
- Equipment List .............................................................. L-31
- Expectations for Member Growth ............................... L-32

## Section One - Safety
- Safety in the Small Engine Project ............................. L-35
- Safety (What To Do) ...................................................... L-36
- Who Does an Unsafe Worker Affect? ......................... L-38
- Safety Steps ................................................................. L-39
- Safety Contract ............................................................. L-40
- Comments From Other Leaders About Safety ............. L-41
- Small Engines and Community Safety ....................... L-43
- Safety #1 - Word Search Answer Key ......................... L-44
- Safety #2 - Word Search Answer Key ......................... L-45
- Safety Tips for Using Tools ......................................... L-46
- Safety Quiz Answer Key ............................................... L-48
Table of Contents

Section Two
Expectations for Member Growth ........................................... L-55
How Small Engines Work .......................................................... L-57
Differences Between a Two and a Four Cycle Engine ........ L-60
Four Stroke Cycle Engine - Review Answer Key ................. L-62
How Small Engines Work - Crossword Answer Key .......... L-64
How Small Engines Work - Word Search Answer Key ....... L-65
Compression - Crossword Answer Key ................................. L-66

Section Three
Parts of an Engine Checklist ................................................ L-67

Section Four
Care and Handling ................................................................. L-69
Care and Handling - Crossword Answer Key .................... L-71

Section Five
Cleaning Engine .................................................................... L-73
Cleaning Engine - Crossword Answer Key ....................... L-75
Cleaning Engine - Word Search Answer Key .................... L-76

Section Six
Cooling System ....................................................................... L-77

Section Seven
Air Cleaner ............................................................................. L-79

Section Eight
Fuel Strainers .......................................................................... L-81
Section Nine
Crankcase Breathers ............................................................... L-83

Section Ten
Lubrication .................................................................................. L-85
Lubrication - Crossword Answer Key ................................. L-88
Lubrication - Word Search Answer Key ............................. L-89

Section Eleven
Spark Plugs .................................................................................. L-91
Spark Plugs - Crossword Answer Key ................................. L-93
Spark Plugs - Word Search Answer Key ............................. L-94

Section Twelve
Carburetor .................................................................................. L-95
Carburetor - Crossword Answer Key ................................. L-98
Carburetor - Word Search Answer Key ............................. L-99

Section Thirteen
Battery ......................................................................................... L-101
Battery - Crossword Answer Key ....................................... L-104
Battery - Word Search Answer Key ................................ L-105

Section Fourteen
Fuel ................................................................................................ L-107
Fuel - Crossword Answer Key ............................................. L-109
Fuel - Word Search Answer Key ........................................ L-110
Table of Contents

Section Fifteen
Engine Start-up and Shutdown............................................. L-111

Section Sixteen
Storage..................................................................................... L-113
Storage - Crossword Answer Key ........................................ L-115
Storage - Word Search Answer Key..................................... L-116

Appendix - Member Work Sheet Masters
Safety in the Small Engine Project ..................................... L-117
Who does an Unsafe Worker Affect? ................................. L-118
Safety Contract ........................................................................... L-119
Cleaning - Generic Checklist.................................................. L-120
Protect Yourself ......................................................................... L-121
Safety Quiz............................................................................... L-123
Differences Between Two Cycle And Four Cycle Engines L-129
Four Stroke Cycle Engine - Review........................................ L-131
Originals for Crosswords and Word Searches ...................L-133

Evaluation.............................................................................. L-152
Objectives

The club member will:

- gain knowledge in operation, care and maintenance of small engines
- develop and demonstrate safe work habits
- gain knowledge and skills in use of tools and chemicals related to small engines
- demonstrate proper care and maintenance of a work area
- develop problem-solving skills in leadership, communication, planning, assessment, decision-making, evaluation, money management and time management
Planning the Club Year

1. Consider the experience and circumstances of the members and the leaders:
   - Do members all have an engine to work on?
   - Age and attention span of members?
   - Club size.
   - Do you have an appropriate place to meet?
   - Tools available.
   - Adult helpers committed (some clubs make it a requirement that each member provides a helping adult at two of the year’s meetings).

2. Review the table of contents.

3. Decide what topics you will cover.

4. Plan the order of topics.

5. Decide which activities you will do for each topic.

6. Identify resources to use.
Scheduling the Club Year

Some Ideas:

Meet on a monthly basis on a Saturday. Younger members attend from nine to noon. Older members bring a lunch and stay until 3.

Give a copy of written schedule to each member or family.

OR

Meet every two weeks on a week night, 4 to 9.

OR

Meet every week on a week night, 7 to 9.

OR

Meet four times a month, one meeting being a general business meeting and the other three work sessions.

Your meeting schedule will be unique, to suit the circumstances of your club participants.
Achievement Day Requirements

Many of the requirements for Achievement Day are met during the club year. E.G. member explained and demonstrated how to clean an engine. Initial the member’s records at time of completion.

Achievement Day can be a “Recognition/Celebration Day” if checking of work and records is done regularly during the year. Checking of record books could be done by a parent helper who knows what the requirements are.

*Age is a guideline only and should not prevent a member from working on a higher level*

Junior (aged 9 – 11 years)*

1. Attends and participates in at least 70% of all club activities.
2. Displays completed records for meeting attended.
3. Displays engine (clean) worked on during year.
4. Scores a pass on safety quiz/questions administered by leaders or other adults.
5. Correctly identifies at least five tools displayed.
6. Differentiate between two and four cycle engines.
Achievement Day Requirements

Intermediate  (aged 12 - 14 years)*
1. Attends and participates in at least 70% of all club activities.
2. Displays completed records for meeting attended.
3. Displays engine (clean) worked on during year. Answers questions regarding work done on engine.
4. Display/exhibit/poster of hazards in the work place, emphasizing accident prevention.
5. Identifies correctly at least 10 tools displayed.

Senior  (aged 15+ years)*
1. Attends and participates in at least 70% of all club activities.
2. Thorough record of year’s work on a small engine including: before and after photos, settings, record and costs of work done, hours, performance of engine.
3. Display and answer questions about small engine worked on.
4. Exhibit of at least five worn or damaged parts, labelled as to cause of damage and the preventative maintenance or care recommended.
Encouraging Learning

To encourage learning provide:

**Involvement**
- mentally
- physically (hands on)

**Relevance**
- why is this important
- today
- in the future

**Supportive Relationships**
- with leaders
- with fellow members
- with family

**Structure**
- regular meetings
- organized so time is well spent
Encouraging Learning

Reinforcement
- to encourage preferred behaviour
- can come from fellow members as well as adults
- can be a simple smile, nod or pat on the shoulder

Repetition
- emphasize key points
- can be pointed out in different ways

Feedback
- answers “how am I doing?”
- can come from members, leaders, family, engine, wallet!

Variety
- in engines examined
- in teaching methods used
- in teachers/guest speakers
Encouraging Learning

Sequence
- cover topics in a logical order
  (will make sense to the learner)

Association
- compare to something they already know or do
- look for common characteristics or else differences

Practice
- reinforces all the lessons
- builds confidence and skill
- an opportunity to problem solve
- builds independence
Adult helpers are important. “Duty days” can be written into the club schedule. If adults have to change their duty day, it’s up to them to find a replacement.

Observation is very important. They need to slow down and use their senses (sight, sound, touch, smell). See page L-23.

Members need to keep their parts and tools together. Label tools. Good containers include: ice cream pails, zip-lock bags, detergent pails, rinsed chemical pails, coffee cans.

Encourage members to take pictures of their engine before, after and as they go along.

Take apart an engine together, clean it, mount it on a piece of plywood, label parts A to Z, and use it for the rest of the year as a reference.
Ideas and Tips From Other Small Engine Clubs

- Members should record all the specifics of their engine before they start to tear it down. E.G. torque settings, compression tests.

- One club has a tool list in each tool tray at each work session. Members clean and replace their tools at meeting’s end. This develops good work habits and prevents misplaced tools.

- For roll call, we make up a question that applies to what we covered at the last meeting.

- A little coil notebook (pocket-size) is good for jotting notes as they go along. It doesn’t matter if it gets greasy.

- Make sure your press reporter mentions not only the technical part of what members are learning, but also how they are growing in responsibility.

Small Engine Leader’s Guide
Ideas and Tips From Other Small Engine Clubs

Always take old parts with you when ordering or picking up new parts.

Lay parts out in order of disassembly and keep them in order. We use numbered zip-lock bags and put only a few parts in each bag.

Draw a sketch of an assembly before or while you are working on it. This will help when you put it back together. It will also help develop your observation skills.

Cut open a large cardboard box and flatten it to protect the garage or shop floor.

If a Phillips screw is extremely tight, put a bit of valve lapping compound on the screwdriver tip. It will grip better.

Use an old muffin tin to keep nuts, bolts, washers or tiny parts together. You can label the contents with tape, if necessary.

Test the simplest and most probable cause of trouble first. Most small engine service and repair jobs can be done without taking the whole engine apart!
Project Meeting Ideas

Management Practices

- Cleaning the Engine
- Cleaning the Cooling System
- Servicing the Air-Cleaner (several types)
- Servicing the Fuel Strainer (several types)
- Cleaning the Crankcase Breather
- Checking and Changing Crankcase Oil
- Servicing Spark Plugs
- Adjusting the Carburetor
- Battery Service
- Refuelling Engines
- Engine Storage
Project Meeting Ideas

Safety Practices

- Preparing Your Work Area
- Lighting and Ventilation of a Work Area
- How to Use a Fire Extinguisher
- Safe Handling and Storage of Tools
- Safe Handling and Storage of Fuels, Cleaners, etc.
- Safe Disposal of Oily Rags, Old Batteries.
- Safe Use of Compressed Air.

