S2 Topic 6

How Can You Tell an Acid from an Alkali?

Level: S2

Topic: Common acids and alkalis and their tests (Sections 10.1 & 10.2 of Unit 10)

Introduction:

This exemplar is developed to illustrate how ELAs are introduced for a major topic (or unit of work) using an incremental approach. Five 40-minute lessons on the topic, *Common Acids and Alkalis*, are designed according to the guiding principles for ELA design stated in Chapter 5, Section 5.2.2.

First, concept names in English are introduced after the Chinese terms have been introduced through various teaching/learning activities. This ensures that the terminology is learned in context and students can capitalize on mother-tongue teaching to get access to the English terms. For example, the names of some apparatus and concepts in English are introduced in practical work conducted in Chinese (see *Lesson Plan 1*/*教案一* and *Worksheet 1*/*工作紙一*). These terms are either frequently used in science activities (e.g. *spotting tile*) or relatively significant in the conceptual understanding of the topic, such as *litmus paper*, *acidic* and *alkaline*.

Besides concept names, verb phrases and statements for description and explanation are intentionally introduced. It is believed that students can grasp more firmly the meaning of a concept when they are asked to describe or explain some phenomena at the sentence level using the concept learned. For example, in an end-of-lesson practice (see *Worksheet 2*), students have to apply their knowledge of litmus paper to decide whether a substance is acidic or alkaline. In Part I of the worksheet students practise using concept names and key terms only. Then in Part II, they have to describe the test results and draw their own conclusions. The phrases and sentence structures found in Part I provide the foundation for students to construct their answers in Part II. Through this practice, students are expected to develop the ability to express in English their understanding of 'how to distinguish acidic and alkaline solutions using common indicators', which is one of the learning outcomes in the CDC syllabus.

To foster effective learning, ELAs can be introduced in a way that enables students to use the relevant English (terms, phrases, etc) in various contexts. For example, the concept names in the topic 'Common Acids and Alkalis' are introduced in both the context of laboratory work (see *Worksheet 1*/*工作紙一* and *Worksheet 4*) and in describing daily products (see *Worksheet 2*).

Towards the end of the topic, one or two activities using English as the medium of learning can be introduced as students may have developed gradually the English competence needed to work on the activities in English alone. In this exemplar, providing English instructions for students to carry out an experiment (see *Lesson Plan 2*/*教案二* and *Worksheet 4*) and reading a passage in English for revision (see *Lesson Plan 3*, *Reading Passage 1*, *Diagrams 1 and 2*) are suggested at the end of the topic. All four language skills are integrated in this type of activity. For example, in order to carry out the experiment, students have to employ their reading skills to follow the instructions in *Worksheet 4*, listening and speaking skills to discuss the results, and writing skills to report the results in the worksheet. In doing the reading comprehension task, reading skills are employed to extract relevant information from the reading passage and complete the concept maps. In addition, students are asked to explain part of the concept maps to each other orally so that they can practice their listening and speaking skills.

教案(一)

科目	綜合科學
年級	中二
課題	常見的酸和鹼
節數	2 (第一、第二課節)
教學目標	學生能： • 以石蕊試紙、pH 試紙及通用指示劑測試溶液，將物質分成酸鹼兩類。 • 說出石蕊試紙在接觸酸性和鹼性物質時的顏色轉變。 • 利用 pH 值的概念將物質分成酸性、中性和鹼性三類。 Language Objectives: After completing the activity, students should be able to • understand and use the English terms appropriately (e.g. *acid, alkali, acidic, alkaline, litmus paper, pH paper* and *universal indicator);* a • state and explain (verbally and in written form) whether a substance is acidic or alkaline based on its pH value.
教材	工作紙(一), Worksheet 2, 工作紙(三)

