SMALL ENGINES

Leader Guide

Alberta Government

CANADA
4-H Alberta

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.

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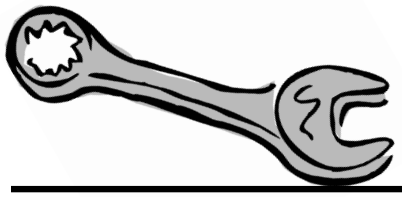
August 1999/cas



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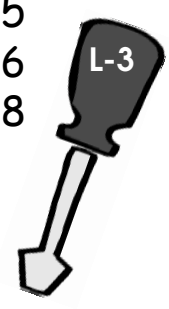

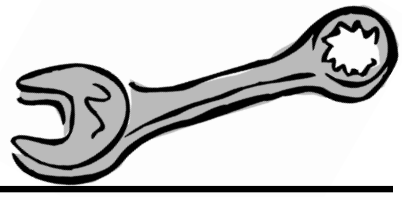

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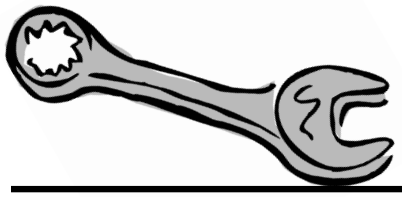

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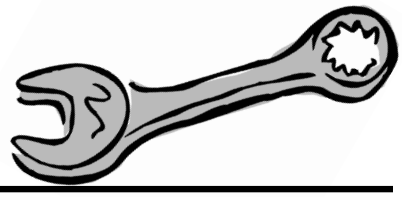

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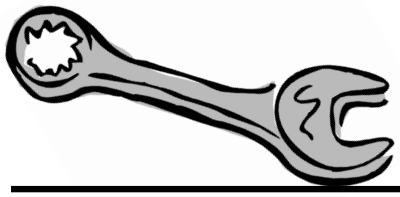
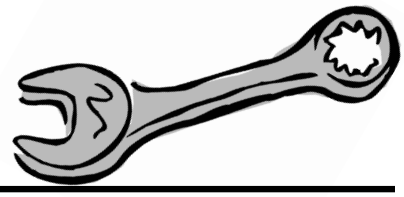


Objectives

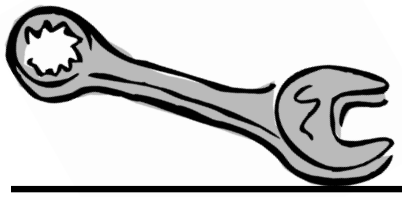
The club member will:

- 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.

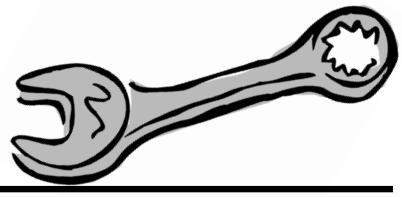
OR

- 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

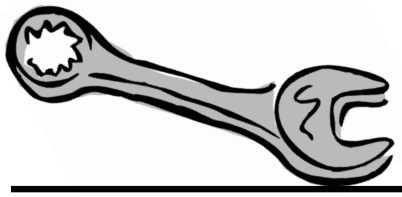
Many of the requirements for Achievement Day are met during the club year. E.G. member explained and demonstrated how to clean an engine. Initial the member's records at time of completion.

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.



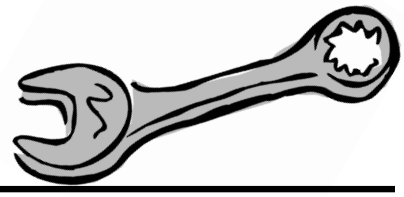
Achievement Day Requirements

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.



Notes

Encouraging Learning

To encourage learning provide:

Involvement

- mentally
- physically (hands on)

Relevance

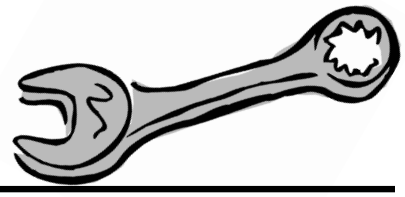
- why is this important
- today
- in the future

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

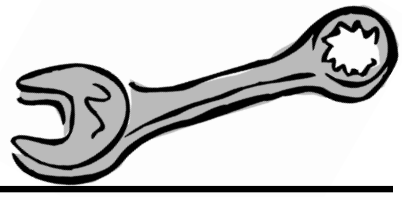
  (will make sense to the learner)

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



Ideas and Tips From Other Small Engine Clubs

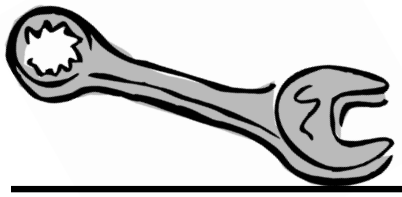
- Adult helpers are important. "Duty days" can be written into the club schedule. If adults have to change their duty day, it's up to them to find a replacement.

- 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

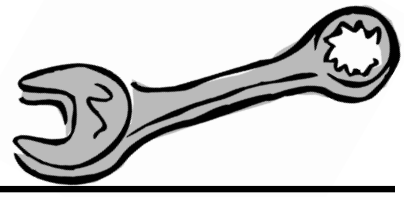
- Members should record all the specifics of their engine before they start to tear it down. E.G. torque settings, compression tests.

- 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.



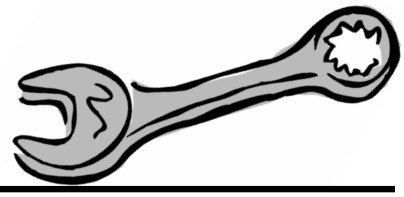
Ideas and Tips From Other Small Engine Clubs

- 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.

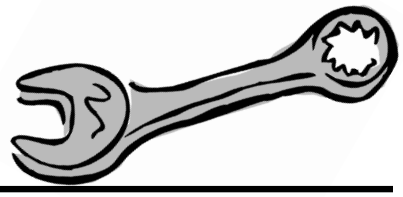
Related Careers

- 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.



Things To Do With Your Club

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

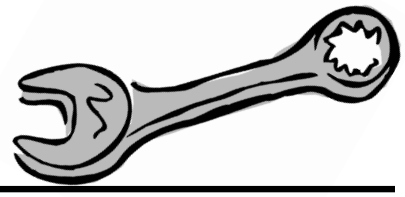
- to identify various systems or parts.
- to become familiar with a different engine.

Tour

- farm or business tours to see small engines at work in various settings.
- to see shop and working area layouts
- 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

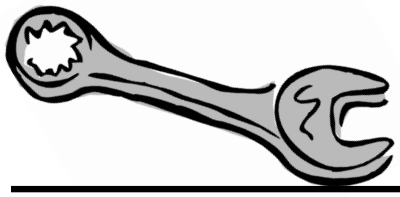
Part way through the club year, designate one session for visitors to attend so members can "show off" what they have learned and done so far. This would be a good review and a good motivator for the members.

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.



Small Projects To Do With Your Club

- 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.

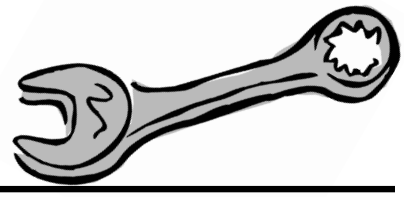
- Demonstrate how to remove broken bolts. Allow for practice.

- 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?

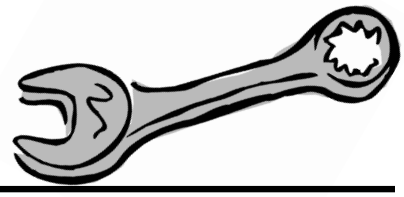
Observation - Your Most Important Tool!

Feel

- vibration, roughness?
- power level?
- heat?
- grit in the oil?

Smell

- exhaust?
- leaks?
- burning?



Resources for Learning

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

Resources for Learning

Things

- magazines, books, newsletters
- owners' manuals
- advertisements
- comics and cartoons
- video tapes
- catalogues
- sales displays

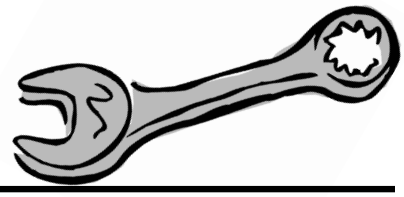
Web sites and news groups

1. Briggs & Stratton

   http://www.BriggsandStratton.com/

2. Kohler Engines page.

   http://www.kohlerco.com/powersystems/engines/index.html



Resources for Learning

3. Tecumseh Engines page.

   http://www.tecumseh.com/engines.htm

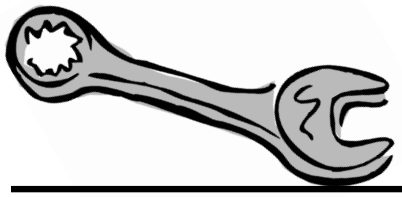
4. Jacks Small Engines & Generator Service, LLC. Web Div.

   http://www.jackssmallengines.com/index.htm

   "the largest online lawn mower & generator parts supplier"

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.
6. Give feedback. Encourage.



Equipment List

One set of equipment for every 2-4 engines.

Tools

Slot head screwdrivers 4", 6", 8"

Phillips head screwdrivers 4", 6"

Spark plug deep sockets 13/16" x 3/8"

drive, 3/4" x 3/8" drive

Ratchet handle 3/8" drive

T-handle 3/8" drive

Open end wrenches 7/16", 1/2", 9/16"

Combination pliers 7"

Needle nose pliers

Nut drivers 1/4", 3/8"

Socket set 3/8", 7/16", 1/2", 5/8", 9/16"

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

Supplies

Degreaser

Wire brush

Sandpaper

2 paintbrushes

Bristle brush

Petroleum jelly

Baking Soda

Pail

Putty knife

Wooden Scraper

Pen knife

Clean rags

Oil

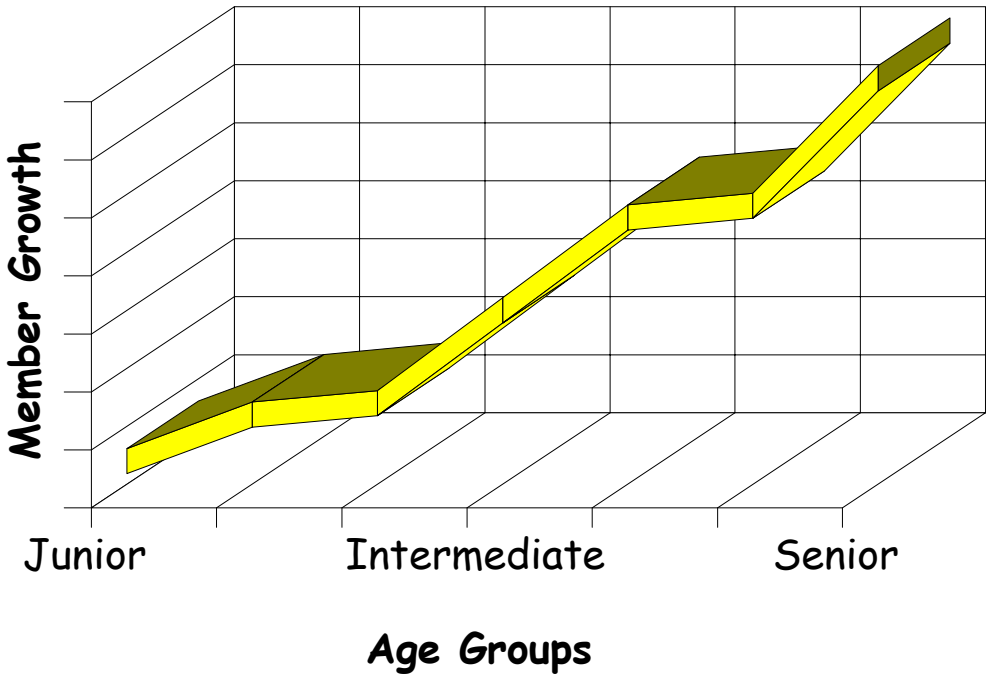
Gasoline

Solvent

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)

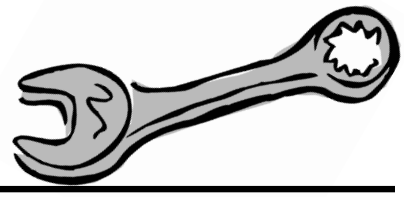


Expectations for Member Growth cont'd...

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".



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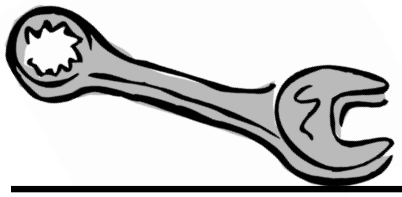
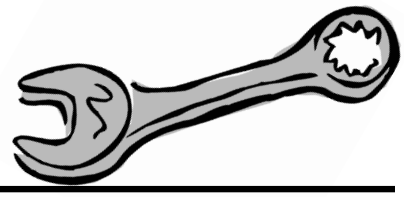


Safety in the Small Engines Project

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



Safety

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.

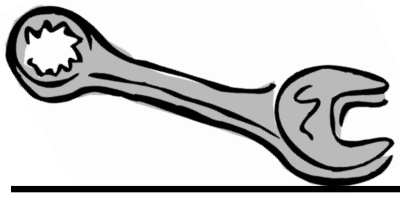
What to do

- 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.

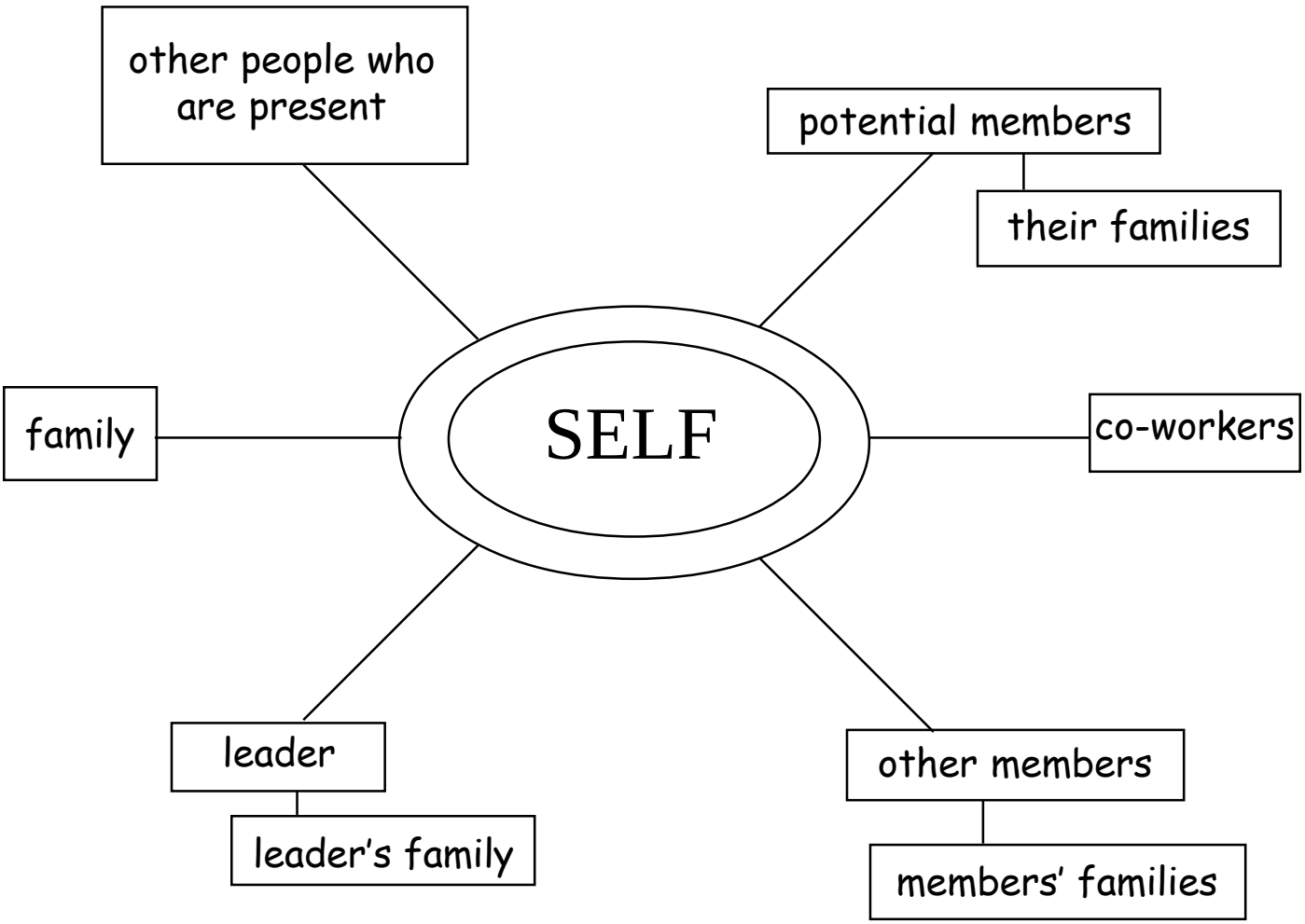
- Have the members "safety check" the work area. Point out factors that make a safe work area (lighting, ventilation, cleanliness etc.)

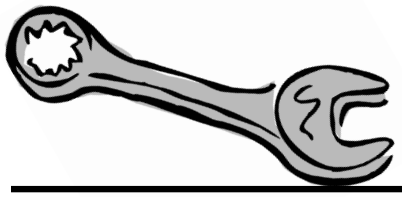


Safety

- 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)

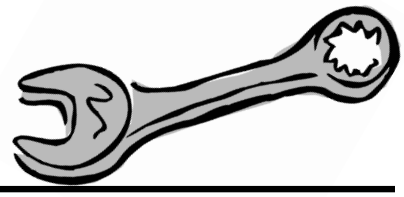




Safety Steps

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.

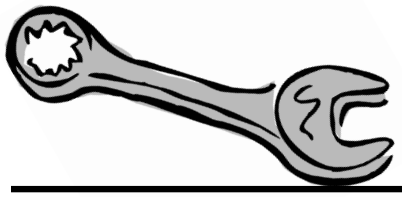


Safety Contract

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



Comments From Other Leaders About Safety.

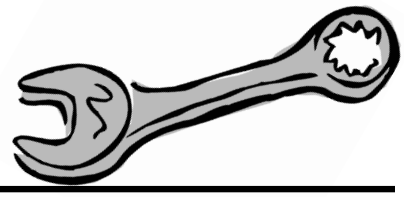
- You have to work safely yourself. Everyone is learning from you.

- 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.

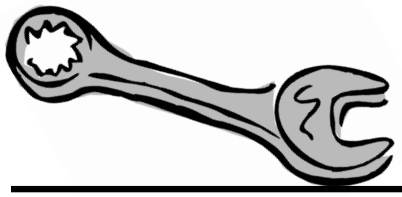
- If you can, take a first aid course!



Comments from other leaders about safety.

