

Inside Small Gasoline Engines. *Journal by Bob Thomas*

It occurred to me some time ago that a small gasoline engine contains examples of a lot of things mentioned in the curriculum. Because these engines are small and fairly easy to get, it seemed that it would be practical to use one in an EIR session.

The following is an account of our experience, plus some thoughts and suggestions. On pages 3 and 4, you will find diagrams that can be used in preparation or during a presentation.

There's no need to have a functioning engine. I checked with some small-engine shops, and found someone who let me have some unrepairable engines for a few dollars. From these, I chose a four-cycle lawn-mower engine.

The first order of business was to clean it up, because we were working with a 6/7 class and it's well known that kids this age are real dirt magnets. I used engine cleaner from Canadian Tire but you might have better success with a garage that could steam clean the outside as it is the worst part to clean. The inside was pretty clean already with the exception for the soot deposits in the combustion chamber, which had to be scraped and wire-brushed. Once this was done, a quick cleanup with mineral spirits followed by soap and water did the trick.

****Hint** - In the interest of domestic harmony, resist temptation to use the dishwasher or the bathtub for any of this.

Disassembly is pretty straightforward except for pulling the flywheel (which may be unnecessary anyway). Since this engine never had to run again, I made free use of the hammer and the hacksaw. I made sure that I could get the timing gears and valve train together so the kids could see how they worked. It's unnecessary and dangerous to remove the valves and valve springs, but they should be exposed. I took the piston rings off so the piston would slip into the cylinder easily. They're pretty easy to pop off but **ALWAYS** use eye protection and heavy gloves for this. They're extremely brittle and break like glass.

I took some parts from a second engine as well, particularly the spark coil, which I cut in half to show the windings.

I mounted the carburetor on a small piece of plywood so we could use a small glass jar of water in place of the float bowl. With a short piece of plastic tubing fitted, I could blow a good lungful of air through the venturi and demonstrate Bernoulli's principle.

At this point, with a bucket of parts and some simple diagrams in hand, we were ready for the session.

We spent a few minutes at the beginning using the diagrams to describe the basic four-stroke cycle, then went to hands-on activities.

Some items covered in the hands-on portion:

1. The carburetor with its venturi, function of throttle and choke:

**Hint – a sheet of newspaper paper held downwind of the carburetor will show that the air stream is indeed picking up water. Also, we had several pieces of plastic tubing so more than one volunteer could try blowing without spreading germs.

2. The action of pistons, cams, gears, and valves:

All this comes under the heading of "motion" in the curriculum, and the kids can see it all working together to make the engine run.

3. Since the magneto was functional, I could spin the motor with a 1/2" electric drill and make the spark plug function.

In our case, we'd done some electrical stuff previously with the group, and they've seen how moving a magnet near a coil of wire makes electricity. This was a nice follow-up activity.

**Hint – don't forget to connect the return path from the shell of the plug to the engine.

Otherwise, it won't work, and you can get a real jolt if you touch the plug and the engine.

**Hint – You don't need to spin the engine very fast to make this happen. If the recoil starter is functional, it will do. Since you want the head off anyway, you're not working against compression.

4. All the real-world details -- bearings, oil seals, oil slingers, and so on:

Once the kids saw the bits and pieces, we got some good questions about some of these things.

5. We had the connecting rod (in several pieces) and other parts from an engine that seized due to lack of oil -- a dramatic illustration!

Other curriculum/grade level topics one can get into include:

1. Combustion products

Greenhouse gases, NOx emissions, etc.

2. Efficiency

Where does all the energy go? (most of it goes into the exhaust!)

In a high-school group you could introduce the idea that there's a whole big subject called thermodynamics. It's unlikely that any detailed discussion of entropy, Carnot & Otto cycles, etc. would be appropriate, but it would be wise to be ready to discuss the Diesel cycle.

The myth about the 300-mile-per-gallon carburetor could also be discussed.

3. The limits on performance

For instance, if we try to run the engine too fast, the valve springs can't get the valves closed, and the forces involved in accelerating the piston can get very large.

4. The function of the governor (many small engines have one) to regulate the speed.

We did cover this, but the concept seems to be more appropriate to a higher grade.



