



## Acids, Bases and pH!

### Teacher Background Information:

This lab is intended to introduce students to the concepts of acids, bases and pH using household chemicals and products. Students design their own set of experiments to determine the best suitable indicator to test the pH of the various substances.

### Educational Goals: Students will be able to...

- Measure the pH using a pH meter, pH or litmus paper, and/or indicators.
- Categorize or Group substances based on physical properties
- Observe physical properties of acids and bases.

### Student Objectives:

- To determine the pH range of red cabbage juice, beet juice and blueberry juice
- To classify household substance as acids or bases using natural indicators
- Measure pH using a pH meter, pH or litmus paper, and/or indicators
- To analyze which natural indicator is the best for each household substance

**Time Required:** 1 x 45-60 minute class period

### Materials (you may choose other household products or let students bring some in):

- |                   |  |
|-------------------|--|
| • Soda            | • Salt water   |
| • Lemon juice     | • pH meter   |
| • Lawn Fertilizer | • Litmus Paper   |
| • Hibiscus Tea    | • pH paper   |
| • Vinegar         | • Various Indicators Juices (Red cabbage, blueberries, Beets)* |
| • Orange juice    | • Beakers  |
| • Shampoo         | • Pipettes   |
| • Baking Soda     | • Spotting Plates  |
| • Spaghetti Sauce | • Glass Stirring Rods  |
| • Milk            |  |
| • Distilled water |  |

\*Fresh Red Cabbage and Beet Juice: (students will determine this)

- red/orange colour = pH 0 - 7
- Blue/green colour = pH 7 - 14

\*Fresh Blueberry Juice:

- Blue colour = pH 0 - 7
- Green colour = pH 7 - 14

**Green Chemistry Principles Addressed:** Pollution Prevention □ Safer Solvents and Auxiliaries □ Use of Renewable Feedstocks □ Inherently Safer Chemicals for Accident Prevention

### Teacher Prep:

- Place samples with labels of the above materials at several stations in the classroom.
- Prepare various indicator solutions, pH paper, and pH meter for student use. Each student team will need a spot plate to test their samples.

### Procedure and Teacher Notes:

- Explain to students that today they will be learning more about acids and bases.
- Explain the stations you have set up around the room
- Hand out Students Worksheets
- Ask students to complete the lab activity according to the worksheet
- Give each group of students a well plate that they will use to develop their procedure explained in Part I of the Student Worksheet
- Notes for Part I:
  - Students will be given the task of developing a procedure to determine the pH range of different natural indicators. They will develop this test with common household chemicals that are generally known to be acidic or basic (lemon juice, baking soda, distilled water, vinegar, lawn fertilizer).
  - The students should use the three provided natural indicators (cabbage juice, blueberry juice and beet juice) to determine the pH range of each indicator. Students will typically use the three rows to create a matrix of the 5 household products each with the three indicators in them. They can then determine the actual pH of each of the wells using pH paper and/or a pH meter.
  - They should use 2-3 drops of the household product, with 2 drops of indicator in each well.
- When everyone is finished with their observations, have groups whiteboard their results on which indicator gave the best results for each substance.
- Upon collecting all of their results from Part I, students should then use the data from Part I to predict the pH of other common household items using the natural indicators.
- Provide other example materials (apple juice, yogurt, body wash etc.) for students to predict pH.
- Ask students to evaluate the 'greenness' of the above lab activity based on the 12 principles.



## Acids, Bases and pH! Student Worksheet

Name(s) \_\_\_\_\_ Hour: \_\_\_\_\_ Date: \_\_\_\_\_

### Part I: Determining the pH range of various juice indicators

1. Look at your spot plate and notice how many wells are on each plate. Each team needs to develop a plan for testing the indicators for pH range of 0-14. You have three natural indicators that you will be using to determine the pH: cabbage juice, blueberry juice and beet juice. Using the following materials, determine the color range and the pH range of each natural indicator: lemon juice, baking soda, distilled water, vinegar, lawn fertilizer and pH meter or pH paper.
2. Your job is to write a procedure for how you determined the color range of each natural indicator and then fill out the tables. Make sure you have recorded the pH and color of that indicator as you will be using this data for Part 2.

Procedure to determine pH range of cabbage juice, blueberry juice and beet juice





## Acids, Bases and pH! Student Data Table Part II

Name(s) \_\_\_\_\_ Hour: \_\_\_\_\_ Date: \_\_\_\_\_

Solution	Color in Cabbage Juice	Color in Beet Juice	Color in Blueberry Juice	Acid or Base?	Predicted pH
<b>Unknown Sample -</b>					

## Analysis and Conclusion

1. What color did all the indicators turn to indicate a neutral substance?
2. What color did the cabbage juice turn to indicate an acid? \_\_\_\_\_ A base? \_\_\_\_\_  
What color did beet juice turn to indicate an acid? \_\_\_\_\_ A base? \_\_\_\_\_  
What color did blueberry juice turn to indicate an acid? \_\_\_\_\_ A base? \_\_\_\_\_
3. Which indicator do you think work best overall and why?
4. Which indicator do you think works best for acidic items and why?
5. Which indicator do you think works best for alkali items and why?
6. Look at the 12 principles of green chemistry and in your group discuss which principles are used in this lab and why. Be prepared to share in class.