- 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.

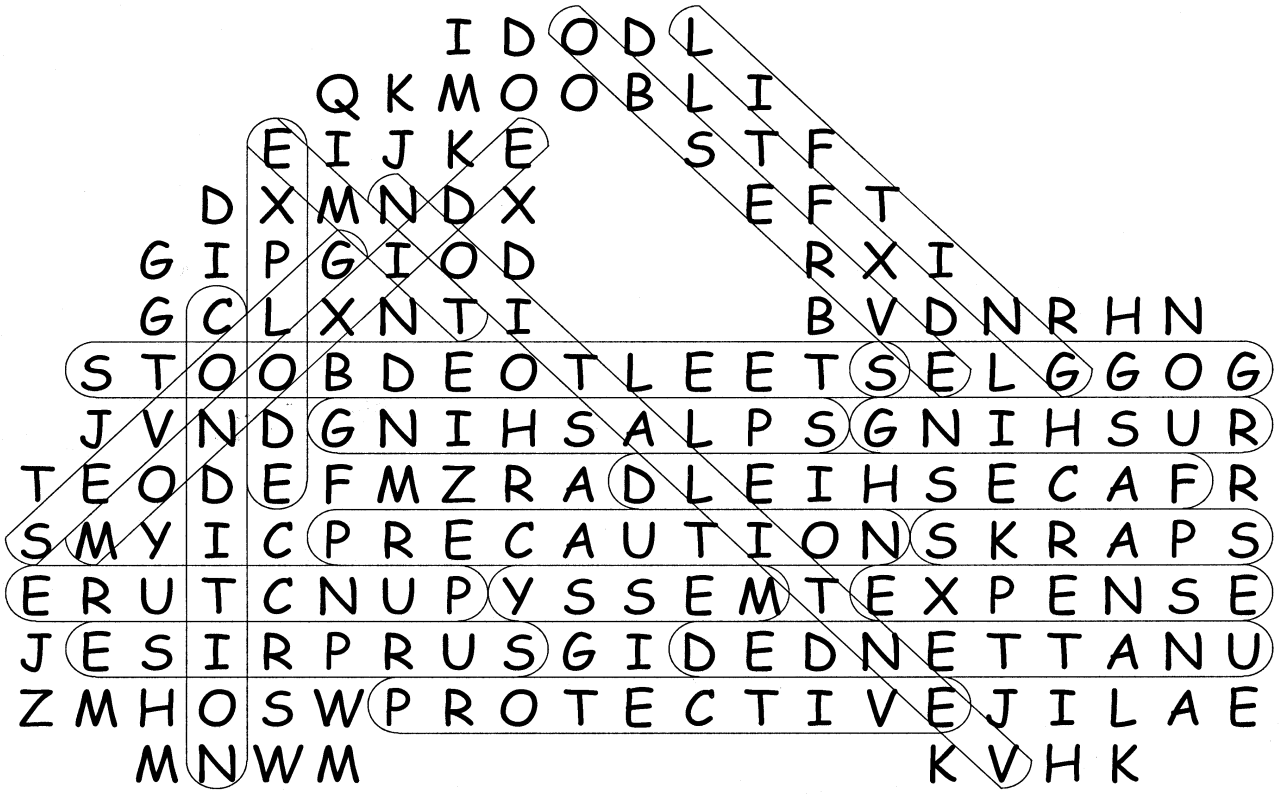


Small Engines and Community Safety

Every year many people are injured while using small engines. What could your club do to educate people about safety and small engines?

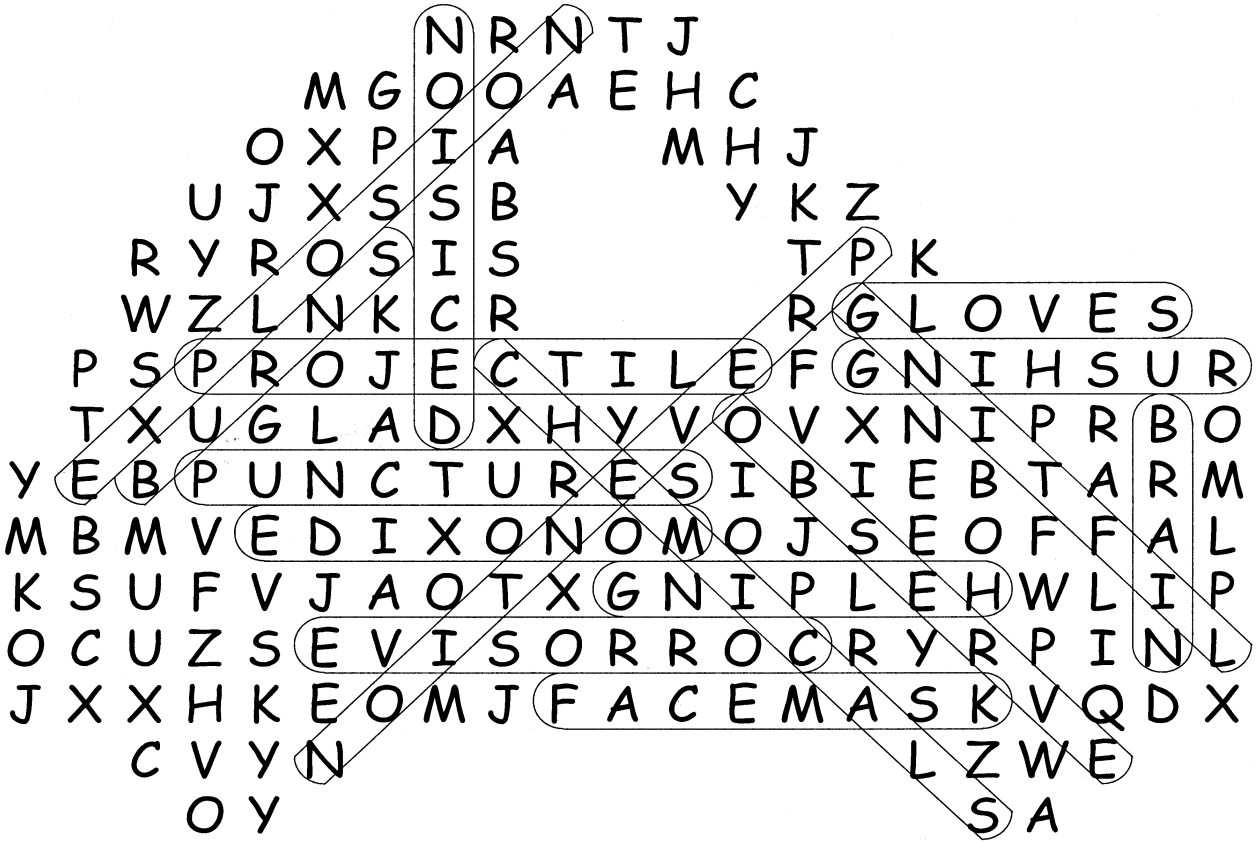
- a display at a fair or mall
- a float in a parade
- posters at the community hall
- a skit about safety at a community meeting
  (maybe at your sponsor's?)
- an article in the local paper
- feature safety at your visitor's day or Achievement Day.
  do a presentation for a local service or commodity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

Safety #1 - Word Search
Answer Key

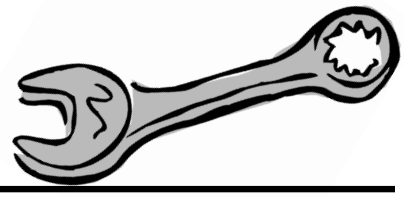


condition
expense
explode
faceshield
gloves
goggles
lifting
messy
monoxide
observe
precaution
protective
puncture
rushing
sparks
splashing
steel toed boots
surprise
time
unattended
ventilation

Safety #2- Word Search
Answer Key



brain	facemask	prevention
burns	gloves	projectile
chemicals	helping	punctures
corrosive	lifting	rushing
decision	monoxide	
explosion	observe	



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.

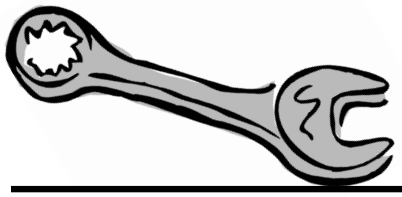
- Clean all tools. Greasy tools slip and cause accidents.

- 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)

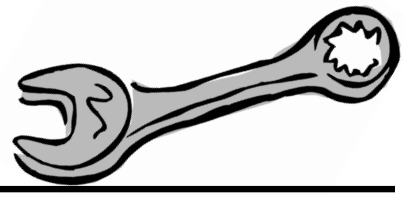


Safety Tips for Using Tools

- 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.



Safety Quiz (answers)

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

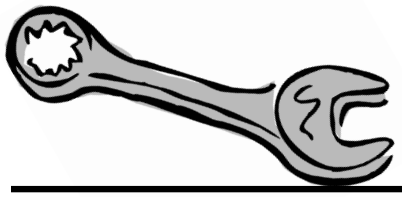
   answer is c)

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



Safety Quiz (answers) cont'd...

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

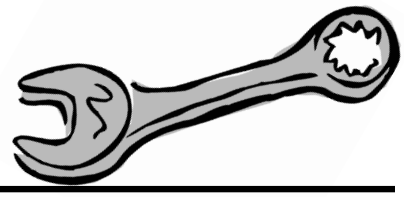
   b) carbon monoxide

   c) mono carbonide

   d) vanilla extract

   e) sulphur dioxide

   answer b)



Safety Quiz (answers) cont'd...

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)

Safety Quiz (answers) cont'd...

11. Hand injuries can be prevented or reduced by:

    a) wearing gloves

    b) thinking a job through first

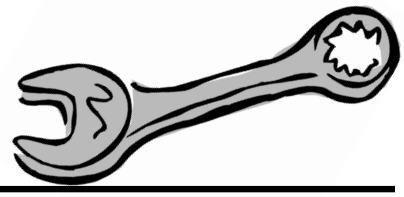
    c) visually examining before touching

    d) all of the above

    answer d)

12. Link the activity to the safety gear.

cleaning battery	face shield
grinding a part	eye goggles
testing engine	ear muffs
fuelling engine	fire extinguisher
using solvent	rubber gloves
carrying heavy parts	steel toed boots



Safety Quiz (answers) cont'd...

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

Safety Quiz (answers) cont'd...

answer c)

15. Lungs can be damaged by:

    a) breathing in welding fumes

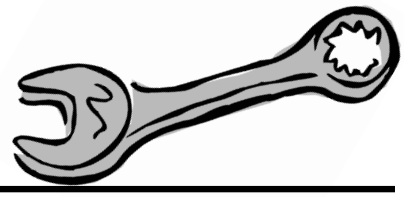
    b) inhaling carbon monoxide

    c) siphoning gas by mouth and tube

    d) smoking while working

    e) all of the above

    answer e)

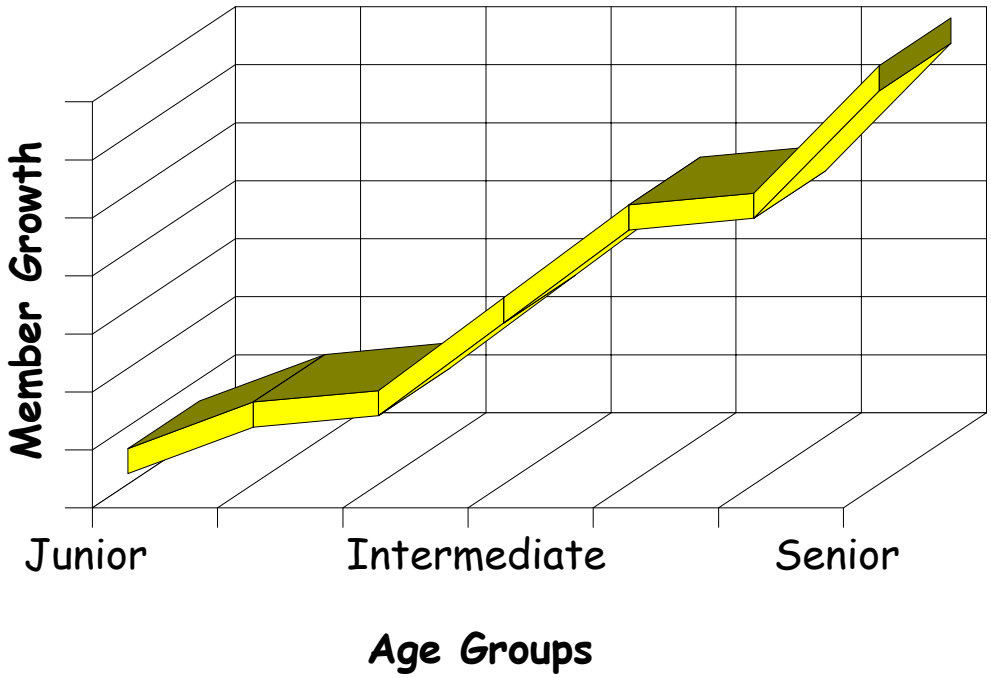


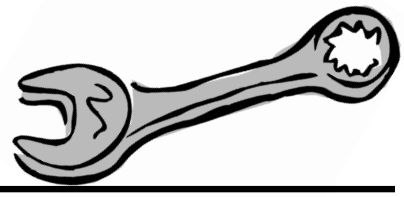
Notes

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)



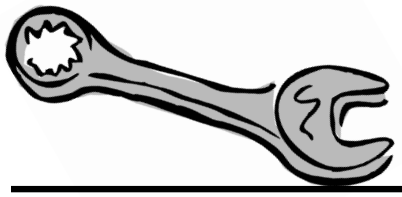


Expectations for Member Growth cont'd...

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".**



How Small Engines Work

Junior

Identify a two cycle engine

Identify a four cycle engine

Name three differences between a two cycle and four cycle engine

Name two types of machines that use small engines

Identify source of lubrication for two cycle engine

Locate source of lubrication for four cycle engine

Classify member's own engine as a two or four cycle engine

Explain why it is important to know whether an engine is two or four cycle

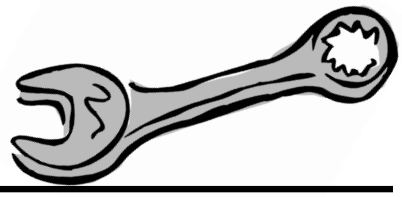
Name the two strokes of a two cycle engine

Name the four strokes of a four cycle engine

Name three risks associated with small engines work

Name safety practises to reduce/eliminate those risks

Name three things an engine needs to run (compression, ignition, fuel/air mix)



How Small Engines Work

Intermediate (prerequisite: Junior Level)

Name five differences between a two cycle and a four cycle engine

Name five types of machines that use small engines

Locate ports (two cycle)

Explain/demonstrate how to mix fuel for a two cycle engine

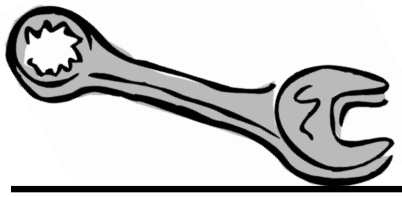
Name and indicate three types of crankshaft positions

Demonstrate or explain valve position during each stroke

Name five risks associated with small engines work

Name safety practises to reduce/eliminate those risks

With little or no assistance, compression test a small engine



How Small Engines Work

Senior (prerequisite: Intermediate Level)

Name at least seven differences between two cycle and four cycle engines

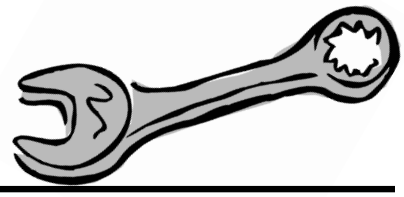
Name seven machines that use small engines

Identify seven risks in small engines work

Name safety practises to reduce/eliminate those risks

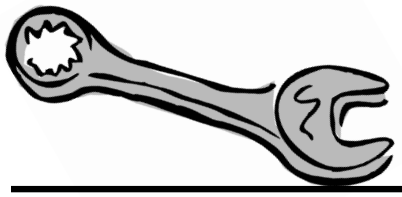
Teach/demonstrate how to compression test a small engine

Compare/contrast compression tests of a small engine and a larger engine



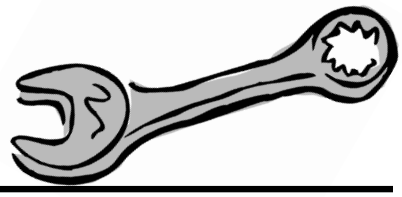
Differences Between A Two And A Four Cycle Engine

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



Differences Between A Two And A Four Cycle Engine

	Two Cycle Engine	Four Cycle Engine
Sound	louder in operation	generally quieter
Initial Cost	less	more
General Maintenance	less	more
General Operating Efficiency (hp. wt. ratio)	more efficient	less efficient
Number of major moving parts	fewer	more



Four Stroke Cycle Engine - Review (answers)

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

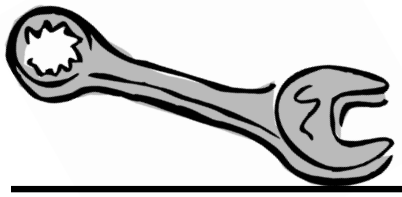
2. What position are the valves in, during the four cycles?

Position of Valves During Strokes

Stroke	*Intake*	*Exhaust*
Intake	Open	Closed
Compression	Closed	Closed
Power (Ignition)	Closed	Closed
Exhaust	Closed	Open

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)



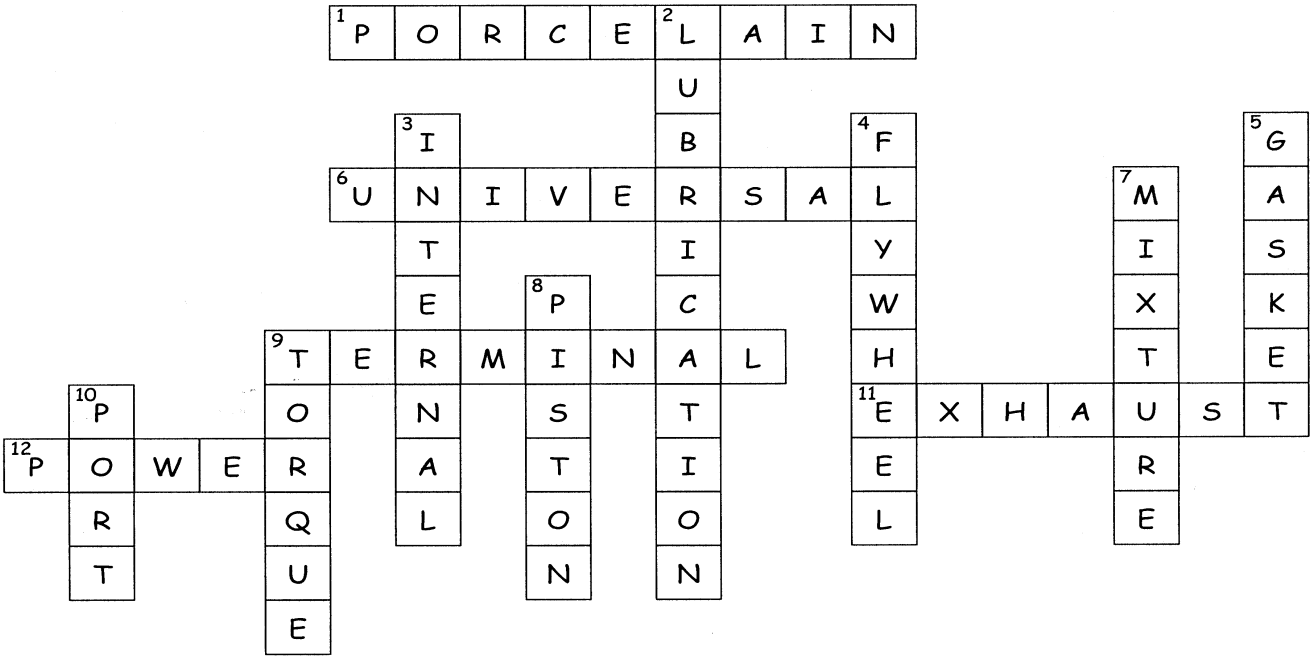
Four Stroke Cycle Engine - Review (answers) cont'd...

