

SI A&P - Full Discipline Demo - Fetal Pig

Electrolytes and Acid-Base Balance

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI A&P - Full Discipline Demo - Fetal Pig
Course	SI A&P - Full Discipline Demo - Fetal Pig
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

Terms to match:

- Acid
- Base
- Buffer
- Electrolyte

Descriptions:

- Substance that readily dissociates into ions in biological fluids
- Substance that donates hydrogen ions (H^+) to an aqueous solution
- Substance that accepts hydrogen ions or that produces hydroxide ions (OH^-) in an aqueous solution
- Substance that maintains the pH of a solution by either releasing or binding to hydrogen ions

Matched answers:

- 1 Electrolyte
- 2 Acid
- 3 Base
- 4 Buffer

Correct answers:

1 Electrolyte 2 Acid 3 Base 4 Buffer

Categorize each statement as true or false

⚡ Na ⁺ is critical for nerve impulse transmission and muscle contraction.	
⚡ The ions that result from dissociated electrolytes decrease fluid conductivity.	
⚡ The most important buffer system in the blood involves carbonic acid (H ₂ CO ₃) and bicarbonate (HCO ₃ ⁻).	
⚡ The combined actions of the carbonic acid (H ₂ CO ₃)-bicarbonate (HCO ₃ ⁻) buffer system allows the blood pH to maintain a range of 3.5-4.5.	
True	False
1	2

Correct answers:

1 Na⁺ is critical for nerve impulse transmission and muscle contraction.

The most important buffer system in the blood involves carbonic acid (H₂CO₃) and bicarbonate (HCO₃⁻).

2

The combined actions of the carbonic acid (H₂CO₃)-bicarbonate (HCO₃⁻) buffer system allows the blood pH to maintain a range of 3.5-4.5.

The ions that result from dissociated electrolytes decrease fluid conductivity.

Exploration

___ is the most abundant cation in the intracellular fluid?

- ☐ Sodium (Na⁺)
- ☐ Calcium (Ca²⁺)
- ☒ Potassium (K⁺)
- ☐ Magnesium (Mg²⁺)



pH is a measure of the concentration of hydrogen ions $[H^+]$ in a substance.

☒ True



☐ False

When a buffered solution becomes too alkaline, the weak acid will bind to the ____ in the solution, lowering the pH.

☐ acids

☒ bases



☐ electrons

☐ water

Exercise 1

How do the procedures and materials used in this experiment model the carbonic acid-bicarbonate buffer system in the body.

In this experiment, the water filled beaker models the blood, the exhaled breath containing carbon dioxide models the carbon dioxide product of cellular respiration that enters the bloodstream, and the sodium bicarbonate buffer added to the beaker models the bicarbonate buffer system present in the blood.

Based on the color of the buffered and unbuffered solutions at the end of 60 seconds of exhaling into them, what can you conclude about the pH of each solution. Reference Data Table 1 in your explanation.

The unbuffered solution became acidic after exhaling into it for 60 seconds as the pH indicator turned from red to yellow as recorded in Data Table 1. The buffered solution remained basic after exhaling into it for 60 seconds as the pH indicator did not change colors as recorded in Data Table 1.

Data Table 1: pH Change With and Without Buffer
(SAMPLE ANSWER BELOW)

	Initial Color	Final Color
Buffer not Present	Orange	Yellow
Buffer Present	Fuchsia	Fuchsia

Exercise 2

Was your saliva considered acidic, neutral, or basic? How does its pH relate to its function in the body? Reference Data Table 1 in your explanation.

The saliva pH of 7 recorded in Data Table 1 is neutral. Saliva is secreted in the mouth where carbohydrate digestion begins with the enzyme amylase. Amylase requires neutral conditions to function.

Was your urine considered acidic, neutral, or basic? How is the pH of urine related to the acid-base balance of the blood? Reference Data Table 1 in your explanation.

The urine pH of 6 recorded in Data Table 1 is neutral. The kidneys contribute to the acid-base balance of blood by absorbing bicarbonate ions from the urine back into the bloodstream or by secreting hydrogen ions from the bloodstream into the urine. These processes regulate the concentrations of buffer system ions in the bloodstream and result in normal secreted urine pH ranges from 4.6-8.0.