教學步驟

學習重點	學習活動	時間/分鐘
知道有些物質是酸性，有些是鹼性	1. 教師示範以紅色和藍色石蕊試紙分別測試兩種家居物品：檸檬汁和稀釋洗手液，以展示不同的顏色變化。 2. 學生分組測試其他物質 (見工作紙一)，並完成表一和題 (1) 和 (2)。 (註：老師可因應學生的能力改寫題 (1) 和 (2)，例如老師可刪除題 (2)並把題 (1) 改寫如下： *(1) 跟據表(一)中紅、藍色石蕊試紙的顏色變化結果，所提供的物品可分為多少類？_____ 你會如何分類？* 用以增強問題的開放性，提升對學生的高階思維的要求。) 3. 從實驗結果，教師引出酸性和鹼性的概念，並引導學生說出相關石蕊試紙的顏色轉變及指出蒸餾水是中性液體。 4. 學生完成工作紙(一)題 (3)。 5. 學生分組測試一些實驗室的化學品，並完成工作紙(一)餘下部分。	40
ELA	6. Students complete Worksheet 2 in class and group discussion is encouraged. Teacher will ask students to answer the questions on the worksheet.	15

pH 值的概念	7. 運用 pH 試紙及通用指示劑測試酸性和鹼性物品，從而引出 pH 值的概念 (工作紙三)。教師先示範一次並指出可從 pH 試紙顏色找出物品的 pH 值。	15
總結	以提問做總結，先以 CMI，再以 EMI 重温。 EMI Questions: • Name the paper that can be used to test whether a substance is acidic or alkaline. • If a substance is an acid, (a) what will be the colour change in the litmus paper? (b) what will be its pH value? • If a substance is an alkali, (a) what will be the colour change in the litmus paper? (b) what will be its pH value?	10

工作紙(一)　用石蕊試紙測試物質並將它們分類

實驗一

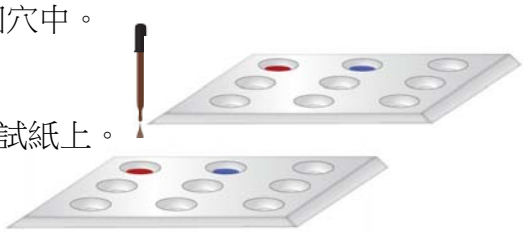
儀器及材料

滴管 (dropper)	1	藍色石蕊試紙	7 小片
滴試瓷磚 (spotting tile)	1	紅色石蕊試紙	7 小片
測試物品 (參考下表)		乾布	1 塊

步驟

1. 分別把一片紅色和一片藍色石蕊試紙放在滴試瓷磚的凹穴中。

2. 用滴管抽取表(一)中的物品，分別滴在紅色和藍色石蕊試紙上。



3. 細心觀察試紙的顏色變化，並把結果記錄在下表中。

4. 以蒸餾水清洗滴試瓷磚後把它抹乾，並重複步驟 1 至 3 以測試其它物品。

結果 (表一)

物品名稱	紅色石蕊試紙的顏色	藍色石蕊試紙的顏色
醋		
漂白水		
洗潔精		
可樂汽水		
玻璃清潔劑		
蘋果汁		
蒸餾水		

注意:
- 每測試一種物品後，必須把滴管洗淨以減低污染。

(1) 跟據表(一)中紅、藍色石蕊試紙的顏色變化結果，所提供的物品可分為多少類？

_____

(2) (a) 一類物品會把紅色石蕊試紙變成 _____.

(b) 另一類物品會把藍色石蕊試紙變成 _____.

(c) 用紅色或藍色石蕊試紙測試蒸餾水，試紙顏色 _____.

(3) **小結**

紅色和藍色試紙分別稱為 _____(red litmus paper) 和 _____ (blue litmus paper)。它們可用來 測試 (test) 物品是 酸性 (acidic) 或是 鹼性 (alkaline)。酸性物品把藍色石蕊試紙轉成_____，而鹼性物品則把紅色石蕊試紙轉成_____。

註：石蕊試紙 (litmus paper) 有液體裝，稱為 石蕊溶液 (litmus solution)。

實驗二

儀器及材料

滴管 (dropper)	1	藍色石蕊試紙	7 小片
滴試瓷磚 (spotting tile)	1	紅色石蕊試紙	7 小片
測試物品 (參考下表)		乾布	1 塊

步驟

如實驗一的步驟一樣，將表(二)中各化學物品逐一用石蕊試紙測試並將結果記錄在表(二)。

結果：(表二) 化學物品酸鹼測試結果

化學物品名稱	紅色石蕊試紙的顏色	藍色石蕊試紙的顏色	酸性 / 鹼性
氫氯酸			
氫氧化鈉			
硫酸			
石灰水			

Worksheet 2

Part I

Fill in each blank with one of the following words: *blue, red, litmus paper, acidic and alkaline.*

1.