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.)

How Small Engines Work - Crossword Puzzle
Answer Key



Across

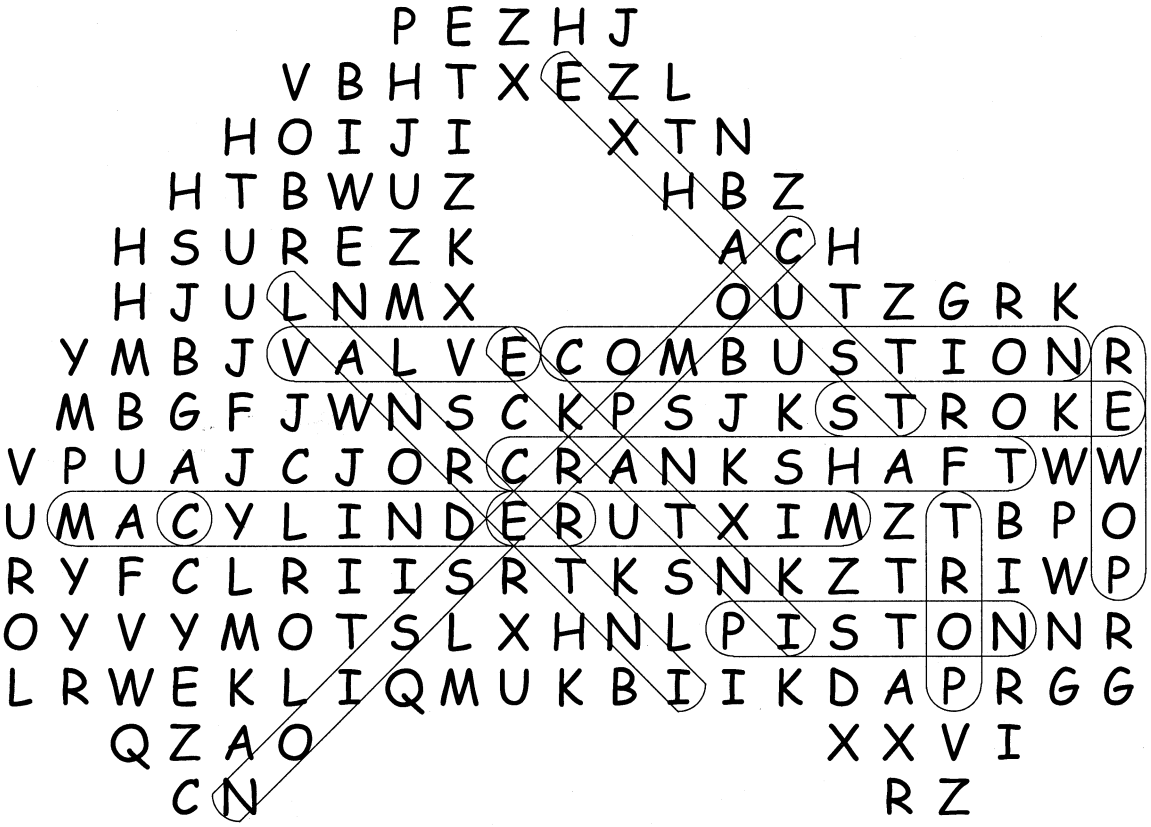
1. A hard, brittle material, like china.
6. A double-hinged connector.
9. The end.
11. Hot, dirty, used air.
12. Strength.

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.
9. Turning force.
10. Opening.

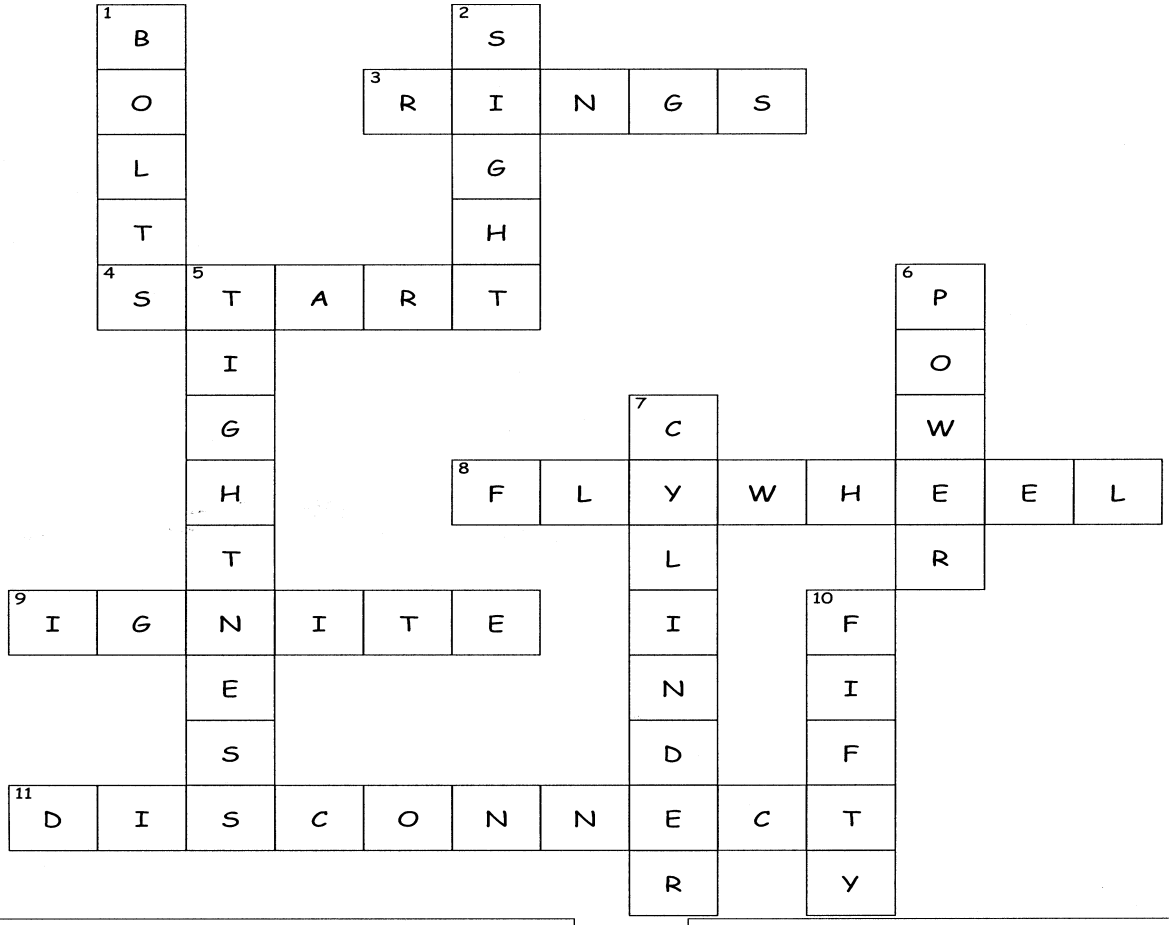
How Small Engines Work - Word Search
Answer Key

How Small Engines Work
Word Search Answer Key



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

Compression - Crossword Puzzle
Answer Key

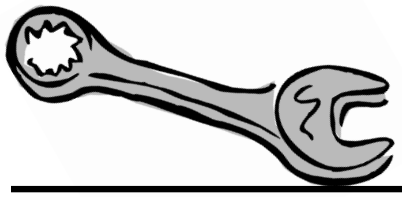


Across

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.

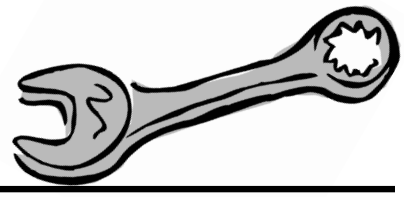


Parts of an Engine Checklist

Junior
Identify ten (10) parts on a small engine, model of a small engine or diagram of a small engine.

Intermediate (prerequisite: Junior Level)
Identify twenty (20) parts on a small engine, model of a small engine or diagram of a small engine.

Senior (prerequisite: Intermediate Level)
Identify thirty (30) parts on a small engine, model of a small engine or diagram of a small engine.



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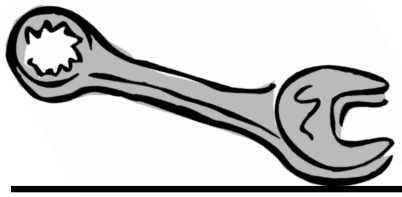
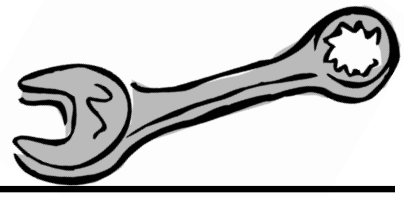


Care and Handling

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



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)

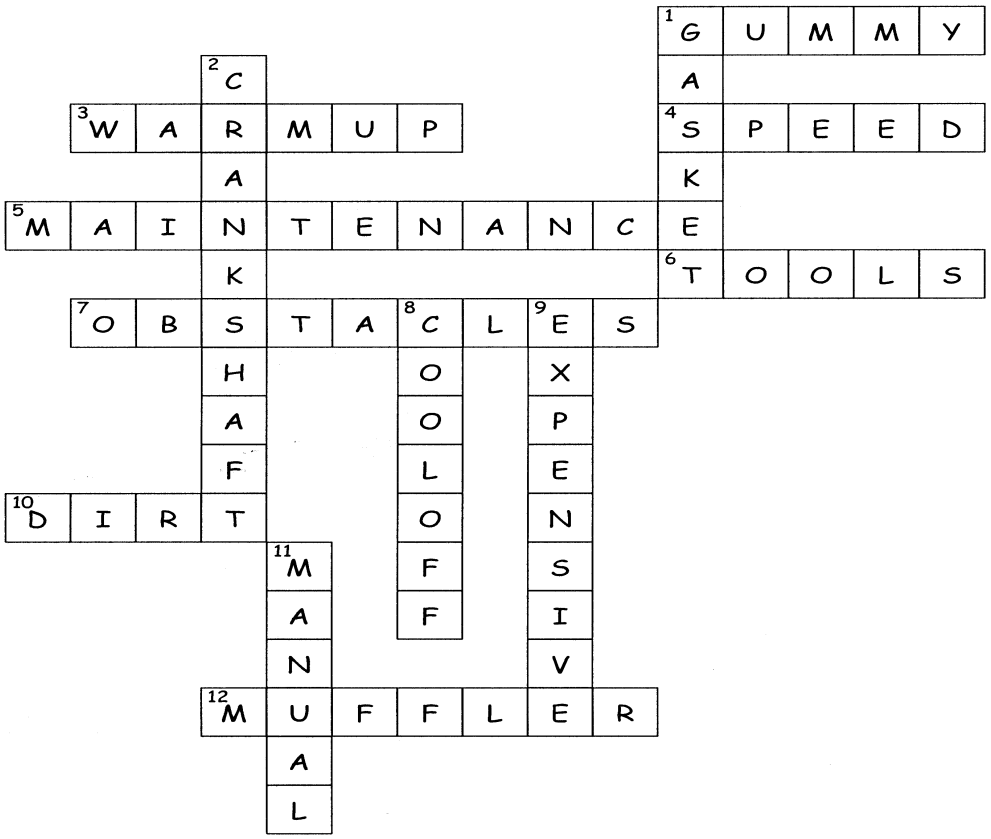
Senior (prerequisite: Intermediate Level)

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

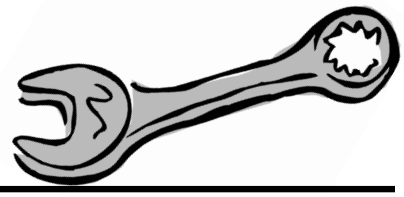


Across

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 _____.



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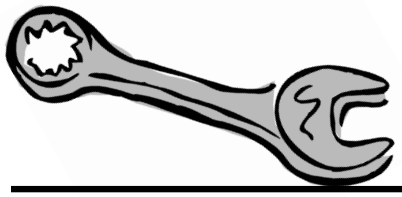
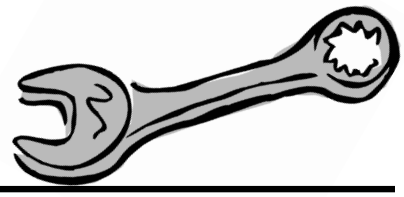


Cleaning Engine

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

Intermediate (prerequisite: Junior Level)

Give three reasons for cleaning a small engine or its parts

Identify three safety risks

Explain ways to reduce/eliminate risks

Conduct visual inspection independently, noting potential problems

Select correct solvents, materials, tools independently

Initiate clean-up

Use appropriate amount of force

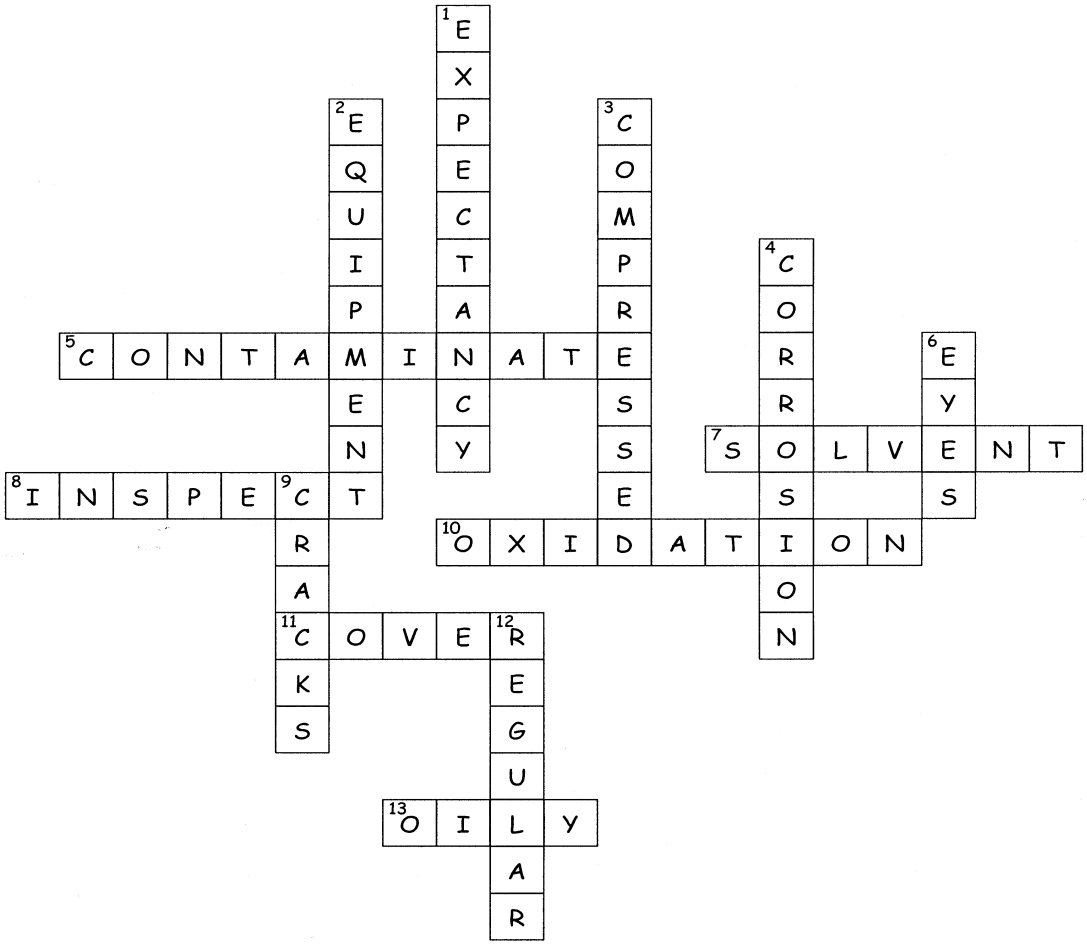
Record efforts and observations independently

Senior (prerequisite: Intermediate Level)

