YEAR 8

Cabbage Litmus Paper

40 mins +

MATERIALS

- ½ a red cabbage chopped.
- 500ml cold water.
- Blender/ Juicer.
- Chux cloth (for lining colander).
- Colander/ Fine Mesh Strainer.
- Large bowl (1-2 L).
- Paper kitchen towel.
- Scissors.

METHOD:

1. Place the chopped cabbage & 500ml of water into the blender and blitz.

2. Line a colander or strainer with the Chux and strain, reserving the liquid.

3. Quickly soak the paper towel in the reserved liquid & leave to dry.

4. Once dry cut into strips. The paper is now ready to test solutions like soapy water, tap water or lemon juice to see if they are basic or acidic.

WHY?

Pigment molecules give fruit & vegetables their colour & the pigment in red cabbage is called Anthocyanin. Anthocyanin is special in that it is known as an acid-base indicator. When exposed to either an acid or base Anthocyanin molecules change shape which causes them to absorb light differently. This effects what colour our eyes perceive and is why we will see purple for neutral, red/pink for an acid or green/blue for a base.

Cabbage Litmus Paper Experiment

Lesson Outline:

Time allocation: **40 mins**

Format: Class demonstration & Independent/ group work.

Student outcomes:

- Identify Anthocyanin as a pigment which gives fruit and vegetables their red – purple colour.
- Observe the chemical/physical reaction of acid- base indicator pigment Anthocyanin when exposed to an acid or base.
- Correctly identify an acidic or basic solution using Litmus paper.
- Enhance literacy skills.
- Enhance food literacy and food experience skills.

Materials:

FOR CLASS DEMONSTRATION

- 1/2 red cabbage, chopped
- 500ml water
- Blender/ juicer/ Thermomix
- Colander/ fine mesh strainer
- Chux cloth to line colander
- Paper kitchen towel
- Scissors

FOR EACH GROUP

- Lemonade
- Vinegar
- Lemon juice
- Soap
- Laundry powder
- Bicarb soda/ baking powder
- Tap water
- Disposable pipettes/ eye droppers

Optional/ Extra Material:

Preparation: Print a worksheet for each student. You may also wish to have already made a batch of dried Litmus paper to use immediately whilst the batch you freshly prepare is used for a later class.

Setup: **2 mins**

Assemble all necessary equipment for the students to access when conducting their experiment/s. Solutions can be made available for groups in cups or set out to be accessed as needed by each group.

Introduction: **5 mins**

In today's experiment we are going to make Litmus paper from red cabbage.

Ask: Has anyone ever used Litmus paper or know what it is used for?

Litmus paper is one of the oldest forms of pH indicator.

It is used to indicate whether a solution is acidic or basic and is often made by extracting various pigments from Lichen. However, today we are going to extract the water -soluble pigment Anthocyanin from red cabbage to make our Litmus paper.

Anthocyanin is the pigment contained within the cells of the cabbage that give it its reddish -purple colour. Anthocyanin is unique because it is known as an acid- base indicator, which means that when it is exposed to either an acid or base its molecule changes shape which effects how light is then absorbed by the molecule. This changes how the human eye perceives its colour, Anthocyanin is generally purple when neutral but will turn pink-red when exposed to an acid or blue – green when exposed to a base.

Ask: Does anyone know what pH is or why you would need to know it?

pH is a scale that ranges from 0- 14 that is used to measure acidity and basicity of solutions and liquids. It inversely indicates the concentration of hydrogen ions in solution. Less than 7 indicates acidity, 7 is neutral and greater than 7 indicates basicity/ alkalinity.

Common uses of pH include water, soil, and food testing.

Ask: Does anyone know why we'd test these things?

Water- acid rain, chlorination of swimming pools, drinking water supply safety.

Soil- salinity, soil quality, mineral depletion from crops.

In food production pH testing is used for quality control and safety. For example, salami should have a pH of 5.3 or less to protect against the growth of bacteria (Staphylococcus aureus) so that food poisoning doesn't occur because bacteria won't grow well in acidic conditions.

Demonstration: 5 mins

Select students to assist with the demonstration if desired.

1. Chop the cabbage and place into the blender/ Thermomix.
2. Add 500ml of water and blitz until broken down.
3. Line a colander with Chux towel or use a fine mesh strainer.
4. Strain the cabbage juice, reserving the liquid.

Alternatively if using a juicer, juice the cabbage and then combine with the water.

This cabbage juice is now an acid-base indicator solution.

5. Take sheets of paper towel and quickly submerge them in the liquid to make the Litmus paper.
6. Leave them to dry or place them in a drying cabinet to dry.
7. When dry cut the paper into strips and have students conduct the testing of the selected solutions in groups of 2 or 3.

Investigation: 15 mins

Encourage the students to test the various solutions by adding a small drop to their Litmus paper, observing, and recording their results on their worksheet and identifying whether the solutions are acidic or basic.

