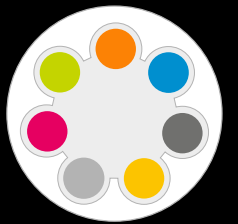


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▶ How acidic are the things we drink?

Measuring the pH of common drinks





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▶ How acidic are the things we drink?

Measuring the pH of common drinks

Objective

Introduction and theory

Activity description

Resources and materials

Using the Labdisc

Experiment

Results and analysis

Conclusions

Activities for further application

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▶ How acidic are the things we drink?

Measuring the pH of common drinks

Objective



The objective of this activity is to compare the pH of fizzy drinks and alcoholic beverages, formulating a hypothesis and proceeding to check it using the Labdisc pH sensor.

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Introduction and theory



The aim of the introduction is to focus students on the lesson subject by refreshing acquired knowledge and asking questions which encourage research development. Key concepts from the theoretical framework, applied by the students during the lesson, are taught.

Introduction

Have you ever felt a burning sensation at the top of your stomach after eating a large meal, or having a specific food or beverage? It could even happen with something healthy like a seasoned lettuce with lemon juice. This feeling is known as heartburn. Heartburn is caused by excessive consumption of certain substances that can change the normal acidity of our stomach. Do you know exactly what the concept “acidity” means? In this class we invite you to discover the true meaning of this word, and to measure how acidic different beverages that we often drink really are.



Can you name some popular drinks that people consume on a regular basis? Try to organize them according to their degree of acidity.

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How acidic are the things we drink?

Measuring the pH of common drinks

Introduction and theory



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Have you ever heard about the term “pH”? What do you think it refers to?

Carry out the experiment activity with your class so that at the end you’ll be able to answer the following question:

?

How acidic are common beverages?

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▶ How acidic are the things we drink?

Measuring the pH of common drinks

Introduction and theory



Theoretical

When we talk about acid and alkaline, we are referring to the amount of hydrogen present in a solution. Acid raises the concentration of hydrogen, while an alkali lowers the hydrogen concentration. To know if a substance is acid or alkaline we measure the pH (potential of hydrogen), with a pH meter and probe. The pH is measured on a scale of 1 to 14. The higher the pH, the more alkaline (or base) the solution, 1 is the most acidic and 14 the most alkaline. If the pH is 7 it is considered neutral, below this value it is considered acidic and above basic. Inside our stomach we can find a pH 1 (extremely acidic), wine has a pH of 3.5, blood of 7.35, sea water of 8.5, etc.

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▶ How acidic are the things we drink?

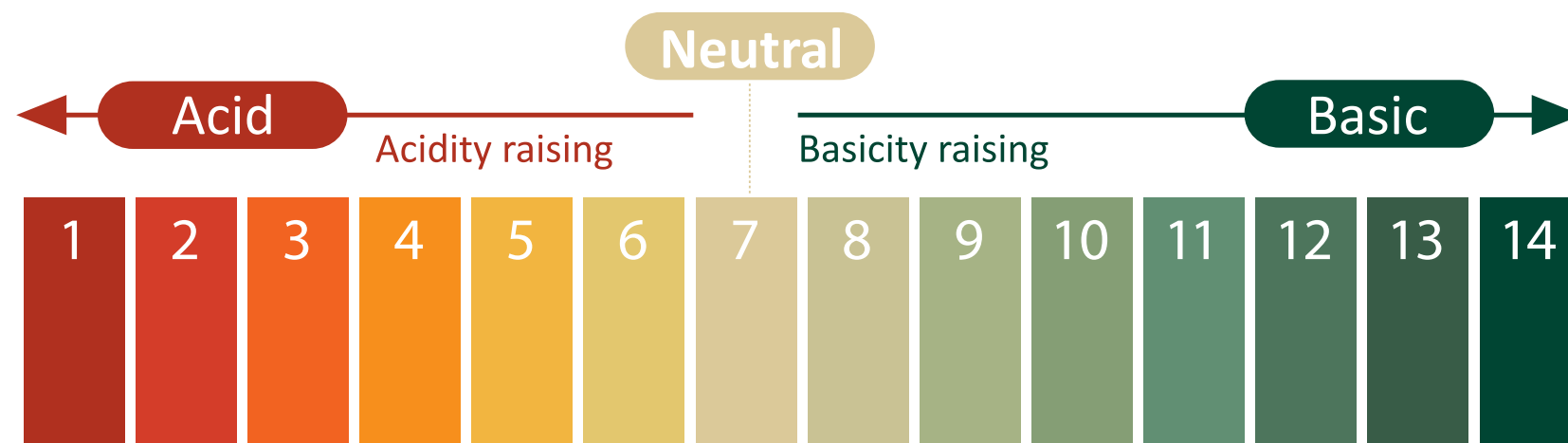
Measuring the pH of common drinks

Introduction and theory



Every solution inside or outside the human body is acid, alkali or neutral. This means that blood, gastric juice, wine, coffee and so on have each a specific pH.