Related Careers

- What careers involve working with engines?
- What kind of training is required?
- Where is that training available?
- How can I get more information?
Project Meeting Ideas

Records

- Engine specifications before and after work
- Expenses
- Possible problems to keep an eye on
- Tools you have had to borrow - put on purchase or “wish list”?
- Use photography as a type of record.
- Use video tape as a type of record - record the operation of the small engine before and after the project. This could be shown at Achievement Day.
Try some of these methods with your club.

**Demonstrations**

The leader, a helper or an older member can demonstrate the “how to” of some procedure. This is a very strong teaching tool.

**Build a “Reference Board”**

Tear down, clean and mount the parts of a small engine on a sheet of plywood. Label A to Z. Use during the rest of the year. The club members can do this together.

**Parts identification**

Lay out a collection of parts for members to identify.

**Practice diagnosing**

Borrow a poorly running small engine (or “sabotage” your own).

Challenge members to trouble-shoot the problem using only their four senses of sight, hearing, touch and smell.
Things To Do With Your Club

Swap engines or buddy up with a fellow member
- to identify various systems or parts.
- to become familiar with a different engine.

Tour
- farm or business tours to see small engines at work in various settings.
- to reinforce safe working habits
- to appreciate the value of and importance in small engines
- to see the range in care and maintenance practices
- to recognize the importance of accurate problem identification and speedy economical repair.

Trade Shows/Fairs/Exhibitions
- attend as a small group
Things To Do With Your Club

The small engine as a jig-saw puzzle
After teaching about how a certain part is assembled, provide samples of that part for members to reassemble. They could work with a buddy, and adult or as a team.

Visitor’s night or day
Part way through the club year, designate one session for visitors to attend so members can “show off” what they have learned and done so far. This would be a good review and a good motivator for the members.

Photo album of small engines
Ask members to keep an eye out for small engines in their travels and bring back pictures where possible. Pictures from magazines could be included.

Display four or five small engines
have members identify certain parts on all engine.
Make an engine stand out of short lengths of 2 x 4's and lag bolts, screws or nails. Attach your engine to it so the engine will not move during work.

Practice tightening various threaded fasteners to different torque values using a torque wrench.

Demonstrate how to remove broken bolts. Allow for practice.

Demonstrate how to repair stripped threads. Allow for practice.

Demonstrate how oil can clean. With engine grease and oil on your hands, wipe them clean with clean engine oil.

Examine a collection of old spark plugs. Attempt to analyze the engine condition by their appearance. Clean gaps and test them.

Put a bad plug in an engine and test the spark first at the plug tip, then at the base. Explain the difference you notice.
Observation - Your Most Important Tool!

What can you see?
What is missing?

- is it running?
- smoke - volume, colour?
- cracks?
- worn or missing parts?
- any parts discoloured by heat?
- how good a job is it doing?

Listen

- is it rough, smooth, intermittent?
- varying?
- vibration?
- is something hitting?
Observation - Your Most Important Tool!

<table>
<thead>
<tr>
<th>Feel</th>
</tr>
</thead>
<tbody>
<tr>
<td>vibration, roughness?</td>
</tr>
<tr>
<td>power level?</td>
</tr>
<tr>
<td>heat?</td>
</tr>
<tr>
<td>grit in the oil?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smell</th>
</tr>
</thead>
<tbody>
<tr>
<td>exhaust?</td>
</tr>
<tr>
<td>leaks?</td>
</tr>
<tr>
<td>burning?</td>
</tr>
</tbody>
</table>
People

- farmers
- parents
- local small engine repair people
- former 4-H'ers (especially those in related field of study or line of work)
- mechanics
- oil field workers
- people who use a lot of small engines in the community

Places and organizations

- agricultural societies, exhibitions
- colleges, universities
- museums
- private industry
- snowmobile clubs
Things

- magazines, books, newsletters
- owner’s manuals
- advertisements
- comics and cartoons
- video tapes
- catalogues
- sales displays

Web sites and news groups

1. Briggs & Stratton
   http://www.BriggsandStratton.com/

2. Kohler Engines page.
   http://www.kohlerco.com/powersystems/engines/index.html
Building Skills in the 4-H Member

1. Explain the task and why it is important.
2. Describe what the member needs to be able to do.
3. List steps to the job.
4. Show each step.
5. Watch as the member does each step.

3. Tecumseh Engines page.
   http://www.tecumseh.com/engines.htm

   http://www.jackssmallengines.com/index.htm
   “the largest online lawn mower & generator parts supplier”
<table>
<thead>
<tr>
<th>Tools</th>
<th>Supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slot head screwdrivers 4&quot;, 6&quot;, 8&quot;</td>
<td>Degreaser</td>
</tr>
<tr>
<td>Phillips head screwdrivers 4&quot;, 6&quot;</td>
<td>Wire brush</td>
</tr>
<tr>
<td>Spark plug deep sockets 13/16&quot; x 3/8&quot; drive, 3/4&quot; x 3/8&quot; drive</td>
<td>Sandpaper</td>
</tr>
<tr>
<td>Ratchet handle 3/8&quot; drive</td>
<td>2 paintbrushes</td>
</tr>
<tr>
<td>T-handle 3/8&quot; drive</td>
<td>Bristle brush</td>
</tr>
<tr>
<td>Open end wrenches 7/16&quot;, 1/2&quot;, 9/16&quot;</td>
<td>Petroleum jelly</td>
</tr>
<tr>
<td>Combination pliers 7&quot;</td>
<td>Baking Soda</td>
</tr>
<tr>
<td>Needle nose pliers</td>
<td>Pail</td>
</tr>
<tr>
<td>Nut drivers 1/4&quot;, 3/8&quot;</td>
<td>Putty knife</td>
</tr>
<tr>
<td>Socket set 3/8&quot;, 7/16&quot;, 1/2&quot;, 5/8&quot;, 9/16&quot;</td>
<td>Wooden Scraper</td>
</tr>
</tbody>
</table>

Label, engrave or otherwise identify tools to prevent loss or mix-ups. Some members will bring their own tools.

One set of equipment for every 2-4 engines.
We have different expectations for the three ages of 4-H members (junior/intermediate/senior). We expect members to show personal growth in:

- project knowledge (content)
- correct performance of activities (application)
- working effectively with others (cooperation)
- working independently (independence)
Expectations for Member Growth cont’d…

The checklists in this manual give performance guidance for the three age groups. E.G. by club year end we would expect a junior member to be able to identify 10 parts of a small engine, an intermediate 20 parts and a senior 30 parts.

Intermediate members should be able to meet all the junior expectations plus the intermediate expectations for a section they have worked on. A senior should meet the junior and intermediate expectations plus those listed for senior members.

These lists are for the leaders’ guidance. They are not absolute requirements. The checklists start with Section Two, “How Small Engines Work”.
# Safety in the Small Engines Project

<table>
<thead>
<tr>
<th>At Risk</th>
<th>Risk</th>
<th>Preventative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>- lifting too much</td>
<td>- proper foot placement</td>
</tr>
<tr>
<td></td>
<td>- falls</td>
<td>- limit weights lifted alone - ask for help</td>
</tr>
<tr>
<td></td>
<td>- lifting incorrectly</td>
<td>- keep floor clean and clear</td>
</tr>
<tr>
<td></td>
<td>- turning incorrectly</td>
<td>- lift smoothly</td>
</tr>
<tr>
<td></td>
<td>- trying to catch a falling, heavy object</td>
<td>- lift with legs, keep back straight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ask for and give help</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- use available equipment to lift</td>
</tr>
<tr>
<td></td>
<td>- exposure to loud noises</td>
<td>- wear hearing protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- reduce exposure</td>
</tr>
<tr>
<td>Eyes</td>
<td>- splashes</td>
<td>- reduce risk of splash</td>
</tr>
<tr>
<td></td>
<td>- dust, flying objects</td>
<td>- wear eye protection</td>
</tr>
<tr>
<td></td>
<td>- fumes, smoke</td>
<td>- use compressed air with extreme caution</td>
</tr>
<tr>
<td></td>
<td>- struck</td>
<td>- &quot;think ahead&quot; - what direction will this part or tool move in?</td>
</tr>
<tr>
<td></td>
<td>- tools slipping or bouncing toward eyes</td>
<td>- good ventilation</td>
</tr>
<tr>
<td></td>
<td>- flash/heat</td>
<td>- reduce chance of fire</td>
</tr>
<tr>
<td></td>
<td>- compressed air used improperly</td>
<td>- keep face back from work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- clean engine thoroughly before working on it</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- keep tools in good repair</td>
</tr>
<tr>
<td>Lungs</td>
<td>- dust</td>
<td>- wear dust mask</td>
</tr>
<tr>
<td></td>
<td>- fumes from cleaning agents, exhaust, fuel</td>
<td>- provide adequate ventilation</td>
</tr>
<tr>
<td></td>
<td>- flash/heat from fire/explosion</td>
<td>- keep work place clean</td>
</tr>
<tr>
<td></td>
<td>- carbon monoxide poisoning</td>
<td>- use solvents sparingly</td>
</tr>
<tr>
<td></td>
<td>- inadequate ventilation</td>
<td>- work to prevent fire</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- avoid inhaling fumes</td>
</tr>
<tr>
<td>Skin, Limbs,</td>
<td>- exposure to fuel, solvents, battery acid</td>
<td>- wear appropriate protective gear</td>
</tr>
<tr>
<td>Hands, Feet</td>
<td>- rips, punctures from sharp, rough edges</td>
<td>- use inspection techniques that prevent rips and tears</td>
</tr>
<tr>
<td></td>
<td>- rips, punctures from tools</td>
<td>- emphasize &quot;observation first&quot; to avoid</td>
</tr>
<tr>
<td></td>
<td>- burns from hot parts</td>
<td>- tools in good repair</td>
</tr>
<tr>
<td></td>
<td>- electrical shock/burn</td>
<td>- put heavy parts securely on work surface</td>
</tr>
<tr>
<td></td>
<td>- crushing - heavy tools or engines</td>
<td>- keep out of the &quot;line of fire&quot; on working machine</td>
</tr>
<tr>
<td></td>
<td>- punctures - debris thrown up by machine</td>
<td>- keep compressed air away from skin burns</td>
</tr>
<tr>
<td></td>
<td>- punctures - pressurized air</td>
<td></td>
</tr>
</tbody>
</table>
You want to end the 4-H year with all the members and leaders you started with. And you want everyone to have all body parts in good condition. Make safety a standard for your club.

