### Extension Activity

Little wonder: pH experiments the microscale way

**Making a pH profile of a natural indicator**

### Nature has its own acid/base indicators as chemicals in flowers, fruit skins, and leaves. Red cabbage leaves are the most commonly used example but investigating other materials makes for an open-ended chemistry lesson.[1] This makes a wonderful basis for investigations by students, as almost every sample is slightly different. There is a rival to red cabbage and that is the Butterfly Pea Flower, normally grown in Thailand, but now available online or in tea shops, because it is used in colourful teas and cocktails. The red leaves of the oxalis plant and poinsettias, or the flowers of lobelias, aubretia, and roses, are other good examples.

### The compounds responsible are anthocyanins,[2] and Ref. [2] describes more of the chemistry involved.

## Safety notes

### The solutions and solids used are of low hazard, but eye protection should be worn.

### Materials

* Strongly coloured flowers or fruit such as berries or grapes.
* Small glass vial or test tube
* Hot plate (optional)
* Beaker and forceps (optional)
* Water
* [Reaction sheet](https://beta.scienceinschool.org/wp-content/uploads/2021/08/Indicator-templates.pdf), laminated or in a plastic wallet
* A selection of buffers in dropper bottles
* Wooden splints or toothpicks

### Procedure

1. Cut a flower head or leaf into pieces, or peel the skin from the fruit (e.g. black grape, blueberry) with blunt forceps.
2. Place the pieces into a vial or test tube.
3. Add 3 ml of water and then place the vial on a hot plate until the water just boils, or insert the test tube into a beaker of boiling water for 1 min.
4. Carefully remove the vial with forceps, or move the test tube to a holder, and allow to cool.
5. Insert the paper reaction sheet into a plastic folder.
6. Place the correct buffer in the relevant circle.
7. Add 1 drop of plant indicator to each circle.
8. Cut a wooden splint to a point and stir each circle before photographing the results.

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### An example of a plant indicator pH profile obtained with the Butterfly Pea Flower is shown below.

### Butterfly pea flower

Butterfly pea pH range Image courtesy of Beth Sutherland and Pixie Murray

# References

### [1] An article on different uses of red cabbage extracts beyond that as a pH indicator: <https://www.chemedx.org/article/aqueous-red-cabbage-extracts-more-just-ph-indicator> .

### [2] A series of posters of various anthocyanin indicator examples: <https://www.compoundchem.com/page/3/?s=anthocyanin>

# Resources

* Try your hand at doing [experiments in hydrogel spheres](https://www.scienceinschool.org/content/small-beautiful-microscale-chemistry-classroom).
* Bring other small-scale experiments into your classroom: Kalogirou E, Nicas E (2010) [Microscale chemistry: experiments for schools](https://www.scienceinschool.org/2010/issue16/microscale). *Science in School* **16**:27-32.
* Check out this infographic showing the [colour changes](https://www.compoundchem.com/2014/04/04/the-colours-chemistry-of-ph-indicators/) of a variety of pH indicators.