Orange juice changes blue litmus paper to red.

It is _____.

2.

Detergent changes red litmus paper to blue.

It is _____.

3.

7-up changes blue _____ to red.

It is acidic.

4.

Liquid A changes _____ litmus paper to _____ .

It is alkaline.

Part II

Complete the sentences on the right hand side. You can follow the sentence pattern in Part I.

5.

Apple juice

_____.

It is _____.

Apple juice (blue litmus paper → red)

6.

Tooth paste

_____.

It is _____.

Tooth paste (red litmus paper → blue)

7.

Window cleaner

_____.

_____.

Window cleaner (red litmus paper → blue)

8.

Vinegar

_____

.

_____.

Vinegar (blue litmus paper → red)

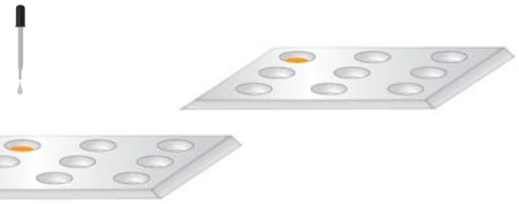
工作紙(三)

找出下列物品的 pH 值

儀器及材料

滴管 (dropper)	1	pH 試紙	10 小片
滴試瓷磚 (spotting tile)	1	pH 顏色圖表 (pH colour chart)	1
測試物品 (參考下表)		乾布	1 塊

步驟



1. 把一小片 pH 試紙放在滴試瓷磚的凹穴中。
2. 用滴管把一滴檸檬汁加在 pH 試紙上。
3. 細心觀察 pH 試紙的顏色變化，並跟 pH 顏色圖表對照，找出對應的 pH 值，然後把結果記錄在下表中。(填寫 pH 值前，先根據過往的測試結果，寫下該物品屬酸性 / 中性 / 鹼性)
4. 以蒸餾水清洗滴試瓷磚後把它抹乾，並重複步驟 2 至 4 以測試其它物品。

結果

物品名稱	以往測試的結果 (酸性 / 中性 / 鹼性)	pH 值
醋		
漂白水		
洗潔精		
可樂汽水		
玻璃清潔劑		
蘋果汁		
蒸餾水		
氫氯酸		
石灰水		

注意:
- 每測試一種物品後，必須把滴管洗淨以減低污染。

結論

酸性 (acidic) 物品的 pH 值是 _____。

中性 (neutral) 物品的 pH 值是 _____。

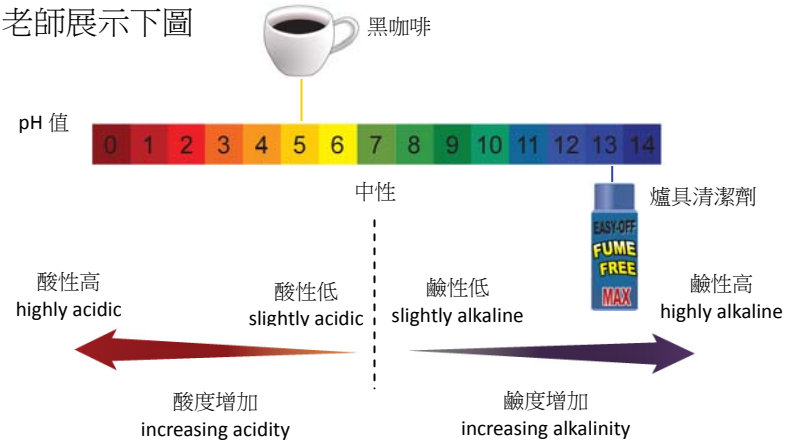
鹼性 (alkaline) 物品的 pH 值是 _____。

教案(二)

科目	綜合科學
年級	中二
課題	常見的酸和鹼
節數	2 (第三、第四課節)
教學目標	學生能： • 運用 pH值的概念分辨物質的酸鹼度 • 指出 pH值的範圍是 0 至 14 • 說明 pH值愈低，代表酸度愈高；pH值愈高，代表鹼度愈高 • 知悉 一般日常及實驗室物品的酸鹼度 ELA objectives – students should be able to • tell whether a substance commonly used in daily life is acidic or alkaline • test the acidity and alkalinity of substances with pH paper.
教材	Worksheet 4