What to do

- Have members complete the page "Who does an unsafe worker affect?" individually or in pairs. Talk about it.

- Teach them the "safety steps", using one of their engines. Ask them what might happen if they ignore or skip a step.

- Show them safety equipment they'll use this year. Have them try the equipment on.

- Have the members "safety check" the work area. Point out factors that make a safe work area (lighting, ventilation, cleanliness etc.)
Safety

Review the safety logos and symbols on supplies and equipment.

Safety crossword puzzle.

Recognize safe working habits when you see them. Some clubs have a "safety award" given out at Achievement Day.

Go to a safety supply store as a club and encourage the parents to take their children.

Complete the safety contract with each member (page L-36) in member guide. Sample in Leaders' appendix)
Who Does An Unsafe Worker Affect? (answers)

- family
- other people who are present
- leader
- leader’s family
- other members
- members’ families
- potential members
  - their families
- co-workers
Safety Steps

1. Name the risks.
2. Safeguard the work area.
3. Wear necessary protective equipment.
4. Use the right tools.
5. Follow correct procedure.
6. Monitor work habits.
7. Correct as necessary.

*Ensure all adult helpers follow safety procedures.
Section One

Safety Contract

I will:

- identify risks of activities
- take actions to eliminate or reduce risk
- ask for help when needed
- select the correct tools, equipment and materials for the activity
- watch for and allow for proximity of other people
- stop work and move back when asked to
- exit work area on command (in case of emergency)
- return tools and supplies to storage after use
- follow safe disposal procedure
- dress appropriately for club activities
- share responsibility for safety in the club

_________________________  _________________________  _________________
Member  Leader  Date

Small Engine Leader’s Guide
Comments From Other Leaders About Safety.

- You have to work safely yourself. Everyone is learning from you.

- Some kids hurt themselves because they are embarrassed to ask for help. I just keep telling them that I’m still learning too.

- At the beginning of a work session ask members
  a) what risks this activity might involve
  b) how to protect themselves from it

- Treat safety matter-of-factly, as part of regular procedure. The kids see that it is part of your routine and it will become part of theirs.

- If you can, take a first aid course!
Some accidents may happen. Try to learn from them.

A first aid kit should be handy.

Safe work habits help insure you can keep on doing work that you like. They are part of growing up.

The brain is the most important piece of safety equipment.

Don’t turn the blade attached to the engine unless the spark plug wire is off and held away from the spark plug.

*Ask parents for their support of safe work habits. Make sure they know at the beginning of the year, that safety will be stressed.
Every year many people are injured while using small engines. What could your club do to educate people about safety and small engines?

- a display at a fair or mall
- a float in a parade
- posters at the community hall
- a skit about safety at a community meeting (maybe at your sponsor's?)
- an article in the local paper
- feature safety at your visitor's day or Achievement Day.
- do a presentation for a local service or commodity club. (Lion's Club, Elk's Club, Wheat Pool, UGG)
Safety #1 - Word Search
Answer Key

condition  monetide  steel toed boots
expense  observe  surprise
explode  precaution  time
faceshield  protective  unattended
goggles  puncture  ventilation
lifting  sparks
messy  splashing
Safety #2- Word Search
Answer Key

- brain
- burns
- chemicals
- corrosive
- decision
- explosion

- facemask
- gloves
- helping
- lifting
- monoxide
- observe

- prevention
- projectile
- punctures
- rushing
Section One

**Safety Tips for Using Tools**

- Pull on a wrench rather than push it. You can hurt yourself if it slips. If you must push, push with an open hand to avoid scraped knuckles.

- Clean all tools. Greasy tools slip and cause accidents.

- Store tools carefully. Damaged tools are dangerous.

- Keep long hair, clothing, jewellery and body parts away from equipment and tools.

- Use the right size tool for the job.

- Use the correct tool for the job. (E.G. do not use a screwdriver as a pry bar)
Safety Tips for Using Tools

- Safety goggles or a face shield will protect your eyes from dust, chunks, caustic materials and compressed air.

- Grind off mushroomed tops on chisels.

- Replace or repair a tool as soon as it shows signs of wear.
Choose the best answer

1. How should you dispose of oily rags?
   (in a metal container with lid, preferably outside)

2. To clean your hands after working with grease use gasoline.
   True or False (false)

3. Before you turn the blade of a lawn mower by hand you should:
   a) spit on your hands
   b) wear gloves
   c) disconnect the spark plug wire
   d) clean the blade
   e) check the oil level
   answer is c)

4. When using a wrench, it is best to:
   a) pull it towards you
   b) push it away from you
   answer a) - prevents scraped knuckles

Small Engine Leader’s Guide
5. When lifting something heavy:
   a) bend over at the waist and grasp it firmly
   b) bend with your knees and grasp it firmly
   c) lift it with one strong jerk
   answer b)

6. If you wear glasses with hardened lenses you do not need to wear safety goggles. True or False (false)

7. Use compressed air to blow dirt off your clothes.
   True or False (false)

8. A running gas engine produces deadly gas:
   a) hydrogen sulphide
   b) carbon monoxide
   c) mono carbonide
   d) vanilla extract
   e) sulphur dioxide
   answer b)
9. The reason we don't smoke around batteries is:
   a) it wastes time
   b) smoke weakens the charge
   c) it's a bad habit and turns your teeth brown
   d) batteries give off an explosive gas
   e) cigarette ash corrodes battery posts
   answer c)

10. When using a fire extinguisher, aim the spray:
   a) at the top of the fire
   b) all over the fire
   c) at the base of the flame
   d) at the smoke
   answer c)
11. Hand injuries can be prevented or reduced by:

   a) wearing gloves
   
   b) thinking a job through first
   
   c) visually examining before touching
   
   d) all of the above

   answer d)

12. Link the activity to the safety gear.

   cleaning battery — eye goggles
   
   grinding a part — fire extinguisher
   
   testing engine — rubber gloves
   
   using solvent — face shield
   
   carrying heavy parts — steel toed boots
   
   carrying heavy parts — ear muffs
13. Check to see if anyone is nearby you before working on your engine because:

a) you don’t want them borrowing your tools

b) they could be hurt by what you are doing

c) they should mind their own business

d) you can get them to do some of your work

e) they could bump into you and hurt you

f) b and e

answer f)

14. If you splash battery acid on yourself, rinse immediately with

a) 2% milk

b) cleaning solvent

c) lots of water

d) baking soda in water

e) a gasoline/oil mixture
answer c)

15. Lungs can be damaged by:

a) breathing in welding fumes
b) inhaling carbon monoxide
c) siphoning gas by mouth and tube
d) smoking while working
e) all of the above

answer e)
Expectations for Member Growth

We have different expectations for the three ages of 4-H members (junior/intermediate/senior). We expect members to show personal growth in:

- project knowledge (content)
- correct performance of activities (application)
- working effectively with others (cooperation)
- working independently (independence)
The checklists in this manual give performance guidance for the three age groups. E.G. by club year end we would expect a junior member to be able to identify 10 parts of a small engine, an intermediate 20 parts and a senior 30 parts.

Intermediate members should be able to meet all the junior expectations plus the intermediate expectations for a section they have worked on. A senior should meet the junior and intermediate expectations plus those listed for senior members.

These lists are for the leaders’ guidance. They are not absolute requirements. The checklists start with Section Two, “How Small Engines Work”.