Set approximate date for next cleaning

Be able to teach cleaning an engine to another person

Cleaning Engine - Crossword Puzzle
Answer Key

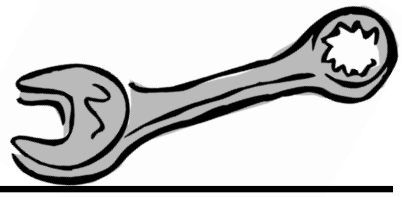


Across

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

```
          W E Y I W
        W D H D P M X N
      K Z U I P     O L A
    O W E S Q R       K U C
  B N M P T K Q         A I R
  E Z O E C A D         U O D A J U Y
K S S D X O T N E M P I U Q E U C S Y N
R A H T R V G T I M S T R A P M O K G D X
U L B A D O E T T I M I N G J G L R H S A X
C M U E J E R L S S N A Q G P V A R Q Z F H
D A R D M Y S A E E V I T C E F F E N C N H
B I U M H V W G G J O F I N S P E C T I O N
P R D G M W T Z W E T O T V O Q G T D B K
  A I Q L               C G S S
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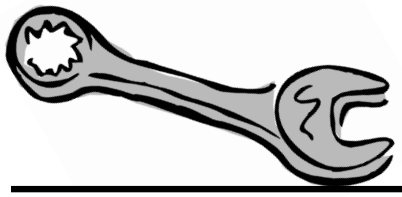
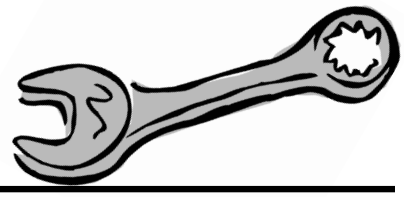
contaminate
correct
cracks
disposal
dust covers
effective
equipment
inspection
order
parts
routine
solvent
storage
timing



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

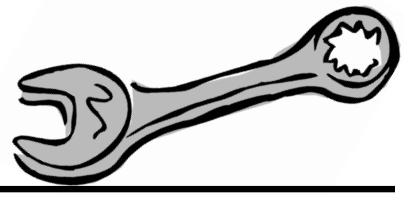
Identify risks associated with cleaning air cleaners

Name safety practises 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



Air Cleaner

Intermediate (prerequisite: Junior Level)

Explain in detail how the air cleaner of the member's small engine works

Give at least four explanations why an air cleaner is important

Clean air cleaner, with little assistance

Independently record efforts in record book

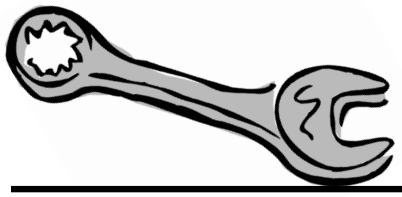
Senior (prerequisite: Intermediate Level)

Independently clean air cleaner more often, in dusty conditions

Teach/demonstrate to others how air cleaners work

Teach/demonstrate how to clean at least one type of air cleaner on small engines

Compare similarities/differences in air cleaners between a small engine and a large engine (car, truck, tractor, etc..)



Fuel Strainers

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

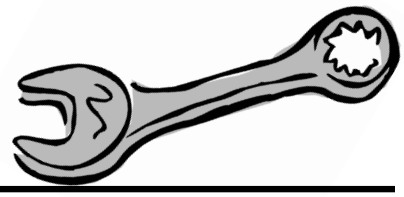
Name risks associated with cleaning the fuel strainer

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



Fuel Strainers

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)

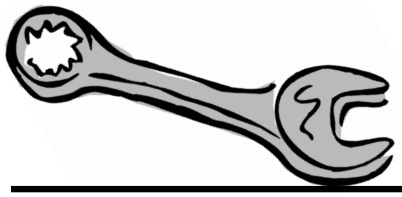
Independently assemble tools and materials for cleaning fuel strainer

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

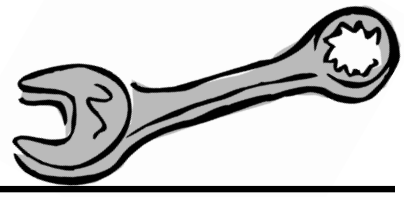
Recognize and name at least three of the tools and materials needed to service the crankcase breather

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



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)

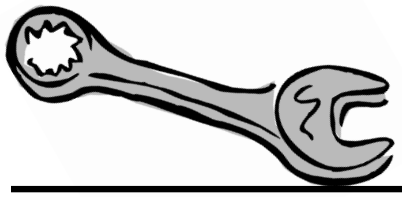
Name four purposes of the crankcase breather

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



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

Lubrication

Intermediate (prerequisite: Junior Level)

Give at least four examples of what lubrication does for an engine

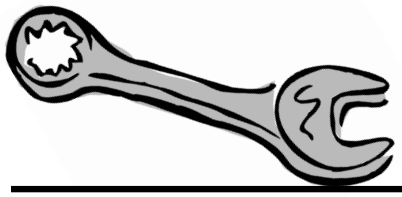
Name at least two ways oil gets on the bearing surfaces of an engine

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



Lubrication

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

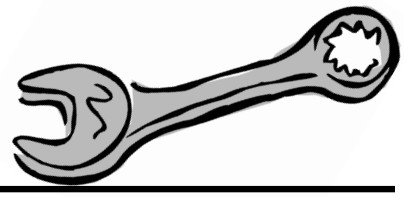
Independently change oil in a small engine

Teach other members about engine lubrication

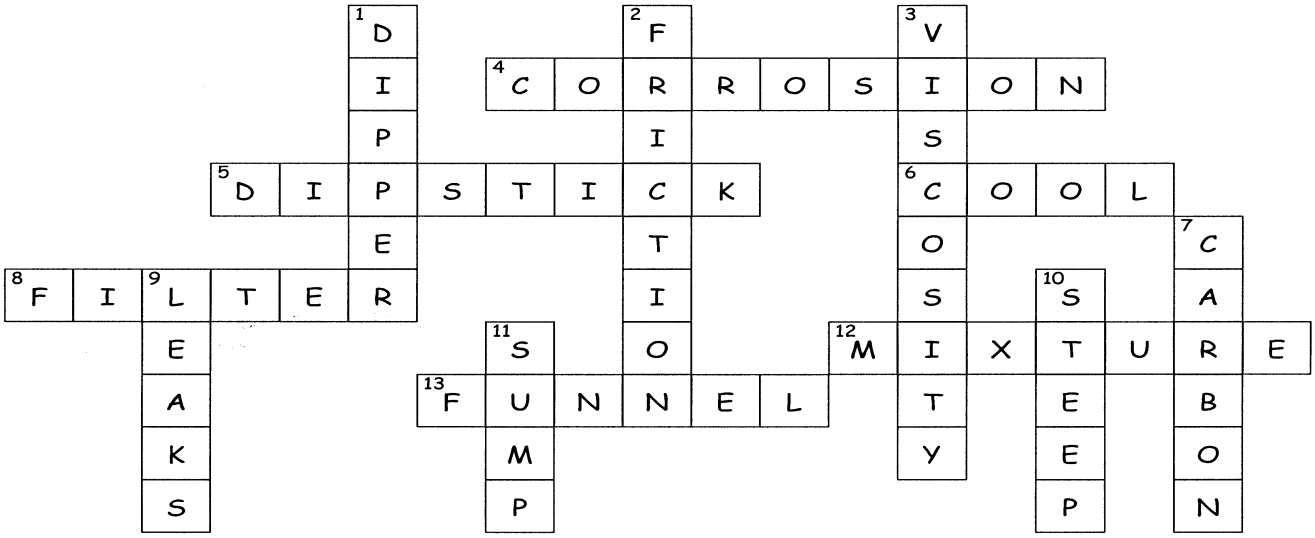
Demonstrate changing oil

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

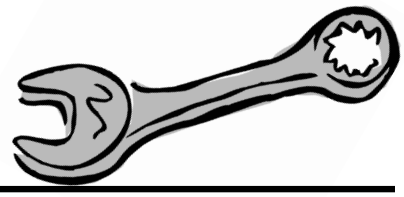
4. Lubrication prevents _____.
5. Check oil levels with a _____.
6. Oil helps _____ an engine.
8. Takes dirt out of oil.
12. Two cycles use an oil gas _____.
13. Use a _____ to aid oil.

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 _____.

Lubrication - Word Search
Answer Key

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



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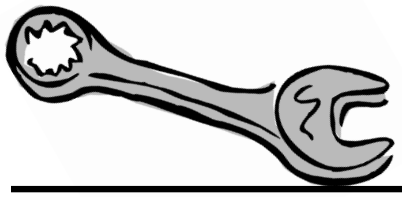
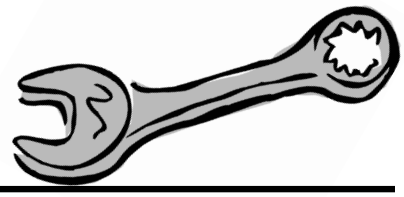


Spark Plugs

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



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

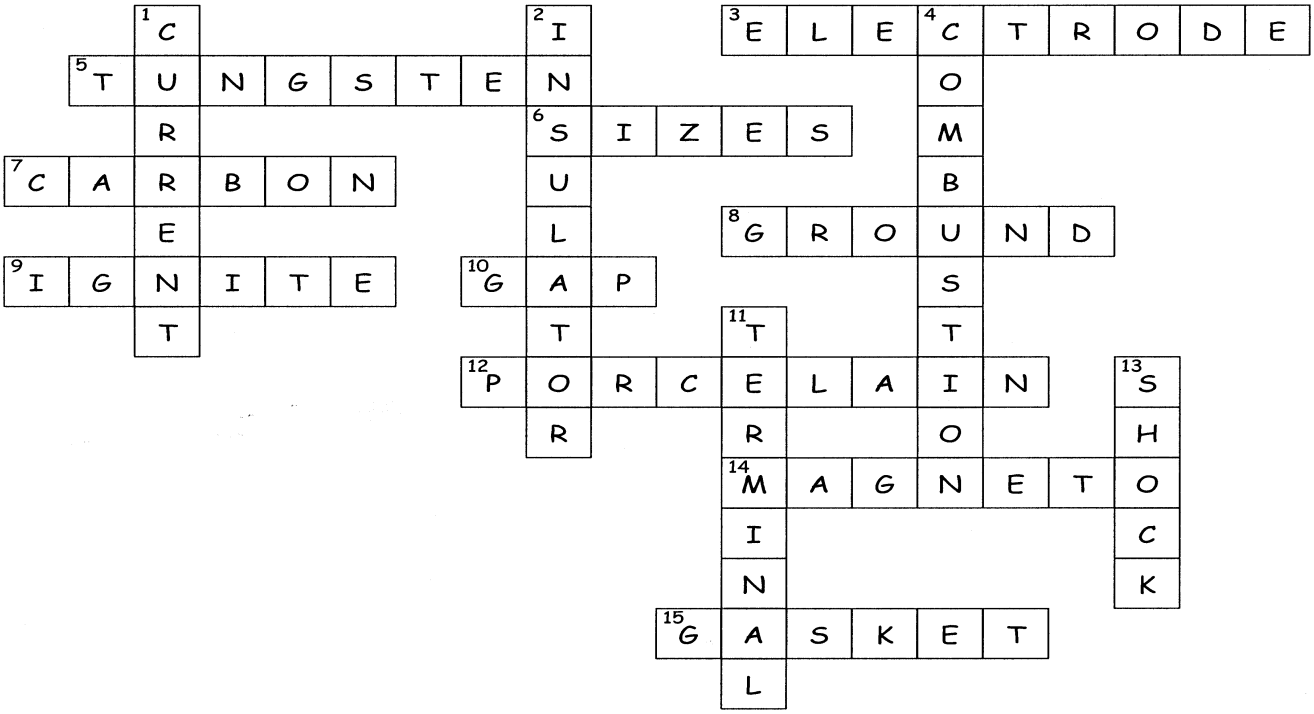
Explain the importance of using correct plugs

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

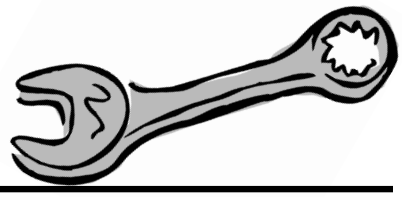


Across

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

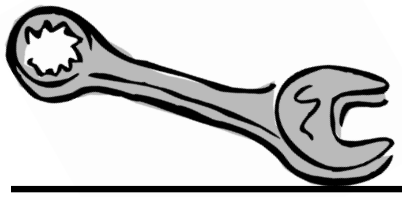
1. Flow of electrons.
2. Something that does NOT conduct electricity.
4. What happens when fuels starts to burn.
11. The end.
13. Touch the wrong wire and you'll get a _____.



Spark Plugs - Word Search
Answer Key