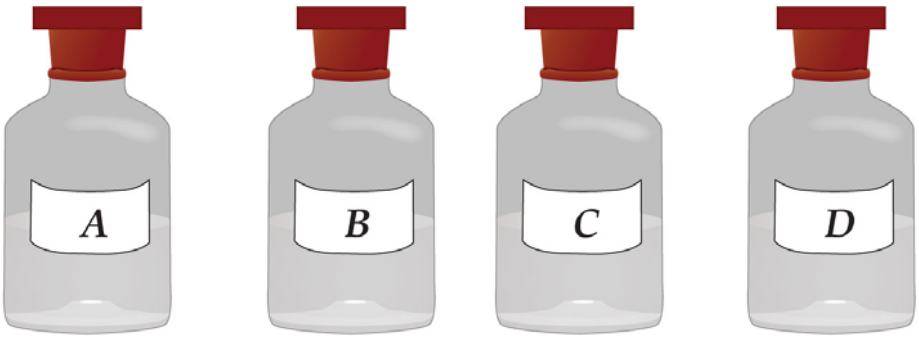
教學步驟

學習重點	學習活動	時間/分鐘
温習及引起學生對 pH 值的學習動機	1. 老師提出以下問題，讓學生温習測試酸性、鹼性物品的方法及引起學生對 pH 值的學習動機。 • 哪些東西可用來測試物品是酸性或是鹼性？ • 有物品 A 和 B，物品 A 的 pH 值為 8 而 B 的則為 10。 ⇨ 物品 A 和 B 分別是酸性、鹼性或是中性？ ⇨ 物品 A 和 B 都是鹼性，但有不同的 pH 值 這代表什麼呢？	5
pH 值用的意義及數值範圍	2. 老師着學生檢視工作紙(三)的實驗結果，引導學生總結出： • 同屬酸性的物質，其 pH 值可能不同，但都是少於 7 • 同屬鹼性的物質，其 pH 值可能不同，但都是高於 7	10

比較一般日常及實驗室物品的 pH 值	3. 老師展示下圖  並利用上述兩個結論引出下列概念： • 不同的酸度和鹼度 • 酸性高、酸性低 • 鹼性高、鹼性低 並加以解釋 老師亦指出酸性和鹼性物品是具有腐蝕性，要小心處理，並且當物品的酸性或鹼性愈高，腐蝕性愈強，可能嚴重傷害人體。	15
ELA	4. Teacher displays 4 reagent bottles labeled as *A*, *B*, *C* and *D* on the teacher's bench and introduces the task. 5. Students follow the prescribed steps to test the unknown solutions and record the results. They should decide whether the substance in each bottle is highly or slightly acidic, alkaline or neutral, based on its pH value. 6. Teacher will call some students to tell the class their results.	40
總結	以問題測試學生對 pH 值的理解，先以 CMI，再以 EMI 重温。 • The pH value of apple juice is about 4. Name some substances which are more acidic than it. • If a substance is more alkaline than lime water, what could its pH value be?	10

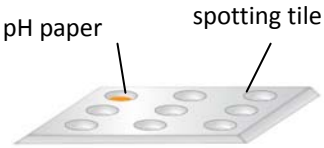
Worksheet 4

Task: To find out the acidity and alkalinity of the substance in each bottle.

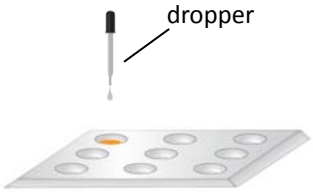


Apparatus and Materials:

- pH paper 3
- pH colour chart 1
- spotting tile 1
- dropper 4

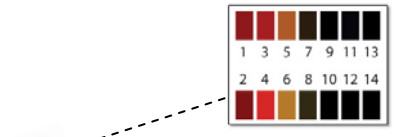


Steps:



1. Put a small piece of pH paper in one of the cavities of the spotting tile.

2. Use a dropper to add one drop of the liquid from bottle *A* to the pH paper.



3. Match the colour of the pH paper against the pH colour chart.

4. Record the result of the pH value in Table 1.

6. Repeat steps 1 to 4 to find out the pH values of the liquids in other bottles

Results

Table 1

	pH value	Complete each sentence with one of the following words: *highly acidic, slightly acidic, highly alkaline, slightly alkaline, neutral*
Solution in bottle A		The solution is _____.
Solution in bottle B		The solution is _____.
Solution in bottle C		The solution is _____.
Solution in bottle D		The solution is _____.