What is an example of a body fluid that has a significantly different pH from the ones you measured in this exercise? What is the purpose of this fluid's pH?

Stomach acid had a very acidic pH of around 2. The acidic solution is necessary to break down protein molecules by the enzyme pepsin which only functions in acid conditions.

Data Table 2: pH Values
(SAMPLE ANSWER BELOW)

Fluid	pH Value
Saliva	Note to instructors: Normal saliva ranges between pH 6.7-7.0. Student results will vary.
Urine	Note to instructors: Healthy urine ranges between pH 4.5-8.0. Student responses will vary.

Exercise 3

What effect did the salt solution have on the electrical conductivity through the water? Refer to your results in Panels 1-2 and Photos 1-2 in your explanation.

The salt solution increased electrical conductivity, as evident by the LED light turning on only when the salt solution was used as documented in Panels 1-2 and Photos 1-2.

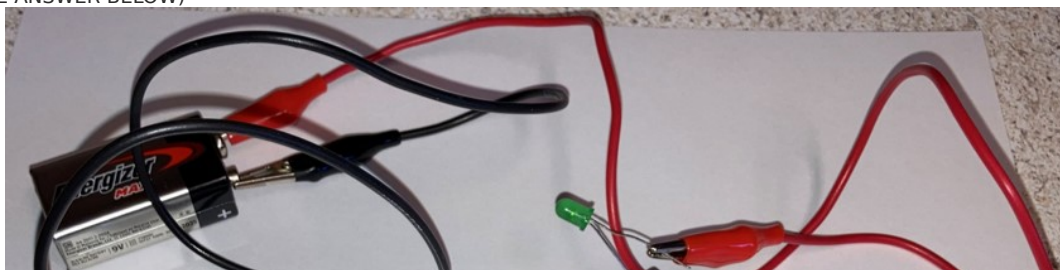
Which electrolytes were present in the salt solution used in the procedures. What are the functions of these electrolytes in the human body?

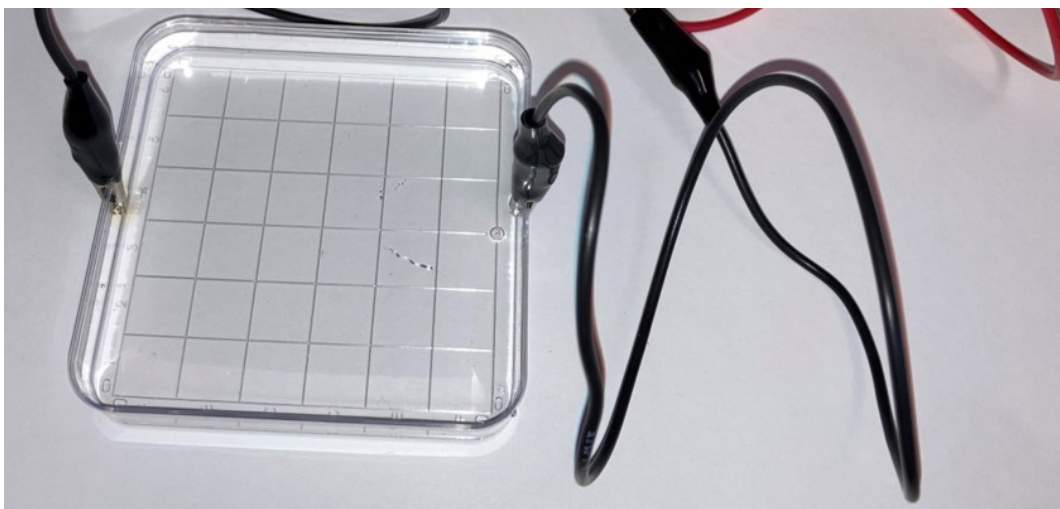
Sodium (Na^+) and chloride (Cl^-) were present in the salt solution. Na^+ is a critical molecule for nerve impulse transmission and muscle contraction.

Observation 1: LED with Distilled Water
(SAMPLE ANSWER BELOW)

LED light will either be very dim or produce no light at all.

