Acid-base indicators - a flowery alternative

A guide for group leaders using the video

Hello to you, the group leader!

These notes are designed to help you run a special kind of science teacher group meeting, using the video on www.scienceteachingalive.com or the DVD you have.

This kind of meeting is about helping other teachers to feel comfortable with doing practical work, and organising their own lessons so that their students do the activities.

If your participants want a workshop on the science content knowledge, you will find Teachers' Notes on the website that will help you with this.

Suggestions for your workshop programme

A. You can do this workshop at two levels:

For a simple approach, you can focus on the differences between acidic and basic substances, just as Brian does in the video.

For high schools, you can go further and make an indicator that shows differences between strong and weak acids, and strong and weak bases (also called alkalis). Then you relate this to the pH scale which is done in high school.

B. Welcome the people and remind them that **in workshops things get produced** – the thing might be a new understanding, or an issue resolved, or a physical thing made or a document written. They have to produce, not just listen.

Here are three products that could come out of this workshop:

1. A table that shows the colour changes of an indicator substance when you add it to acidic and basic solutions.
2. A sheet of indicator paper, coated with an indicator substance, and ready to use.
3. A worksheet to guide students in their own investigation.

C. Do a swift review of acids and bases, indicators and pH scale.
Check that they all remember why chemists use indicators. Keep it short, about 5 minutes, otherwise the workshop becomes a lecture session.

On the website you'll find some internet links that explain acids and bases at a simple level or in much more depth. Teachers can choose how deep to go.

D. Show the video right through. You need 7 minutes.

E. Tea as an indicator - demonstration (See video **0:44 to 1:12**)

Demonstrate the first activity, using tea as the indicator.

Lemon juice and tea react to form a pale solution, but sodium bicarbonate and tea react to form a dark solution. Lemon juice is an acid, sodium bicarbonate is a base, and water is neutral.

(If you add plain water to the tea, the solution will go paler too, but you'll have to add lots of water, about three times as much as you see in the glass.)

Note that though the methylated spirit in the video is purple, that's not the reason why the solution is purple. The colour of the indicator solution comes from the **flowers**, not the meths.

F. Remind the groups of the three workshop products you are aiming for. Hand out the equipment that they will need; try to keep the groups small – two or three participants.

G. Use flower or vegetable substances as indicators (Video **1:12 to 3:30**)

You might not be able to find those dark purple petunias that Brian uses. Relax, there are many alternatives. Rose petals, geranium petals, morning glory petals, red cabbage and beetroot all contain substances that change colour when the pH of the solution changes. See *What you will need to prepare*, below.

Choose one or two indicator substances and hand out them out with the equipment. For flower petal indicators, let the teachers use a similar method to the one you see Brian use. For red cabbage, cut up the red cabbage or use a grater.

Then you'll need some substances to test, such as vinegar, lemon juice, Handy Andy, bicarbonate of soda, Scrubb's Cloudy Ammonia solution, milk, salt, sugar. (Some of these are neither acidic nor basic but neutral.)

Figure 1 *Substances to test - does your indicator show that they are acidic or basic?*

If you go for the high school level, you'll need five known substances in beakers or bottles:

(1) dilute hydrochloric acid, (2) vinegar, (3) clean water, (4) sodium bicarbonate solution, and (5) dilute sodium hydroxide solution. Put a label on each of these beakers or bottles. These are the known solutions that you see at the top of the table in **Figure 2**.

The pH of these solutions ranges from about pH1 (strong acid) to pH3 for vinegar, pH7 for water, pH8.5 for sodium bicarbonate and pH14 for sodium hydroxide.

So now the teachers find out the colour changes of their chosen indicator in each of these known substances. They might find a range of colours.

Figure 2 *Indicator substances and their colour ranges in acids and alkalis. Your group may get different colour ranges, because they may have found other varieties of beetroot, for example.*

Plant part used	Colour when added to HCl (strong acid) 1 mol/L	Colour when added to vinegar (weak acid)	colour when added to water (neutral)	Colour when added to sodium bicarbonate (weak alkali)	Colour when added to NaOH (strong alkali) 1 mol/L
Beetroot in water solution	Reddish purple	Red	Red	Red	Yellow
Curry powder in water solution	Yellow	Yellow	Yellow	Yellow	Orange
Onion in water solution	Clear	Clear	Clear	Yellow	Yellow
Brown chrysanthemum petals in alcohol	Red	Reddish purple	Dark red	Dark blue or dark brown	Blue-green
Red cabbage in water solution	Red	Red	Purple	Blue	Green, then Yellow
Red rose petals in alcohol solution	Red	Red	Pink	Blue	Blue
Morning glory petals in alcohol solution	?	?	?	?	?

H. Another product of the workshop is the indicator paper. Make some in the way you see Brian make it, and hang the papers up to dry. Don't have filter paper? Relax, you can use the white edges of a newspaper. Paper towel should also work.

I. Summing up the activity: When most people have completed the activities, sum up in a discussion:

- can we do this in our classrooms? If not, why not?
- What questions will we use to focus the students' activities?

L. Now move to the final product of the workshop – a student worksheet. The menu on the website www.scienceteachingalive.com has a suggestion on how to design this. Teachers will want to take a copy of their own worksheet, so try to have a photocopier available, or provide pens and sheets of blank paper.

What to prepare

Computer equipment you need to show the DVD. This could mean a laptop and power supply.

If you have a data projector, you'll need a power cord for it, plus an RGB cable to connect it to the computer. Data projectors don't always "see" the computer, so connect up everything before the show and make it displays the video.

If you are going to show the video via the internet in a new venue, make sure that the computer can connect to the internet in that place.

Other Items	**Where to get them**
❑ Pot of black tea, ready to use (there's no time in the workshop to make it there)	Your kitchen or Supermarket, grocer's shop, spaza shop
❑ Glasses for the tea	
❑ Knives and cutting boards or a grater if you are using red cabbage, beetroot, onion, etc.	
❑ Beakers, glasses **or** test-tubes.	
❑ Substances to test: Scrubb's ammonia, HandyAndy, soap, white vinegar, milk, salt, onion, sugar, cut lemon **or** bottle of lemon juice, bicarbonate of soda, also known as sodium bicarbonate and baking soda.	
❑ Methylated spirit (Water will dissolve many substances but alcohol is a better solvent for this purpose.)	
❑ Plastic bags for grinding flower petals	
❑ Indicator flowers or vegetables such as red cabbage **or** beetroot, curry powder, purple grapes, cherries, onions, blackberries.	Fruit market
❑ Indicator flowers with dark-coloured petals, such as petunias **or** red roses, chrysanthemums, geraniums, blue hydrangeas, morning glories, red poppies, violets, poinsettias, red hibiscus. (These all have different colour changes; it's best to try a few types before the workshop.)	Gardens, local wild areas, gardens of neighbours.
If you run the workshop at the high school level	
❑ Small bottles, test-tubes or medical specimen bottles (five per group). You need these if you do the workshop at high school level.	School lab, hardware stores, plumbing shops, swimming-pool shops.
❑ Bottle of dilute hydrochloric acid (sold as "Spirits of salts" and as "Pool acid" in hardware stores and plumbing shops. **Read precautions**! Add small amounts to water!)	
❑ Bottle of dilute sodium hydroxide solution (sold as "caustic soda" or "drain cleaner" in supermarkets and hardware stores. **Read precautions**!	