Inside the human body under ideal conditions we should find an acidity degree between 7.35 and 7.45, this means slightly basic.



Inside our organism it is vital to maintain a certain acid-basic balance, because a lot of metabolic reactions that perform fundamental roles inside our body can only happen at precise levels of acidity or basicity. A small change in the pH of the solution can affect the rate of important chemical reactions that our metabolism depends on, so risking the natural processes that occur in our body.

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Measuring the pH of common drinks

Introduction and theory



For example, during exercise the acidity of the muscles rises because of the generation of lactic acid. This causes pain and a decrease of voluntary muscle contraction.

Now students are encouraged to raise a hypothesis which must be tested with an experiment.

?

If you have a fizzy drink and alcoholic beverage, do you think there is a difference in their pH? Which one do you expect to be more acidic and which one more basic?

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Measuring the pH of common drinks

Activity description



During the following activity students will measure the pH of different kinds of fizzy and alcoholic beverage, using the Labdisc pH sensor. The results will then be arranged in order from lowest to highest pH. In conclusion, students should relate the excessive consumption of acidic substances to physical symptoms that people experience.

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Measuring the pH of common drinks

Resources and materials

- 1 Labdisc
- 2 USB connector cable
- 3 pH sensor
- 4 Tape to mark the glasses
- 5 Wash bottle
- Distilled water
- Beaker or some other glass
- Distilled beverage (brandy, vodka, cognac, gin, rum or whiskey)
- Beer
- White or red wine
- Orange juice
- Coca Cola
- Sprite



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Using the Labdisc and sensor



a. Using the Labdisc

To collect measurements with the Labdisc pH sensor, the Labdisc must be configured according to the following steps:

- 1 Turn on the Labdisc by pressing
- 2 Press , and select "SETUP" by pressing
- 3 Now select option "SET SENSORS" with
- 4 Select only the pH sensor and then push
- 5 Once you have done that you will return to setup, press
- 6 Select "1/sec" with and then press
- 7 Press and select "NUMBER OF SAMPLES" with
- 8 Select "10000" with and then press





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Measuring the pH of common drinks

Using the Labdisc and sensor



- 9 To go back to the measurements press  three times
- 10 Then press  to start measuring
- 11 Once you have finished measuring stop the Labdisc by pressing  (you will see the instruction "Press SCROLL key to STOP), then press 

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Measuring the pH of common drinks

Using the sensor



b. Care and cleaning of the sensor

The pH sensor is very sensitive, and requires certain treatment. Please consider that:

- 1 After each measurement the pH probe should be cleaned with distilled water. Always keep the wash bottle and distilled water close at hand. If you don't have a wash bottle you will need a syringe of at least 10 ml in order to clean the sensor properly.
- 2 Following each time the sensor is washed, ensure it is dried with absorbent paper, without touching the transparent ball at the tip of the sensor.

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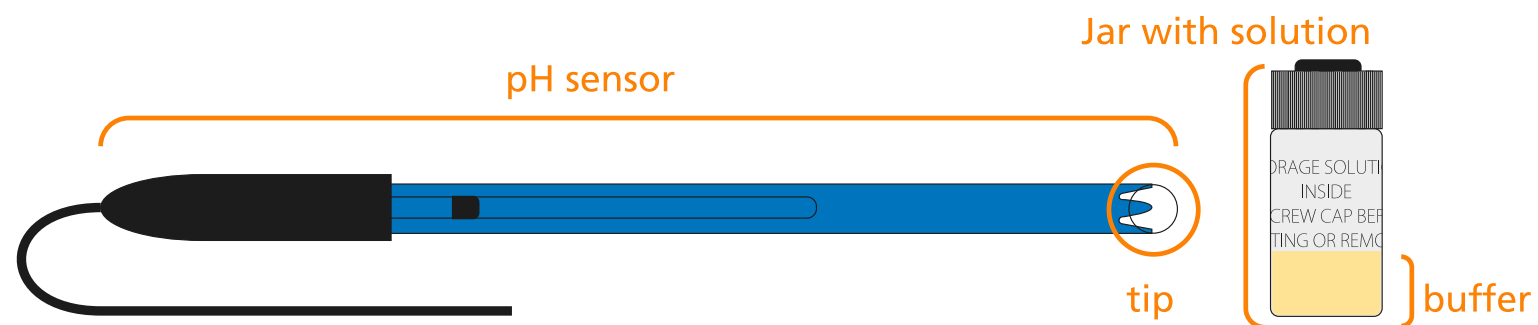
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Using the sensor



- 3** Whenever the sensor is not used it must stay inside the buffer solution inside the jar. Ensure the sensor is always cleaned and dried properly before inserting the tip of the sensor into the solution (see steps 1 and 2).



