

## **Prize Winner**

# Scientific Inquiry

## Year 9-10

## Sienna Hill

## Our Lady of the Sacred Heart College





Department of Defence





# Acid Neutralisation by Different Brands of Antacids

Determining the most effective brand of antacid that best neutralises stomach pH at the 5-minute time period.

**Oliphant Science Awards** 

**Scientific Inquiry** 

Sienna Hill

### PH NEUTRALISATION BY DIFFERENT BRANDS OF ANTACIDS OLIPHANT SCIENCE AWARDS | SIENNA HILL | OUR LADY OF THE SACRED HEART

### ABSTRACT

The purpose of this investigation was to determine the most effective brand of antacid medication that best neutralises stomach pH at the 5-minute time period. In this experiment, four different brands of antacid tablets (Eno, Rennie, Mylanta and Gaviscon) were tested for their effectiveness of neutralising hydrochloric acid (pH 0.9, 160mM). A pH meter was used to determine the pH after a 5-minute period. The most effective brand was Rennie which contained the active ingredients calcium carbonate (625g), alginic acid (150mg) and magnesium carbonate (73.5mg). Rennie was thought to be the most effective antacid due to the combination and concentration levels of its active ingredients. From the results obtained, it was concluded that the hypothesis was not supported, because it was predicted that Mylanta would be the most effective brand. Pharmacists and doctors can benefit from the results of this experiment because it will allow them to make informed decisions when prescribing antacid medication. This in turn will benefit patients who require antacid medication to relieve heart burn.

### INTRODUCTION

Antacids are over the counter medication that relieve heart burn, which occurs when stomach acid backs up into the oesophagus (*Figure 1*). Heartburn is a burning sensation occurring in the chest and throat and is most commonly caused by "highly acidic or fatty foods" <sup>[2]</sup>. Sometimes medication like aspirin or ibuprofen induce gastric reflux. GERD, or gastroesophageal reflux disease is a "digestive disorder affecting the muscle ring" <sup>[6]</sup> between the stomach and the oesophagus. Antacids come in the form of tablets, gummies and liquid and common active ingredients include calcium carbonate, sodium bicarbonate, and magnesium trisilicate.



Figure 1 - 6 reasons why low stomach acid causes eczema and allergies. (2019, June 19). Valery Reut. https://valeryreut.com/6-reasonswhy-low-stomach-acid-causes-eczema-andallergies/

The stomach consists of many "gastric pits that are lined with three types of cells: chief cells, mucosal cells and parietal cells" <sup>[8]</sup> (*Figure 2*). Chief cells are responsible for producing an inactive enzyme called pepsinogen, mucosal cells secrete mucous to protect the inner lining of the stomach, and parietal cells secrete hydrochloric acid into the stomach lumen (pH 0.9, 160mM). The hydrochloric acid has a dual action in the stomach – it can kill bacteria and viruses to help prevent stomach infections, and it also assists in protein hydrolysis when it converts pepsinogen into a protein digesting enzyme called pepsin (*Figure 2*).



Figure 2 - Treatment options for GERD or acid reflux disease - Comparative effectiveness review summary guides for consumers - NCBI bookshelf. (2011, September 23). National Centre for Biotechnology Information. https://www.apsubiology.org/anatomy/2020/2020\_Exam\_Reviews/Exam\_3/CH23\_Stomach\_Histology\_and\_Physiology.htm

Mucosal cells continually secrete mucus to protect the duodenum, stomach, and oesophagus structures from the highly acidic hydrochloric acid. However, too much acid can result in the lining being damaged by acid causing inflammation, ulcerations, nausea, and pain in the abdomen.

The ingredients in antacids are bases which can "counteract acid in the stomach" <sup>[4]</sup>. When an individual consumes an antacid tablet a neutralization reaction occurs, causing the stomach lumen to be more neutral in its pH. Gaviscon, Mylanta, Rennie, and Eno are four examples of quick, fast-acting antacids that claim to relieve heartburn by soothing the oesophagus. Carbonates are a common active ingredient in antacids, because when the alkaline carbonates react with hydrochloric acid, the products formed are a salt, carbon dioxide gas and water.

E.g. calcium carbonate + hydrochloric acid → calcium chloride (salt) + carbon dioxide (gas) + water

 $CaCO_3 + 2HCI \rightarrow CaCl_2 + CO_2 + H_2O$ 

Hydroxides are also a common active ingredient because when they react with hydrochloric acid, the products formed are salt and water.

E.g. sodium hydroxide + hydrochloric acid  $\rightarrow$  sodium chloride (salt) + water

 $NaOH + HCI \rightarrow NaCI + H_2O$ 

All of the products from both types of reactions are neutral (pH 7) in nature. pH scale is used to indicate the acidity/alkalinity of a substance, with 0-6 being acidic, 7 neutral and 8-14 being alkaline.

### AIM

To determine the most effective brand of antacid that best neutralises stomach pH (replicated by hydrochloric acid pH 0.9, 160mM) at the 5-minute time period.

### HYPOTHESIS

It is hypothesised that when different brands of antacid's effectiveness were compared within a 5-min period, then the Mylanta double strength tablets will be the fastest acting because the active ingredient combination is advertised to be double strength (Magnesium Hydroxide 400mg, Aluminium Hydroxide-Dried 400mg, Simethicone 40mg).