```
        M R O Y F
      E P I S T O N X
    Z P A S I   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
```

carbon
cold
cylinder
electrode
foul
gap
gasket
gauge
hot
ignition
insulator
overheat
piston
polarity
porcelain
reach
service
socket
solvent
spark
voltage



Carburetor

Junior

Name one function of the carburetor

Explain, in simple terms, fuel/air mixture

Explain, in simple terms, three problems related to incorrect fuel/air mixture

Locate carburetor on own small engine

Explain, in simple terms, the passage of air and fuel through the carburetor

Name type of carburetor on member's small engine

Name one condition that indicates carburetor trouble

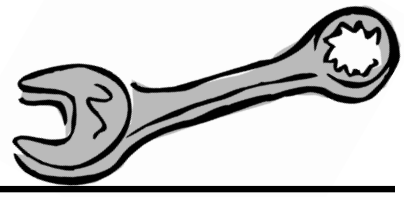
Name risks associated with working on a carburetor

Name and practice appropriate safety procedures

With assistance, check carburetor operation

With assistance, adjust carburetor

With assistance, record efforts in record book



Carburetor

Intermediate (prerequisite: Junior Level)

Name two functions of the carburetor

Explain fuel/air mixture in greater detail

Identify five problems related to incorrect fuel/air mixture

Locate carburetor on other members' small engines

Name three types of carburetors

Name two conditions that indicate carburetor trouble

With little assistance, check carburetor operation

With little assistance, adjust carburetor

Independently record efforts and observations

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

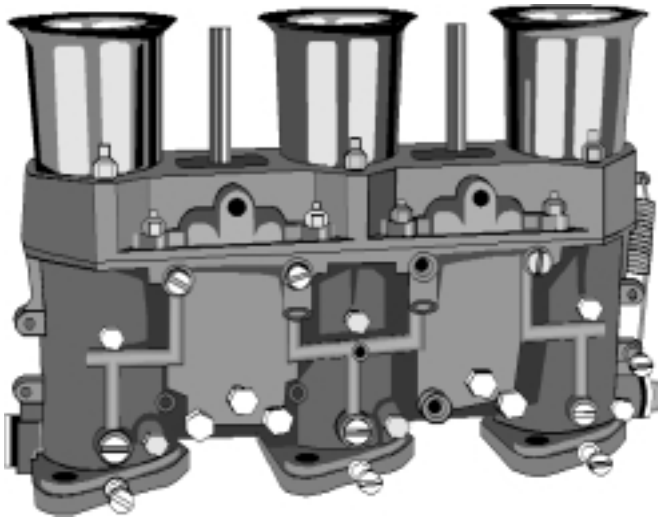
Independently check carburetor operation

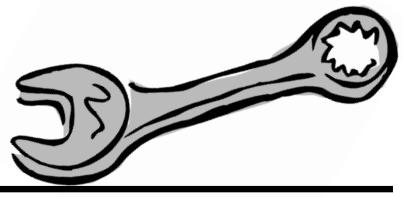
Independently adjust carburetor

Teach, in simple terms, how a carburetor works to younger members

Demonstrate checking carburetor operation

Demonstrate adjusting carburetor





Carburetor - Crossword Puzzle
Answer Key

1 A		2 V	E	L	O	C	T	I	Y				3 C	
C		A											A	
4 E	X	P	L	O	S	I	5 V	E					R	
L		O					E						B	
E		R					N		6 G	O	7 V	E	R	N	O	R
R		I		8 J	E	T					E		N	
A		Z				U					N			
T		E			9 G	R	A	10 V	I	T	Y			
E						I		A						
								11 C	Y	L	I	N	D	E	R
					12 T			U						
					H			U						
		13 D	I	A	P	H	R	A	G	M				
					O									
					T									
					T									
					L									
					E									

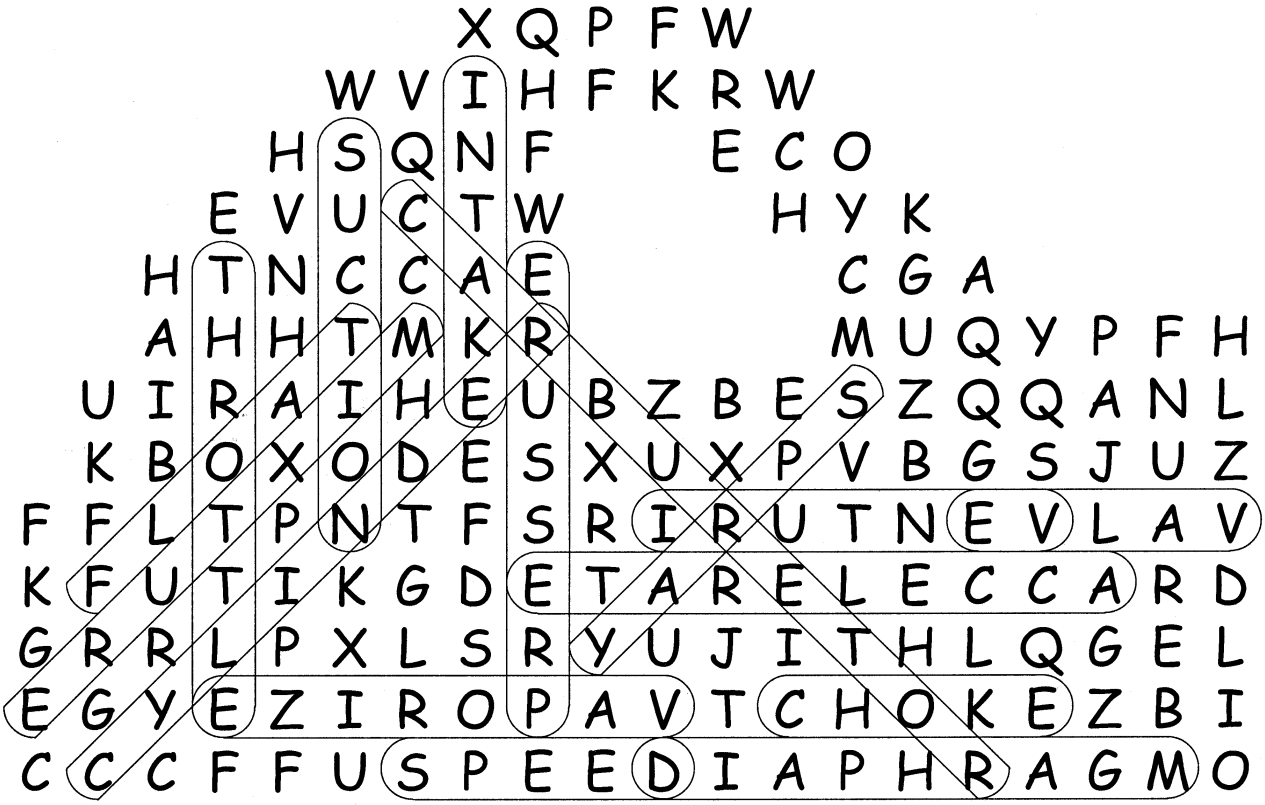
Across

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.

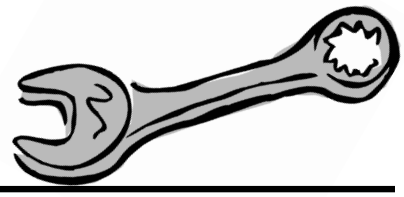
Down

1. To speed up.
2. To turn into vapour.
3. Black gunk.
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
carburetor
choke
cylinder
diaphragm
float
intake
mixture
pressure
speed
spray
suction
throttle
valve
vaporize
venturi



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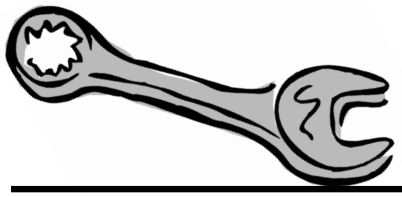


Battery

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

Battery

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

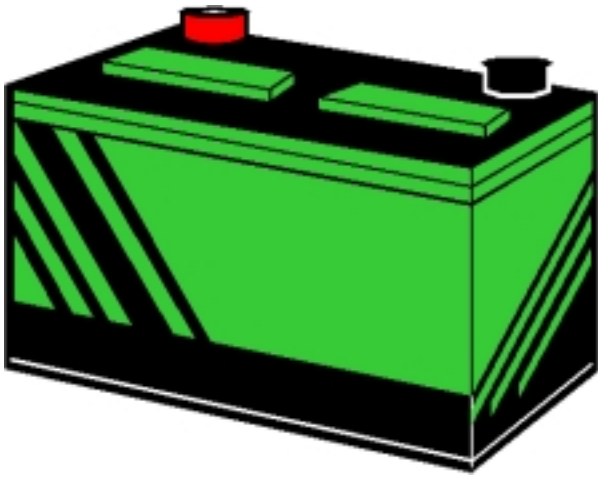
With a little assistance, check and replace battery liquid

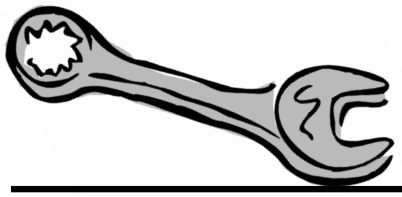
With a little assistance, check battery charge

With a little assistance, clean battery

With a little assistance, check battery frame and cables

Independently record efforts in record book

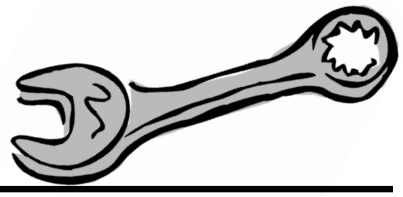




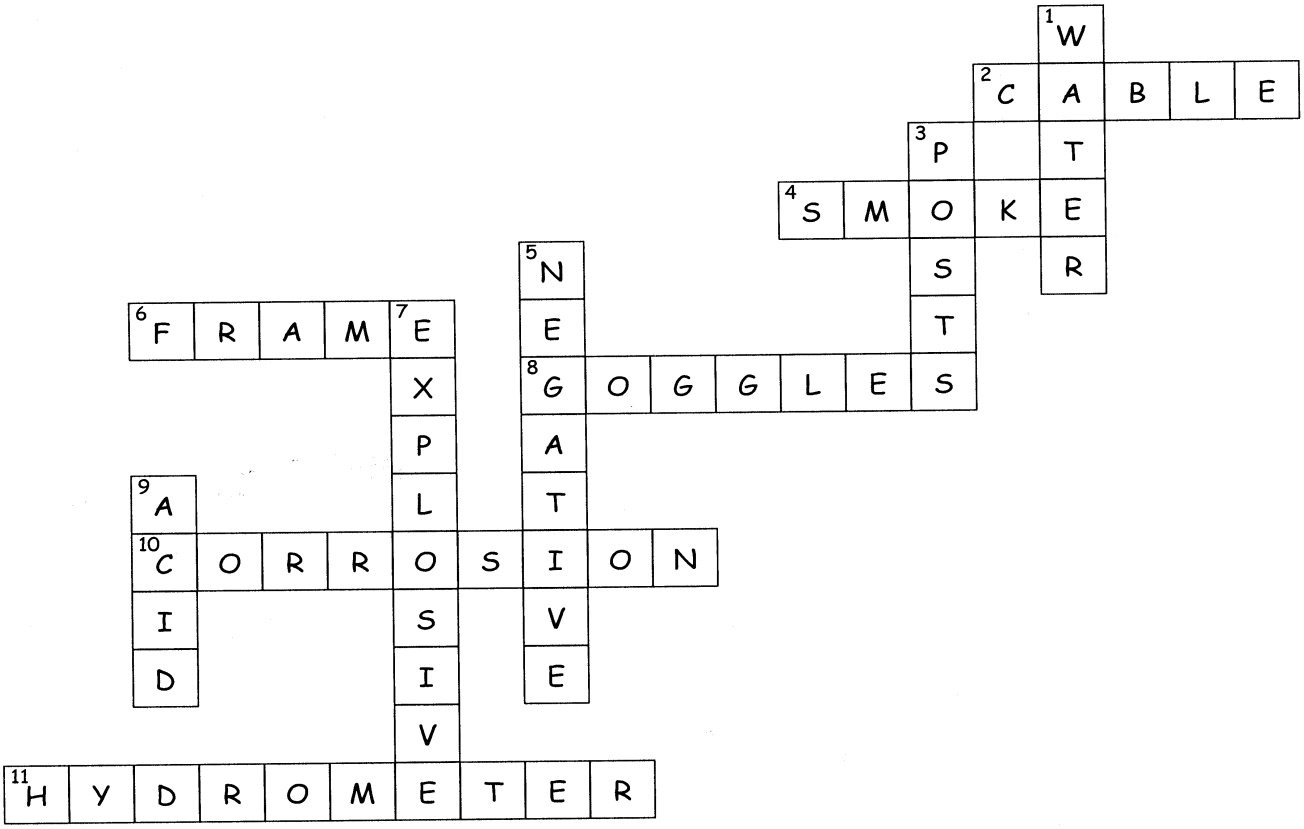
Battery

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



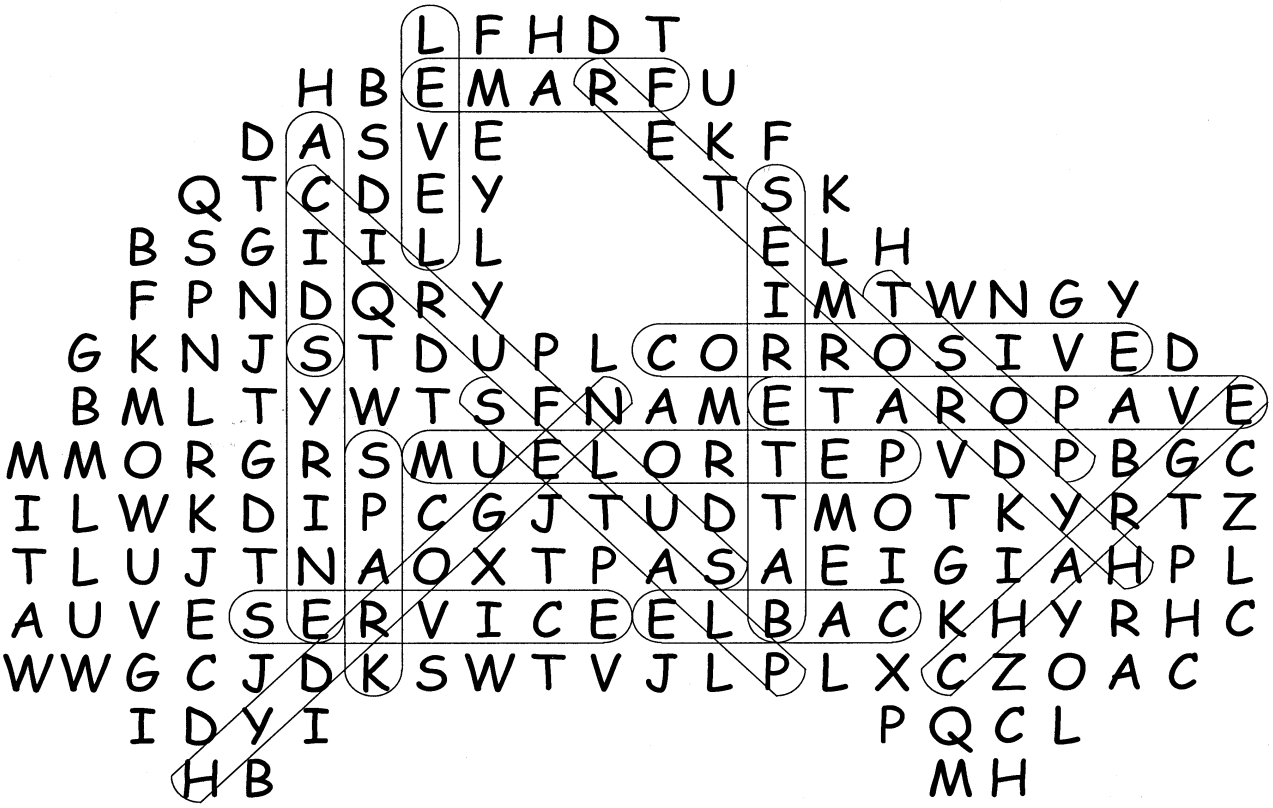
Across

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.

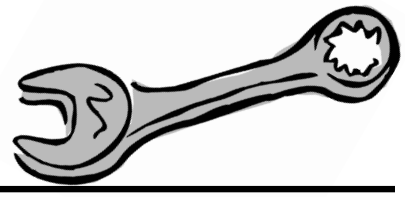
Down

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

Battery - Word Search
Answer Key



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



Notes

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

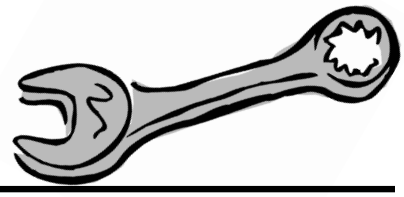
Name and recognize all tools for fuelling

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



Fuel

Intermediate (prerequisite: Junior Level)

Give two reasons why gasoline is well suited for spark-ignition engines

Explain, in simple terms, the relationship between octane rating and compression ratio

Independently record efforts in record book

With little assistance mix fuel for a two cycle engine

With little assistance fuel a small engine

Explain problems of detonation

Senior (prerequisite: Intermediate Level)

Give three reasons why gasoline is well-suited to spark-ignition engines

Independently select fuel for a given small engine

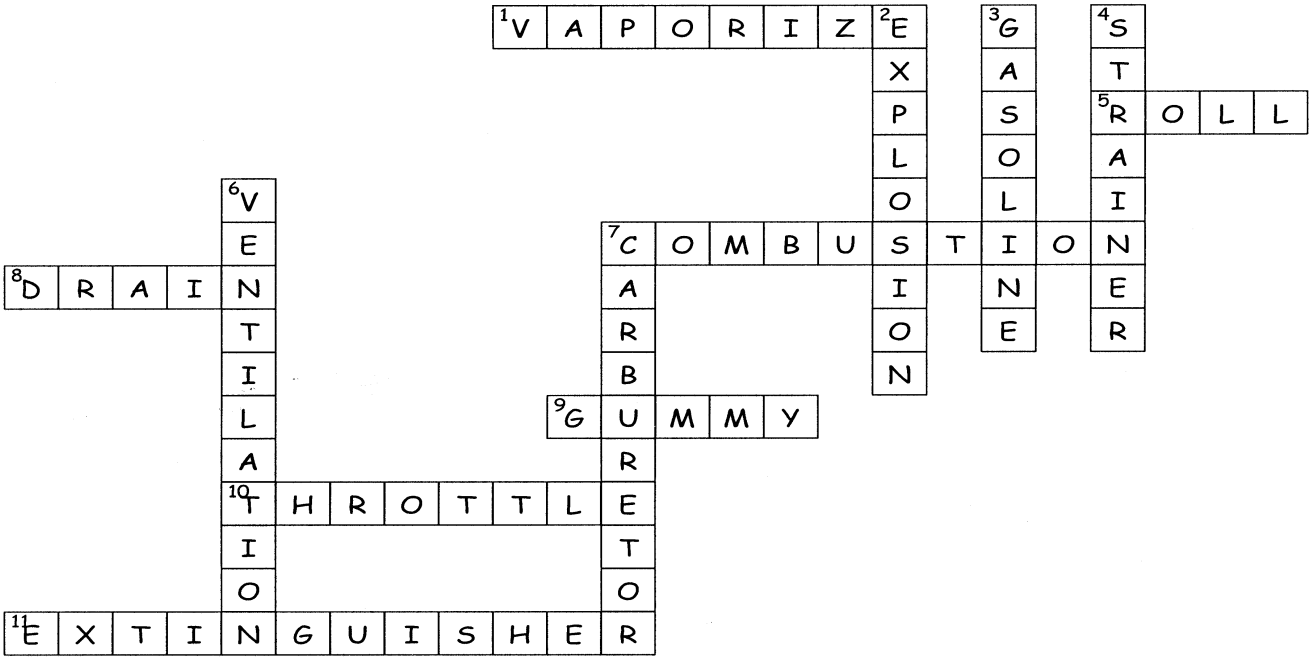
Identify damage caused by detonation

*Teach younger members about mixing fuel

*Teach younger members about safe fuelling

* Assumes adult presence

Fuel - Crossword Puzzle
Answer Key

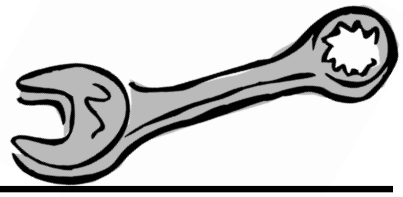


Across

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

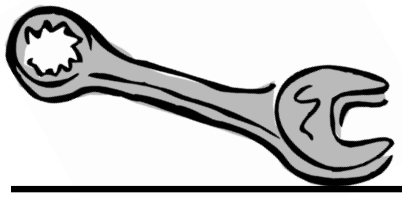
2. Fuel plus spark equals _____.
3. Two cycles burn an oil/_____ mixture.
4. Cleans dirt out of fuel.
6. Movement of air.
7. Mixes fuel and air.



Fuel - Word Search
Answer Key

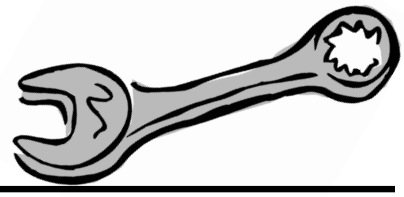
```
                C Y M W H
              U V O D W D Z X
            S G V M G     S G F
          V Y S E P C       V N S
        Q C P J N R M         T T C
        A A G J T E Q           L R V B E R H
    B R R N O I S O L P X E N A T C O Y L I
  K M B E O L S H E U A S P I L L F D G Q B
L V C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

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



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

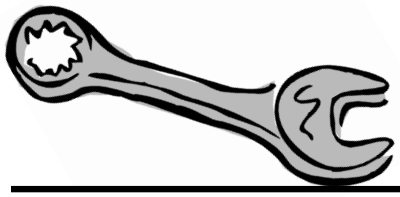
Removes load from engine

Allows for cool-down

Senior (prerequisite: Intermediate Level)

Independently starts up and shuts down engine

Teach/demonstrate start-up/shutdown of engine



Storage

Junior

Name at least two things you can protect your engine from, by storing it properly

Recognize and name at least five tools and supplies for storage preparation

Name at least three major jobs that must be done to prepare a small engine for storage

With assistance perform at least one of the major jobs

With assistance record efforts in record book

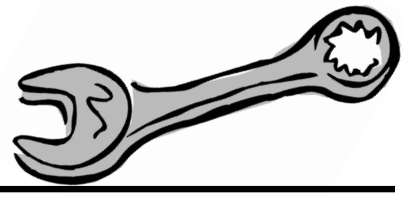
Intermediate (prerequisite: Junior Level)

Name at least four things you can protect your engine from, through proper storage

Assemble at least eight tools and materials required for storage preparation

With assistance perform at least two major jobs needed before storage

Independently record efforts in record book



Storage

Senior (prerequisite: Intermediate Level)

Independently assess and plan for additional service

Assemble independently tools and materials required for storage

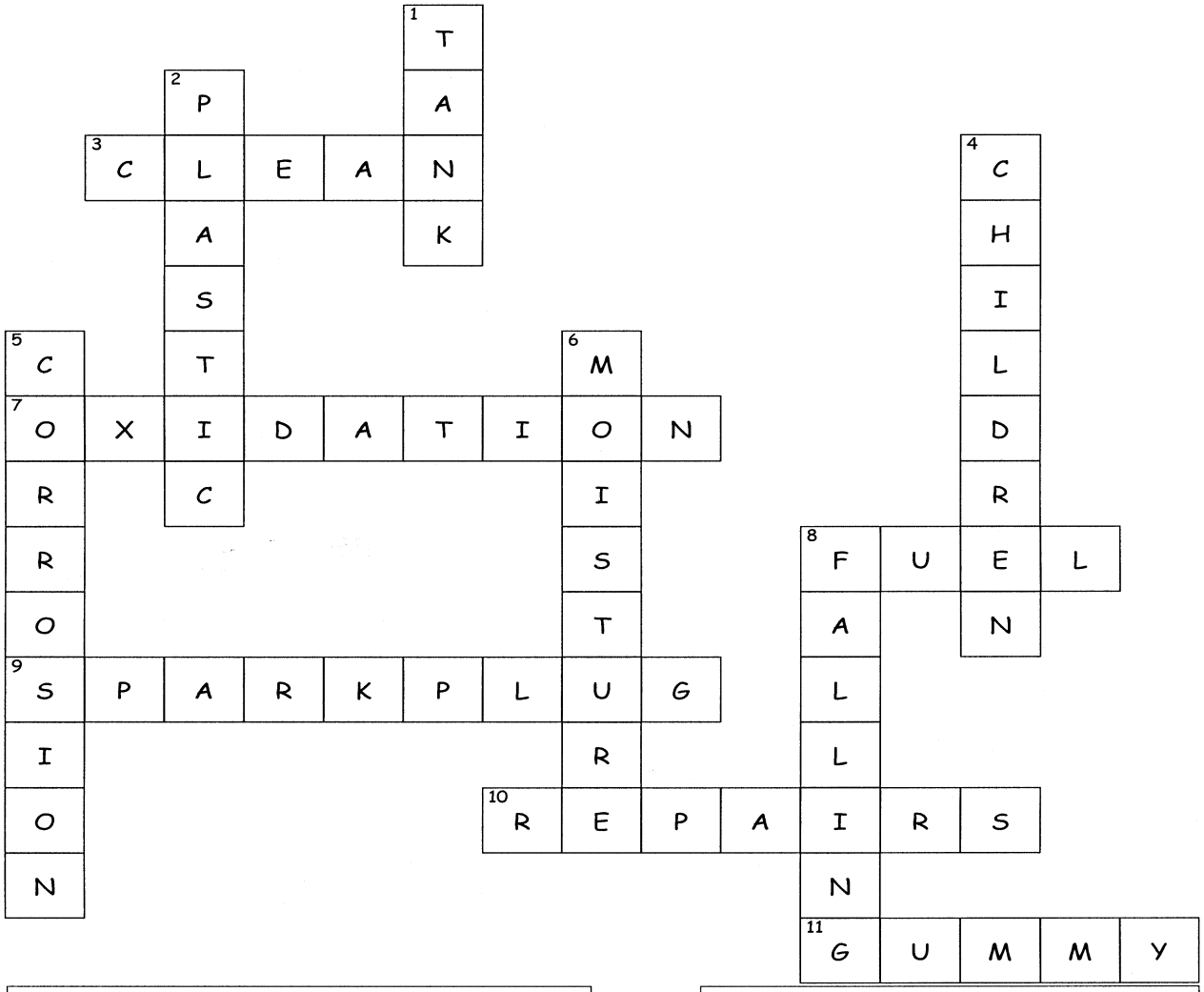
With little assistance prepare small engine for storage

Check on small engine at least twice during storage period

Draw comparisons between small engine storage and storage of other machines and equipment

Teach/demonstrate the basics of engine storage

Storage - Crossword Puzzle
Answer Key

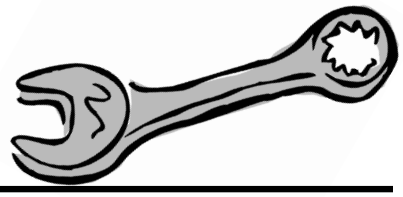


Across

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

Down

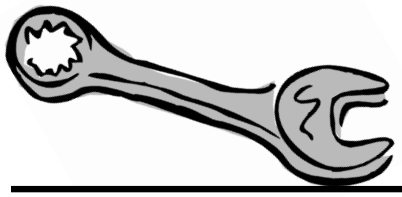
1. Holds fuel.
2. Cover with this.
4. Keep small _____ away.
5. Protect from _____.
6. Condensation.
8. Watch out for _____ objects!