Small Engine Leader’s Guide
<table>
<thead>
<tr>
<th>Junior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify a two cycle engine</td>
</tr>
<tr>
<td>Identify a four cycle engine</td>
</tr>
<tr>
<td>Name three differences between a two cycle and four cycle</td>
</tr>
<tr>
<td>Name two types of machines that use small engines</td>
</tr>
<tr>
<td>Identify source of lubrication for two cycle engine</td>
</tr>
<tr>
<td>Locate source of lubrication for four cycle engine</td>
</tr>
<tr>
<td>Classify member’s own engine as a two or four cycle engine</td>
</tr>
<tr>
<td>Explain why it is important to know whether an engine is</td>
</tr>
<tr>
<td>two or four cycle</td>
</tr>
<tr>
<td>Name the two strokes of a two cycle engine</td>
</tr>
<tr>
<td>Name the four strokes of a four cycle engine</td>
</tr>
<tr>
<td>Name three risks associated with small engines work</td>
</tr>
<tr>
<td>Name safety practices to reduce/eliminate those risks</td>
</tr>
<tr>
<td>Name three things an engine needs to run</td>
</tr>
<tr>
<td>(compression, ignition, fuel/air mix)</td>
</tr>
</tbody>
</table>
## Section Two

### How Small Engines Work

**Intermediate** *(prerequisite: Junior Level)*

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name five differences between a two cycle and a four cycle engine</td>
</tr>
<tr>
<td>Name five types of machines that use small engines</td>
</tr>
<tr>
<td>Locate ports (two cycle)</td>
</tr>
<tr>
<td>Explain/demonstrate how to mix fuel for a two cycle engine</td>
</tr>
<tr>
<td>Name and indicate three types of crankshaft positions</td>
</tr>
<tr>
<td>Demonstrate or explain valve position during each stroke</td>
</tr>
<tr>
<td>Name five risks associated with small engines work</td>
</tr>
<tr>
<td>Name safety practises to reduce/eliminate those risks</td>
</tr>
<tr>
<td>With little or no assistance, compression test a small engine</td>
</tr>
</tbody>
</table>
Name at least seven differences between two cycle and four cycle engines
Name seven machines that use small engines
Identify seven risks in small engines work
Name safety practises to reduce/eliminate those risks
Teach/demonstrate how to compression test a small engine
Compare/contrast compression tests of a small engine and a larger engine
## Differences Between A Two And A Four Cycle Engine

<table>
<thead>
<tr>
<th></th>
<th>Two Cycle Engine</th>
<th>Four Cycle Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>mixed</td>
<td>straight gas</td>
</tr>
<tr>
<td>Oil</td>
<td>in fuel</td>
<td>in a sump</td>
</tr>
<tr>
<td>Muffler</td>
<td>-exhaust ports on the cylinder itself</td>
<td>muffler is threaded or bolted to the engine near one end</td>
</tr>
<tr>
<td>Number strokes per crankshaft revolution</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Method of getting fuel/air mixture in combustion chamber and burned gases out</td>
<td>-no valve usually -uses ports (piston closes off ports)</td>
<td>-intake valve -exhaust valve</td>
</tr>
<tr>
<td>Number moving parts in the engine</td>
<td>fewer simpler in design</td>
<td>more</td>
</tr>
<tr>
<td>Weight</td>
<td>lighter/hp</td>
<td>heavier/hp</td>
</tr>
<tr>
<td>Size</td>
<td>smaller</td>
<td>bigger</td>
</tr>
<tr>
<td>Pollution</td>
<td>more pollution in exhaust gases than 4 stroke</td>
<td>less pollution than 2 stroke</td>
</tr>
<tr>
<td>Camshaft</td>
<td>usually doesn't have one</td>
<td>always</td>
</tr>
</tbody>
</table>
## Differences Between A Two And A Four Cycle Engine

<table>
<thead>
<tr>
<th></th>
<th>Two Cycle Engine</th>
<th>Four Cycle Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sound</strong></td>
<td>louder in operation</td>
<td>generally quieter</td>
</tr>
<tr>
<td><strong>Initial Cost</strong></td>
<td>less</td>
<td>more</td>
</tr>
<tr>
<td><strong>General Operating Efficiency (hp. wt. ratio)</strong></td>
<td>more efficient</td>
<td>less efficient</td>
</tr>
<tr>
<td><strong>Number of major moving parts</strong></td>
<td>fewer</td>
<td>more</td>
</tr>
</tbody>
</table>

**Small Engine Leader’s Guide**

Section Two
Section Two

Four Stroke Cycle Engine - Review (answers)

1. Name the four strokes that make up the four stroke operating cycle. (intake, compression, power, exhaust)

2. What position are the valves in, during the four cycles?

<table>
<thead>
<tr>
<th>Stroke</th>
<th>Intake</th>
<th>Exhaust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Compression</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Power (Ignition)</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Exhaust</td>
<td>Closed</td>
<td>Open</td>
</tr>
</tbody>
</table>

3. What four things does a gasoline engine need to do work?
   i) Suck in fuel/air mixture
   ii) Compress that mixture in a small space.
   iii) Ignite the mixture and use the power of the explosion to turn a crankshaft.
   iv) Exhaust the burned gases out of the engine.

4. Name positions of a crankshaft. Point to them on a small engine that is available. (vertical, horizontal, multipurpose)
5. Why is timing of the valves (opening and closing) important to the engine’s operation?
   - fuel/air mixture might not enter and be present to be compressed and ignited
   - if valves are open during compression or power, there will be reduced or no compression or power
   - if exhaust valve does not open at right time, the engine would heat up and possibly crack

6. Why is it important that valves fit well?
   - leaky valves would lead to less compression and lower power
   - heat cannot escape as well and the head of the exhaust valve would burn or warp out of shape

7. Exhaust valves must never be exchanged with intake valves. Why?
   - the two types of valves are made of different materials to withstand their working conditions. (The exhaust valve must withstand high heat and corrosion.)
Section Two

How Small Engines Work - Crossword Puzzle

Answer Key

Across
1. A hard, brittle material, like china.
6. A double-hinged connector.
9. The end.
11. Hot, dirty, used air.
12. Strength.

Down
2. Oil provides _________.
3. Not external.
4. Attaches to crankshaft.
5. Flat piece of material that reduces leaks.
7. An oil/gas blend or _________.
8. Moves inside cylinder.
10. Opening.
How Small Engines Work - Word Search

Answer Key

How Small Engines Work Answer Key

P E Z H J
V B H T X E Z L
H O I J I  X T N
H T B W U Z  H B Z
H S U R E Z K  A C H
H J U L N M X  O U T Z G R K
Y M B J  V A L V E  C O M B U S T I O N R
M B G F J W N S C K P S J K S T R O K E
V P U A J C J O R  C R A N K S H A F T T W W
U M A C Y L I N D E R  U T X I M Z T B P O
R Y F C L R I I S R T K S N K Z T R I W P
O Y V Y M O T S L X H N L P I S T O N N R
L R W E K L I Q M U K B I I K D A P R G G
Q Z A O  X X V I
C N  R Z

cam 
intake 
stroke
combustion 
internal 
valve
compression 
mixture
crankshaft 
piston
cylinder 
port
exhaust 
power

Small Engine Leader’s Guide
**Compression - Crossword Puzzle Answer Key**

**Across**

3. If these are dry, compression will be lower.
4. Good compression makes it easier to _____ your engine.
8. Turn this when checking compression.
9. The spark causes the gases to _____.
11. It is important to _____ the spark plug wire before compression testing.

**Down**

1. Loose cylinder head ____ allow gases to escape.
2. Use this sense to check for burned spots.
5. Check spark plug for _____.
6. Good compressions means more _____.
7. The space where the air/gas mixture is compressed is the _____.
10. Check compression every _____ hours of use.
# Parts of an Engine Checklist

<table>
<thead>
<tr>
<th>Level</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior</td>
<td>Identify ten (10) parts on a small engine, model of a small engine or diagram of a small engine.</td>
</tr>
<tr>
<td>Intermediate</td>
<td><strong>Identify twenty (20) parts on a small engine, model of a small engine or diagram of a small engine.</strong></td>
</tr>
<tr>
<td>Senior</td>
<td><strong>Identify thirty (30) parts on a small engine, model of a small engine or diagram of a small engine.</strong></td>
</tr>
</tbody>
</table>

**Prerequisites:**
- Junior Level for Junior
- Intermediate Level for Intermediate
- Advanced Intermediate Level for Senior
### Care and Handling

<table>
<thead>
<tr>
<th>Junior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protects engine from damage in travel to and from meetings</td>
</tr>
<tr>
<td>Cleans engine on a regular basis</td>
</tr>
<tr>
<td>Stores engine out of weather/harm’s way</td>
</tr>
<tr>
<td>Checks oil level before use (four cycle)</td>
</tr>
<tr>
<td>Checks for worn parts and leaks regularly</td>
</tr>
<tr>
<td>Steadies engine on work surface during repair, service or inspection</td>
</tr>
<tr>
<td>Lists three examples of improper care and handling</td>
</tr>
<tr>
<td>Identifies three examples of improper care and handling (external)</td>
</tr>
</tbody>
</table>
## Care and Handling

### Intermediate  (prerequisite: Junior Level)

- Warms engine up before applying load
- Stops engine if a problem is suspected
- Checks for obstacles to engine (E.G. rocks or steel pins in lawn)
- Uses engine within load and speed limits
- Lets engine cool off before shutting off
- List five examples of improper care and handling
- Identifies five examples of improper care and handling (internal)

### Senior  (prerequisite: Intermediate Level)

- List five examples of improper care and handling and the consequences
- Identify seven examples of improper care and handling (or the consequences)
Care and Handling - Crossword Puzzle

