SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

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Scientific Inquiry

Year 9-10

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Sahib Kaur

Our Lady of the Sacred Heart College

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YEAR 9 | OUR LADY OF THE SACRED HEART COLLEGE

ANTIBACTERIAL HAND SOAP EFFECTIVENESS IN PREVENTING MICROBE TRANSMISSION

SCIENTIFIC INQUIRY

MADISON GURNEY-WHITE & SAHIBJOT KAUR

2021 | OLIPHANT SCIENCE AWARDS

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ABSTRACT

Within the community of a human's microbiome, resides many forms of bacteria, viruses, and fungi, which can be transferred through the air and by direct contact with surfaces, animals, faeces, and food.[1] What is the best method in preventing bacterial spreading? If it is soap, which hand soap is the most effective?

There are various bacteria and viruses present within communities that are continually transmitted. Therefore, it is essential for individuals to discover the most effective and efficient hand soap to protect themselves and others. Many types of hand soaps are available, with some advertising they, '*kill 99% of germs'*, while others concerned with the qualities and benefits it places on the skin, such as *'soft on hands'*. The purpose of the following investigation is to determine the most effective brand of antibacterial hand soap in preventing microbial transmission and inhibiting bacterial growth.

Five different hand soaps were analysed, regarding their effectiveness in preventing the transmission and growth of antibacterial agents. Over a time period of 7 days, identified microbial colonies were recorded, both digitally (through visual file) and noted. After the 7-day time period, for each brand of antibacterial hand soap (for each trial), the bacterial colonies were compared to their controls. Many observations were made, during the practical, and the most effective hand soap in preventing microbe transmission was discovered. Dettol and Palmolive were the most effective at preventing microbe transmissions on agar plates, whereas the Balnea, Carex and Coles trials showed considerable quantities of bacterial colony growth. Therefore, when selecting future hand soaps, Dettol and Palmolive liquid hand washes are advised.

INTRODUCTION – INFORMATION/RESEARCH / EVIDENCE

Microorganisms form a large quantity of the living material on Earth, and they are organised into seven main divisions: bacteria, archaea, protozoa, algae, fungi, viruses and helminths. [2] Some microorganisms aid in positive processes such as oxygen production, whilst others can be pathogenic (causes disease to humans and plants) [3]. Each varying microorganism has a different *cellular composition* (cell composition/structure), *morphology* (form), *locomotion* (ability of movement), and r*eproduction* (offspring method).[4]

Bacteria: Bacteria, is a unicellular microorganism and is classified as a prokaryotic cell (an organism without a *'distinct membrane-bound'*[5] nucleus). Bacteria can be identified in four main shapes; Bacillus (Rod shaped), Coccus (Spherical shaped), Spirilla (Spiral shaped), and Vibrio (Curved shape)[6]. The bacteria cell wall is

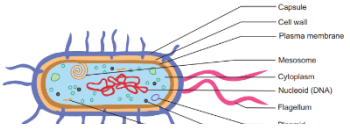


Figure 1 - Bacterial cell structure example (Brainkart, n.d.)

[1](Iowa state Uni: n.d.)
[2] (Harvard: 2017)
[3] (UNESCO: 2021)
[4] (Harvard: 2017)
[5] (Iowa state Uni: n.d.)
[6] (Libre texts: 2021)

composed of the polymer Peptidoglycan (or Murein)[7] which consists of amino acids, and sugars, forming a mesh-like layer[8] on the outside of the plasma membrane. Bacteria reproduces through *'binary fission'*,[9] a form of asexual reproduction. During binary fission, bacteria duplicate their genetic material (DNA) and divide in half to become two identical, yet separate independent organisms.[10] Movement of the bacteria occurs in some species if they have a flagellum - a tail-like appendage that is attached to the cell membrane.

Bacteria can be classified into varying groups through different methods. One classification uses gram staining, either gram-positive (staining purple) or gram-negative (staining pink); which is dependent upon the cell wall structure. Another divides the bacteria dependent upon response to oxygen; either aerobic (living in O_2 presence), anaerobic (living without O_2) or facultative anaerobes (live in both environments).[11] Another, refers to the bacteria's method of obtaining energy; autotrophs use sunlight as energy, heterotrophs consume other organisms, saprophytes use decayed material, and chemoautotrophs obtain energy through chemical reactions.

Bacteria grows best in warm, moist conditions, with a surrounding environment rich in proteins, and a pH level that is neutral or low in acidity[12]. The fastest growth occurs in temperatures ranging between 5^0 C and 57^0 C which is commonly known as the Temperature Danger Zone (TDZ).

Antibacterial agents in soap:

Antibacterial agents are active substances against pathogenic bacteria[13]. They complete this act through reducing the metabolic activity of the bacteria, to prevent further spread. The most common antibacterial agents identified in hand soap, include Triclosan and Triclocarban.

Triclosan and Triclocarban:

Triclosan and Triclocarban are believed to be the active ingredients in ¾ of all antibacterial liquid soaps[14]. It is used as an antiseptic, disinfectant, and preservative in varying products. When used at high concentrations, the two agents inhibit the bacterial enzyme *'enoyl-acyl carrier protein reductase'*[15] which disrupts the catalysis of fatty acid biosynthesis[16]. In turn, this prevents cell membrane production which leads to bacterial growth inhibition[17].

Concerns that bacteria found on the skin can become immune to triclosan, was disregarded after a risk assessment by the 'National Industrial Chemicals Notification and Assessment Scheme (NICNAS)'[16]; (Refer: PEC30-Triclosan.pdf (industrialchemicals.gov.au)).

[7] (Biology dictionary: 2017)
[8] Ibit
[9] (Harvard: 2017)
[10] (Libre texts: 2021)
[11] Ibit
[12] (Iowa state Uni: n.d.)
[13] (Macri: 2017)
[14] (PubChem: n.d.)
[15] (Macri: 2017)
[16] (PubChem: n.d.)