### VARIABLES

#### Independent

The independent variable was the brand of antacid, which included Gaviscon, Rennie, Mylanta, and Eno.

#### Dependent

The dependent variable was the pH of the acid at the 5-minute time period.

### **Controlled Variables**

- 1. Amount of HCl (60mL)
- 2. HCl molarity (160mM)
- 3. Size of beaker (100mL)
- 4. HCl pH (0.9)
- 5. The brand of pH meter
- 6. Method of stirring (by hand)
- 7. Time period (5 minutes)
- 8. Temperature of HCl (37°C)

### Control

1. The control for this experiment was HCl acid with pH 0.9, 160mM.

### MATERIALS

- 1. 4 brands of antacid tablets (Gaviscon, Mylanta, Rennie, Eno)
- 2. 12 x 60mL of HCl (pH = 0.9, 160mM)
- 3. 12 x 100mL beakers
- 4. pH meter
- 5. Stopwatch
- 6. Marker
- 7. Mortar and pestle

- 8. Safety goggles and lab coat
- 9. Thermometer
- 10. Heating block
- 11. 4 x stirring rods.

### FAIR TESTING

This experiment was a fair test because the method will the same for each brand of antacid. This experiment was a fair test because the pH of the hydrochloric acid and the temperature at which the reaction occurred (37°C) were consistent. It was also fair because the time stayed consistent – giving each antacid an equal amount of time to neutralise the HCl.

### METHOD

- 1. 60mL of HCl acid was measured out using a measuring cylinder and placed into a 100mL beaker. Using a pH meter, the pH of the acid was recorded.
- 2. A heating block was set up and set to 40°C, and the beaker was put on the heating block.
- 3. A thermometer was inserted into the beaker.
- 4. One Rennie tablet was crushed into powder using a mortar and pestle, and once the temperature of the HCl reached 37°C, the powder was mixed into the acid.
- 5. The stopwatch was started, and a stirring rod was used to continually mix the antacid and acid. This replicates the stomach constantly churning.
- 6. Once 5 minutes had passed, the pH meter was cleaned and inserted into the antacid/acid solution. The pH was recorded into a table.
- 7. Steps 1-6 were repeated two more times using Rennie tablets.
- 8. Steps 1-7 were repeated using Gaviscon, Mylanta, and Eno.

This method was chosen because after completing some research, it was founded that a few different practical's involving antacids and HCl followed a very similar method. The method used in this investigation was inspired by: 'Using indigestion tablets to neutralise an acid. (2018, January 2). RSC Education. <u>https://edu.rsc.org/experiments/using-indigestion-tablets-to-neutralise-an-acid/698.article</u>'.

**RISK ASSESSMENT** 

### **OSA RISK ASSESSMENT FORM**

### for all entries in (<) Models & Inventions and Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

NAME: \_

\_ ID:\_\_\_\_

SCHOOL: \_\_\_\_\_

Activity: Give a brief outline of what you are planning to do.

The purpose of this investigation is to determine the brand of antacid that will neutralise stomach acid. Stomach acid will be recreated through the use of hydrochloric acid (160mM/pH 0-2), and a stopwatch will be used to time the time taken to reach neutral pH. A pH meter will be used to measure the pH of the acid. The brands that will be tested are Mylanta, Gaviscon, Rennie, and Quick-Eze.

#### Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Type of Risk	What is the risk?	How will I manage/control the risk?
Chemical Risks: Hydrochloric acid <3 M (<10% wt/wt)	High concentrations can cause irritation of the eyes, lungs, and skin. It is a dangerous liquid with many hazards because it has corrosive potential and must be used with care. Sometimes acidic mists are released, and these are hazardous if they encounter the skin, eyes, or internal organs, the damage can be irreversible or even fatal in severe cases.	Avoid inhalation of vapour. Store in a cool, dry, well-ventilated area away from sources of moisture. Keep away from incompatible materials such as oxidizing agents, organic materials, metals, and alkalis. Hydrochloric acid can corrode metallic surfaces

Chemical Risks: Antacid tablets	Releases carbon dioxide in contact with water. Will pressurize container and may cause breakage or explosion. Do not eat, as this is a medication.	Do not react with water in a closed container due to possibility of explosion. Store tablets in dry location, and do not eat
<i>Sharps risks:</i> Glassware: (5 x 100ml beakers)	Breakage of beaker, cuts from chipped rims. Breakage of thermometer, glass cylinder may break, possibility of cuts from broken glass. Tile can break to form sharp fragments, which may cause injury.	Sweep up broken glass with brush and dustpan; do not use fingers. Inspect and discard any chipped or cracked beakers, no matter how small the damage.
<i>Other hazards:</i> Stopwatch	If connected to a string, can be swung around on cord to hit people or other objects. The stopwatch contains a lithium battery, which may occasionally ignite or rupture. Do not disassemble, deform under pressure, heat to 100°C or higher, or incinerate the stopwatch.	The stopwatch will only be used when timing and will be held firmly in one hand (to reduce the risk of being swung or hitting something). It will be kept on a cool dry surface to make sure it does not overheat, rupture, ignite or deform.
Other hazards: pH Meter	If one meets the live components of the pH meter, electrocution may occur. This can damage the equipment or injure the person. It is at risk of overheating, and could damage the workbench or the beaker/solution it is placed in.	I should have a safety debriefing of how to use the meter and must be competent before proceeding. This meter should be tested annually for electrical safety. The equipment must not be used if the outer casings are damaged. Any damage or misuse of the equipment must be reported to the person responsible for that area. Spilled liquids to be cleaned up immediately to reduce risk of electrocution.