Lesson Plan 3

科目:	綜合科學
年級:	中二
課題:	常見的酸和鹼
ELA:	How can you tell an acid from an alkali?
節數:	1 (第五課節)

Description: This lesson consists of an ELA only. It is a follow-up lesson on some concepts (see lesson plans 1 and 2) which students have learned through CMI. Students will be required to read a passage about acid and alkali and complete two concept maps relating to the passage. Then different students will be asked to explain different parts of the concept maps to the class.

Content Objectives: After completing the activity, students should be able to:

- better understand the key concepts related to acids and alkalis (e.g., *acidity, alkalinity, indicators, litmus, universal indicator high acidity, low acidity, high alkalinity* and *low alkalinity)*;
- consolidate their understanding of these key concepts by completing and discussing these two concept maps;

Language Objectives: After completing the activity, students should be able to:

- understand and use the English terms related to this topic (e.g., *acids, tested by, litmus paper, changes colour, from blue to red, universal indicator, indicate, high acidity, low acidity, materials at home, fruit juice, soft drinks, taste sour, materials at laboratory, hydrochloric acid, strong acid, corrosive, destroy, surface, burn, alkalis, from red to blue, high, low alkalinity, detergents, cleaners, lime water*);
- read and understand the given passage containing concepts such as *acidity, alkalinity, indicators, litmus, universal indicator* which they learned in the previous two double lessons.
- extract information from the passage and complete the given two concept maps;
- read out the key terms in the concept maps and answer the related questions verbally.

Materials: Reading Passage 1 and worksheets with concept maps (Diagram 1 & Diagram 2)

Steps:

Pre-reading – Whole-class activity (10 min)

1 Using questioning, teacher reviews the subject matter about acid and alkali students learned in the last four lessons. The questions should be designed to check students' understanding of the following key words and their ability in using them: acid/acidic, neutral, alkali/alkaline, litmus paper, pH paper, universal indicator.

2 Explain to the class that they are going to read an English passage about acid and alkali. Tell students that they have already learned the key words in the passage and ask them to ignore any difficult words they do not understand.

3 Divide the class into groups of four or five. Ask the students to go through the passage and help each other in understanding it.

4 Show the first concept map on the board (the term *concept map* need not be introduced to students). Explain what students are required to do with the worksheet after their reading.

5 Tell students that they will be asked to come out and explain to the class their completed worksheets.

Reading and completing the worksheet – Group work (15 min)

6 Students read in groups and complete the worksheet. Teacher provides guidance to individual groups where necessary.

Post-reading activity– whole-class activity (15 min)

7 Ask one group to come out and present their answers on acid by using a visualizer.

8 Ask each member of the group to use one sentence to tell the class something about acid which is based on the concept map.

9 Teacher provides feedback and asks other students to give answers where necessary.

10 Repeat with the worksheet on alkalis.

(Reading Passage 1)

How can you tell an acid from an alkali?