**Answer Key**

<table>
<thead>
<tr>
<th>Across</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Old gas gets __________.</td>
<td>1. Don’t blow a __________.</td>
</tr>
<tr>
<td>2. Let your engine __________ before applying a load.</td>
<td>2. A lawn mower has a vertical __________.</td>
</tr>
<tr>
<td>3. Adjust your __________ according to the terrain.</td>
<td>4. Provide for __________ before shutting down.</td>
</tr>
<tr>
<td>5. Regular __________ will help your engine last.</td>
<td>9. Repairs can be __________.</td>
</tr>
<tr>
<td>6. Use proper __________.</td>
<td>11. Refer to your operator’s __________.</td>
</tr>
<tr>
<td>7. Before you mow, check the lawn for __________.</td>
<td></td>
</tr>
<tr>
<td>10. Don’t let __________ get into the engine.</td>
<td></td>
</tr>
<tr>
<td>12. Reduces noise.</td>
<td></td>
</tr>
</tbody>
</table>

**Labels**

1. Gummy
2. A
3. Speed
4. K
5. Tools
6. Maintenance
7. Obstacles
8. H, O,
9. X, E
10. Dirt
11. M, F
12. S, I
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
### Cleaning Engine

#### Junior

- Give one reason for cleaning a small engine or its parts
- Identify one potential safety risk
- Explain ways to reduce/eliminate risks
- Identify safety equipment needed
- Conduct visual inspection with guidance
- Recognize and correctly interpret safety logos
- Ask for help, if needed
- Follow procedure for cleaning, with guidance
- Correctly dispose of waste
- Assist cleaning up work areas
- Record efforts and observations, with guidance
### Cleaning Engine

<table>
<thead>
<tr>
<th>Intermediate</th>
<th>(prerequisite: Junior Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give three reasons for cleaning a small engine or its parts</td>
<td></td>
</tr>
<tr>
<td>Identify three safety risks</td>
<td></td>
</tr>
<tr>
<td>Explain ways to reduce/eliminate risks</td>
<td></td>
</tr>
<tr>
<td>Conduct visual inspection independently, noting potential problems</td>
<td></td>
</tr>
<tr>
<td>Select correct solvents, materials, tools independently</td>
<td></td>
</tr>
<tr>
<td>Initiate clean-up</td>
<td></td>
</tr>
<tr>
<td>Use appropriate amount of force</td>
<td></td>
</tr>
<tr>
<td>Record efforts and observations independently</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Senior</th>
<th>(prerequisite: Intermediate Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set approximate date for next cleaning</td>
<td></td>
</tr>
<tr>
<td>Be able to teach cleaning an engine to another person</td>
<td></td>
</tr>
</tbody>
</table>
Cleaning Engine - Crossword Puzzle

Answer Key

Across
5. To make dirty.
7. A liquid to help clean.
8. To examine carefully.
10. Rusting.
11. To keep the dust out.
13. Dispose of ________ rags carefully

Down
1. Cleaning adds to the life ________ of an engine.
2. Tools or ________.
3. Remove dust with ________ air.
4. An eating away of material.
6. Protect your ________ when cleaning.
9. Cleaning makes it easier to find ________.
12. Cleaning should be done on a ________ basis.
Cleaning Engine - Word Search

Answer Key

contaminate
correct
disposal
dust covers
effective
equipment
storage

inspected
order
parts
routine
sovent

Small Engine Leader’s Guide
**Cooling System**

### Junior

- Explain in simple terms how heat leaves a working engine
- Give one reason why the cooling system is important
- Name two consequences if the cooling system is not maintained
- With assistance, clean the cooling system
- Identify at least three parts of the cooling system
- Explanation how a dirty engine affects the cooling system
- Identify risks related to cleaning the cooling system
- Name safety practices to reduce/eliminate risks
- Identify (when shown) tools and supplies used to clean the cooling system
- Record efforts in record book, with assistance
## Cooling System

### Intermediate (prerequisite: Junior Level)

- Inspect the cooling system, with some assistance
- Give at least two reasons why the cooling system is important
- Explain, in greater detail, how heat leaves an engine
- Recall and assemble the tools and supplies for cleaning a cooling system
- With little assistance, clean the cooling system
- Estimate and schedule next cleaning
- Independently record efforts in record book
- Explain the importance of using a wooden rather than metal scraper to clean fins

### Senior (prerequisite: Intermediate Level)

- Conduct a thorough inspection of the cooling system independently
- Record findings in record book
- Give detailed explanation of how heat leaves an engine, explaining the job of the main parts
- Demonstrate the cleaning of a cooling system
## Air Cleaner

### Junior

- Identify the three types of air cleaners from examples, models, diagram or photograph
- Explain why it is important to know what type of cleaner your engine has
- Explain, in simple terms, how an air cleaner works
- Give two explanations why an air cleaner is important to an engine
- Identify risks associated with cleaning air cleaners
- Name safety practices to reduce/eliminate those risks
- Locate the air filter on your own engine
- With assistance, clean the air cleaner
- Record efforts in record book, with assistance
**Section Seven**

**Air Cleaner**

<table>
<thead>
<tr>
<th><strong>Intermediate</strong> (prerequisite: Junior Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain in detail how the air cleaner of the member’s small engine works</td>
</tr>
<tr>
<td>Give at least four explanations why an air cleaner is important</td>
</tr>
<tr>
<td>Clean air cleaner, with little assistance</td>
</tr>
<tr>
<td>Independently record efforts in record book</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Senior</strong> (prerequisite: Intermediate Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independently clean air cleaner more often, in dusty conditions</td>
</tr>
<tr>
<td>Teach/demonstrate to others how air cleaners work</td>
</tr>
<tr>
<td>Teach/demonstrate how to clean at least one type of air cleaner on small engines</td>
</tr>
<tr>
<td>Compare similarities/differences in air cleaners between a small engine and a large engine (car, truck, tractor, etc..)</td>
</tr>
</tbody>
</table>
### Junior

- Name and identify the type of fuel strainer on member’s small engine
- Explain why it is important to service the fuel strainer (name at least one consequence of not servicing the fuel strainer)
- Name at least one indicator that the fuel strainer should be serviced (using your four observation senses)
- Name at least three of the tools and materials required for servicing the fuel strainer
- Name risks associated with cleaning the fuel strainer
- Name safety practises to reduce/eliminate those risks
- With assistance, clean a fuel strainer and replace
- Safely dispose of dirty rags
- Record efforts in record book, with assistance
**Intermediate** (prerequisite: Junior Level)

- Name and identify two types of fuel strainers
- Give at least three consequences of not servicing fuel strainers
- Name at least two indicators that a fuel strainer needs servicing
- Independently record efforts and observations

**Senior** (prerequisite: Intermediate Level)

- Independently assemble tools and materials for cleaning fuel strainer
- Name and identify three types of fuel strainers
- Independently clean a fuel strainer and replace
- Demonstrate to another person how to disassemble, service and replace a fuel strainer
- Note similarities/differences between fuel strainers of small engines and those of a larger engine
### Crankcase Breathers

**Junior**

- Name one purpose of the crankcase breather
- Name one type of valve in the crankcase breather
- Locate the crankcase breather on a small engine, model, diagram or photograph
- Name at least two consequences of not maintaining the crankcase breather
- Recognize and name at least three of the tools and materials needed to service the crankcase breather
- With assistance, clean a crankcase breather
- Name risks associated with cleaning the crankcase breather
- Name and practice safety practises to reduce/eliminate risks
- Record efforts in record book, with assistance
Section Nine

Crankcase Breathers

**Intermediate** (prerequisite: Junior Level)

- Name at least two purposes of the crankcase breather
- Name at least two types of valves in the crankcase breather
- Name at least three consequences of not maintaining the crankcase breather
- Recognize and name all the tools and materials necessary to service a crankcase breather
- Clean a crankcase breather, with minimal assistance
- Independently record efforts and observations in record book

**Senior** (prerequisite: Intermediate Level)

- Name four purposes of the crankcase breather
- Name three types of valves in the crankcase breather
- Name four possible consequences of not maintaining the crankcase breather
- Independently assemble the tools and materials for servicing a crankcase breather
- Teach/demonstrate the cleaning of a crankcase breather
## Section Ten

### Lubrication

**Junior**

- Give two examples of what lubrication does for the engine
- Explain source of lubrication for two cycle and four cycle engines
- Name one way that oil gets on the bearing surfaces of an engine
- Identify correct oil for member’s small engine
- Check oil level using a dipstick
- Give at least one reason for frequent oil changes
- Name two consequences of dirty oil for a small engine
- Name risks associated with changing oil
- Name and practice related safety practices
- Recognize and name at least four tools and materials needed for an oil change
Section Ten

**Lubrication**

**Intermediate** (prerequisite: Junior Level)

- Give at least four examples of what lubrication does for an engine
- Name at least two ways oil gets on the bearing surfaces of an engine
- Name at least three consequences of dirty oil for a small engine
- With some assistance, change the oil in a small engine
- Give at least three reasons for frequent oil changes
- Independently record efforts in record book
**Senior** (prerequisite: Intermediate Level)

- Name at least three ways that oil gets on the bearing surfaces of an engine
- Name five consequences of dirty oil for an engine
- Identify damage caused by lubrication related problems
- Independently assemble all the tools and materials needed for an oil change
- Independently change oil in a small engine
- Teach other members about engine lubrication
- Demonstrate changing oil
- Independently book next oil change for own small engine (if a four cycle)
- Note similarities/differences between lubrication of small engines and larger engines
Lubrication - Crossword Puzzle
Answer Key

Across
4. Lubrication prevents _____________.
5. Check oil levels with a _____________.
6. Oil helps ____________ an engine.
8. Takes dirt out of oil.
12. Two cycles use an oil gas _____________.
13. Use a ____________ to aid oil.