Importance of the antibacterial agents in soap:

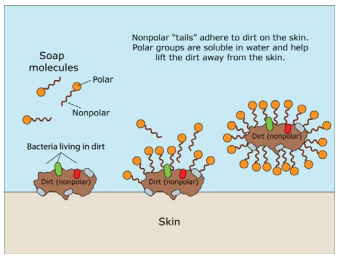


Figure 2 - Interaction of antive soap particles and 'germs/dirt' on the skin. (Ref: Unesco: 2021)

Germs and bacteria are attracted to the natural oils found on the skin. As water and oil do not mix, soap must be used to remove substances, including bacteria. When the 'pin shaped' soap molecules are applied to the skin, the hydrophilic head bonds with the water, whilst the hydrophobic tail curls inward, to protect itself against water, forming micelles (soap bubble cages),[17] which loosen and capture the germs from the skin. Soap has both polar and non-polar properties, therefore capable of removing most types of molecules.[18] The antibacterial agents, are intended to stop the possible bacteria (left on the hand after washing) from 'replicating'[19], reducing the risk of bacterial germs and further protecting the user.

The following investigation examines varying types of antibacterial hand soaps, to determine the most effective antibacterial hand soap in inhibiting bacterial growth. The investigation, performed over a 7-day time-period, examined five different antibacterial hand soaps. Each hand soap was tested on an agar plate that was split in half, with one side being the control (bacterial swab only), and the other side containing the bacterial swab and the antibacterial hand soap (trial side). The final number of bacterial colonies present on each agar plate, determined the most effective brand of hand soap.

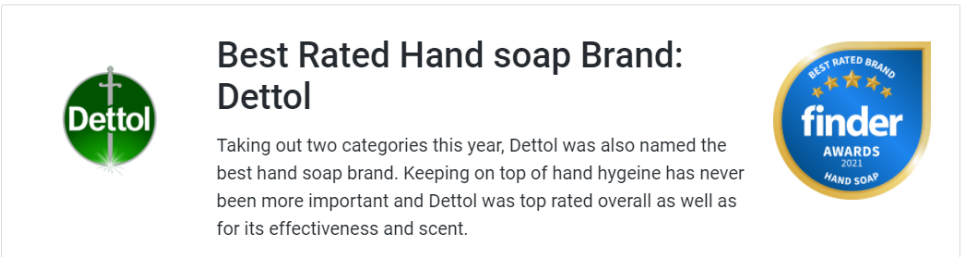
PLANNING AND CONDUCTING

Aim:

To determine the most effective antibacterial hand soap brand in inhibiting microbe transmission and growth.

Hypothesis:

It is predicted that Dettol's Soft on Skin liquid hand wash will be the most effective hand soap because according to Finder, it was considered to be the most effective hand soap. These results were based on customer feedback over a 3 month to 3-year period. Dettol also won the 2021 Finder Award as the Best Rated Hand soap Brand.



Link: [Best hand soap brands in Australia 2021: As chosen by Australians | Finder]

[17] (USA department of health and human services: n.d.)
[18] (Rengel: 2017)
[19] (USA department of health and human services: n.d.)

Method Chosen and Fair Test:

To determine the most effective antibacterial hand soap, a qualitative method chosen was chosen to compare the growth of bacterial growth on agar plates. The following method below was selected as it allowed the trial side (bacterial swab with antibacterial hand soap) to be easily compared against a control side (bacterial swab only), for each brand of antibacterial hand soap. Three trials were conducted for each brand of antibacterial hand soap to see if the results were reliable.

This investigation was a fair test because each antibacterial hand soap was subjected to the same method and had the same number of trials. Controlled variables were also kept consistent (i.e., temperature of the incubator, swab source of bacteria, place of swabbing on agar plate and the amount of antibacterial hand soap used, as detailed below). All of these factors contributed to fair testing because every trial, for each brand tested was treated identically. This allowed results to be fairly compared.

Variables:

Independent variable: Brand of antibacterial hand soap being tested.

Dependent variable: Quantity of bacterial colonies formed on the Agar plates.

Controlled Variables:

Control group	How they were controlled	Why they were controlled
Temperature of the incubator	Checked daily, and kept at a constant rate between 36 – 27 degrees	If increased, then decreased on day; the results of bacterial growth would not be accurate. The temperature was also set at the maximum level as stated in the school policy for growing microorganisms (stated in the risk assessment).
Swab source for bacteria	All swab sources derived from the mouth of individual participant; Sahibjot.	Different people have different bacterial characteristics; if used different people then experiment would not have been fair test.
Place of swabbing on agar plate	The mouth swab was placed over entire plate, whereas the soap swab was only completed on one half of the line.	If changed then identified bacterial colonies would not result in a fair test
Amount of hand soap used	An individual cotton bud, of the same size, was used to retrieve the soap samples (a different one was used for each sample).	If different size cotton buds were used to retrieve the soap samples, the trials would be unfair and result in biased results.

The Controls:

Control 1: bacteria only with no antibacterial soap (set up to see if antibacterial soap inhibits bacterial growth).

Control 2: agar plate that has no bacteria and no antibacterial soap (set up to prove that the agar plates were not contaminated).

Equipment and materials:

1. X 20 Sterilised agar plates
2. X 35 cotton buds
3. X 5 different hand soap brands (Dettol, Palmolive, Carex, Balnea and Coles)
4. X 5 30 mL beakers
5. X 1 Marker pen
6. X 1 Incubator
7. X 1 Sticky Tape

Scientific Method of Investigation

1. A line was drawn down the middle of one sterilized agar plate. One side was labelled C (for control) while the other side (the trial side) was labelled with the name of the tested antibacterial hand soap. (Appendix One)
2. Step one was repeated twice more for the same brand of antibacterial soap. A separate agar plate (the second control) was labelled as 'control'.
3. Steps one and two, were repeated for the other 4 antibacterial hand soap brands.
4. A dry cotton bud was then gently rubbed against the inside of a person's cheek.
5. The lid of the initial agar plate was lifted off, and the cotton bud was streaked onto the agar, in a zig zag pattern (Appendix Two).
6. The previous cotton bud was discarded and a new one was dipped into the first brand of antibacterial hand soap. This hand soap was carefully traced over the bacterial streak on the trial side of the agar plate.
7. Steps 4 – 6 were completed for the other 4 brands of antibacterial hand soap.
8. Each agar plate was sealed with sticky tape and placed into an incubator for 7 days at an average temperature of 36 degrees Celsius.
9. The agar plates were examined daily, with photos taken and observational data recorded.

RISK ASSESMENT

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: Madison Gurney-White and Sahibjot Kaur ID:_____

SCHOOL: Our Lady of the Sacred Heart College

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

The purpose of the following experiment is to compare varying antibacterial agents within hand soaps, to determine the most effective antibacterial hand soap in preventing microbe transmissions and bacterial growth. The most effective hand soap will be determined through placing varying hand soaps upon bacterial streaks on an agar plate, then promoting bacterial growth in an incubator at 37^0C, for 7 days. As a result, the most effective antibacterial hand soap will be determined through noting the number of bacterial colonies present in each agar plate.