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Experiment



The following steps explain how to perform the experiment:

- 1 Take the six plastic glasses and mark each of them with the name of the substance you will analyze (e.g. wine)
- 2 Put a small amount of the drink inside the glass, about 50 ml (you should be able to completely insert the tip of the sensor into the solution)
- 3 To start measuring remove the electrode from the buffer and clean it with plenty of distilled water. Dry it with absorbent paper.
- 4 Measure the pH of the different substances inside the glasses according to the following order: White soda, orange juice, cola soda, distilled beverage, wine and finally beer.
- 5 To collect data put the electrode inside the sample without touching the sides of the plastic glass


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Measuring the pH of common drinks

Experiment



- 6 Press the  button of the Labdisc
- 7 Observe the pH variation displayed on the Labdisc screen
- 8 Wait until the pH value you are measuring stabilizes. It is ready when the second decimal displayed on the screen varies between ± 1 .
- 9 Once you have taken the first measurement clean the electrode again with distilled water and dry using the absorbent paper
- 10 Once you have finished measuring turn the Labdisc off
- 11 Remember to wash the sensor after each measurement with plenty of tap water, rinsing well the tip of the electrode
- 12 Obtain the pH for each substance. Once you have finished remember to place the sensor back inside the buffer solution.

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Measuring the pH of common drinks

Results and analysis



The following steps explain how to analyze the experiment results.

- 1 Connect the Labdisc to the computer
- 2 On the upper menu press the button  and select 
- 3 Select the last experiment from the list
- 4 Observe the graph displayed on the screen
- 5 Press the button  and write notes on the graph specifying your observations
- 6 Press  to select data points on the graph and pick one representative point for each of the solutions (the representative points are the ones achieved once the measurement reaches a plateau)

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Measuring the pH of common drinks

Results and analysis



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How do your results relate to your initial hypothesis? Explain.

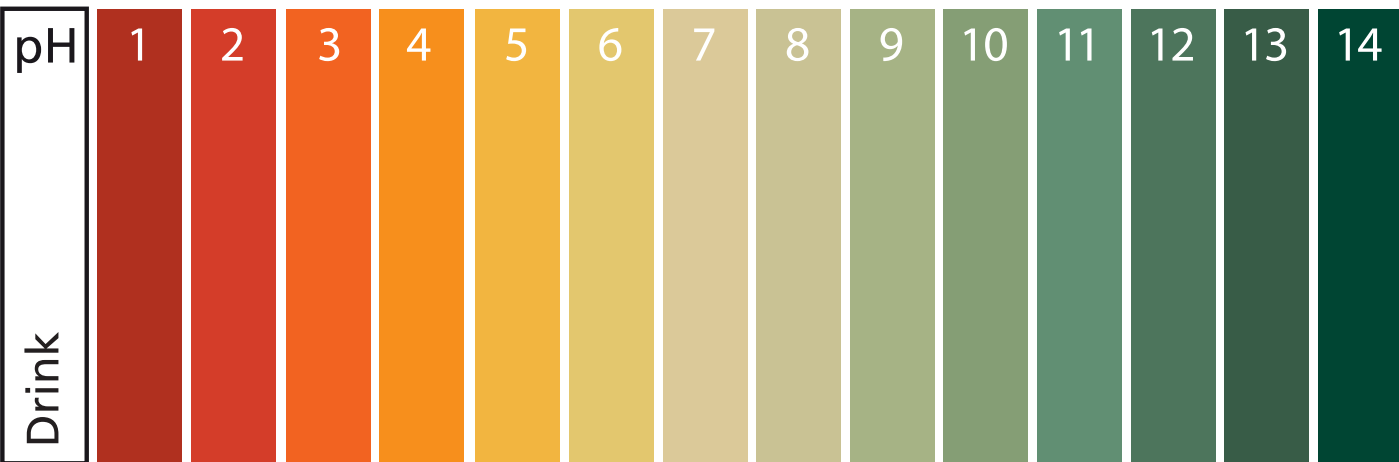
?