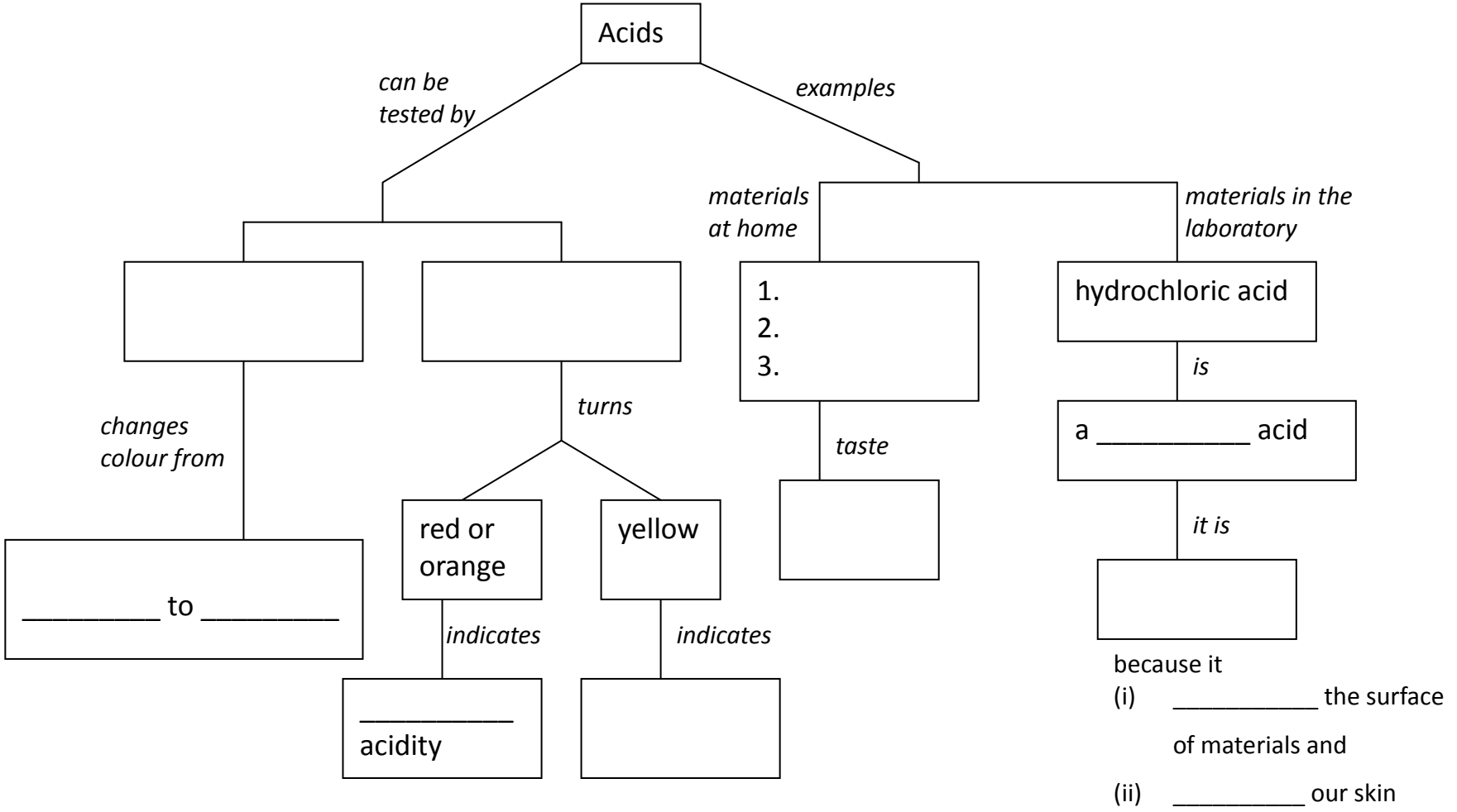
We can group substances according to the characteristics whether they are acidic, neutral or alkaline. How can we do this?

We can use litmus paper, pH paper or universal indicator. When we put a drop of acid on a piece of blue litmus paper, it will turn red; when we put a drop of alkali on a piece of red litmus paper, it will turn blue. However, litmus paper cannot tell how acidic or how alkaline a substance is. Universal indicator or pH paper is more useful than litmus paper because it can tell the acidity (that is, how acidic) and the alkalinity (that is, how alkaline) a substance is. Universal indicator is made from a mixture of different indicators. It shows different colours in substances with different acidity or alkalinity. It turns red, orange, orange yellow, or yellow in acidic solutions. A red or an orange colour indicates an acid with high acidity, and a yellow or an orange yellow colour indicates low acidity. In alkaline solutions, universal indicator turns dark green, bluish green, blue or purple. A blue or purple colour means an alkali with high alkalinity, and a dark green or bluish green colour means low alkalinity. A neutral solution will turn a universal indicator light green.