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.

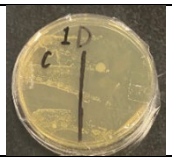
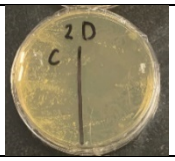
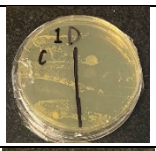
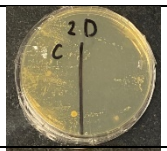
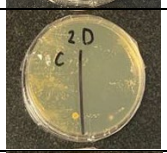
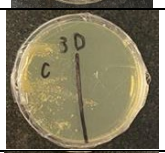
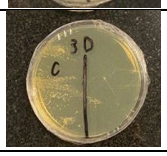
R I S K S:	HOW I WILL PREVENT THESE RISKS:
Chemical risks: Antibacterial hand soaps, contain fragrances, many have phthalates; consequently, trigger allergies, if eaten then cause vomiting or diarrhoea; irritate and cause swelling or sharp pain in the eyes.	Hand soap label to be consulted before usage. Safety precautions to be taken - lab coat and gloves to be worn. Not used near the eyes. Hands to be washed with water before touching the area. If eyes do contact then flushed out with water, at room temperature. Not to be consumed.
Biological Risks: Agar is harmless, but bacteria or fungi grown on agar may be pathogenic. Knowledge of microbiology and aseptic techniques is required to minimise risks to staff, students and the environment.	Agar will not be incubated at temperatures around 37°C, as increases growth of pathogenic organisms. The policy of my school's authority will be consulted and referred to regarding suitable organism growth within supervised school experiments. I will tightly seal the agar plates after required steps complete, and not to be re-opened.
Sharps risks: Plasticware (Agar Plate), if broken, chipped or contains sharp edges, or sharp fragments, then hold possibility of cuts and injury toward user.	Broken, chipped or sharp-edge plasticware will be discarded, and not be used. If dropped and breaks, then hands will not be used to retrieve; instead will be swept up, with dustpan and broom.
Electrical risks: Incubator used to encourage bacterial growth on agar plates. Possible contamination of incubator is possible, temperatures greatly impact bacteria growth, possibly to unsafe level. If cord is damaged then presents risk to user, such as electric shock.	The agar plates will be tightly sealed before being placed into the incubator, and regularly checked. Cord will be inspected for damage, heat corrosion, or lose connection, if identified then replaced immediately.
Other hazards: Permanent Marker — Inhaling contents may be harmful, due to toxic volatile solvents. May cause severe irritation, if used on skin as a cosmetic. An allergic reaction is possible. Pen liquid may be flammable.	The pen will be recapped tightly after use, and fumes will not be inhaled. The safety data sheet from the manufacturer will be consulted before use.

RESULTS

Table One - Dettol:

Please note: C = Control (bacteria sample, no antibacterial soap)

Control = Agar only, no bacterial sample and no antibacterial soap

Day	Temperature (^{0}c)	T1	T2	T3	Control
1 (3rd June, Thursday)	37				
2 (4th June, Friday)	37				
[Weekend]	-	-	-	-	-
3 (7th June, Monday)	37				
4 (8th June, Tuesday)	37				
5 (9th June, Wednesday)	37				

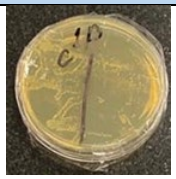
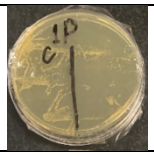
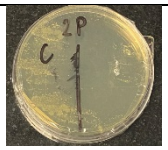
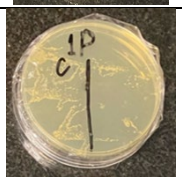
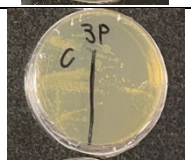
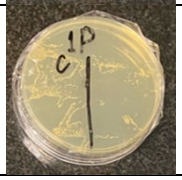
Observations:

- For trial 1, there is bacterial growth, even in the presence of antibacterial hand soap (as seen in the colony that is located toward the top quadrant). This colony is likely due to contamination.
- Overall, when observing the control side (C) against the trial side, most bacterial growth was prevented (especially trials 2 and 3).

Table Two - Palmolive:

Please note: C = Control (bacteria sample, no antibacterial soap)

Control = Agar only, no bacterial sample and no antibacterial soap

Day	Temperature (^{0}c)	T1	T2	T3	Control
1 (3rd June, Thursday)	37				
2 (4th June, Friday)	37				
[Weekend]	-	-	-	-	-
3 (7th June, Monday)	37				
4 (8th June, Tuesday)	37				
5 (9th June, Wednesday)	37				

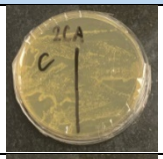
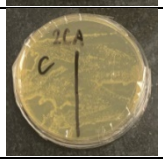
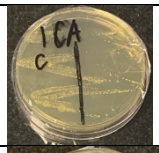
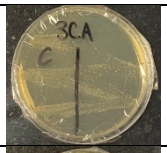
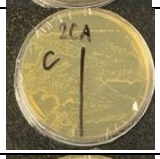
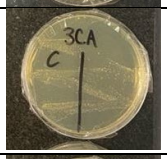
Observations:

- The control side (C) contained many bacterial growths, whereas bacterial grow was generally prevented on the trial side (particularly for trial two).
- The bacterial growth on the trial side appears to be reasonably close to the middle line. This is possibly due to contamination from the control side (C).

Table Three - Carex:

Please note: C = Control (bacteria sample, no antibacterial soap)

Control = Agar only, no bacterial sample and no antibacterial soap

Day	Temperature (^{0}c)	T1	T2	T3	Control
1 (3rd June, Thursday)	37				
2 (4th June, Friday)	37				
[Weekend]	-	-	-	-	-
3 (7th June, Monday)	37				
4 (8th June, Tuesday)	37				
5 (9th June, Wednesday)	37				

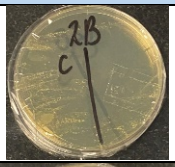
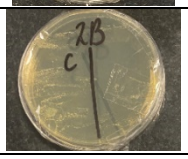
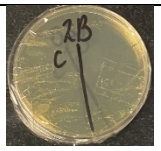
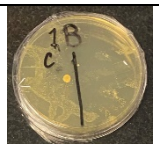
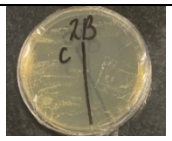
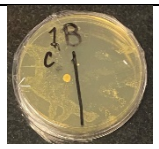
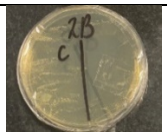
Observations:

- Bacterial growth for both the control side (C) and the trial side occurred for this hand soap (especially for trial 2).
- On the trial side, there are many bacterial colonies present (especially for trials 2 and 3) which indicates that the hand soap is not as effective in preventing microbe transmission and growth.