### Risk Assessment indicates that this activity can be safely carried out

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RISK ASSESSMENT COMPLETED BY (student name(s)): \_\_\_\_\_

SIGNATURE(S): \_\_\_\_\_

By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME:

SIGNATURE: \_\_\_\_\_\_ DATE: \_\_\_\_\_

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### RESULTS

	pH of HCl at the 5-Minute Time Period				
Antacid Brand	Trial 1	Trial 2	Trial 3	Average	
Rennie	5.3	5.4	5.3	5.3	
Mylanta	3.9	3.7	3.7	3.7	
Gaviscon	2.6	2.4	2.3	2.4	
Eno	4.7	4.3	4.6	4.5	
Control	0.9	0.9	0.9	0.9	

### The Effectiveness of Antacid Brands In Neutralising Hydrochloric Acid in a 5-Minute Time Period

### Chemical Reactions of Main Active Ingredients in Antacid Tablets

Antacid Brand & Concentration	Reactant and Product	Balanced Equation
Rennie (73.5mg) Gaviscon (105mg)	Magnesium Carbonate and HCI	$MgCO_3 + 2 HCI \rightarrow MgCl_2 + CO_2 + H_2O.$
Rennie (625mg) Gaviscon (187.5mg)	Calcium Carbonate and HCl	$CaCO_3 + 2HCI \rightarrow CaCl_2 + CO_2 + H_2O.$
Rennie (150mg)	Alginic Acid and HCl	$C_6H_8O_6 + HCI \rightarrow C_6H_7O_5CI + H_2O$
Eno (232mg), Gaviscon (106.5mg)	Sodium Bicarbonate and HCl	$HCI + NaHCO_3 \rightarrow H_2O + CO_2 + NaCI$
Mylanta (400mg) Gaviscon (160mg)	Aluminium Hydroxide and HCl	$AI(OH)_3 + 3HCI \rightarrow 3H_2O + AICI_3$
Mylanta (400mg)	Magnesium Hydroxide and HCl	$Mg(OH)_2 + 2HCI \rightarrow MgCl_2 + 2H_2O$

Graph



### DISCUSSION

The practical conducted compared three different brands of antacids, including Rennie, Gaviscon, Mylanta (double strength), and Eno. The most effective brand of antacid was Rennie, because after a period of 5 minutes, the average pH of the hydrochloric acid was 5.3. The active ingredients of Rennie are calcium carbonate, alginic acid, and magnesium carbonate (625g, 150mg, 73.5mg respectively). The least effective brand of antacid was Gaviscon (sodium alginate 250mg, sodium bicarbonate 106.5mg, calcium carbonate 187.5mg), where the average pH was 2.4. The second most effective brand was Eno (sodium bicarbonate 232mg, sodium carbonate 50mg, citric acid anhydrous 218mg), with an average pH of 4.5; followed by Mylanta Double Strength (aluminium hydroxide 400mg, magnesium hydroxide 400mg, simethicone 40mg) with an average pH of 3.7.

Alginic acid is found in a variety of antacid brands, because it effectively creates a protective barrier over the oesophagus to prevent acid reflux. In this experiment, alginic acid is only present in Rennie – perhaps making it an important ingredient when combatting gastric reflux. The chemical composition and combination of active ingredients in Rennie had a more potent effect compared to the other brands. This experiment also proved that Rennie has optimal concentrations of each active ingredient because it was able to increase the pH of HCl to 5.3 in five minutes. Due to the high concentration of calcium carbonate, the hydrochloric acid could be neutralised at a fast rate. The neutralising abilities of the other antacids were weaker in comparison to those of Rennie since they did not neutralise the hydrochloric acid as effectively in a 5-minute time-period.

This experiment was a fair test because the same method was repeated three times for each antacid tablet brand to determine if results were reliable. The pH of the HCl (0.9) was consistent because the HCl used during the experiment was from the same stock. The time period for each reaction was 5 minutes for each trial. This gave each antacid brand an equal amount of time to neutralise the HCl.

The purpose of this control (HCl) for this experiment was to show that antacid tablets are essential for pH neutralisation of an acid. The hydrochloric acid served as a benchmark pH (0.9) because the control samples were not treated to an antacid tablet. The control used in this experiment proved the experiment's validity because the pH of all the other experimental samples increased during the 5-minute time period.

Random errors are caused by unknown variations within the experiment that are unpredictable and difficult to avoid. These errors cannot be controlled and are found to result in slight a discrepancy in results across trials of the same antacid brand. The changes affect the precision of results and are defined as natural variation within the data. It is quite difficult to minimise the effect of these errors, as they are hard to avoid. A random error for a given antacid brand in this investigation included the amount of active ingredients in each antacid tablet and the fluctuation of temperature. If one tablet for a given antacid brand had a slightly higher concentration of the active ingredients, the rate of the neutralisation reaction with hydrochloric acid would increase. The variation of the temperature occurred because it was difficult to keep the temperature of the hotplate at a constant 37 degrees Celsius (which would have replicated the temperature inside the stomach). If the increased slightly, then the collision rate between the active ingredients in the antacid tablet and the hydrochloric acid would also increase, which would hasten the rate of the neutralisation reaction. Random errors cannot be fixed but their effects can be minimised by conducting multiple trials and calculating an average result.