Which was the most acidic substance you analyzed? Which one was the most basic?

?

Locate each substance on the pH scale displayed on the theoretical background, according to the data you collected.

- Coca Cola
- Sprite
- Orange juice
- Wine
- Beer
- Distilled beverage



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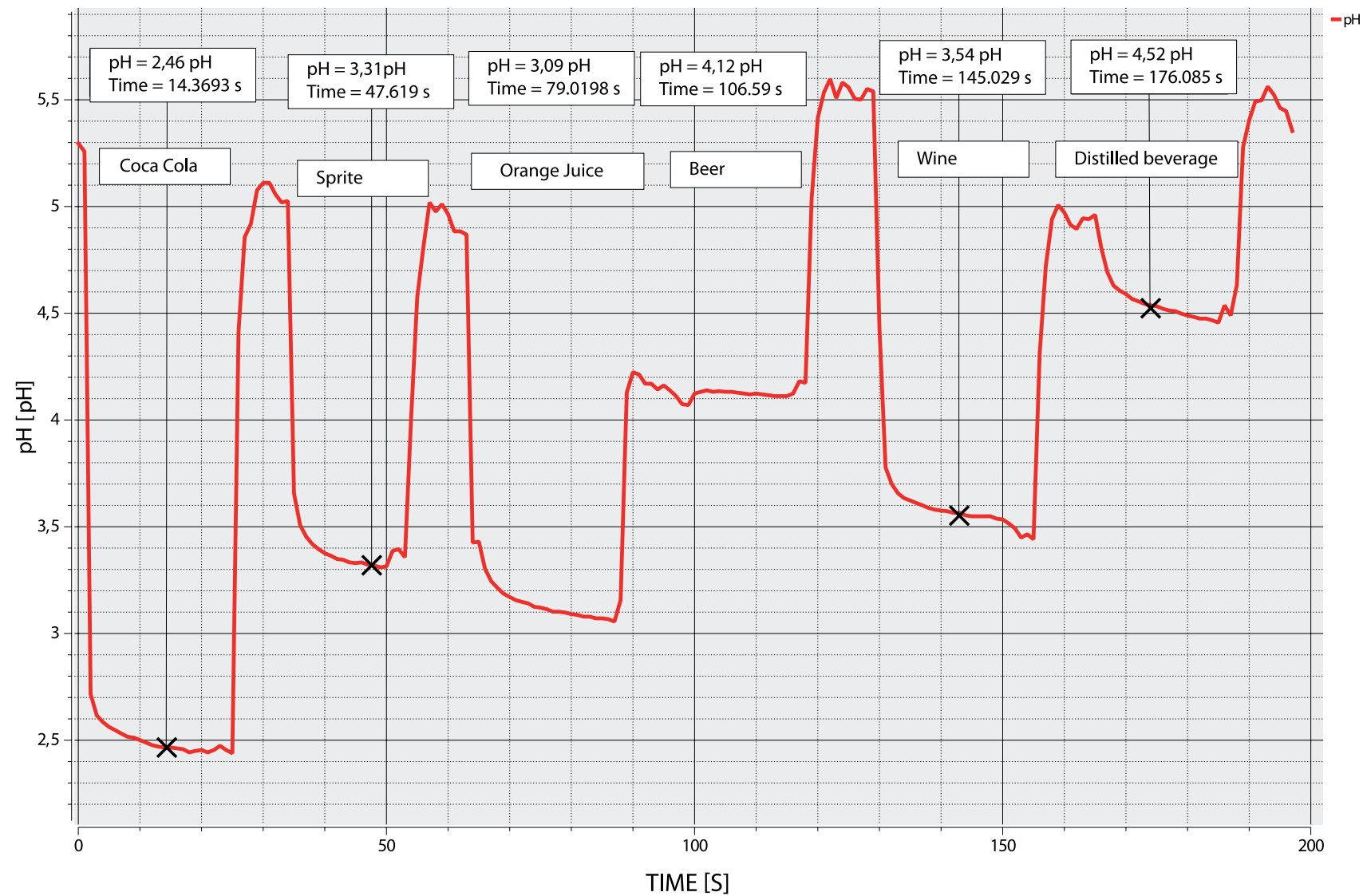
▶ How acidic are the things we drink?

Measuring the pH of common drinks

Results and analysis



Students should come up with a graph similar to the one below:



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▶ How acidic are the things we drink?

Measuring the pH of common drinks

Conclusions



Following are some questions and answers which should be developed by students in order to elaborate on their conclusions.

?

How does the proton (hydrogen) concentration of Coca Cola compare to the distilled beverage?