Table Four - Balnea:

Please note: C = Control (bacteria sample, no antibacterial soap)

Control = Agar only, no bacterial sample and no antibacterial soap

Day	Temperature (^{0}c)	T1	T2	T3	Control
1 (3rd June, Thursday)	37				
2 (4th June, Friday)	37				
[Weekend]	-	-	-	-	-
3 (7th June, Monday)	37				
4 (8th June, Tuesday)	37				
5 (9th June, Wednesday)	37				

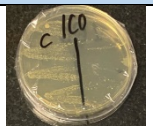
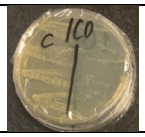
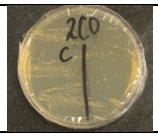
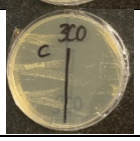
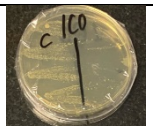
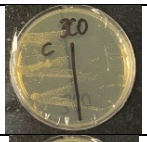
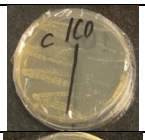
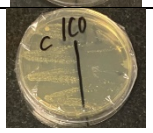
Observations:

- Trial three has few bacterial colonies on the trial side compared to the other trials.
- Throughout the 7-day course, it appears that the bacteria from the control side (C) slowly spread to the right side of the agar plate.
- A large bacterial colony progressively gets larger between June 4th and June 7th for trial one (control side (C)). This is likely to be from contamination.

Table Five - Coles:

Please note: C = Control (bacteria sample, no antibacterial soap)

Control = Agar only, no bacterial sample and no antibacterial soap

Day	Temperature (^{0}c)	T1	T2	T3	Control
1 (3rd June, Thursday)	37				
2 (4th June, Friday)	37				
[Weekend]	-	-	-	-	-
3 (7th June, Monday)	37				
4 (8th June, Tuesday)	37				
5 (9th June, Wednesday)	37				

Observations:

- The bacterial colonies are seen on the trial side of the agar plate. This indicates that the Coles brand of hand soap is not as efficient when preventing microbe growth compared to other brands.

DISCUSSION OF RESULTS:

The investigation conducted, examined various antibacterial hand soaps to determine which is the most effective in inhibiting microbe transmission and growth. The most effective hand soap was identified by producing a bacterial streak on agar plates and then coating the bacterial streak with antibacterial hand soap. Through extensive observations over seven days, it was concluded that the most effective hand soap in preventing microbe transmission and growth was Dettol, followed by Palmolive. This conclusion could be made because for all three trials, Dettol had the least number of grown bacterial colonies on the trial side of the agar plates. These results suggest that Dettol must have the greatest amount of active ingredients (triclosan and triclocarban) that cause the inhibition of bacterial growth.

Balnea and Coles brands had more bacterial growth on the trial side over the 7-day time period which suggests that they were less effective in preventing bacterial growth, compared to Dettol and Palmolive brands. Carex proved to be the least effective in preventing bacterial growth, compared to the other hand soaps. These results suggest that Carex must have the least amount of active ingredients (triclosan and triclocarban) that cause the inhibition of bacterial growth.

EVALUATION

This investigation is relevant in today's society due to the ongoing Covid-19 global pandemic. Hand soap and hand sanitizer have become increasingly important due to the rapid transmission of both bacteria and viruses in local communities. To ensure that results were reliable, three trials were conducted for each hand soap over a 7-day time period.

Two controls were used in this experiment. Control 1 contained the bacterial streak but no antibacterial soap. The purpose of this control was to observe if antibacterial soap inhibits bacterial growth. Control 2 was the agar only and it did not contain a bacteria streak or antibacterial soap. The purpose of this control was to prove that the agar plates were not contaminated.

Random errors are caused by uncontrolled factors which produce natural variation in results. Random errors cause results to be imprecise. The first random error was the number of bacterial cells that were streaked onto the agar plates. For a given brand of antibacterial hand soap, if a slightly larger amount of saliva was streaked onto an agar plate, then it would contain more bacterial colonies, compared to another plate that contained less saliva. Consequently, the plate that contains more bacterial cells is likely to not be completely covered with antiseptic hand soap. This would result in greater bacterial growth compared to an agar plate that contained less saliva. This random error would have also increased the chance of cross contamination on the trial side of the agar plate (bacterial streak with antiseptic soap).

Another random error for a given brand was the amount of antiseptic hand soap that was applied to the bacterial streak on the trial side of agar plates. If slightly more antibacterial hand soap was applied to the trial side of the agar plate (bacterial streak with antiseptic soap), then it is likely to have less bacterial growth because more of the bacterial streak would be covered.

Random errors cannot be fixed by the experimenter; however, their effects can be minimised by completing numerous trials and by calculating an average.

Systematic errors are due to human errors, faulty equipment or errors in the method. Systematic errors cause inaccuracies in results. These errors can be corrected by the experimenter. One systematic error was that the same agar plate was used for the control (bacteria streak only) and the trial (bacterial streak and antiseptic hand soap). This caused the trial side of the plate to be contaminated with bacterial colonies from the control side. An improvement would be to use separate plates for the control (bacteria streak only) and trial (bacterial streak with antiseptic soap) for each brand of antiseptic soap. Another systematic error was that the most effective antibacterial hand soap was determined based on general observations of agar plates (e.g., Dettol was more effective in preventing bacterial growth than Palmolive because it overall appeared to have less bacterial colonies) rather than counting the precise number of bacterial colonies for each trial, for every brand of hand soap.

A future experiment that is relevant and interesting would be to investigate is the effectiveness of different brands of hand sanitiser. Due to the current Covid-19 pandemic, many people constantly carry around and use hand sanitisers. Individuals in society would benefit from this research because they would find it to useful to know which hand sanitiser is the most effective at preventing microbial growth.