Down
1. This splashes oil in the engine.
2. Lubrication reduces _____________.
3. Thickness of a liquid.
7. Oil washes away bits of _____________.
9. New gaskets prevent _____________.
10. Avoid ____________ slopes.
11. Oil collects in a _____________.

Small Engine Leader’s Guide
Lubrication - Word Search
Answer Key

bearings  friction  rings
clean     funnel    schedule
cooling   mixture  sump
corrosion particles viscosity
crankcase plug

cylinder power

dipstick recommendation
# Spark Plugs

<table>
<thead>
<tr>
<th>Junior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify spark plug</td>
</tr>
<tr>
<td>Locates spark plug on own engine</td>
</tr>
<tr>
<td>Locates spark plug on other engines</td>
</tr>
<tr>
<td>Name three parts of a spark plug</td>
</tr>
<tr>
<td>Explain purpose of a spark plug in simple terms</td>
</tr>
<tr>
<td>Protects spark plugs from damage during handling and service</td>
</tr>
<tr>
<td>List two potential safety risks for servicing spark plugs</td>
</tr>
<tr>
<td>Recommend steps to reduce/eliminate risks</td>
</tr>
<tr>
<td>Test for spark in the plug</td>
</tr>
<tr>
<td>Cleans around plug before attempting to service</td>
</tr>
<tr>
<td>Check gap, with assistance</td>
</tr>
<tr>
<td>Clean plug, with assistance</td>
</tr>
</tbody>
</table>
# Spark Plugs

## Intermediate (prerequisite: Junior Level)

- List three causes of spark plug failure
- Find spark gap in service manual
- Identify two engine troubles by examining plugs
- Select appropriate tools for working on plugs
- Clean, gap plugs correctly?
- Use appropriate amount of force
- Identify five parts of a spark plug
- Record any work done
- Differentiate between cold and hot plugs
- Explain the importance of using correct plugs

## Senior (prerequisite: Intermediate Level)

- Set and keep spark plug maintenance schedule
- Teach/explain/demonstrate gap checking to another person
Spark Plugs - Crossword Puzzle
Answer Key

Across
3. A wire-like part of the plug
5. A hard, white metal.
6. Spark plugs come in different __________.
7. Black crud.
8. Electrical connection.
9. To start burning.
10. Close the __________.
12. Like china.
14. Makes an electric spark.
15. Spark plug should have one.

Down
1. Flow of electrons.
2. Something that does NOT conduct electricity.
4. What happens when fuels starts to burn.
11. The end.
13. Touch the wrong wire and you’ll get a __________.
Section Eleven

Spark Plugs - Word Search

Answer Key

- carbon
- cold
- cylinder
- electrode
- foul
- gap
- gasket
- gauge
- hot
- ignition
- insulator
- overheated
- piston
- polarity
- porcelain
- reach
- service
- socket
- solvent
- spark
- voltage
- M R O Y F
- E P I S T O N X
- P R 1 6
- C K C
- U W T G R F
- A C U
- R O Q H A P J
- R O I
- S V S L S E P
- O B L T Y C Z
- Y K K O B K B H E L E C T R O D E Q T I
- Z O P C L E P O R C E L A I N N I K H Q A
- E G Z Y F Y T A T I E C Y L I N D E R C F B
- E A V U W U Z A V Y U V C U G Y K K A A O R
- M T J V M H K R G C J X O S I U B R P E U S
- H P G A U G E Y S E U F T N E V L O S R L F
- H I D J Y S V U Z H C H X I G N I T I O N
## Carburator

<table>
<thead>
<tr>
<th>Junior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name one function of the carburetor</td>
</tr>
<tr>
<td>Explain, in simple terms, fuel/air mixture</td>
</tr>
<tr>
<td>Explain, in simple terms, three problems related to incorrect fuel/air mixture</td>
</tr>
<tr>
<td>Locate carburetor on own small engine</td>
</tr>
<tr>
<td>Explain, in simple terms, the passage of air and fuel through the carburetor</td>
</tr>
<tr>
<td>Name type of carburetor on member’s small engine</td>
</tr>
<tr>
<td>Name one condition that indicates carburetor trouble</td>
</tr>
<tr>
<td>Name risks associated with working on a carburetor</td>
</tr>
<tr>
<td>Name and practice appropriate safety procedures</td>
</tr>
<tr>
<td>With assistance, check carburetor operation</td>
</tr>
<tr>
<td>With assistance, adjust carburetor</td>
</tr>
<tr>
<td>With assistance, record efforts in record book</td>
</tr>
</tbody>
</table>
# Section Twelve

**Carburetor**

<table>
<thead>
<tr>
<th><strong>Intermediate</strong> (prerequisite: Junior Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name two functions of the carburetor</td>
</tr>
<tr>
<td>Explain fuel/air mixture in greater detail</td>
</tr>
<tr>
<td>Identify five problems related to incorrect fuel/air mixture</td>
</tr>
<tr>
<td>Locate carburetor on other members' small engines</td>
</tr>
<tr>
<td>Name three types of carburetors</td>
</tr>
<tr>
<td>Name two conditions that indicate carburetor trouble</td>
</tr>
<tr>
<td>With little assistance, check carburetor operation</td>
</tr>
<tr>
<td>With little assistance, adjust carburetor</td>
</tr>
<tr>
<td>Independently record efforts and observations</td>
</tr>
</tbody>
</table>
## Carburetor

**Senior** (prerequisite: Intermediate Level)

- Name three functions of the carburetor
- Name seven problems related to improper fuel/air mixture
- Name three conditions that indicate carburetor trouble
- Independently check carburetor operation
- Independently adjust carburetor
- Teach, in simple terms, how a carburetor works to younger members
- Demonstrate checking carburetor operation
- Demonstrate adjusting carburetor
**Carburetor - Crossword Puzzle**

**Answer Key**

**Across**

2. Speed.
4. Gas fumes are __________.
6. Speed control for engine.
8. Tube with a small opening.
9. Natural force that pulls things toward earth’s centre.
11. Container.
13. Flexible wall separating two cavities.

**Down**

1. To speed up.
2. To turn into vapour.
5. Narrow place in a carburetor.
7. A hole for air movement.
10. Free of atmospheric pressure.
12. A value that controls amount of fuel.
Carburetor - Word Search
Answer Key

accelerate  intake  throttle

carburetor  mixture  valve

choke  pressure  vaporize

cylinder  speed  venturi

diaphragm  spray  suction

Small Engine Leader’s Guide
# Battery

**Junior**

- Explain the role of the battery
- Give one reason why the service of a battery is important
- Explain how often a battery should be checked and/or cleaned
- Explain, in simple terms, how a battery works
- Name risks associated with batteries
- Name and practice appropriate safety procedures
- Recognize and name at least five of the tools and materials needed to service a battery
- With constant assistance, check and replace battery liquid
- With constant adult presence, check battery charge
- With constant adult presence, clean battery
- With assistance, check battery frame and cables
- With assistance, record efforts in record book

---

**Small Engine Leader’s Guide**
Intermediate (prerequisite: Junior Level)

Give two reasons why service of a battery is important

Explain how a battery works

Name at least eight tools and materials needed to service a battery

With a little assistance, check and replace battery liquid

With a little assistance, check battery charge

With a little assistance, clean battery

With a little assistance, check battery frame and cables

Independently record efforts in record book
Battery

Senior (prerequisite: Intermediate Level)

- Give three or more reasons why service of a battery is important
- Explain (teach) to a younger member how a battery works
- Independently assemble all the tools and materials needed to service a battery
- Independently assemble all the tools and materials needed to service a battery
- *Independently check and replace battery liquid
- *Independently check battery charge
- *Independently clean battery
- *Independently check battery frame and cables
- Demonstrate to younger members, battery care and service

*Assumes adult presence for safety’s sake, but senior member works with little assistance
Battery - Crossword Puzzle
Answer Key

Across
1. Use this to test battery charge.
2. A wire connector.
4. Don’t do this around batteries.
6. Holds the battery.
8. Use these to protect eyes.
10. Dirty posts are signs of

Down
1. If splashed with acid, rinse with this.
3. Put petroleum jelly on these.
5. Not positive.
7. Batteries give off an gas.

Section Thirteen
Battery - Crossword Puzzle
Answer Key

Across
1. Use this to test battery charge.
2. A wire connector.
4. Don’t do this around batteries.
6. Holds the battery.
8. Use these to protect eyes.
10. Dirty posts are signs of

Down
1. If splashed with acid, rinse with this.
3. Put petroleum jelly on these.
5. Not positive.
7. Batteries give off an gas.