Storage - Word Search
Answer Key

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

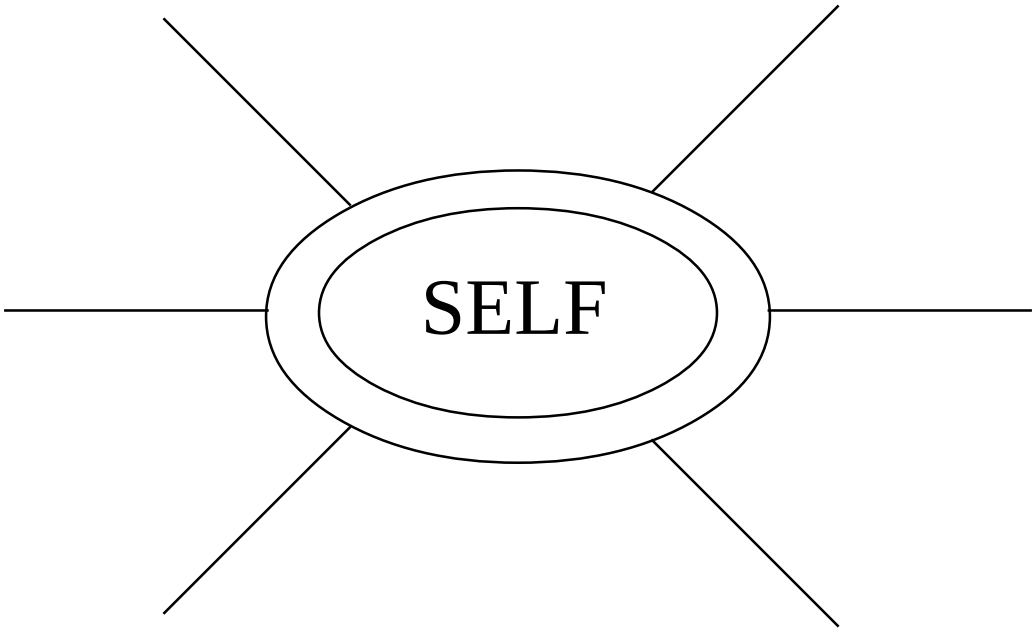
clean
cover
damage
disconnect
drain
gum
investment
moisture
plastic
protection
repair
tarp

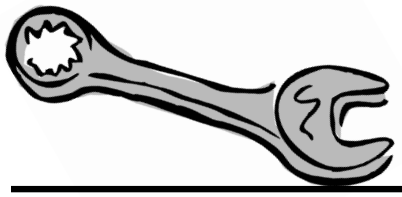


Safety in the Small Engine Project

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

Who does an unsafe worker affect?



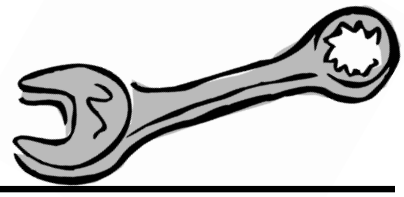


Safety Contract

I will:

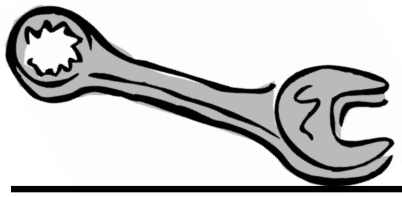
- ☑ identify risks of activities
- ☑ take actions to eliminate or reduce risk
- ☑ ask for help when needed
- ☑ select the correct tools, equipment and materials for the activity
- ☑ watch for and allow for proximity of other people
- ☑ stop work and move back when asked to
- ☑ exit work area on command (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



Cleaning - A Generic Checklist

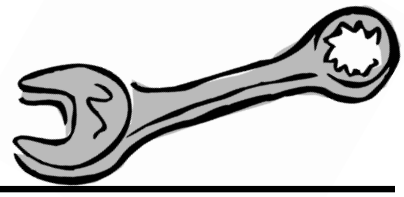
	Leader's initials/date
Name two benefits of this cleaning	
Identify potential risks, if any	
Take steps to reduce or eliminate safety risks	
Wear appropriate protective gear	
DO NOT CONTINUE UNTIL THESE STEPS ARE COMPLETE	
Visual inspection	
Use correct solutions and materials	
Recognize and correctly 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	



PROTECT YOURSELF

Protect your **BACK**

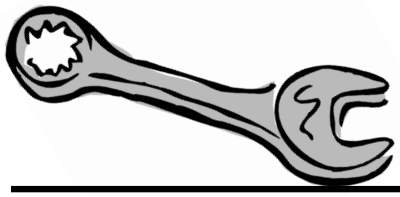
Protect your **EARS**



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

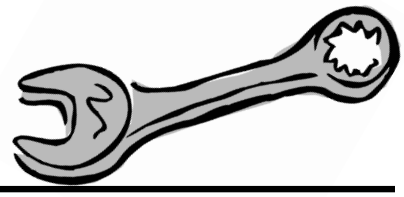
   d) clean the blade

   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



Safety Quiz cont'd...

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

Safety Quiz cont'd...

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

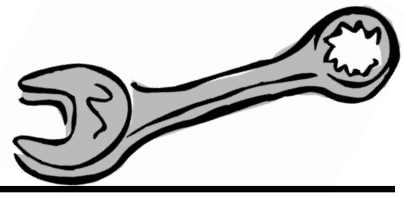
10. When using a fire extinguisher, aim the spray:

    a) at the top of the fire

    b) all over the fire

    c) at the base of the flame

    d) at the smoke



Safety Quiz (answers) cont'd...

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

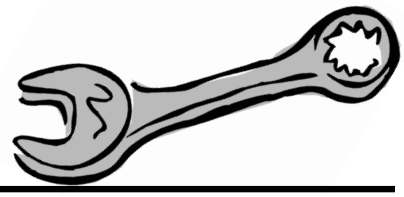
Safety Quiz cont'd...

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



Safety Quiz cont'd...

15. Lungs can be damaged by:

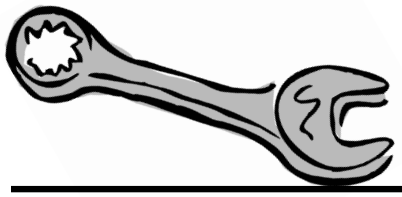
    a) breathing in welding fumes

    b) inhaling carbon monoxide

    c) siphoning gas by mouth and tube

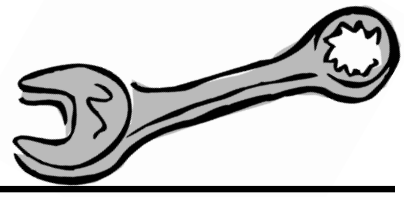
    d) smoking while working

    e) all of the above



Differences Between A Two And A Four Cycle Engine

	Two Cycle Engine	Four Cycle Engine
Fuel		
Oil		
Muffler		
Number strokes per crankshaft revolution		
Method of getting fuel/air mixture in combustion chamber and burned gases out		
Number moving parts in the engine		
Weight		
Size		
Pollution		
Camshaft		



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Oil		
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Number strokes per crankshaft revolution		
Method of getting fuel/air mixture in combustion chamber and burned gases out		
Number moving parts in the engine		
Weight		
Size		
Pollution		
Camshaft		

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?

Position of Valves During Strokes

Stroke	*Intake*	*Exhaust*
Intake		
Compression		
Power (Ignition)		
Exhaust		

3. What four things does a gasoline engine need to do work?

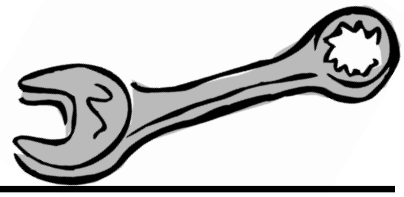
   i) _____

   ii) _____

   iii) _____

   iv) _____

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



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?

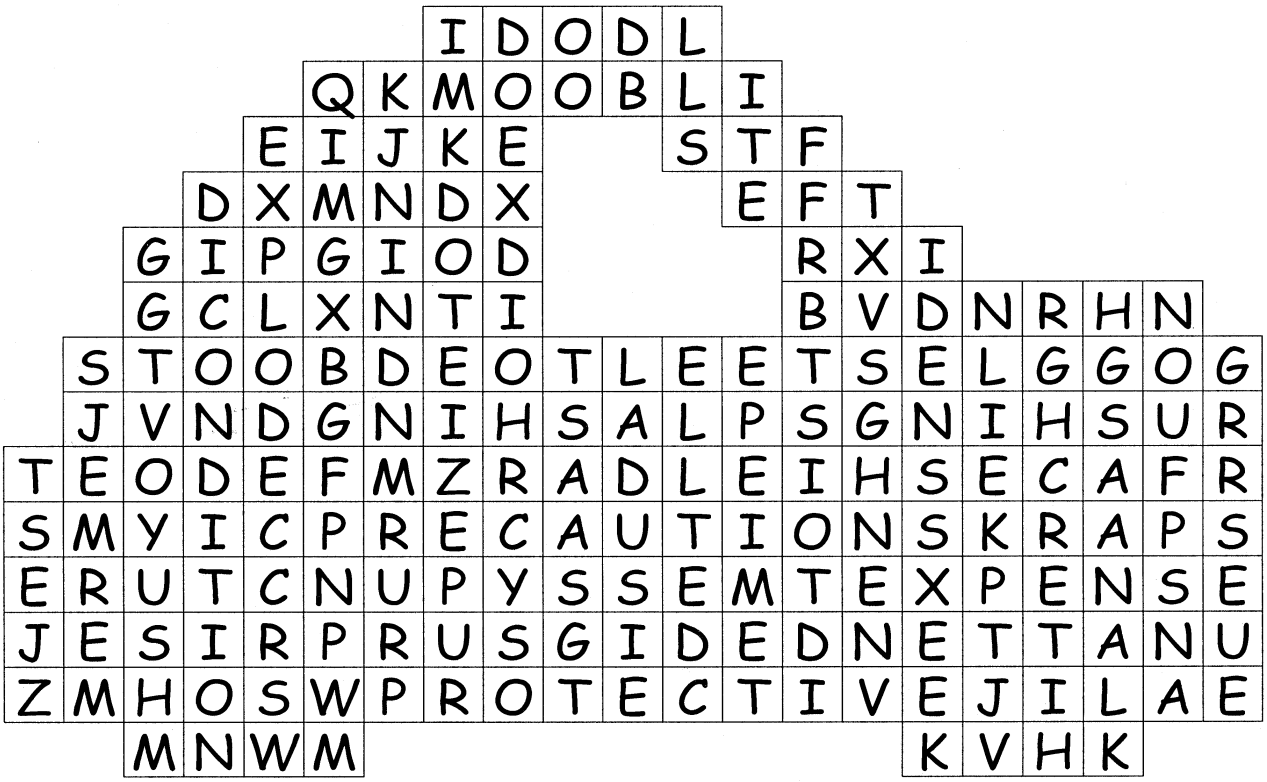
_____

_____

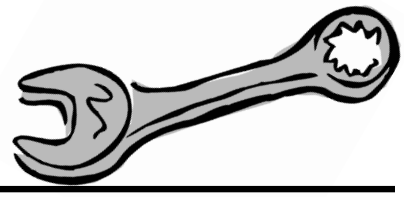
_____

_____

Safety #1 - Word Search



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

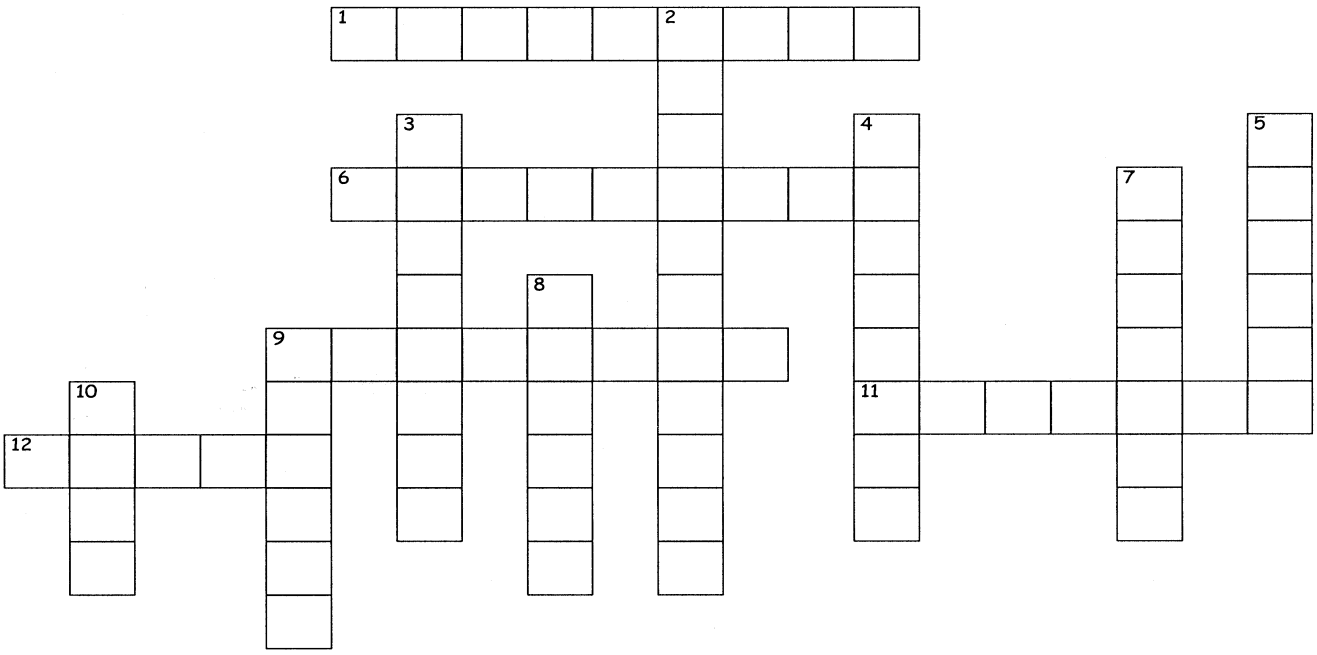


Safety #2 - Word Search

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

brain
burns
chemicals
corrosive
decision
explosion
facemask
gloves
helping
lifting
monoxide
observe
prevention
projectile
punctures
rushing

How Small Engines Work - Crossword Puzzle

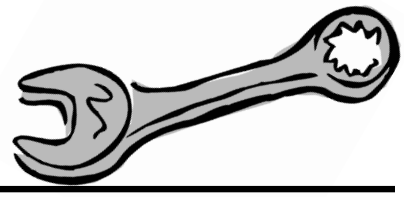


Across

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.
9. Turning force.
10. Opening.

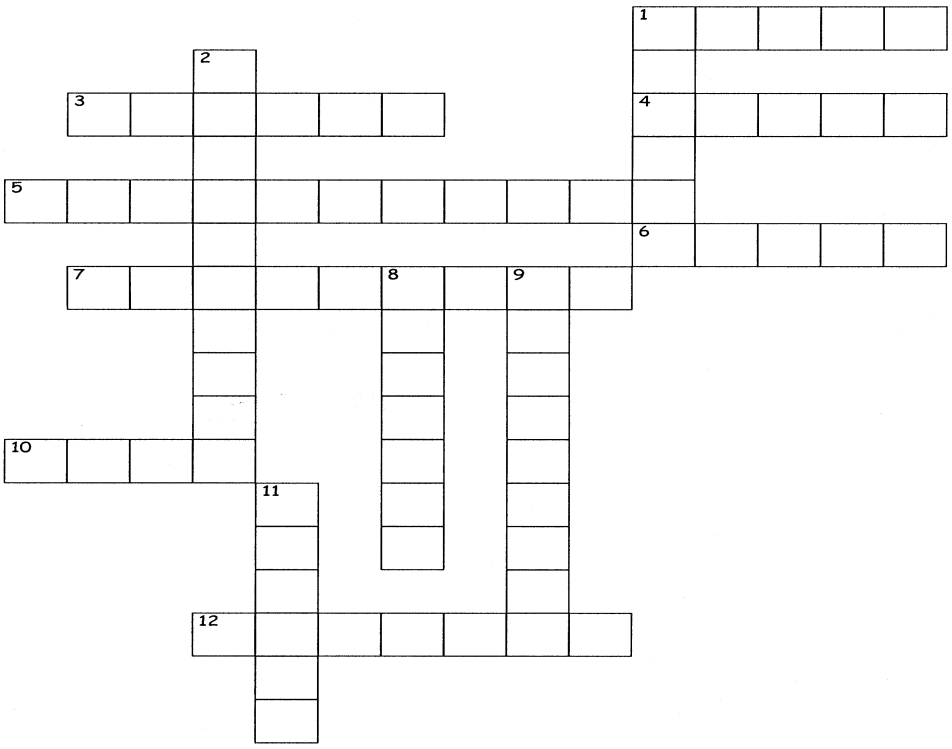


How Small Engines Work - Word Search

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

Care and Handling - Crossword Puzzle



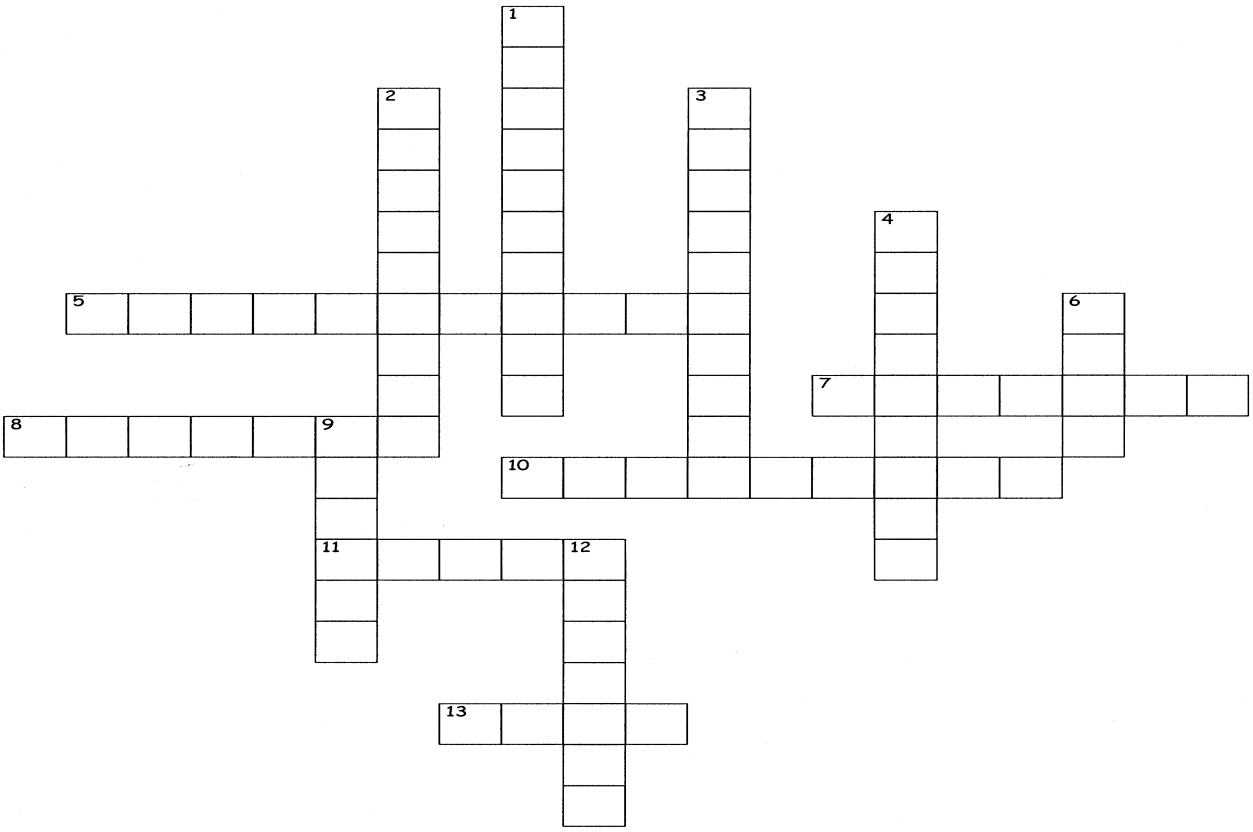
Across

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 _____.