Photo 1: LED with Distilled Water
(SAMPLE ANSWER BELOW)



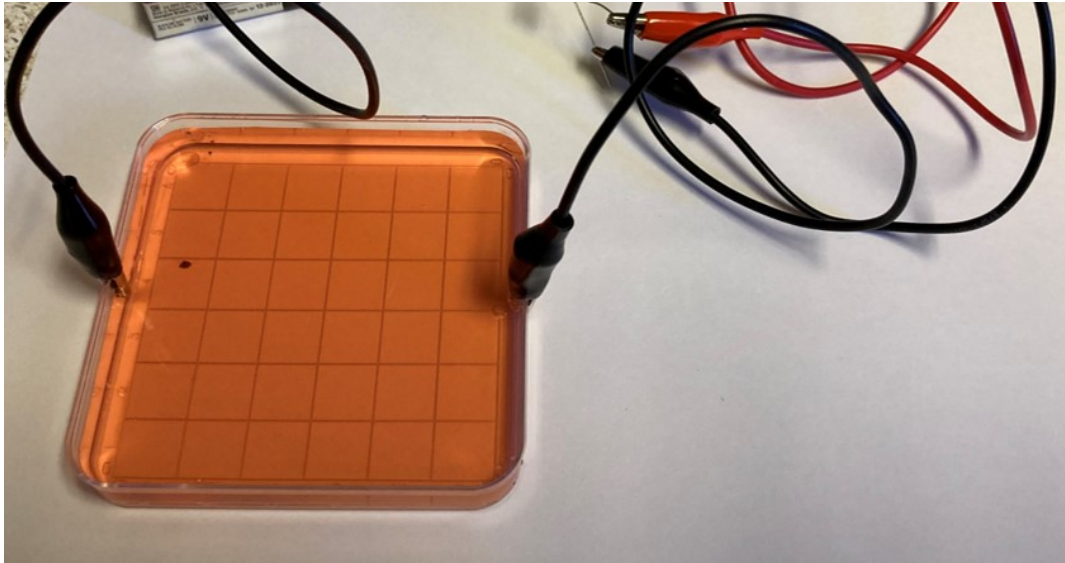


Observation 2: LED with Electrolytes
(SAMPLE ANSWER BELOW)

LED light will be brightly lit.

Photo 2: LED with Electrolytes
(SAMPLE ANSWER BELOW)





Competency Review

Na⁺, Ca²⁺, and K⁺ are examples of ____ present in the human body.

- ☐ acids
- ☐ bases
- ☐ buffers
- ☒ electrolytes

✓

A substance with a pH below 7.0 is considered an acid.

- ☒ True
- ☐ False

✓

Electrolytes function to maintain ____ in the human body.

- ☐ water balance
- ☐ pH
- ☐ electrical conductivity
- ☒ All of the above

✓

____ regulates fluid movements in the body and forms hydrochloric acid in the stomach.

- ☐ Ca²⁺
- ☒ Cl⁻
- ☐ K⁺
- ☐ Na⁺

✓

The carbonic acid-bicarbonate buffer system allows the blood pH to maintain a range of 7.35-7.45.

- ☒ True
- ☐ False

✓

Phenol red turns ____ when exhaling into unbuffered distilled water for 60 seconds.

- ☐ black
- ☒ yellow
- ☐ green
- ☐ fuchsia

✓

Human saliva is pH neutral to slightly acidic.

- ☒ True
- ☐ False

✓

A(n) ____ is part of a setup used to measure the electrical conductivity of a solution.

- ☐ 9-volt battery
- ☐ alligator clip
- ☐ LED
- ☒ All of the above

✓

Na^+ and Cl^- electrolytes decrease the conductivity of distilled water.

- ☐ True
- ☒ False

✓

Extension Questions

Acidosis is a condition in which the pH of the blood falls below the healthy range, and alkalosis is a condition in which the pH of the blood rises above the healthy range. Apply your knowledge of the acid-base balance within the body to predict which body system(s) would be malfunctioning to result in either acidosis or alkalosis? (SAMPLE ANSWER BELOW)

Either the respiratory system or the urinary system malfunctions would cause the imbalance in the blood pH as those are the two body systems most heavily involved in maintaining acid-base balance in the body.