Systematic errors are potential errors in the method, or possible human errors, which can be controlled by the experimenter. These errors can affect the accuracy of the results obtained within the experiment. To highlight systematic errors, it is important to conduct the experiment multiple times. A systematic error in this investigation would have been not allowing the neutralisation reaction to occur over a longer time period. Various antacid manufacturing companies recommend that it takes around 30 minutes for most antacid tablets to function effectively. Due to time restraints, a 5-minute period had to be established to ensure there was enough time to conduct three trials for each antacid brand.

In the future, if this experiment were to be conducted again, an improvement would be to time how long each antacid tablet takes to neutralise the HCl from pH 0.9 to pH 7. It would also be interesting to see how long the effects of each antacid brand lasts for. The pH of each antacid tablet brand could be measured every 30 minutes over a four-hour period. Ideally, the most effective antacid brand should neutralise the hydrochloric acid in the shortest period and also its effects should be the longest lasting.

This experiment should provide doctors and pharmacists with more insight when they are required to recommend the most effective antacid brand to people who struggle with frequent heart burn. This experiment proved that Rennie was the most effective antacid tablet during a 5-minute time period and is therefore the brand that doctors, and pharmacists should recommend for rapid heartburn relief.

### CONCLUSION

The aim of this investigation was to determine the most effective brand of antacid that best neutralises stomach pH at the 5-minute time period. In this experiment, four different brands of antacid tablets (Eno, Rennie, Mylanta and Gaviscon) were tested for their effectiveness of neutralising hydrochloric acid. Tablets were crushed with a mortar and pestle and added to hydrochloric acid (pH 0.9, 160mM). A pH meter was used to determine the pH after a 5-minute period. Three trials were conducted for each brand of antacid tablet. Results showed that all antacid brands began to neutralize the hydrochloric acid to some extent. However, the aim was achieved because it was determined that the most effective antacid brand was Rennie. This particular brand contained the active ingredients calcium carbonate (625g), alginic acid (150mg) and magnesium carbonate (73.5mg). Rennie was thought to be the most effective antacid due to the combination and concentration levels of its active ingredients.

From the results obtained, it was concluded that the hypothesis was not supported, because it was predicted that Mylanta would be the most effective brand as they advertised that their active ingredients were of double strength. Pharmacists and doctors can benefit from the results of this experiment because it will allow them to make informed decisions when prescribing antacid medication. This in turn will benefit patients who require antacid medication to relieve heart burn.

Word Count: 2186

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### APPENDIX

### Image of Equipment



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Laft -	auguenum, unu esophagus to protocr	11.1.0.6		magnesium	Mg U3	MgCO3(s) + 2HU(aq)	
	thom, but too much acid or protective			carbonato		$\frac{1}{12} \left( \frac{1}{2} \left( \frac{1}{2} \right) + \frac{1}{12} \right) $	1
	In eur anisms can loud to the lining being			c o d tu an i an	Neller	$+ \frac{1}{2} \left( \frac{1}{2} \right) + \frac{1}{2} \left( \frac{1}{2} \right)$	1
	The clamp mation because and alcosections			biographic la		$\frac{1}{10000000000000000000000000000000000$	lag
	The supertable include between hearthurn			DICUTEVNOTE	2 10 19 19 19 19 19 19 19 19 19 19 19 19 19		-
	and nain in the abdeman		14	No. 1. Contraction of the			
	wind hatter the analytication.		40	roactan	have	ucts	
		(46.)	t	(s) = solid		(0) = g o s	
.8	4.	•10		$(aq) = dissin(1) \Rightarrow liquit$	d d	5-	5.

11 5	acids and bases	19/5	common an
	acid neutralisation		examples of antaci
	e is a reaction between an acid and a base,		1. gaviscon
B. 7. 18	resulting in Water and satt. Ht ions and		• gaviscon liquid, li
teres a la co	DH- combine to create water.		and tablets cont
	Salts are formed in accordance to the figure		ingradiants: sodiu
<u>- 4 5 6 691-</u>	Weights of the acids bases. The Hadd add		sodium bicarbonat
6.0.0	amount of a cid needed = a mount ph		e sodium alginate a
	that would give I molecule of (H+) 7 MH7		a film over the co
Certinal	qmountof base = qmount + hat add alkali / volume to neutralise = x cm3		to prevent reflux.
143	Would give a molecule of (OH-)	No th	ogaviscon soothes!
a first fi	O volume of acid added to alkali -	1	relieving hoortburn
	Acids and bases		2. Mylanta
	acids are substances that release protons,		° mylanta is a fast ac
	and bases are substances that a ccept them.	1.1.1	magnesium hydroxide
	a cids increase concerntrations of H+ ions,	, , , , , , , , , , , , , , , , , , ,	and simethicono.
1	bases release (OH-)ions.	h la a	• Free from lactose,
	Solutions with 77 pH are considered		• magnosium is a com
	acidic, and <7 pH are considered		as the hydroxide ions
	basic (or alkaline).		with a cidic H + ions,
×	ephis a measure of how much hydrogen	fin at	3. guickeze
FORMULA FOR HY	(in an ionio form) is prosent. It stands		o antacid tablets that
	fig.5 for potential of hydrogen /power		Carbonate, magnosii
	of hydrogen.		nesium trisilicate.
	H hydroxide ions = (OH).	167 V	o they come in chewy t
	antacids are comprised of bases		4. ronnie
- AV.2	including Magnesium hydroxide,		· those poppermint to
	and sodium hydrogen carbonate.	- 101	corbonate, magnesi
1.83	as the amount of H'lons in creases, the	1. 1. <u>1</u> . 1	alginic acid.
	amount of (OH-) decreases proportion-	<u> </u>	o alginic a cid also wa
			and stabiliser.
	$\circ \circ \circ \circ \cdot \operatorname{IM} g (OH)_2 (S) + ZHC ( (99) \longrightarrow ZH_2O (1) + \cdots$		is most ontacids con
	MgCl2 (aq)		n n n d d N N N N N N N
		(	
1. S.C.			