L-104
Small Engine Leader’s Guide
Battery - Word Search
Answer Key

acids
batteries
cable
charge
corrosive
evaporate
frame
hydrogen
hydrometer
level
petroleum
post
service
spark
sulfuric
syringe

Small Engine Leader’s Guide
Section Fourteen

Fuel

**Junior**

Give one reason why gasoline is well suited for spark-ignition engines

Give a simple explanation of octane rating, with assistance

Name risks associated with working with fuel

Name and practice appropriate safety procedures

Name and recognize all tools for fuelling

With assistance mix fuel for a two cycle engine

With assistance fuel a small engine

Select appropriate storage for fuel

With assistance record efforts in record book
# Section Fourteen

## Fuel

<table>
<thead>
<tr>
<th><strong>Intermediate</strong> <em>(prerequisite: Junior Level)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Give two reasons why gasoline is well suited for spark-ignition engines</td>
</tr>
<tr>
<td>Explain, in simple terms, the relationship between octane rating and compression ratio</td>
</tr>
<tr>
<td>Independently record efforts in record book</td>
</tr>
<tr>
<td>With little assistance mix fuel for a two cycle engine</td>
</tr>
<tr>
<td>With little assistance fuel a small engine</td>
</tr>
<tr>
<td>Explain problems of detonation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Senior</strong> <em>(prerequisite: Intermediate Level)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Give three reasons why gasoline is well-suited to spark-ignition engines</td>
</tr>
<tr>
<td>Independently select fuel for a given small engine</td>
</tr>
<tr>
<td>Identify damage caused by detonation</td>
</tr>
<tr>
<td>*Teach younger members about mixing fuel</td>
</tr>
<tr>
<td>*Teach younger members about safe fuelling</td>
</tr>
<tr>
<td>* Assumes adult presence</td>
</tr>
</tbody>
</table>
Fuel - Crossword Puzzle
Answer Key

Across
1. The carburetor does this to the fuel.
5. Stop, drop and __________.
7. What happens when fuel starts to burn.
8. If your engine will be stored, __________ the fuel.
9. Old gas becomes __________.
10. A valve that controls the amount of fuel.
11. Have one nearby.

Down
2. Fuel plus spark equals __________.
3. Two cycles burn an oil/__________ mixture.
4. Cleans dirt out of fuel.
7. Mixes fuel and air.
Section Fourteen

Fuel - Word Search

Answer Key

carburetor  gum  spill

clean  leak  stop

compression  mixture  strainer

drop  octane  vaporize

explosion  roll  ventilation

extinguisher  spark

Small Engine Leader’s Guide
Engine Start-up and Shutdown

Junior

Give two reasons why one should use proper procedures in starting/shutting down an engine
Dresses appropriately
Reads operator’s manual (if available)
Moves engine out of enclosed area (and can explain why)
Steadies engine before starting
With assistance, disengages any power-driven equipment
Keep other people and pets out of harm’s way
With some assistance, starts engine (follows steps in members’ checklist)
With reminder, removes load from engine
With reminder, allows for cool-down
Turns off switch
### Engine Start-up and Shutdown

**Intermediate** (prerequisite: Junior Level)

- Give four reasons why you should use proper procedures in starting/shutting down an engine
- With little assistance starts engine
- With little assistance disengages power-driven equipment
- Removes load from engine
- Allows for cool-down

**Senior** (prerequisite: Intermediate Level)

- Independently starts up and shuts down engine
- Teach/demonstrate start-up/shutdown of engine
### Storage

<table>
<thead>
<tr>
<th><strong>Junior</strong></th>
<th><strong>Intermediate</strong> (prerequisite: Junior Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name at least two things you can protect your engine from, by storing it properly</td>
<td>Name at least four things you can protect your engine from, through proper storage</td>
</tr>
<tr>
<td>Recognize and name at least five tools and supplies for storage preparation</td>
<td>Assemble at least eight tools and materials required for storage preparation</td>
</tr>
<tr>
<td>Name at least three major jobs that must be done to prepare a small engine for storage</td>
<td>With assistance perform at least two major jobs needed before storage</td>
</tr>
<tr>
<td>With assistance perform at least one of the major jobs</td>
<td>Independently record efforts in record book</td>
</tr>
<tr>
<td>With assistance record efforts in record book</td>
<td></td>
</tr>
</tbody>
</table>
Section Sixteen

Storage

<table>
<thead>
<tr>
<th>Senior (prerequisite: Intermediate Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independently assess and plan for additional service</td>
</tr>
<tr>
<td>Assemble independently tools and materials required for storage</td>
</tr>
<tr>
<td>With little assistance prepare small engine for storage</td>
</tr>
<tr>
<td>Check on small engine at least twice during storage period</td>
</tr>
<tr>
<td>Draw comparisons between small engine storage and storage of other machines and equipment</td>
</tr>
<tr>
<td>Teach/demonstrate the basics of engine storage</td>
</tr>
</tbody>
</table>
Storage - Crossword Puzzle
Answer Key

Across
3. Not dirty.
7. Rust.
8. Drain this.
9. Regap this.
10. Do these before storage.
11. Old gas becomes _________.

Down
1. Holds fuel.
2. Cover with this.
4. Keep small ________ away.
5. Protect from _________.
6. Condensation.
8. Watch out for ________ objects!

Small Engine Leader’s Guide
Storage - Word Search
Answer Key

- clean
- gum
- repair
- cover
- investment
- tarp
- damage
- moisture
- plastic
- disconnect
- protection
- drain
- protection

Small Engine Leader’s Guide
## Safety in the Small Engine Project

<table>
<thead>
<tr>
<th>At Risk</th>
<th>Risk</th>
<th>Preventative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>- lifting too much</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- falls</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- lifting incorrectly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- turning incorrectly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- trying to catch a falling, heavy object</td>
<td></td>
</tr>
<tr>
<td>Ears</td>
<td>- exposure to loud noises</td>
<td></td>
</tr>
<tr>
<td>Eyes</td>
<td>- splashes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- dust, flying objects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- fumes, smoke</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- struck</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- tools slipping or bouncing toward eyes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- flash/heat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- compressed air used improperly</td>
<td></td>
</tr>
<tr>
<td>Lungs</td>
<td>- dust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- fumes from cleaning agents, exhaust, fuel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- flash/heat from fire/explosion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- carbon monoxide poisoning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- inadequate ventilation</td>
<td></td>
</tr>
<tr>
<td>Skin, Limbs,</td>
<td>- exposure to fuel, solvents, battery acid</td>
<td></td>
</tr>
<tr>
<td>Hands, Feet</td>
<td>- rips, punctures from sharp, rough edges</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- burns from hot parts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- electrical shock/burn</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- crushing - heavy tools or engines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- punctures - debris thrown up by machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- punctures - pressurized air</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- cut - lawnmower blade</td>
<td></td>
</tr>
</tbody>
</table>
Who does an unsafe worker affect?

SELF
Safe Contract

I will:

☐ identify risks of activities
☐ take actions to eliminate or reduce risk
☐ ask for help when needed
☐ select the correct tools, equipment and materials for the activity
☐ watch for and allow for proximity of other people
☐ stop work and move back when asked to
☐ exit work area on command (in case of emergency)
☐ return tools and supplies to storage after use
☐ follow safe disposal procedure
☐ dress appropriately for club activities
☐ share responsibility for safety in the club

_________________________     ___________________________     ___________________________
Member                            Leader                                Date

Small Engine Leader’s Guide
### Cleaning - A Generic Checklist

| Task                                           | 
|------------------------------------------------|---------------------------------------------------------------|
| Name two benefits of this cleaning             |                                                               |
| Identify potential risks, if any               |                                                               |
| Take steps to reduce or eliminate safety risks |                                                               |
| Wear appropriate protective gear               |                                                               |
| **DO NOT CONTINUE UNTIL THESE STEPS ARE COMPLETE** |                                                               |
| Visual inspection                              |                                                               |
| Use correct solutions and materials            |                                                               |
| Recognize and correctly interpret hazard logos |                                                               |
| Use correct equipment, tools                   |                                                               |
| Notice and allow for proximity of others       |                                                               |
| Use appropriate amount of force                |                                                               |
| Ask for help if needed                         |                                                               |
| Clean thoroughly, following procedure:         |                                                               |
| Correctly dispose of waste                     |                                                               |
| Leave work area in good condition              |                                                               |
| Record efforts/observations                    |                                                               |

**Leader’s initials/date**
PROTECT YOURSELF

Protect your BACK

Protect your EARS
Appendix

Protect your EYES

Protect your LUNGS

Protect your SKIN, HANDS, FEET
Safety Quiz

Choose the best answer

1. How should you dispose of oily rags?

2. To clean your hands after working with grease use gasoline.
   True or False

3. Before you turn the blade of a lawn mower by hand you should:
   a) spit on your hands
   b) wear gloves
   c) disconnect the spark plug wire
   d) clean the blade
   e) check the oil level

4. When using a wrench, it is best to:
   a) pull it towards you
   b) push it away from you
5. When lifting something heavy:
   a) bend over at the waist and grasp it firmly
   b) bend with your knees and grasp it firmly
   c) lift it with one strong jerk

6. If you wear glasses with hardened lenses you do not need to wear safety goggles. True or False

7. Use compressed air to blow dirt off your clothes. True or False

8. A running gas engine produces deadly gas:
   a) hydrogen sulphide
   b) carbon monoxide
   c) mono carbonide
   d) vanilla extract
   e) sulphur dioxide
9. The reason we don’t smoke around batteries is:
   a) it wastes time
   b) smoke weakens the charge
   c) it’s a bad habit and turns your teeth brown
   d) batteries give off an explosive gas
   e) cigarette ash corrodes battery posts