Students should explain that the proton concentration of cola soda is higher than that of the distilled beverage, because it has a lower pH value (therefore, it is more acidic).

?

Would you say that the pH of any sort of alcoholic drink correlates to the alcoholic degree?

Students should find out that there isn't a correlation between the alcohol degree and the acidity degree. We can conclude this because wine has a higher alcohol level than beer, but a lower pH.

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Measuring the pH of common drinks

Conclusions



What are the variations in pH between the soda and alcoholic drink? What could be the reason for this difference?

Students should point out that soda is more acidic than an alcoholic beverage and that this is related to the hydroxyl group (OH^-). The hydroxyl of the alcoholic substances raises the pH (making the solution more basic).

Students should reach following conclusions:

Students will be more familiar with fizzy drinks, realizing that despite their sweet flavor this type of drink is more acidic than an alcoholic beverage. The most acidic soda is cola, which means that it has a higher hydrogen concentration than the other analyzed substances.

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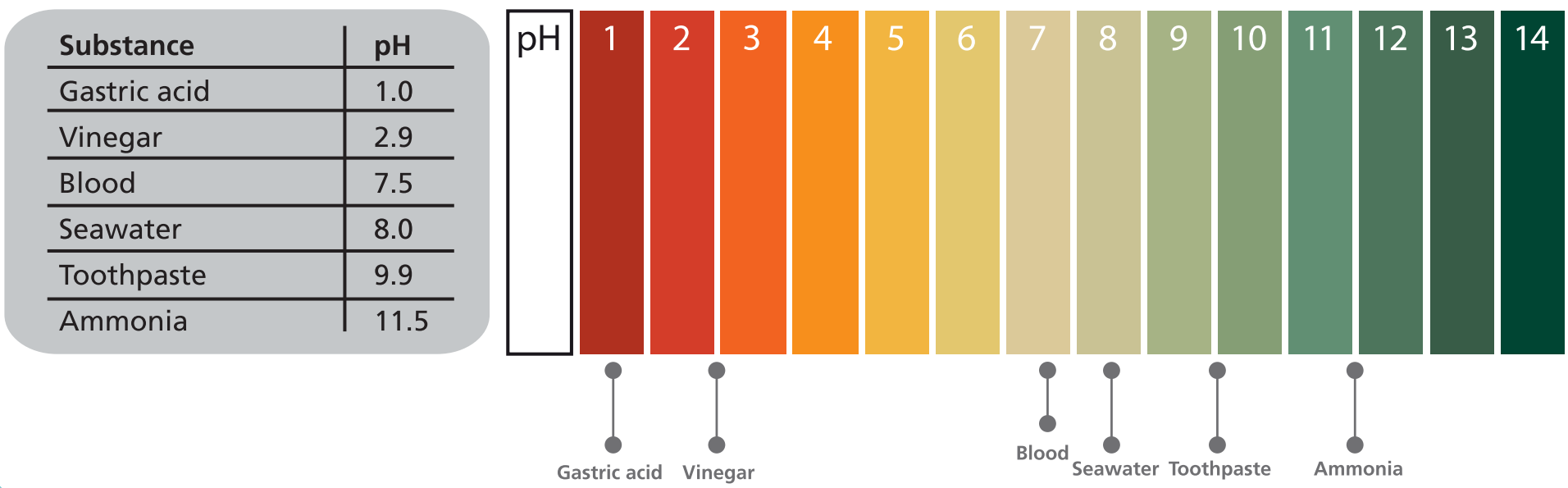
Measuring the pH of common drinks

Activities for further application ◀ ▶

The aim of this section is for students to extrapolate the acquired knowledge during this class through its application in different contexts and situations. Furthermore, it is intended that students question and present possible explanations to the experimentally observed phenomena.

Further questions:

The following substances on the chart according to their pH.



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Measuring the pH of common drinks

Activities for further application



Explain the symptomatology we experience when our gastric acid becomes more acidic or basic.

Students should establish the negative effects of an abrupt pH variation in the stomach, knowing it normally is in a range of 1.0 – 2.0. Students should understand that a sudden drop of this value may cause heartburn and a sudden rise may cause a “heavy” feeling in our stomach.



How are our teeth affected by the excessive consumption of acidic substances?

Students should establish that excessive consumption of acidic beverages causes dental erosion. This means the tooth enamel (the hard, protective coating of the tooth) is lost because of the acid attack. Sometimes the enamel is worn away and the dentine underneath is exposed. In extreme cases erosion may even reach the nerve. This can cause tooth decay, together with weakening and demineralization, which causes dental sensibility.



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