tocids. Fig. 6 ds: iquid sochets ain'3 active um alginate, e, and calcium carbonat cts as a raft, creating ontents of your stomach n = 1 = 1 = 1 = 1 = 1 = 1 cooles the oesophagus, ting tablet containing , bluminium hydroxide, and gluten. imon ingrodiont in antacids, from the Ng(OH)2 combine to produce Water. contain calcium um carbonato and magoblets, and liquid forms. blets contain calcium um carbonato and orks as a food thickener tain calcium corbonato. 7.

2615	symptoms fits	271	5 reference
	symptoms of gastric reflux.		1. acids and bases
	· gastric roflux can be indicated by looking		ce learning hub.
	out for the following:	20,000	. org. nz/resources
E	1. burning sensation after eating in the	5012	2. antacid (n.d.) sc
	chest (worsening at night).	-	NNW. Sciencedirect
11 X V - 4	2. pain in the chest	10 I	antacid < 23/5
Strate Part	3. difficulty swallowing	Sel als	3. chemistry 104: 01
ela se na al	4. reflux of food or acid	1.4.1.2	(2017, Sopt 16) ht
	5) a feeling of a lymp in the threat.		edu/~doddy/chom
- J is a	·it is common that you may experience bitter		<1157
-	tastos in your mouth, a dry cough or a		4. ogbiu, A. Antacids
	discomfort in the upper jab domen.	aib a	effects and drug
	LIS THE ME IT I NOT THE THE STATE OF A DECEMBER OF A DECEM	nii ę	April 2). https://
	Why it is experienced?	-	/drug-closs.html.
	othe most common cause is acidic or high	-1.5.2.0	5. DV el view of a cid
	in fat food. Sometimes certain medication		August 21) chem
10-12-5-10	like aspirin or ibuprofon, so datives and		Chem.libretexts.or
100.000	blood pressure modication may induce		_ ond _ chemical_
	gastric roflux.		< 2615)
	oit could be a sign of gastroesophagea)		6. Richards, L. (n.d)
	roflux disoase (GERD), or possibly	<u>i n s r s r</u>	uses them, side
	prognancy'		work, and more.
	+his investigation will help those	<u> </u>	newstoday.com/
316.3	struggling with froquent heartburn,	ut Alf	- they - work. <1
	and assist them in solecting the	the state	7. (unknown). treat
40	optimum brond.	<u>11</u> 5 11	over-the-counte
	1->it can also benefit doctors phormacists	-	6). Webmd. https:
	when personibing medication to patients		heartburn-gerd/
CL PI	because they will know which brand is		hoortburn - over-
	the best.		626/57
	might holp scientists, they will know		and the second
	the most effective combination of		$\circ$ < $7 = ddte d$
	cnomicols to rollove heartburn.		
	N *		

JAN C

introduction (n.d): Scien https://www.sciencelearn s/3019-acids-and-bases iencedirect.com.https:// t.com/topics/chemistry/

nalysis of an tacid tablet tps://www.chem.latech. 104/104Antacid.com

s: get facts on side g interoctions (2013, www.rxlist.com/antacids < 19 | 5) ds and bases (2020 Libretexts. https:// rg/bookshelves/physical textbook / a cids - b a ses / Antacids; types, who effects, how they h Hps:// WWW. medicol articles/ antacids #how 9 57 ing heartburn with r drugs (2002, feb : 11 w ww. webmd.com/ guide/treatingcounter-medicine

ccessed.