10. When using a fire extinguisher, aim the spray:
    a) at the top of the fire
    b) all over the fire
    c) at the base of the flame
    d) at the smoke
11. Hand injuries can be prevented or reduced by:
   a) wearing gloves
   b) thinking a job through first
   c) visually examining before touching
   d) all of the above

12. Link the activity to the safety gear.

   cleaning battery       eye goggles
   grinding a part        fire extinguisher
   testing engine         rubber gloves
   fuelling engine        face shield
   using solvent          steel toed boots
   carrying heavy parts   ear muffs
13. Check to see if anyone is nearby you before working on your engine because:
   a) you don't want them borrowing your tools
   b) they could be hurt by what you are doing
   c) they should mind their own business
   d) you can get them to do some of your work
   e) they could bump into you and hurt you
   f) b and e

14. If you splash battery acid on yourself, rinse immediately with
   a) 2% milk
   b) cleaning solvent
   c) lots of water
   d) baking soda in water
   e) a gasoline/oil mixture
15. Lungs can be damaged by:
   a) breathing in welding fumes
   b) inhaling carbon monoxide
   c) siphoning gas by mouth and tube
   d) smoking while working
   e) all of the above
## Differences Between A Two And A Four Cycle Engine

<table>
<thead>
<tr>
<th></th>
<th>Two Cycle Engine</th>
<th>Four Cycle Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Muffler</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number strokes per crankshaft revolution</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Method of getting fuel/air mixture in combustion chamber and burned gases out</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number moving parts in the engine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camshaft</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Differences Between A Two And A Four Cycle Engine

<table>
<thead>
<tr>
<th></th>
<th>Two Cycle Engine</th>
<th>Four Cycle Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muffler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number strokes per crankshaft revolution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of getting fuel/air mixture in combustion chamber and burned gases out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number moving parts in the engine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camshaft</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Four Stroke Cycle Engine - Review

1. Name the four strokes that make up the four stroke operating cycle.

2. What position are the valves in, during the four cycles?

<table>
<thead>
<tr>
<th>Stroke</th>
<th>Intake</th>
<th>Exhaust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power (Ignition)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. What four things does a gasoline engine need to do work?
   i) ___________________________________
   ii) ___________________________________
   iii) ___________________________________
   iv) ___________________________________

4. Name positions of a crankshaft. Point to them on a small engine that is available.
Appendix

Four Stroke Cycle Engine - Review

5. Why is timing of the valves (opening and closing) important to the engine’s operation?

____________________________________________
____________________________________________
____________________________________________
____________________________________________

6. Why is it important that valves fit well?

____________________________________________
____________________________________________
____________________________________________
____________________________________________

7. Exhaust valves must never be exchanged with intake valves. Why?

____________________________________________
____________________________________________
____________________________________________
____________________________________________
Appendix

Safety #1 - Word Search

condition  expense  explode  faceshield  gloves  lifting  messy
monoxide  observe  precaution  protective  puncture  rushing  sparks
steel toed boots  surprise  time  unattended  ventilation

Small Engine Leader’s Guide
Safety #2 - Word Search

brain specializes in protecting the face. Gloves are used for protection against pointing objects and chemicals. Corrosive chemicals require special care. A decision to wear a mask can prevent inhaling toxic fumes. Explosions can be extremely dangerous and require immediate assistance.
How Small Engines Work - Crossword Puzzle

Across
1. A hard, brittle material, like china.
6. A double-hinged connector.
9. The end.
11. Hot, dirty, used air.
12. Strength.

Down
2. Oil provides ________.
3. Not external.
4. Attaches to crankshaft.
5. Flat piece of material that reduces leaks.
7. An oil/gas blend or ________.
8. Moves inside cylinder.
10. Opening.
How Small Engines Work - Word Search

- Cam
- Intake
- Stroke
- Combustion
- Internal
- Compression
- Mixture
- Crankshaft
- Piston
- Cylinder
- Port
- Exhaust
- Power

Small Engine Leader’s Guide
Care and Handling - Crossword Puzzle

Across
1. Old gas gets _________.
3. Let your engine _________ before applying a load.
4. Adjust your _________ according to the terrain.
5. Regular _________ will help your engine last.
6. Use proper _________.
7. Before you mow, check the lawn for _________.
10. Don’t let _________ get into the engine.
12. Reduces noise.

Down
1. Don’t blow a _________.
2. A lawnmower has a vertical _________.
8. Provide for _________ before shutting down.
9. Repairs can be _________.
11. Refer to your operator’s _________.
Appendix

Cleaning Engine - Crossword Puzzle

Across
5. To make dirty.
7. A liquid to help clean.
8. To examine carefully.
10. Rusting.
11. To keep the dust out.
13. Dispose of __________ rags carefully

Down
1. Cleaning adds to the life _________ of an engine.
2. Tools or _________.
3. Remove dust with _________ air.
4. An eating away of material.
6. Protect your _________ when cleaning.
9. Cleaning makes it easier to find _________.
12. Cleaning should be done on a _________ basis.
Appendix

Cleaning Engine - Word Search

contaminate equipment storage
correct inspection timing
-cracks order
-disposal parts
-dust covers routine
-effective solvent

Small Engine Leader’s Guide
Appendix

Lubrication - Crossword Puzzle

Across
4. Lubrication prevents _________.
5. Check oil levels with a ________.
6. Oil helps _________ an engine.
8. Takes dirt out of oil.
12. Two cycles use an oil gas _________.
13. Use a ________ to aid oil.

Down
1. This splashes oil in the engine.
2. Lubrication reduces _________.
3. Thickness of a liquid.
7. Oil washes away bits of _________.
9. New gaskets prevent _________.
10. Avoid _________ slopes.
11. Oil collects in a _________.

L-140
Small Engine Leader’s Guide
Lubrication - Word Search

bearings         friction         rings
clean            funnel          schedule
cooling          mixture         service
corrosion        particles       sump
 crankcase       plug            viscosity
cylinder         power           recommendation
Appendix

Spark Plug - Crossword Puzzle

Across
3. A wire-like part of the plug
5. A hard, white metal.
6. Spark plugs come in different _________.
7. Black crud.
8. Electrical connection.
9. To start burning.
10. Close the __________.
12. Like china.
14. Makes an electric spark.
15. Spark plug should have one.

Down
1. Flow of electrons.
2. Something that does NOT conduct electricity.
4. What happens when fuels starts to burn.
11. The end.
13. Touch the wrong wire and you’ll get a __________.
Spark Plug - Word Search

carbon  hot  service
cold  ignition  socket
cylinder  insulator  solvent
electrode  overheating  spark
gap  polarity

gasket  porcelain

gauge  reach

Small Engine Leader's Guide
Carburetor - Crossword Puzzle

Across
2. Speed.
4. Gas fumes are ___________.
6. Speed control for engine.
8. Tube with a small opening.
9. Natural force that pulls things toward earth’s centre.
11. Container.
13. Flexible wall separating two cavities.

Down
1. To speed up.
2. To turn into vapour.
5. Narrow place in a carburetor.
7. A hole for air movement.
10. Free of atmospheric pressure.
12. A value that controls amount of fuel.
Carburetor - Word Search

accelerate         intake         throttle
carburetor         mixture        valve
choke              pressure       vaporize

cylinder           speed

diaphragm          spray
float              suction

Small Engine Leader’s Guide
Appendix

Battery - Crossword Puzzle

Across
2. A wire connector.
4. Don't do this around batteries.
6. Holds the battery.
8. Use these to protect eyes.
10. Dirty posts are signs of __________.
11. Use this to test battery charge.

Down
1. If splashed with acid, rinse with this.
3. Put petroleum jelly on these.
5. Not positive.
7. Batteries give off an __________ gas.

Small Engine Leader’s Guide
Battery - Word Search

acids  frame  post
batteries  hydrogen  service
cable  hydrometer  spark
charge  level  sulfuric
corrosive  petroleum  syrine
evaporate  plates

Small Engine Leader’s Guide
**Across**

1. The carburetor does this to the fuel.
5. Stop, drop and __________.
7. What happens when fuel starts to burn.
8. If your engine will be stored, __________ the fuel.
9. Old gas becomes __________.
10. A valve that controls the amount of fuel.
11. Have one nearby.

**Down**

2. Fuel plus spark equals __________.
3. Two cycles burn an oil/__________ mixture.
4. Cleans dirt out of fuel.
7. Mixes fuel and air.
Fuel - Word Search

carburetor  gum  spill
clean   leak   stop
compression mixture  strainer
drop     octane   vaporize
explosion  roll  ventilation
extinguisher  spark

Small Engine Leader’s Guide
Storage - Crossword Puzzle

Across
3. Not dirty.
7. Rust.
8. Drain this.
9. Regap this.
10. Do these before storage.
11. Old gas becomes ___________

Down
1. Holds fuel.
2. Cover with this.
4. Keep small ________ away.
5. Protect from _________.
6. Condensation.
8. Watch out for _________ objects!

Small Engine Leader's Guide
Your input is a valuable asset to the 4-H program!

As you go through the project year, make your comments and suggestions about the project on this form. When your project is completed, mail this form to us. We want to hear from you!

Please tell us: 

Evaluation date __________

Which topics did you complete this year? ____________________________________

Which activities did you enjoy the most? ____________________________________

What activity did you learn the most from? _________________________________

A suggestion for improvement _____________________________________________

Additional comments ____________________________________________________

________________________________________________

________________________________________________