Many materials that we use at home are either acidic or alkaline. Fruits, fruit juices and soft drinks are acidic; they taste sour. Detergents and many types of cleaners are alkaline. In the laboratory, many acids and alkalis can be found. For example, hydrochloric acid is an acid and lime water is an alkali. Many acids and alkalis in the laboratory are strong acids or strong alkalis. They are corrosive and will destroy the surface of solid materials and burn our skin. We should be very careful in using them and should never touch or taste them. Acidic or alkaline materials used at home are usually weaker but some cleaners are quite strong and are also corrosive.

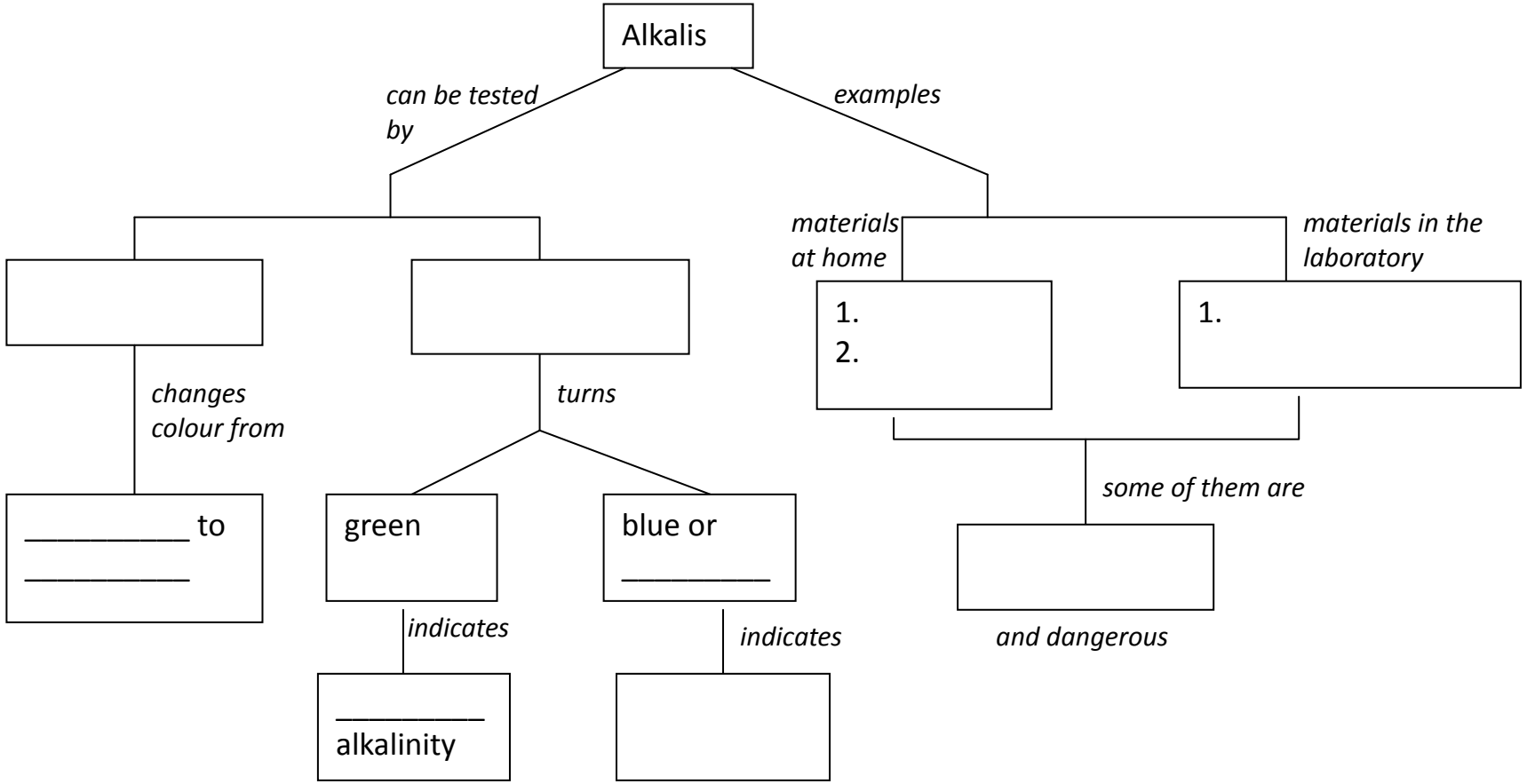
(Diagram 1)

How can you tell an acid from an alkali?