Conclusion:

Have the groups pack up their experiments, they may choose to keep some of their Litmus paper for further exploration at home.

Conduct an overview of the experiment results.

Take away messages:

Anthocyanin is a pigment that is found in the cells of fruits and vegetables that gives them their red-purple colouring.

- Anthocyanin is unique as it is an acid-base indicator pigment that when exposed to either an acid or a base changes colour.

Chemical reactions can create changes we can see.

- When reacting with an acid or a base Anthocyanin undergoes change in its molecular configuration which effects how light is then absorbed by the molecule. This affects which colour the human eye will perceive; purple when neutral, pink-red when acidic or blue-green when basic. .

- pH is a measure used to determine whether solutions are acidic or basic. There are numerous commercial reasons to test water, soil, and food for pH.
- Water is routinely tested to ensure quality. Soils are tested in agriculture to indicate salinity and mineral depletion. Processed foods are tested to ensure food safety and control/ monitor bacterial growth.

Further Topic Inquiry

This experiment can be further explored within the context of the Health and Physical Education Curriculum. Providing an opportunity for students to develop strategies to ensure safety and wellbeing at home and at school, such as identifying and choosing healthier foods and drinks for themselves.

Refresh.ED provides unit resources for specific year groups within their Food & Drink Choice and Food, Drink & Health focus areas. Of particular interest in relation to extending learning within this area is the unit.

- Year 5 Exploring Food and Food Safety.
- Year 6 Food Safety for Health & Environment.

Cabbage Litmus Paper Worksheet

SOLUTION	COLOUR	ACID/BASE
Tap water		
Lemonade/ Soft Drink		
Lemon juice		
Bicarb soda		
Soap		
Vinegar		
Laundry powder		

pH of Common Substances

1.0 Battery acid

1.2 Stomach acid

2.2 Lemon juice

2.9 – 3.3 Apple juice, cola

4.0 – 4.5 Tomatoes

5.0 Black coffee

6.4 Cow's milk

6.4 – 7.0 Human saliva

6.5 Rain water

7.0 Distilled/pure water

7.3 – 7.5 Human blood

7.8 Egg

8.3 Baking soda

11.0 Ammonia

13.8 Oven cleaner

source: http://coolperiodictable.com/resources/acids-and-bases/pH-of-some-common-substances.php

Overview

In this experiment students explore pH. Specifically, the acid- base indicator pigment Anthocyanin will be extracted from red cabbage to manufacture Litmus paper which will then be used to identify various solutions as either acidic or basic in nature.

Some key new vocabulary students will be introduced to includes: Anthocyanin, pigment, pH, acid, base, alkaline, Litmus paper, acid-base indicator, chemical reaction, physical reaction.

Key Messages

- The bright colours of fruit and vegetables are formed by chemicals in their cells called pigments. The pigment in red cabbage is called Anthocyanin and is water soluble.
- Anthocyanin pigment is unique as it can undergo chemical reactions that produce a change in its colour, it is therefore known as an acid-base indicator. When neutral is purple in colour however when exposed to an acid it turns red/pink or blue/green when exposed to a base.
- pH is a measure of acidity and basicity/alkalinity. Measuring pH is useful to monitor and control water, soil, and food quality.
- Chemical reactions produce new products which can affect physical change.

Learning Outcomes:

- Identify Anthocyanin as a pigment which gives fruit and vegetables their red – purple colour.
- Observe the chemical/ physical reaction of acid-base indicator pigment Anthocyanin when exposed to an acidic or basic solution.
- Correctly identify an acidic or basic solution using Litmus paper.
- Enhance literacy skills.
- Enhance food literacy and food experience skills.

General capabilities:

Literacy, Critical & creative thinking, Personal & social capability.

Year 8 Australian Curriculum Links

Strand/ Sub- strand	Curriculum content descriptions
SCIENCE	
Science understanding. *Biological sciences.*	Cells are basic units of living things; they have specialised structures and functions. Identifying structures within cells and describing their function (ACSSU149).
Chemical sciences.	Chemical change involves substances reacting to form new substances. Identifying the differences between chemical and physical changes. Identifying evidence that a chemical change has taken place. Recognising that the chemical properties of a substance, for example its flammability and ability to corrode, will affect its use (ACSSU225).
Science inquiry skills. *Questioning & predicting.*	Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139).
Planning & conducting.	Collaboratively and individually plan and conduct a range of investigation types. Including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125).
Processing & analysing data & information.	Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS145).
Communicating.	Communicate ideas, findings and evidence-based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS148).
ENGLISH	
Literacy. *Interacting with others.*	Use interaction skills when discussing and presenting ideas and information, selecting body language, voice qualities and other elements to add interest and meaning. Participating in pair, group, class, school, and community speaking and listening situations, including informal conversations, discussions, debates, and presentations (ACELY1808).

External Supporting Resources for Teachers

Experiment overview & explanation.

https://www.stevespanglerscience.com/lab/experiments/red-cabbage-chemistry/