2817	Tr'eferences	2/6	plan fo
- 10 9 12 E	picture referencing:		aim: to determine th
0103	1. fig 1 = buy colcium corbonate lanta cids		of antacid that be
6 6 6 5	for heartburn (n.d.) https:// WWW. chemist-4		acid (replicated by
M. Eat	- u. com/pharmacy/digestion - stomach/indig-	h 1	hypothesis: it is hypo
A BA PT	estion-heartbuin/calcium-carbonate.	c.	brands of antacid's
	2. fig 2= breasons why low stomach acid		compared, then the
1444	couse eczema and allorgies (2019, Jun 19).	5.8 0	ise the pH lovel fa
1.84.81	Valery Reut. https://valeryveut.com/6-rea	i ddi a	active ingredient c
	sons-why-low-stomach-acid-couse-		alginate, sodium k
	eczema.		is the most effec
	3. fig 3 = quick and dirty guide to ocid bose		dependent variable:
0.13	5 bolonce (n.d) Medictests. https://medic	. 4.18	antacid tablet to
to to de	notests. com/units/quick-ond-dilty-guide	an matte	independent voriabl
-	- to - ocid - bollance		antacid tablet.
0	4. fig 4 = 9 scept changes in a neutralisat-	41.00	controlled variables
-	ion veoction pH titiotion (n.d) https://		1. a mount of HCI I
1 1 2 2 1 1	WWW.Wpbschoolhouse.b// docbiown.info/p		2. Hel molority (16
11210	age 03/acidsbasessalts 07. html.		3. size of booker (
1	5. Alida.D. (n.d) hydroxide ion: definition t	) (î	4. size of antacid
1. 0. nl	formula. Study.com/https://study.com/		5. HClacid pH (1.
	acodemy liesson   hy droxide-ion-definition-		6. type of pH mete
10	TO TO TIM VIQ-h+MI. THE STREET DOD STORE	d n	moterials:
<u>wana di F</u>	6. fig 6 = richards, L. (n.d). Antacids types,	<u>. I (i n'</u>	1. antacid toblets
	Who usos them, side effects, how they		2. 4 x 60 ml of HCl a
1	work and more. https://https www.medi-		3. 4 x 100 ml beake
<u>1</u> 4 4	colnewstoday.com/articles/antocids#how	13.6	4. pH meter
	they work.		5. stopwatch
-		, i ip	6. Marker
0	DID ENGINE HAR		foir testing:
	<u>C 21187</u>		o this will be a fair t
			Will be repeated
	11001001001001000000		and accurate result
	10	.1	

or prac 🚃

e most effective brand st neutralises stomach HCI pH 1-2, 160 mM). thesised that if different effectiveness Were o gaviscon will poutralstest because the ombination Coodium bicarb, calcium carbonate tive. dealer Manual D the time taken for each neutralise the pH. e: the type/brand of (60 ml) OmM) 100ml) + able+ -2) to 6 0 0 0 Yo I make 5 4 3 2 1426 84 164 cid 15 est because the method to ensure for valid ults (an avorage will

2115	olan for nractical	21
210		-61
-13 A 1	plan continueu:	
0	Mathad	
<b>KUSZ</b> 4	1 (Aml of buddochlaric acid was madericad	1
<u></u>	Dut using a 100ml magguring culinder	
and he	and hlaced into a loomly braker	
	2 a single antosid tablet (brand) and and	
	2. a single antitude rubber coronal and the	
	acid acid	
	3 a stable about were to prove hour	
	Jong it took for the nH to regal 7	
а <u>ца</u> 3	10 ny IT TOOK for the pill is a wary the table	
	4. The TIME Was recorded in a results rable.	
	to an our the velicities of the results	
	TO ENSULE THE TELLUDING OF THE LESUIS.	
	6. STOPS 1-5 MORO REPORTED USING SMORE	
	ultruight brands of antacias.	
	risks include:	
	• hydrochoric acid - burning/irritation of	
1-1-1	lungs/skin, corresiveness and infernal	- 1
101.15	a a mage it inhaled is wallowed.	
	reduced by avoiding Vapovi inholotion.	-
	o antacid tablets - release CO2 and May	
	explode if pressurised	_
	La do not eqt, store in dry, cool area.	
	o beakers - may break, chip, or crack. Cuts	
	frum broken glass	
	La handle with extra coution, clean up mess.	
	<ul> <li>stopwatch - strangulation or erruption</li> </ul>	_
0 5 4 1 0	of lithium battery	
2 h I	Skeep cool, and away from other	
2116	p o p le	

### for all entries in ( $\checkmark$ ) $\Box$ Models & Inventions and $\Box$ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

NAME: SIONNO HIII 015H SCHOOL:

Activity: Give a brief outline of what you are planning to do.

The purpose of this investigation is to determine the brand of antacid that will neutralise stomach acid. Stomach acid will be recreated through the use of hydrochloric acid (160mM/pH 1-2), and a stop watch will be used to time the time taken to reach neutral pH. A pH meter will be used to measure the pH of the acid. The brands that will be tested are Mylanta, Gaviscon, Rennie, and Quick-Eze- Eno.

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- · Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Type of Risk	What is the risk?	How will I manage/control the risk?				
	÷ .					
Chemical Risks:	High concentrations can cause	Avoid inhalation of vapour. Store in a				
Hydrochloric acid <3 M (<10%	irritation of the eyes, lungs, and skin.	cool, dry, well-ventilated area away				
wt/wt)	It is a dangerous liquid with many	from sources of moisture. Keep away				
	hazards because it has corrosive	from incompatible materials such as				
	potential and must be used with	oxidizing agents, organic materials,				
	care. Sometimes acidic mists are	metals and alkalis. Hydrochloric acid				
	released and these are hazardous if	has the ability to corrode metallic				
	they come into contact with the skin,	surfaces				
	eyes, or internal organs, the damage					
	can be irreversible or even fatal in					
	severe cases.	-				