(Diagram 2)

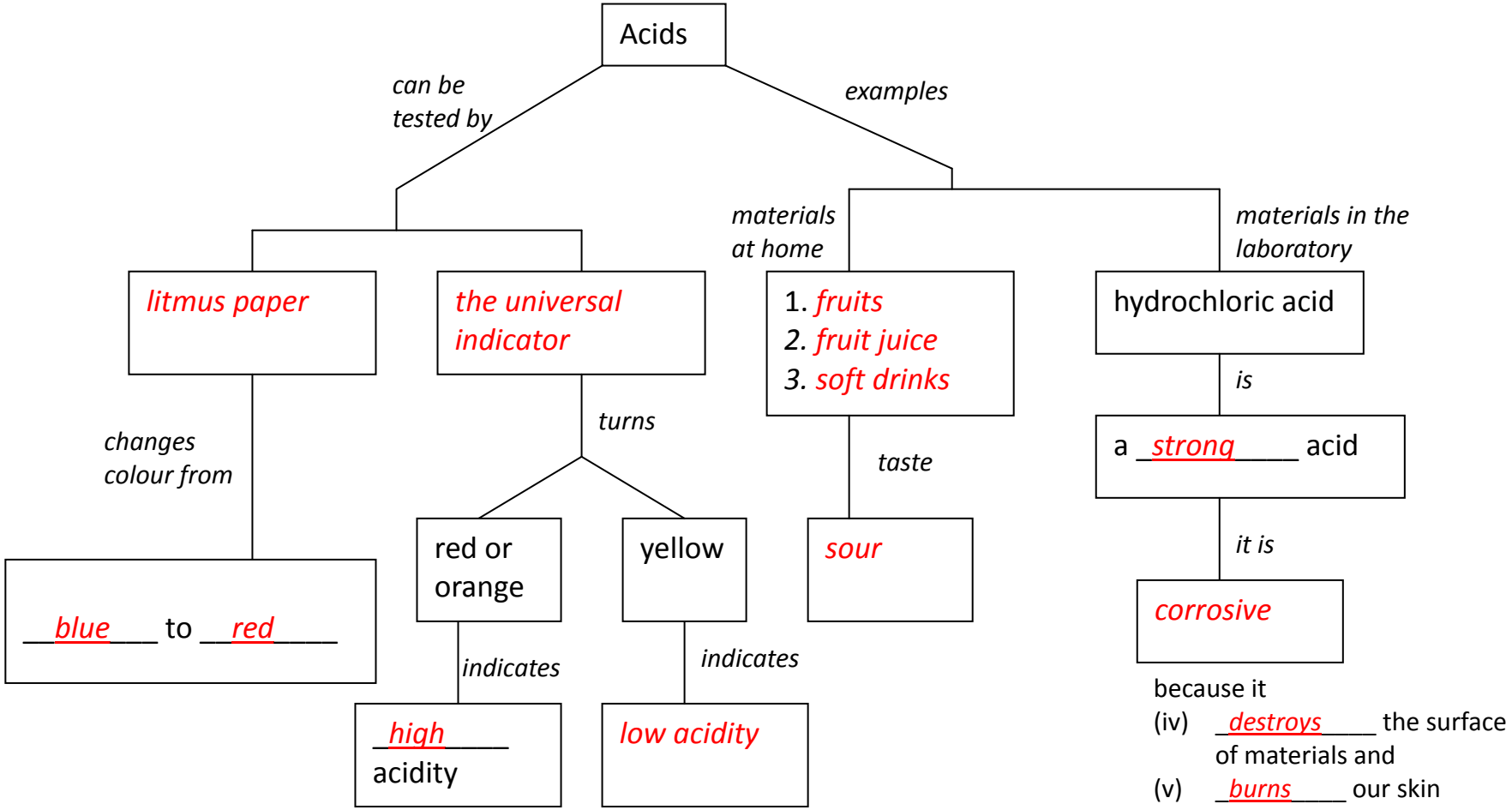
How can you tell an acid from an alkali?



(Diagram 1)

Answers

How can you tell an acid from an alkali?



(Diagram 2)

How can you tell an acid from an alkali?

Answers