CONCLUSION:

In conclusion, the prevention of bacterial growth was examined for five different brands of antibacterial hand soaps over a 7-day time period. Results showed that the most effective hand soap in preventing microbe transmission and growth was Dettol, followed by Palmolive. This conclusion could be made because for all three trials, Dettol had the least number of grown bacterial colonies on the trial side of the agar plates. These results suggest that Dettol must have the greatest amount of active ingredients (triclosan and triclocarban) that cause the inhibition of bacterial growth.

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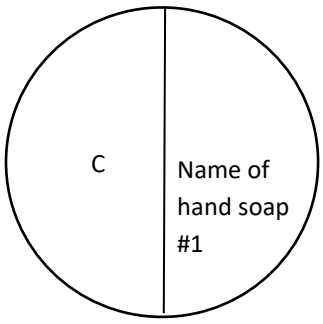
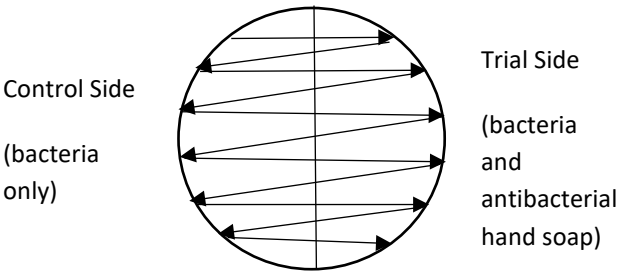
Word Count: 2189

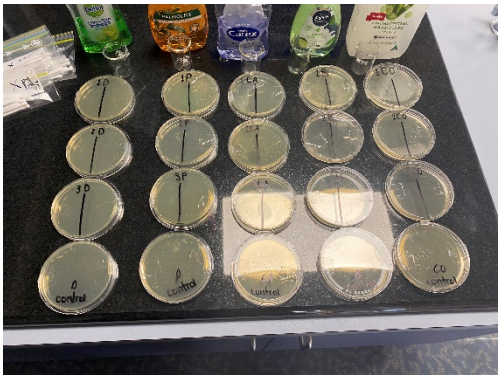
APPENDICES:



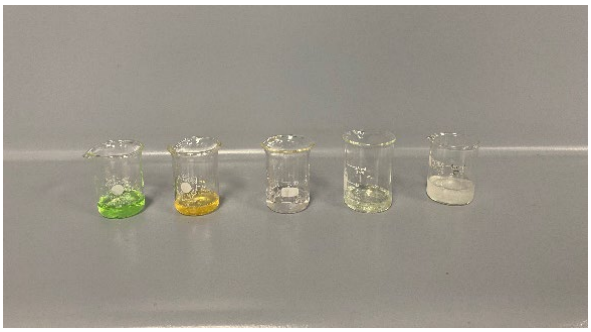
Appendix one - First step of this practical



Appendix two - Streaking of Agar plate



Appendix three – layout before beginning the practical



Appendix four – 50ml beakers with hand soaps

Appendix five – 50ml beakers and hand soaps

Appendix six – Dettol

Appendix seven – Palmolive

Appendix eight – Balnea Body

Appendix nine – Coles

Appendix ten – Carex

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17/5/21

Scientific Inquiry

Name: Madison & Sahib

School: Our Lady of the Sacred Heart College

Year: 9

OSA coordinator: Caroline Beekman

Entry Requirements:

- Scientific method (to investigating) ☐
- Clear / concise communication of ideas ☐
- Original / Authentic inquiry ☐
- Evidence and research regarding the topic (Reading) ☐
- Hypothesis → supported / Not supported ☐

Rules:

- Up to 3 students - highest year level = entry year level
- Animal inclusion meet Animal Ethics Requirements
  └→ Science teacher check
- Science journal / log book include:
  - dates of ongoing ideas
  - raw data
  - Notes
  - Completed risk assesment (Science teacher sign)

Include: (Scientific Report)

- Questioning / Predicting: Question being investigated? Predicted outcome?
- Planning / Conducting: Explain method chosen - possible variables - which variable will you change / which variable will you measure?, is it a 'fair-test', include steps to investigation to allow someone else to do it exactly as you did it.
- Processing / Analysing data & information: Present measurements and observations from investigation in suitable format.
  - tables / graphs, photos / sketches. Analyse the results, what pattern and relationships are seen in the data? What conclusions can be made? Do results support predictions?
- Evaluating: How can the investigation be improved? How could the findings be useful to others? Related questions suitable

17/05/21

Scientific Inquiry (continued)

- for further investigation?
- Communicating: Present Science investigation using Scientific terms; represent data in number of ways – various texts / charts / graphs / tables (use IT)
  - ↳ relate investigation to any research from other Sources.
- Reference Section: All sources of info. accessed
  - ↳ books, website, magazines & any people
  - ↳ Quote in quotation marks (+) reference of source
- Word count included in entry (10% tolerance)
  - ↳ Headings, titles, figure captions tables & references
- Years 7 - 12 = 2000 words

* Online Submission *

19/05/21

Inquiry Planning

Chemistry:

Top 3 chosen

- Antibacterial handsoaps - effectiveness
- Antibacterial hand sanitizer - effectiveness
- Copper in nitric acid and solution colour changing
- Different levels of alkali reaction in water
- Chemical photon energy effecting flame colour
- Water PH in different bottled water brands

Biology / Ecology:

- Bacteria Growth on School drink bottles
- What makes different fruits different? (DNA)
- Light generation by microorganisms
- PH and water quality / difference in different areas around Adelaide
- Soil toxicity in different types soil & the affects these can have on different organisms
- Plant transpiration affected by varying gasses

Physics:

- colour effects on the heat, through light absorbtion
- Different colours absorbing radiation energy

19/05/21

Planning Continued

① Bottled water

(PH - Alkalinity) - acid in the water

- Comparing different bottled waters (brands of water)
  - ↳ looking for optimal 7 (6.5 - 8.5) ↳ Australian
- HOW - Sample of water in each
  - used red cabbage juice (pigmint flavin - changes colour of liquids to indicate pH level)
  - Acidic (vs) Neutral (vs) Alkaline
    - green to blues - optimal @ 7

PART 2:

- Look at influence of bottle to result

② School drink bottle bacteria growth

- types of drink bottles (bacteria growth comparison)
  - ↳ open top (vs) closed top - is there difference in bacteria
- Swap then place into an agar plate - w same conditions
  - ↳ look at growth of organisms / analyse difference
  - ↳ UV lights used to detect bodily pathogens on object
- Too many external factors influencing
- clean off / sanitize @ beginning
  - ↳ leave to grow - Not enough time

variant – · Change of liquid inside (sugary substance)
  - ↳ metal / plastic influence

③ Antibacterial handsoaps effectiveness

- Petri plates > look @ bacteria remaining
  - ↳ Agar (+) Swab (hand) → antibacterial soap (one hand)
- 20 sec. remove germs / chemicals from hands
- Plain soap (softness) vs antibacterial soap
  - ↳ difference?
- Bacterial germs remove
  - ↳ triclosan most common additive to antibacterial soaps prevents further growth on hands, even after removed

21/05/21

Microorganisms

- Form a large quantity of the living material on Earth
  - ↳ aids in the maitance of the Earths ecosystems
- There are seven main (divisions) types of microorganisms: bacteria, archaea, protozoa, algae, fungi, viruses, and helminths (animal parasites that are multicellular)

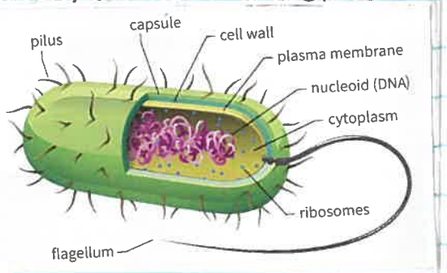
Benefits:
- ~~Each~~ Microorganisms aid in producing oxygen, decomposition of organic material, nutrients, maintain human health

- Some can be 'pathogenic' (cause disease) to humans / plants
  - ↳ Each different type has different:
    - cellular composition: the structure of which cells are composed
    - Morphology: Form / shape / structure of animals / plants
    - locomotion: Movement / ability to move from one area to another.
    - Reproduction: Production of copying something (offspring method)
- Microorganisms, aka, microbes, can be unicellular (single-celled organism), multi-cellular (organism consist of more than one cell), or cell-clusters (a group of cells arranged together)
- Microbiology is the study of these microorganisms, which are too small to be visible by the naked eye.

Bacteria:

- Bacteria are unicellular organisms
  - ↳ prokaryotic = an organism without nucleus; without a distinct membrane-bound nucleus
- Can be found in four main shapes;

REF: libretexts
- Bacillus (rod shape) →
- coccus (Spherical Shape) →
- Spirilla (spiral shape) →
- Vibrio (curved shape) →



REF: Biology Dictionary

- The bacteria cell wall is made from a polymer
  - ↳ Polymers are a substance made from very large molecules (long chains) of repeating networks of smaller molecules forming them
- The polymer is called a Peptidoglycan (Murein) which is made from sugars and amino acids

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Microorganisms

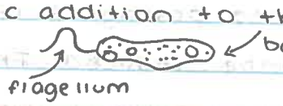
Bacteria (continued):

- When the molecules of pepidoglycan combine (join together) they form a 'crystal lattice structure'
  - ↳ repition of a group of atoms in a 3D space (geometrical) wich continuesly repeat to form an arrangement of points

(Polymer) Pepidoglycan —mesh layer→ plasma membrane → bacteria cell

Pepidoglycan: amino acid (+) Sugars → form cell wall; molecule formation = crystal lattice

- The bacteria reproduces through Binary fission, which is explained
  - a form of asexual reproduction
    - ↳ The single organism becomes 2 seperate organisms, each independant and regenerate as entities to resemble to original cell
    - ↳ The cell will duplicate is genetic material / DNA, then gives each new organism a copy
- The bacteria are also capable to move through the flagella, which is a microscopic addition to their body - also enabling them to swim



- The classification of bacteria is greatly dependant upon the cell wall structure.

① ↳ one classification, uses the Gram staining, classifying the bacteria as either Gram-positive or Gram Negative

② ↳ can also be divided dependant upon response when in O_2
- either aerobic (living in O_2 presence)
- anaerobic (living without O_2)
- facultative anaerobes (live in both environments)

③ ↳ classified according to method of obtaining energy
- Autotrophs = make own food through using energy of Sunlight (if obtain through chemical reactions = chemoautotrophs)
- Heterophs = consume other organisms to obtain energy
- Saprophytes = use decaying life as energy source

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Microorganisms

Bacteria (continued):

- living / growth conditions -
  - can live & grow in cooler & hotter conditions than humans can survive in
  - Growth occurs best in warm and moist conditions, with a surrounding environment rich in proteins. The conditions are also most suitable if the PH level is neutral or low in acidity. The fastest growth occurs in temperatures ranging between (cool) 5°C and (hot) 57°C - This 'zone' is known as the temperature danger zone (TDZ) as it encourages the growth of microorganisms.

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Antibacterial Agents

Also known as an 'antimicrobial' - Antibacterial agents kill microorganisms or stop the growth of microorganisms. In particular these agents fight 'pathogenic bacteria' (Science Direct: 2021) - Bacteria that can cause disease. This means the effect of these pathogens on the surrounding environmental area will be reduced. The reduction in the metabolic activity will further prevent the spread of Bacteria.

Antibacterial agents found in Soap:

The most common compounds, acting as antibacterial agents in soap, are Triclosan and Triclocarbon. These two elements are used to stop the bacteria, remaing on the hands (after washing), from 'replicating'. The antibacterials added to the Soap, will protect the user from the harmful bacteria; rather than the simple soap wash - which only removes dirt from the surface. The only reason for antibacterial agents are to reduce the bacterial germs, as the antimicrobial's have no effect on viruses.