### **OSA RISK ASSESSMENT FORM**

### Tisk assessment

Chemical Risks: Antacid tablets	Releases carbon dioxide in contact with water. Will pressurize container and may cause breakage or explosion. Do not eat, as this is a medication.	Do not react with water in a closed container due to possibility of explosion. Store tablets in dry location, and do not eat
Sharps risks: Glassware: (5 x 100ml beakers)	Breakage of beaker, cuts from chipped rims. Breakage of thermometer, glass cylinder may break; possibility of cuts from broken glass. Tile can break to form sharp fragments, which may cause injury.	Sweep up broken glass with brush and dustpan; do not use fingers. Inspect and discard any chipped or cracked beakers, no matter how small the damage.
Other hazards: Stopwatch	If connected to a string, can be swung around on cord to hit people or other objects. The stopwatch contains a lithium battery, which may occasionally ignite or rupture. Do not disassemble, deform under pressure, heat to 100°C or higher, or incinerate the stopwatch.	The stopwatch will only be used when timing and will be held firmly in one hand (to reduce the risk of being swung or hitting something). It will be kept on a cool dry surface to make sure it does not overheat, rupture, ignite or deform.
Other hazards: pH Meter	If one comes in contact with the live components of the pH meter, electrocution may occur. This can damage the equipment or injure the person. It is at risk of overheating, and could damage the workbench or the beaker/solution it is placed in.	I should have a safety debriefing of how to use the meter and must be competent before proceeding. This meter should be tested annually for electrical safety. The equipment must not be used if the outer casings are damaged. Any damage or misuse of the equipment must be reported to the person responsible for that area. Spilled liquids to be cleaned up immediately to reduce risk of electrocution.

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): \_\_\_\_\_\_\_

SIGNATURE(S)

By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

DATE:

TEACHER'S NAME: Caroline Beekman SIGNATURE:

216

	13	
	3/6	experiment tim
		otoday at lynch (3'
		try the experiment.
		idea what was instor
	1.6	and whether the expl
	4	would even work!!
	- AL	stop ono was to mea
		60 mL into 3 bookers
		Then I crushed up my
	1,	Ronnie (calcium car
	JU R. W.	carbonale 73.59, alg
_	0 I-	a mortar and postle
	3.10	Then I set a timer,
		fine powder into the
		observed. All the pow
2		top of the acid.
		· After about 15 min
-		ching the solution,
		it was 0.8 - it had
		HCI pH was 0.9)!!
		Thon I tried again
		and waited lo min
	1.5.8.1	р Н 1. 2 —
		I was a bit disappo
	× . H	it was the end of lu
		I had a foolproof p
		+ oday's results:
+		
	<u>una Gr</u>	Antovia Irlall(pH)
		tkonnie (0.8 t
	- Bit	
		2 days and analys
	6	2 agys, and unalys
14.		

June), it was time to I had no re for me. orimont

SUVP OUF of HClocid) first antacid = bonate 625mg, magnesiun ginic acid 150 mg), using

placed the acid and Iderlay on the



of just wat-1 testo d th: pH... gone down!! (the

with a fresh beaker before moasuring the

inted because by then, inch-and 1 thought plan!! These were

and the state of the state of the Trial 2 (pH Trial 3 .2 En TO AL +! la lawill + ry again in se what went wrong...

		1	
1516	take 2	76	discussing
1 . N	o errors made duringexperiment:		Something else 1 +
-	athe Helacid was room temperature, so		improved is - my
	it did not accurately replicate internal		that if I had waite
	temperatures inside the body. This can		I would have ne
	be resolved by using a heating block		dps I would hav
2	to warm the HCI acid before adding	11,14	After completing
	the antacid.		that most antac
	issue w/ heating block: same as last		Minutes to work.
have it is a	year. The minimum temp. on the dial	-	not have that m
a a t d t	is 50 degrees, meaning there is nowey		going to have to t
	to keep the liquid a stable 37°C. Unlike		· suggestions limpi
	last year, there is no risk of denaturing		4) M & :
	enzymes. I thought of using a water	-1 8 g-1	1 use a heating b
	bath MH - beaker inside booker	<u>- 84 V h</u>	to 37° G.
		V 4	2. continually sti
	but it was too much work and time is	L L L L	replicate the s
	lunning extremely short.		3. to reduce tim
	• the noxt problem was the antacid	(†)	bronds effecti
	powder not fully dissolving, and		period of 5 m
	floating to the top. This may		- this will be a c
<u>t nder </u>	have something to do with me	(	· other errors:
	stirring the Hcl with a spatula Clroally		Sunbeknownst to me
<u>- 48 mi 1</u>	should have used a stirring rod), or		ator, the pH mete
	the tomperature of the liquid being		I was cleaning it (
	too cold. This can be resolved by		papertowel-which
	Using a stirring rod.		incorrect. The thin
	a nother error made was only stirring the		pH moter is very
	bolution every 2 or so minutes. This does		INUST DE KEPT WE
	hor accurately replicate the stomach	-	TIME, INGVE TO O
	UUCQUSO OUR STOMUCH IS CONSTANTLY		NOTOIO USING IT. 1
BIT A	be enclosed there fore the figure should		ivi e ivi brane domp
	UE CONSTANTIN STILLOU.	2 -	

16. .

and improvements. errors

hink that could be patience. i believe ed longer (mind you, eeded the time), perhe seen better results. some research, I found ids take around 30 Unfortunately, I do uch time, so I am think of an alternative. rovements for next

lock to worm the goid

r the solution to tomach churning. e, compare anteoid interess over a time inutes. controlled variable.

and my OSA co-Ordin or must be kept wet. and drying it with a h apparently was n membrane inside the y sensitive, therefore t. This means next dipit in Hclacid This will keep the (yay! i)

