It's a gas, gas, gas

There is much excellent chemistry that can be done in class using gases but unfortunately, less is done than might be the case due to the difficulty of getting a supply of gases to experiment with.

Some gases are commonly obtained in cylinders: hydrogen, oxygen, carbon dioxide and occasionally nitrogen. These cylinders are bulky and, of growing difficulty these days, relatively expensive.

Other gases can be produced by technicians and stored for short periods in gas jars. The problem here is that relatively large quantities are produced, there is always the risk of spillage and each jar is 'single use' only.

An alternative is at hand.

Here I should cite the work of Bruce Mattson of the Department of Chemistry at Creighton University, Omaha, Nebraska, USA who has pioneered the method that follows and generously made it available to chemists everywhere .

The principle is simple. You simply need the appropriate chemicals (See Table 1) and a syringe and tablet 'blister' (see Figure 1).

Gases are generated within a syringe. A 60 cm^3 plastic Luer Lock syringe is ideal as the screw-cap means that the gas can be produced and stored within the same syringe if required. In most cases a small amount of a solid reagent is cleverly placed in a container in the bottom of the syringe. A 'blister' from tablets works well. The plunger is then pushed as far down as possible.

Then a small volume of the liquid reagent is drawn up into the barrel of the syringe and the lid is put on. The syringe is then shaken. The reaction produces gas and, with a little assistance, this pushes the barrel upwards, filling it with the required gas.

The photographs in the following section are of the process to produce oxygen. The method is the same for all, just the reagents are different.

Figure 1 - Syringe and tablet.

Step 1 - Remove the plunger, and the cap if it is fitted to the syringe.

Step 2 - Take a single 'blister' from a pack of tablets (indigestion tablets are ideal) and weigh out the correct mass of your solid reagent.

Step 3 - Put your finger over the end of the syringe and fill the barrel right to the brim with water. >>

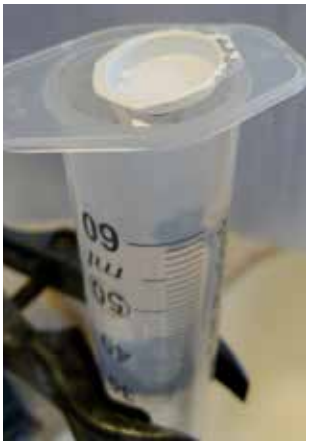

Figure 2 - Place the reagent on top.

Figure 3 - The 'blister' is gently lowered.

Figure 4 - Holding the syringe vertically.

Figure 5 - You will notice the plunger start to move upwards.

Figure 6 - A syringe full of gass to use in experiments.

Figure 7 - Connecting two syringes using a piece of tubing.

Step 4 - now float the 'blister' with your reagent on top (see Figure 2) of the water.

Step 5 - Remove your finger from the end. The water flows steadily out of the syringe and the 'blister' is gently lowered to the bottom of the barrel of the syringe (Figure 3).

Step 5 - insert the plunger (being careful not to shake it too much and displace your carefully lowered solid) and push down as far as you can.

Step 6 - Put some of your other (liquid) reagent into a small beaker or cup (wide enough for the syringe to fit in).

Step 7 - Draw up the required amount of this liquid into the barrel of the syringe.

Step 8 - Still holding the syringe vertically, carefully screw the cap in place (Figure 4).

Step 9 - give the syringe a good shake to mix the reagents.
You will notice the plunger start to move upwards. Pulling gently on it will help the process (Figure 5).

Step 10 - before it gets to the top, go to the sink. Hold the syringe with the nozzle upwards and unscrew the cap (you may here a slight hiss as pressure is released).

Step 11 - Invert the syringe over the sink. Some liquid might be pushed out by the gas pressure. Gently push on the syringe a little to expel the rest of the liquid. A bit of shaking will help to dislodge liquid from the blister.

Step 12 - Replace the cap. You now have a syringe full of gas to use in experiments.

Step 13 (optional) - If you want, you can now transfer the gas to a clean, dry syringe for storage/use. You can do this by simply connecting two syringes with a piece of tubing (Figure 7) and push/pull on the two plungers in tandem. If required, you can insert a tube with some drying agent in (e.g. calcium chloride) to get dry samples of your gases).

The advantage of using your gases in these syringes is that you can use the plunger to simple expel the volume you need and then stop and put the cap back on - that way one syringe of gas can also be used for several tests.

The quantities in the Table 1 (below) will produce about 50-60 cm^3 in 15-60 seconds. More details of the individual methods will be appearing on the SSERC website in the coming weeks. <<

Gas	Solid reagent	Liquid reagent	Comments
Carbon Dioxide	0.2 g sodium hydrogen carbonate	5 cm^3 vinegar	Other dilute acids can be used.
Hydrogen	0.05 g magnesium turnings	3-5 cm^3 1 mol l^{-1} hydrochloric acid	(ribbon or powder can be used if wanted)
Oxygen	0.05 g potassium iodide	3-5 cm^3 6% (20 vol) hydrogen peroxide	Watch out for staining from iodine when you empty out the reaction mixture.
Nitrogen	0.14 g sulphamic acid	5 cm^3 0.5 mol l^{-1} sodium nitrate III (nitrite)	
Nitric oxide	0.25 g sodium nitrate III (nitrite)	3-5 cm^3 acidified iron II sulphate solution*	*See SSERC website (Uses of Iron compounds) for recipe.
Sulphur dioxide	0.35 g solid sodium hydrogen sulphite ($NaHSO^3$)	3 cm^3 6 mol l^{-1} hydrochloric acid	In a hot water bath
Ammonia		5 cm^3 concentrated ammonia (0.880)	
Chlorine	0.22 g calcium hypochlorite	5 cm^3 2 mol l^{-1} hydrochloric acid	(or 1 cm^3 6 mol l^{-1} HCl and 3 cm^3 bleach)
Ethyne	0.2 g calcium carbide	3 cm^3 water	(if your carbide is old, you may need more)

Table 1