Triclosan:

Believed to be the active ingredient in 3/4 of all antibacterial liquid soaps. There is concern that the bacteria found typically

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Antibacterial Agents

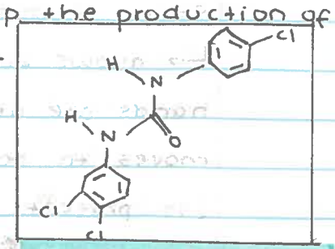
on the skin, can become immune to the effects of ~~triclosan~~ ~~with~~ triclosan: resistant bacteria having mutations in the proteins, meaning the bacteria will survive. However, triclosan is still used as an antiseptic, disinfectant / preservative. When the compound is used at a concentration 'sublethal' it inhibits the enoyl-acyl protein reductase (FabI), which carries enoyl-acyl (a catalyze in the synthesis of fatty acids). This enzyme is critical to the production of living cells (biosynthesis) in fatty acids. When triclosan is used at low concentrations it stops the spread, but at high concentrations kills microorganisms. Triclosan will inhibit the 'enoyl-acyl carrier protein reductases' which therefore inhibits the biosynthetic (production) pathway of fatty acids, which is critical to the production of living cells, in this case - bacteria. Meaning, the formation of the fatty compounds (lipids) is disrupted - soon killing the bacterial cell; as lipids provide a produce of energy for the bacteria supporting cell functions.

simpler

lipid - insoluable in water
↳ organic compounds

Triclocarbon:

Works is the same method as triclosan, via acting as a disinfectant. When used at 'high concentrations' it affects the outside membrane of bacteria that protects it. This then means the membrane becomes 'permeable' (meaning liquids and gasses can pass through). Once through triclocarbon can kill the microorganism, through preventing the creation of 'enoyl-acyl-carrier-protein reductase' (ENR). This an enzyme that bacteria and fungi use to produce their cell membrane; as it is a catalyst in the biosynthesis of fatty acids. (Fatty acids are components of lipids). As they stop the production of cell membranes, it means the cells can not survive; therefore the microorganisms die.
↳ in particular the triclocarbon is important to the type II fatty acid Synthase in system; a catalyst the elongation of fatty acids (the last step)



Chemical Structure

23/05/21

Antibacterial Agents

in soap – Importance of the anti-bacterial agents:

General soap doesn't kill germs – it removes them through breaking them up. The natural oils and dirt that accumulate on our hands, attracts germs which stick to the oils / grease.

As water and oil do not mix, water is not enough.

· Soap molecules are pin-shaped

↳ one end bonds with water, the other end bonds with oils and fats

· Known as the hydrophilic head (water bond) and the hydrophobic tail (oils / fats)

· When the molecules of soap are added they, lift off dirt, oils and germs from the skin

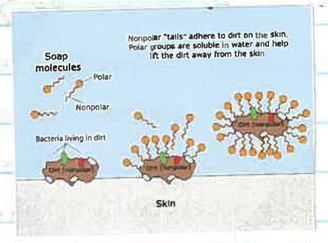
↳ the water washing washes it all away

· Some say antibacterial hand soap is not more effective

↳ As soap molecules have both polar and non-polar properties they can dissolve most molecules

- first loosens the bacteria / viruses allowing them to be washed away

- the antibacterial elements added to these previous soap properties, are intended to stop the bacteria (left on the hand after washing) from 'replicating'.



REF: UNESCO

↳ reduces risk of bacterial germs

· When washing hands, with antibacterial handsoap important steps are as followed;

- Wet hands with clean water (from the running tap) before soap is applied

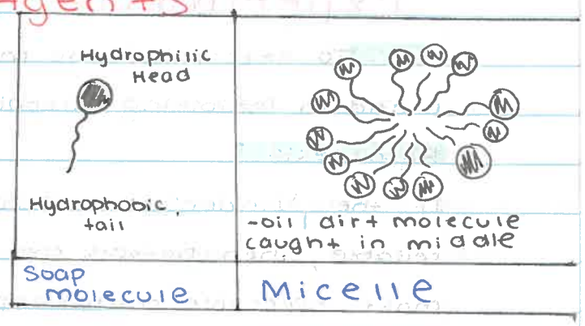
↳ allows for better application of soap, then when the hands are dry. When soap is applied the hydrophilic head moves to bond with water, whilst the tail curls inwards (to protect against water), and in doing so they scoop up the dirt / oil particles in the 'soap-bubble cages' (unesco)

23/05/21

Antibacterial Agents

which are called micelles.

↳ help to trap / remove the germs, chemicals, dirt from the hands.



- Scrub hands with soap for 20 seconds – Pysical actions in this phase of process enable the negative bacteria to be destroyed and removed from the skin.

- Washing with either warm / cold water will remove the prepared bacteria from the hands and instead down the drain.

↳ with the antibacterial agent present and important to removing the bacteria and preventing possible remaining bacterial elements from reproducing on the hands.

- By scrubbing the palms, wrists, back-of-hands; and the spaces between fingers, including finger tips and thumb; helps to ensure all spaces are met and possible bacteria removed.

25/05/21

Experiment Planning

Aim: To determine the most effective antibacterial hand soap brand in inhibiting microbe transmission and growth.

Hypothesis:

If the 'finder' awards for most effective handsoap of 2021 is reliable, then Dettols Soft on Skin liquid hand wash will be the most effective handsoap.

Variables:

Independent Variable: Brand of antibacterial hand soap being tested.

Dependent Variable: Quantity of bacterial colonies formed on the Agar plates.

Controlled variables:

- Temperature of the incubator
- Swab source for bacteria
- Place of swabbing on agar plate
- Amount of hand soap used

Equipment / Materials:

1. x20 sterilised agar plates
2. x35 cotton buds
3. x5 different handsoap brands (Dettol, Palmolive, carex, Balnea, and coles)
4. x5 30 mL beakers
5. x1 marker pen
6. x1 incubator
7. x1 2-metre tape

Method:

1. A line was drawn down the middle of one sterilized agar plate. One side labelled 'c' (for controlled) the other side labelled with the tested hand soap.
2. Step (1) was repeated for another 2 trials of the same brand; then a controlled agar plate was labelled with 'c'.
3. Steps one and two were repeated for the other 4 hand soap brands.

25/05/21

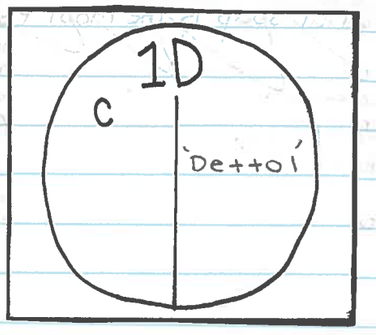
Experiment Planning

Method: (continued)

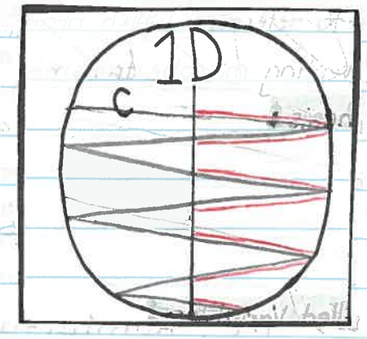
4. A dry cotton bud was then gently rubbed against the inside of a person's cheek.
5. The lid of the initial agar plate was lifted off, and the cotton bud was streaked onto the agar, in a zig zag pattern.
6. The previous cotton bud was discarded, then a new one used to swab the first brand of soap, which was carefully traced over the bacterial streak, only on the trialled side.
7. Steps 4 - 6 were completed for the other 4 brands of hand soap; only on the trials 1, 2, 3; with the controlled agar plate having no substance.
8. Each agar plates lid was tapped to the base, and placed into an incubator, horizontally, with the base to the bottom, for 7 days at an average temperature of 36°C.
9. The agar plates were examined daily, with photos taken and observational data recorded.