	SMIXAYEM											
8/6	+1	ne experi	went (di	ain)	1	1016			910	ph	e d	
	Due to th	o fost op	proachin g	dogdlin	0,					3 11	ti I	1.4
	I had to	complete	the exper	imont	i and			2 120.	4.6.1			ii. 1
	again at	home. 1 t	ook home	all the								
1.582	equipment	and after	sotting (	everything	Чp,			p	H	ne	utr	a1 *
. all v	l decided.	to try ag	ain.	1		c	»				5	mi
SAL L	• started	with Renn	ie, and he	ated the	Hel	1.11.1						
<u> </u>	+0 37°C. 1	)nceitrea	iched this	tempero	ture,	11.6.15	3.0			-		
-	1 mixed in	the crush	ed tablet	and con	tin-		5. 2					
	Vosly stil	red for	5 minute	s. At the		Ł	4.8_					1
	end of th	o time pe	riod-1p	lacod the	2		4.4				17	1
	p.H. meter	inside q	nd the m	oment of			- <u>4</u>		-			
	truth IHE	PHWAS	5.4!!	A W 1 L			21					
<u></u>	T+ MOKED	, yipee!!	And afte	r complet	ing		3.6-					
-	the somo	method 2	more +1	mes, 1 mo	VQd	HA NT	3.2					
	On to G	and Ena	VICN MOJ †	OLIOW O D	y .		2.8_					
	Ingitunt a	unu cno,	vera nra	The resu	173-		2.4					
4	Albrand	+riol ( oH)	+ (10) 2 (0H)	trial 3 (off	1		2	*				
			1 1 1 4 2 (p 11)	III VI S CPII								
	Ronnie	5.3	5.4	5.3			1.0-			-		
		Les contra		3.0		2	1.2					
- Nich	111-110-14/0-1	which we am	Section Record to the sector	2. T. H. Y. H. T.	1		0.8					
	Mylanta	3.9	3.7.4	3.7			0.4					
0	(月天帝)、十月二十一年	11.15年一款市商 十	n nan na na	with a deal of			0				<u>N</u>	
	a the second s	IT NOT SOL	1 keiner 10 keine	shing 0		7						
1.11	Gaviscon	2.6	2.4	2.3					~			
	at the set of the set of a	1.1.1.1.1.2.2.1.2.2	1	U RY I I V I		2×		ł	2			
	1-2-3-110-1-1-17	CLART A 40W	1	10 L 10 L			-		-			
	Eno	4.7	4.3	4.6				-Re	nnie		+	
	All pilling	a kon a pilitar o	1-1-p 5-12-15	310.00	-			- M	vlar	ta		
			1 1 4 1	111 J. 11					1			
												~
. * ]			Ma		18.	1.0						





12/6	analysis of results	18/6	discussion
	ofrom the results obtained, it can be		6 1 andom errors in -
	concluded that Rennie is the most		(unpredictable vori
	effective brand of antacid; the pH		be controlled + 1
	after 5 minutes was 5.3 (an		discroponcies wi
	INCREASE OF 4.4!	0	1. concernitration / al
	orit can be assumed that after 10 minutes,		in ooch ontooid.
	Rennie would have completely neutrali-		2. fluctuation of +
	sed the acid.		use, inability +
	The least effective brand of antacid		· systematic eriorst
	was Gaviscon, at approximately 25 pH		method, affecting
	after 5 minutes.		To highlight system
	The reasoning behind Rennies of fectiveness		repeat experiment
	would be its chamical composistion, the	-	1. Not allowing 30 mi
	active ingredient combination. This proves that		completely neutra
	calcium carbonate (625mg), magnesium.		La Valious antacid n
5	carbonate (73.5mg) and alginic acid (ISDmg)		reccomend waiting
	is the most effective combination to		to work. Due to ma
4	neutralise stom ach acid.		could only do 5-
	<ul> <li>Chemical equations:</li> </ul>		• improvements'
	13 Cacos + H Cl - > Cacl2 + CO2 + H20		• timing sach antacid u
3	→ MgCO3 + 2 HCI → MgCl2 + CO2 + H2O	-	7 (noutral).
	19 C6H806 + HC1-9 C6H705 C1 + H20.		· investigating differe
	· alginic acid creates a barrier over the		Rennie.
	oesophagus to prevent acid veflux, and is		• the most effective bi
	only present in Rennie Land none of the	}	hydrochloric acid in
	Other ontocids).		STILLING A. SMIT
	ethis was a fair test because the same method.	<u>.</u>	assistance
	Was repeated 3 times for each antacid to		omes provided by cor
	piovide accurate/reliable results. The time		CO-ordinator) in ov
	period stoyed consistent, giving each brand		and ensuring prop
	an equal emount of time to neutralise the		were being follow
	HUI (PH V.1)		

20.

.4.

/ analysis \_\_\_\_

this investigation ations that connot lead to small thin data): Mount of active ingredients

temperature (hot plate -o keep temp consistent). potential errors in the

the accuracy of results. natic errors, you should multiple times.

inutes for antaoid to

manufacturing companies 30 mins for the antacid rjor time constroints, we min time periods.

uptil the HCL acid reaches

nt concernirotions of

the shortest period of

oline Beekman (my OSA erseeing the proctical er sofety procedures ed.



- Water from the tap (pH 6.7)