Cleaning Engine - Crossword Puzzle



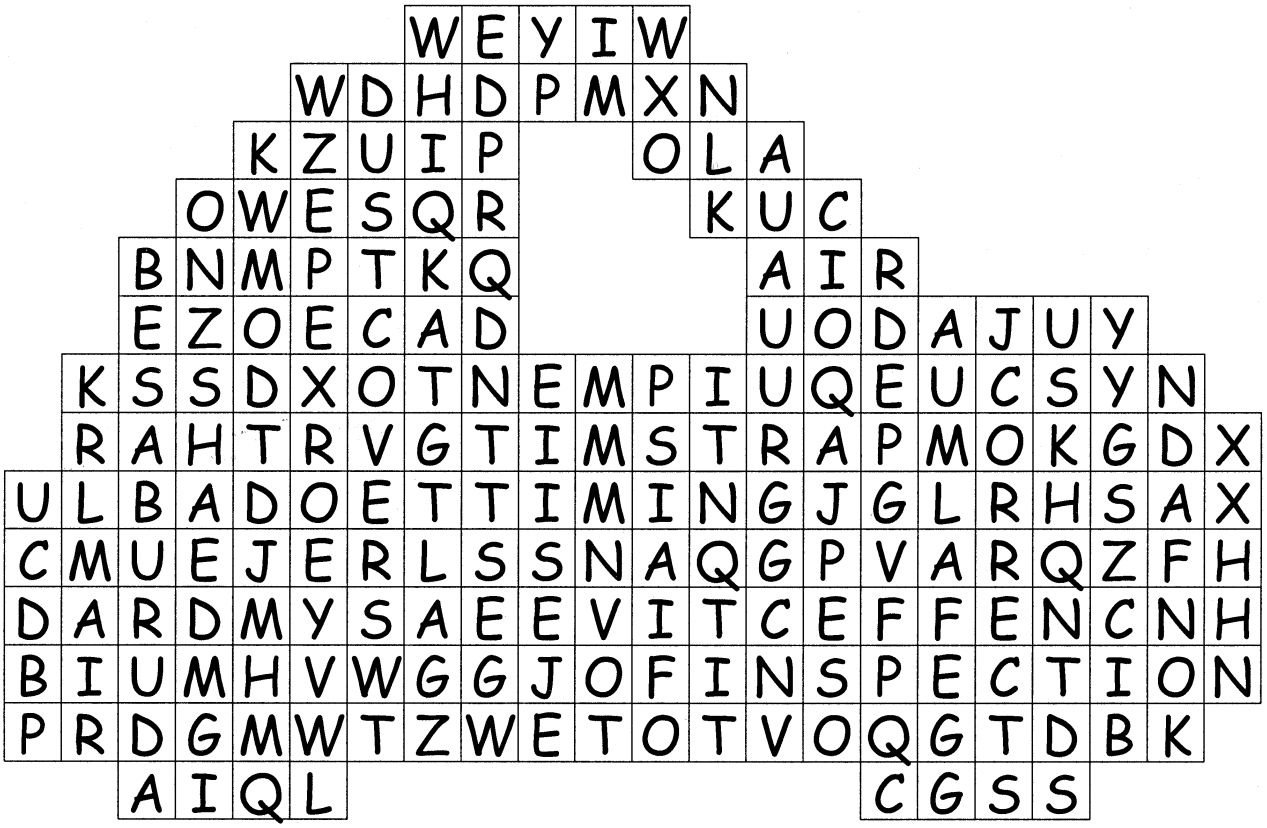
Across

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

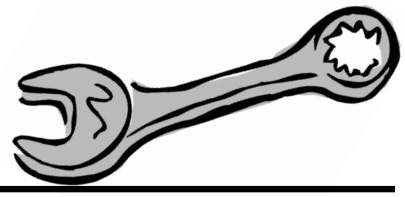
1. Cleaning adds to the life _____ of an engine.
2. Tools or _____.
3. Remove dust with _____ air.
4. An eating away of material.
6. Protect your _____ when cleaning.
9. Cleaning makes it easier to find _____.
12. Cleaning should be done on a _____ basis.

Cleaning Engine - Word Search

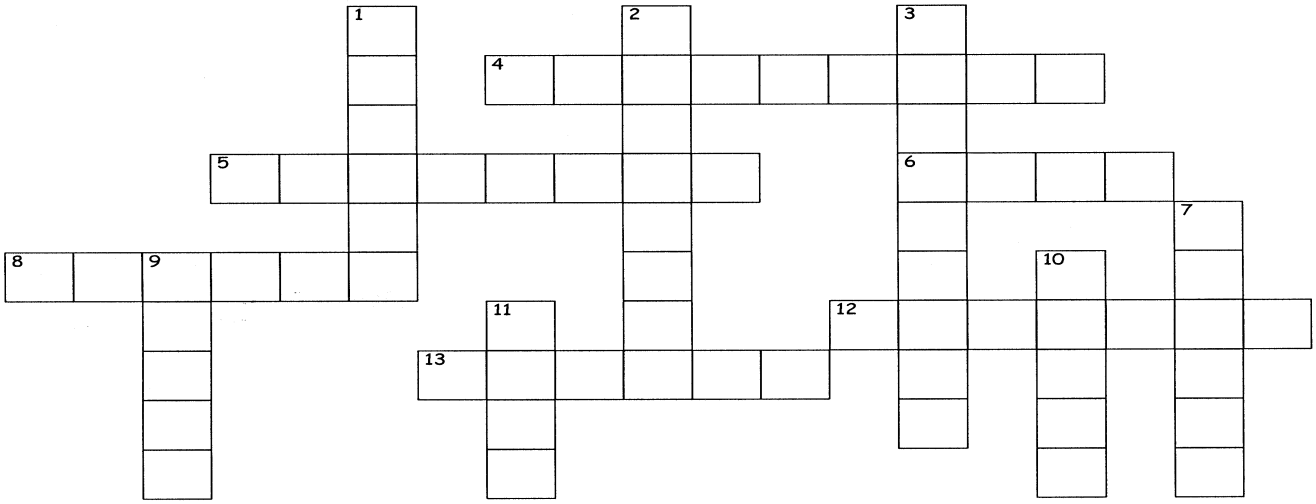


W	E	Y	I	W															
		W	D	H	D	P	M	X	N										
			K	Z	U	I	P			O	L	A							
		O	W	E	S	Q	R				K	U	C						
	B	N	M	P	T	K	Q					A	I	R					
	E	Z	O	E	C	A	D					U	O	D	A	J	U	Y	
K	S	S	D	X	O	T	N	E	M	P	I	U	Q	E	U	C	S	Y	N
R	A	H	T	R	V	G	T	I	M	S	T	R	A	P	M	O	K	G	D	X
U	L	B	A	D	O	E	T	T	I	M	I	N	G	J	G	L	R	H	S	A	X
C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

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



Lubrication - Crossword Puzzle



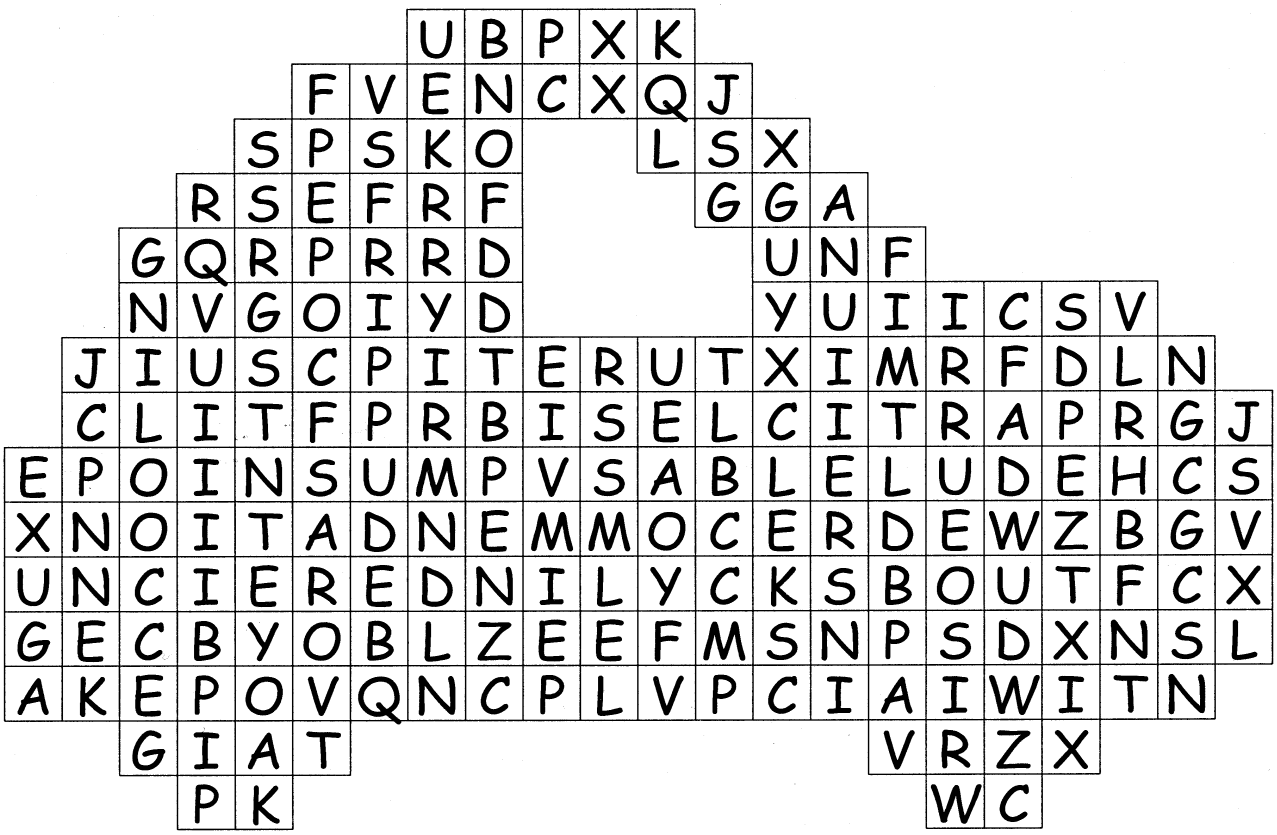
Across

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

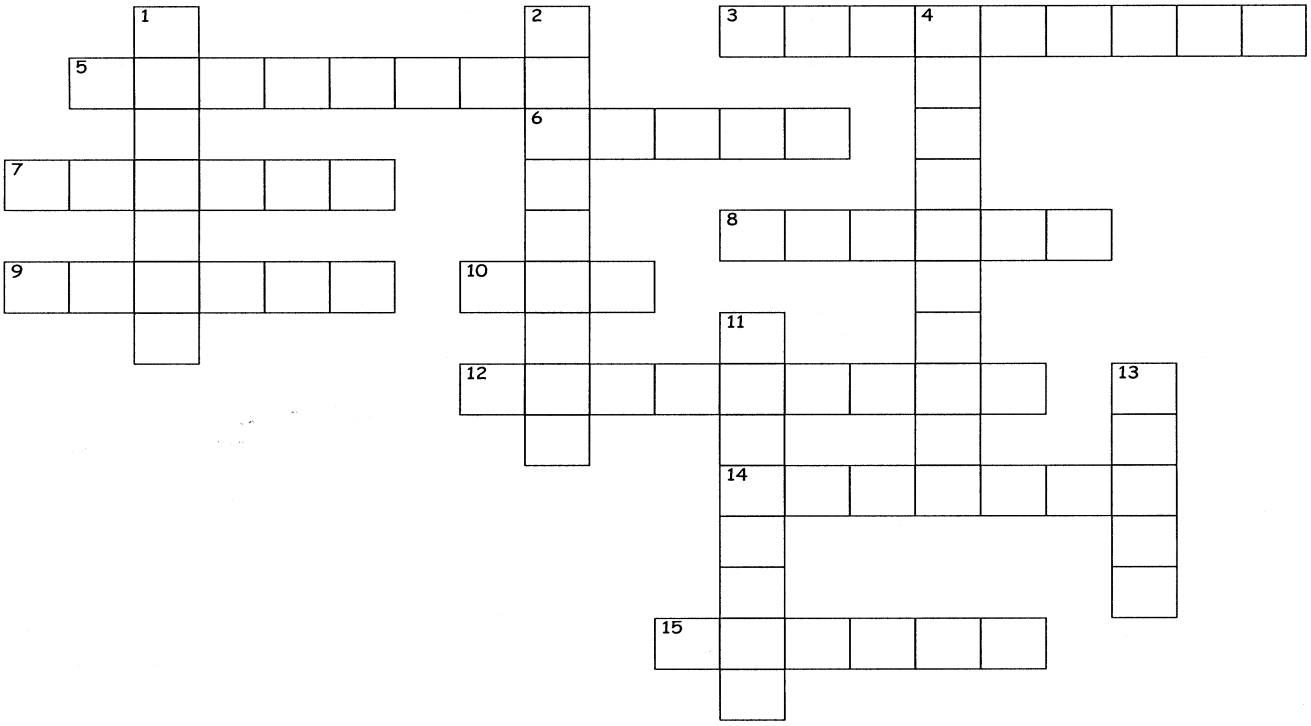
1. This splashes oil in the engine.
2. Lubrication reduces _____.
3. Thickness of a liquid.
7. Oil washes away bits of _____.
9. New gaskets prevent _____.
10. Avoid _____ slopes.
11. Oil collects in a _____.

Lubrication - Word Search



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

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

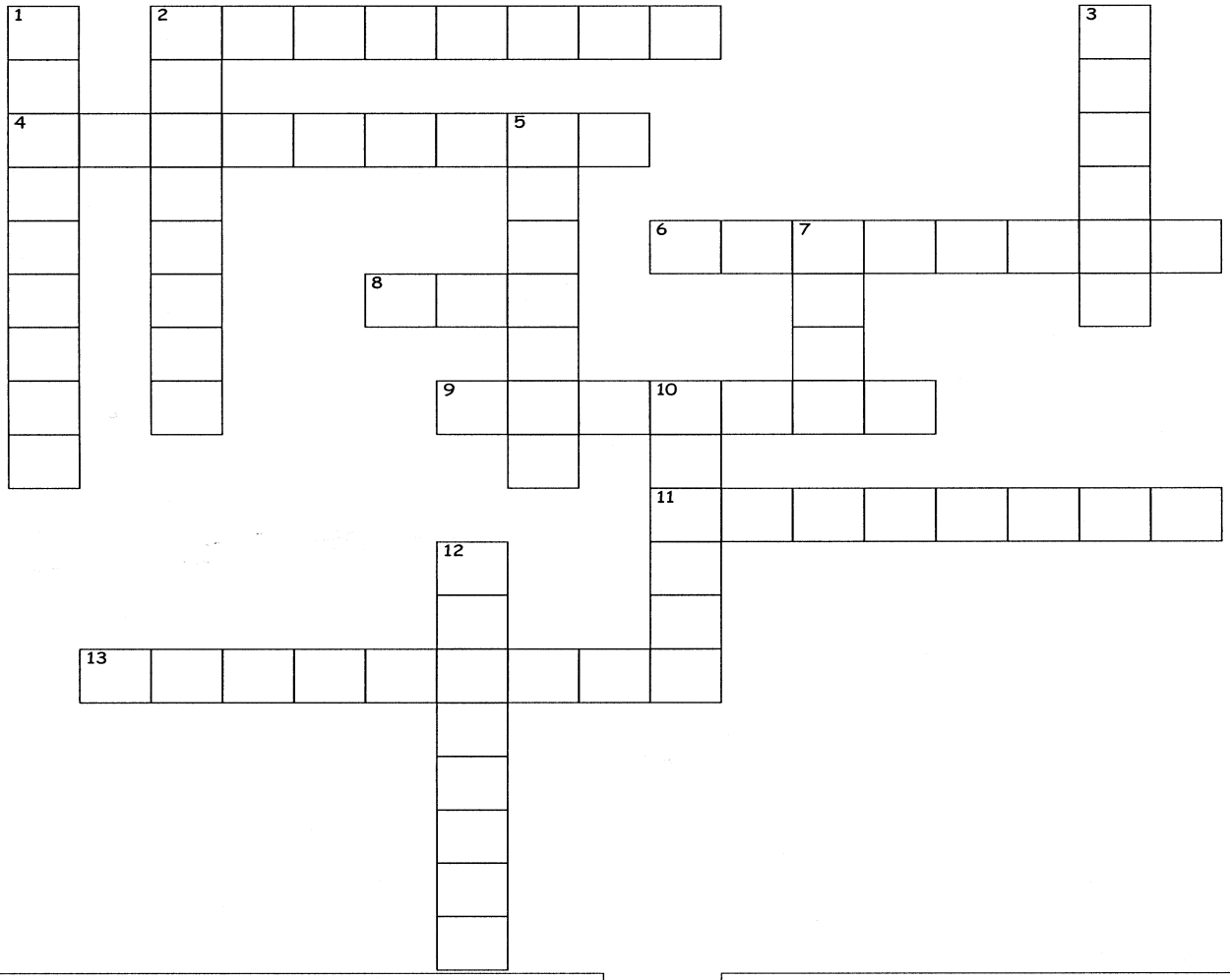
1. Flow of electrons.
2. Something that does NOT conduct electricity.
4. What happens when fuels starts to burn.
11. The end.
13. Touch the wrong wire and you'll get a _____.

Spark Plug - Word Search

				M	R	O	Y	F												
			E	P	I	S	T	O	N	X										
		Z	P	A	S	I			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	

carbon
cold
cylinder
electrode
foul
gap
gasket
gauge
hot
ignition
insulator
overheat
piston
polarity
porcelain
reach
service
socket
solvent
spark
voltage

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

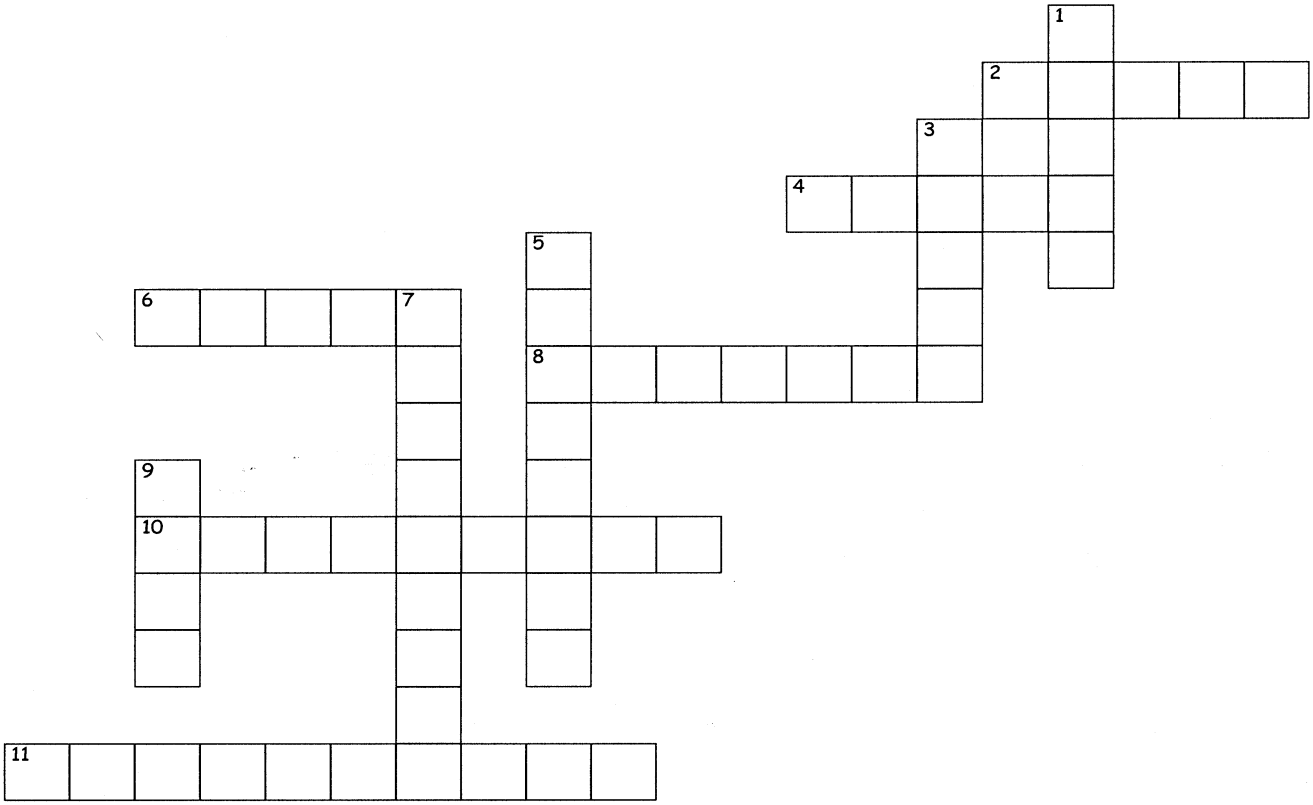
1. To speed up.
2. To turn into vapour.
3. Black gunk.
5. Narrow place in a carburetor.
7. A hole for air movement.
10. Free of atmospheric pressure.
12. A value that controls amount of fuel.

Carburetor - Word Search

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

accelerate
carburetor
choke
cylinder
diaphragm
float
intake
mixture
pressure
speed
spray
suction
throttle
valve
vaporize
venturi

Battery - Crossword Puzzle



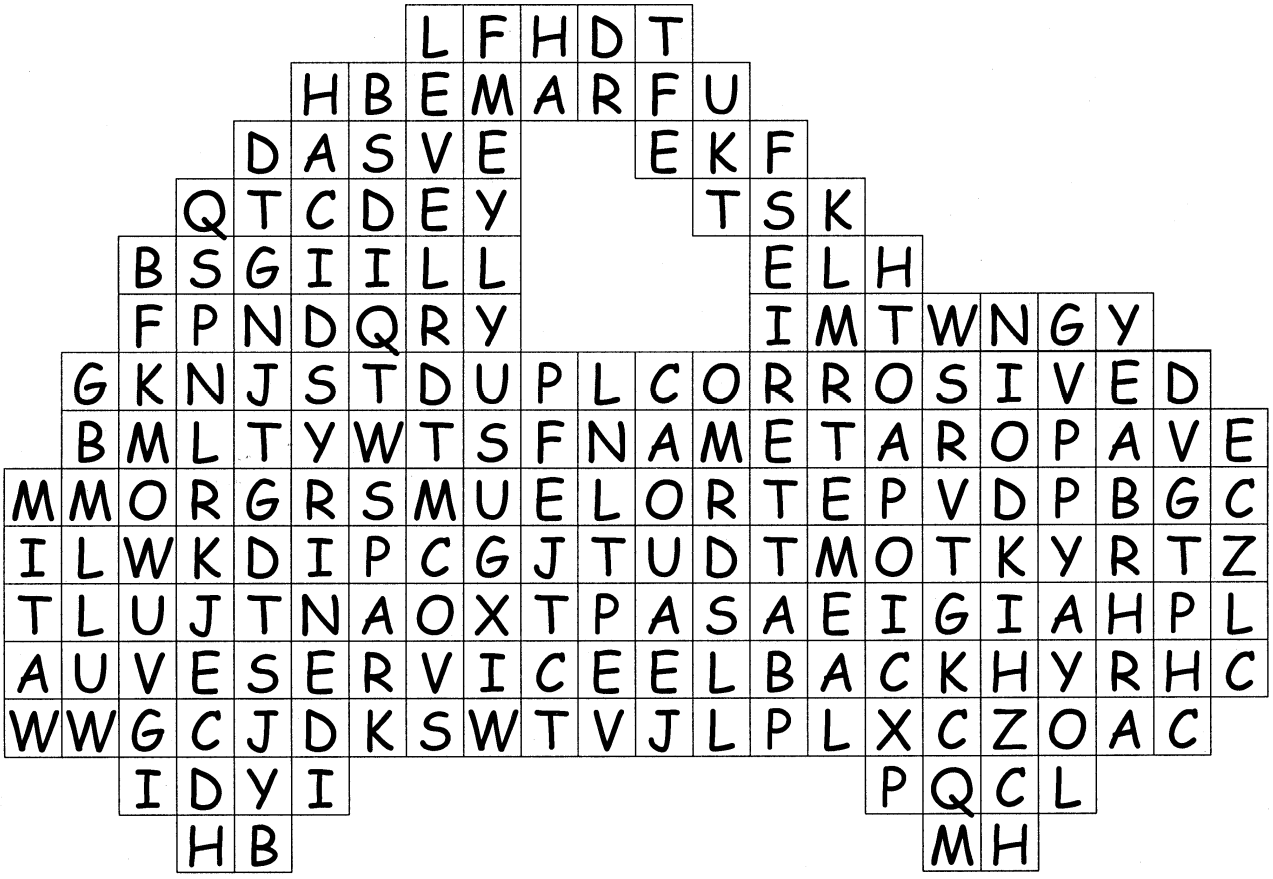
Across

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

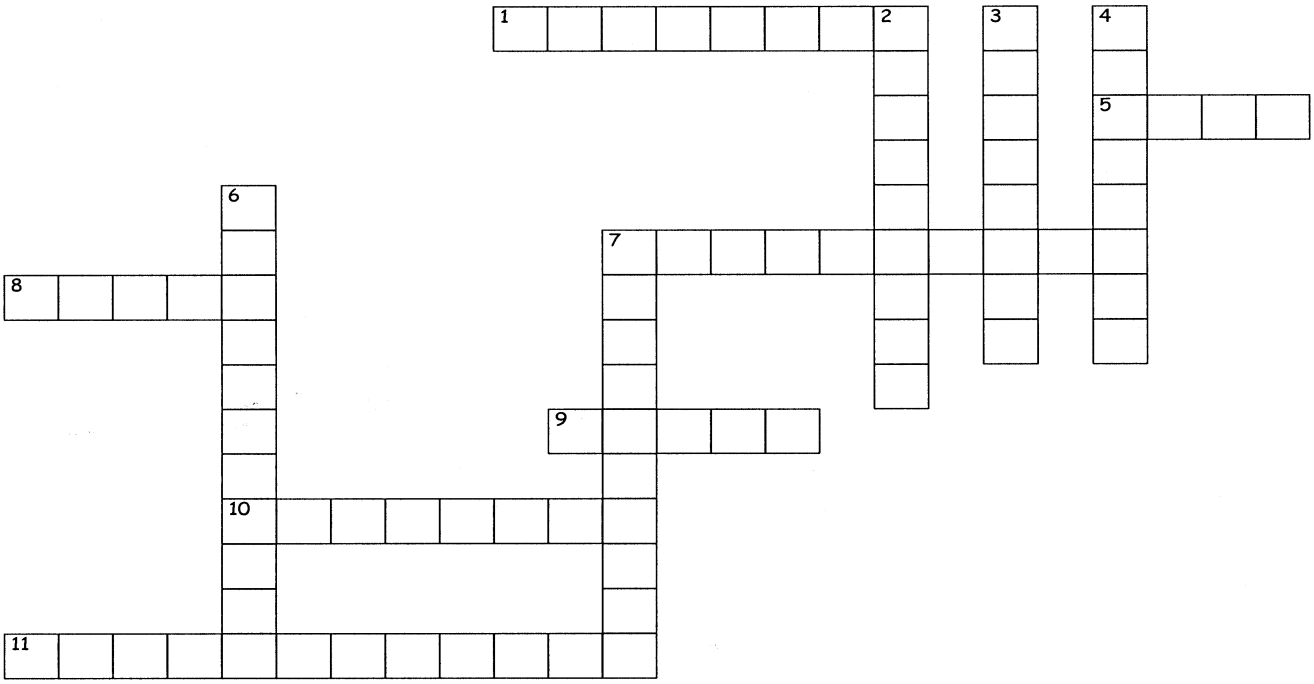
1. If splashed with acid, rinse with this.
3. Put petroleum jelly on these.
5. Not positive.
7. Batteries give off an _____ gas.
9. Caustic liquid.

Battery - Word Search



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

Fuel - Crossword Puzzle



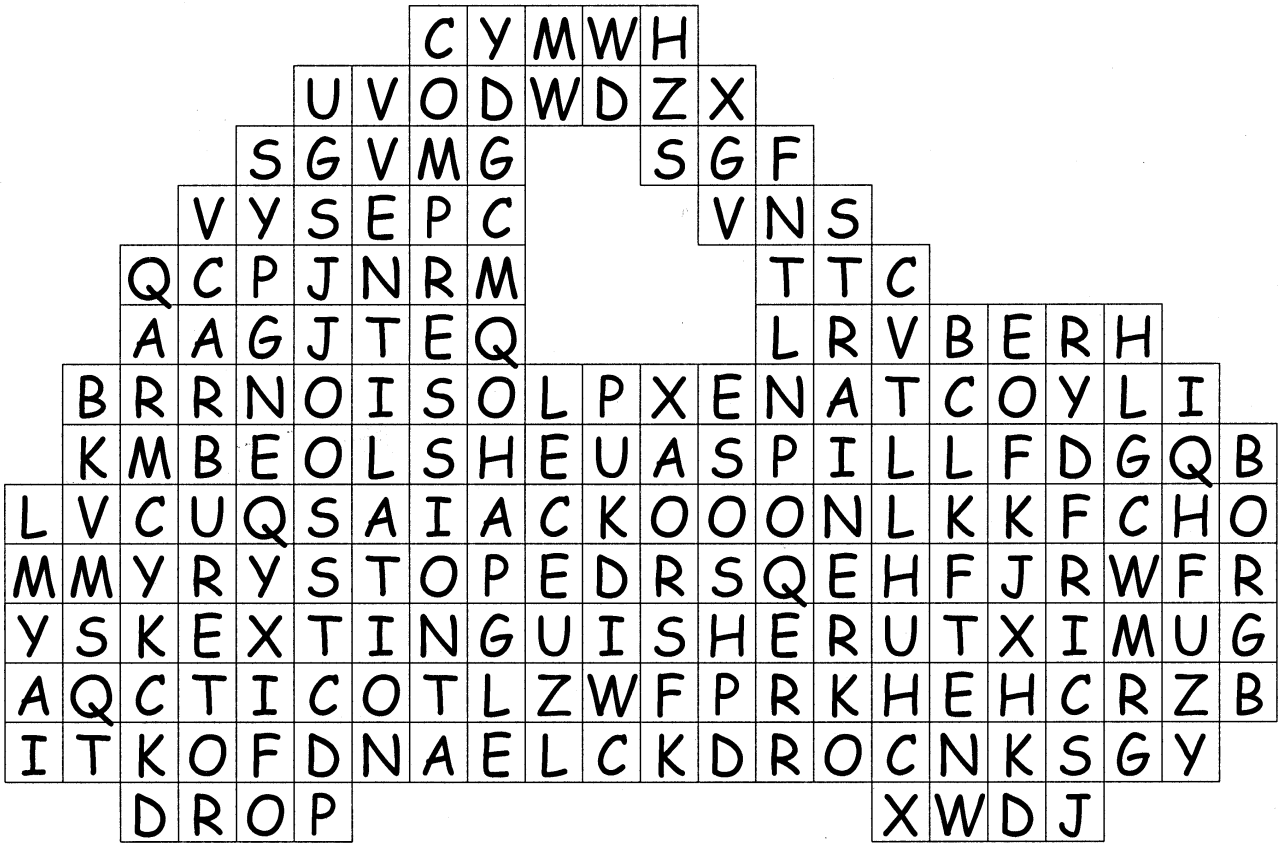
Across

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

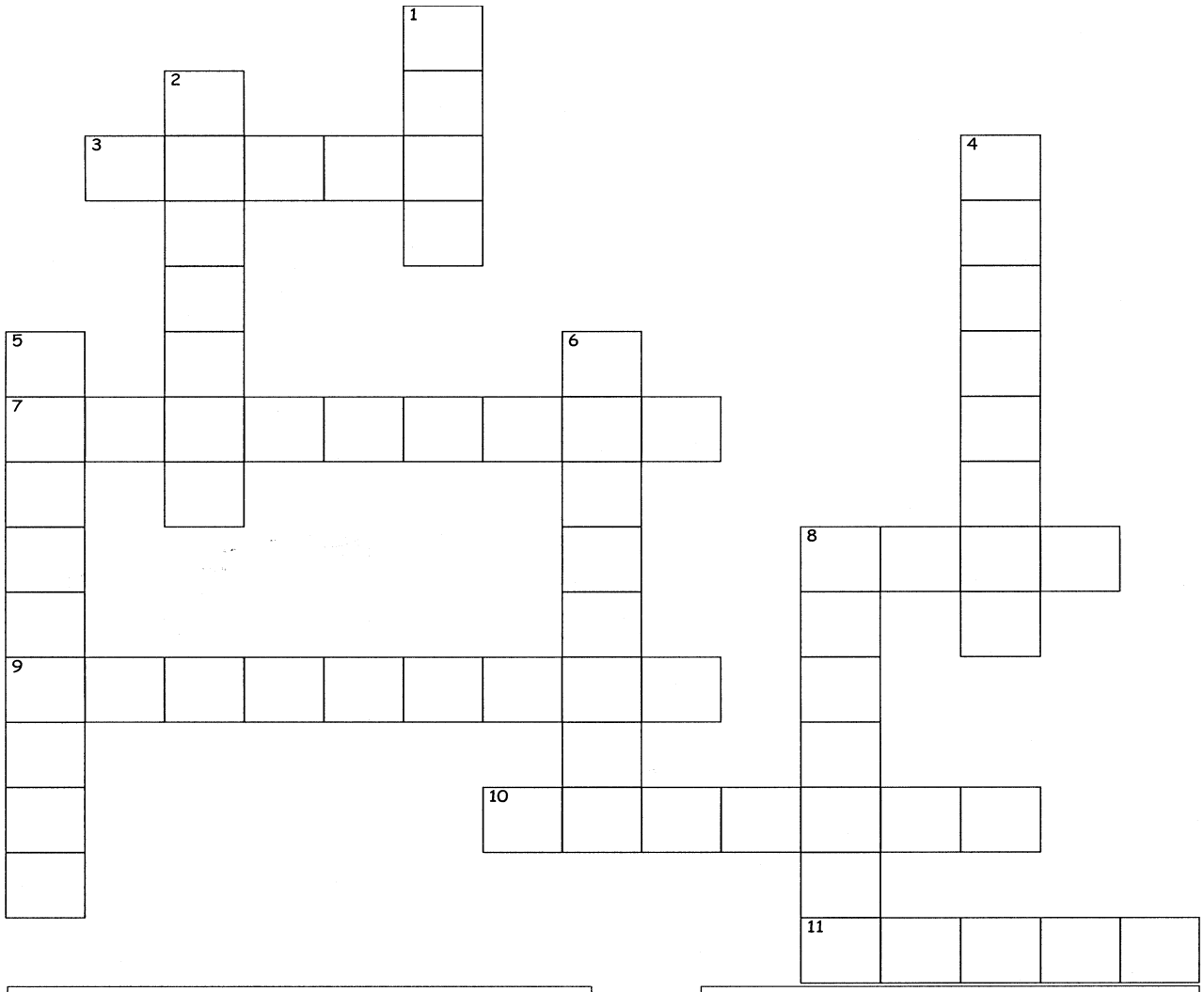
2. Fuel plus spark equals _____.
3. Two cycles burn an oil/_____ mixture.
4. Cleans dirt out of fuel.
6. Movement of air.
7. Mixes fuel and air.

Fuel - Word Search



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

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!

Storage - Word Search

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

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

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!

SMALL ENGINE PROJECT EVALUATION
4-H BRANCH
ALBERTA AGRICULTURE, FOOD AND
RURAL DEVELOPMENT
7000 113 STREET NW RM 200
EDMONTON AB T6H 5T6

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 _____

_____

_____

_____

_____