1/6/21

Further Planning



Example of Step one.



Example of steps 4-6.

= Hand soap

= Bacterial streak

1/06/21

[continued]

Further Planning

Hand Soaps:

The 5 hand soaps above are the five antibacterial hand soaps that will be tested during this experiment.

Method chosen / Fair test:

- comparison of bacterial growth allows for a qualitative method to viewing to viewing the most effective hand soap.
  - L> effective = highest ability in preventing microbial growth and transmission
- Selected method allows trialled soap to be compared against a controlled side, as well as against other soap brands
  - L> viewed / recorded through observational method
- Each antibacterial hand soap will be tested 3 times
  - L> resulting in 3 trials that can be compared to conclude a final result
- Agar plates will be taped, to prevent natural occurances from affecting the results.
  - L> i.e., Humidity etc.
- All agar plates will remain in the incubator for an equal amount of time
  - L> and at a consistent temperature each day
- Bacterial swab will be collected from one persons cheek, to prevent inconsistencies
  - L> Allows for 'fair test'

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: Madison Gurney-White and Sahibjot Kaur ID:_____

SCHOOL: Our Lady of the Sacred Heart college (OLSH)

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

The purpose of the following experiment is to compare varying antibacterial agents within hand soaps, to determine the most effective antibacterial hand soap in preventing microbe transmissions and bacterial growth. The most effective hand soap will be determined through placing varying hand soaps upon bacterial streaks on an agar plate, then promoting bacterial growth in an incubator at 37^0C, for 7 days. As a result the most effective antibacterial hand soap will be determined through noting the number of bacterial colonies present in each agar plate.

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.

Risks	How will I manage/control the risk
Chemical risks: Antibacterial hand soaps, contain fragrances, many have phthalates; consequently trigger allergies, if eaten, then cause vomiting or diarrhoea, and irritate/ cause swelling or sharp pain in the eyes.	Hand soap label to be consulted before usage, if I am at risk, then safety precautions to be taken, lab coat and gloves to be worn. Not used near the eyes. Hands to be washed with water before touching the area. If eyes do contact then flush out with water, at room temperature. Not to be consumed.
Biological Risks: Agar is harmless, but bacteria or fungi grown on agar may be pathogenic. Knowledge of microbiology and aseptic techniques is required to minimise risks to staff, students and the environment.	Agar will not be incubated at temperatures above 37°C, as it increases growth of pathogenic organisms. The policy of my schools authority will be consulted and referred to regarding suitable organism growth within supervised school experiments. I will tightly seal the agar plates after required steps complete, and not to be re-opened.

Risks	How will I manage/control the risk
Sharps risks: Plasticware (Agar Plate), if broken, chipped or contains sharp edges, or sharp fragments, then holds possibility of cuts and injury toward user.	Broken, chipped or sharp-edge plasticware will be discarded, and not be used. If dropped and breaks, then hands will not be used to retrieve, instead will be swept up, with dustpan and broom.
Electrical risks: Incubator used to encourage bacterial growth on agar plates. Contamination of incubator is possible, temperatures greatly impact bacteria growth, possibly to unsafe level. If cord is damaged then presents risk to user, such as electric shock.	The agar plates will be tightly sealed before being placed into the incubator, with the temperature being set at 37^0C maximum, and regularly checked. Cord will be inspected for damage, heat corrosion, or loose connection, if identified then replaced immediately.
Other hazards: Permanent Marker — Inhaling contents may be harmful, due to toxic volatile solvents. May cause severe irritation, if used on skin as a cosmetic. An allergic reaction is possible. Pen liquid may be flammable.	The pen will be recapped tightly after use, and fumes will not be inhaled. The safety data sheet from the manufacturer will be consulted before use.

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Madison Gurney-White, Sahibjot Kaur

SIGNATURE(S): mgw sahibkaur

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

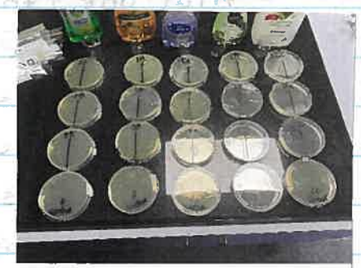
TEACHER'S NAME: Caroline Beekman

SIGNATURE: [signature] DATE: 02/06/2021

2/06/21

Day of the practical!!

- Today is the day of the practical, which will determine which hand soap is the most effective in preventing microbe transmission and growth.
- With the assistance of our OSA coordinators; Ms. Beekman and Ms. Anderson we were able to obtain and prepare the equipment prior to the practical.
- Once we arrived in the Science lab, we proceeded to label the agar plates in order of hand soap and trial no. e.g., (Dettol, trial 1) = D1.
- Once this was completed, we drew a line with a marker down the middle of the lid to differentiate the controlled side and the hand soap trialled side (refer to the right) ⟹
- Each hand soap had four agar plates; three trials and one controlled.
- Prior to this experiment, we discussed who would provide the swab source for the bacterial streak and chose Sahibjot Kaur.
  - ↳ This meant all swab sources were derived from Sahibjot, resulting in a controlled variable, and a fair test.
- A fresh cotton bud was used to derive bacteria for each trial, as well as a new cotton bud for each hand soap.
- Overall today was quite successful, and we are exhilarated for the upcomming results this week.
- This experiment will be observed over a seven-day period, so there will be no results documented today.
- In the next few pages (of this journal) there will be regular updates + pictures to document progression..



Practical set up. (Day of practical).

3/06/21

Day One (Thursday, 3rd June)

Dettol: Minimal bacterial growth can be seen within the initial days specifically within trial 3. So far, dettol is doing an effective job in preventing microbial growth, however in trial 3 there is cross contamination, seen close to the seperation line.

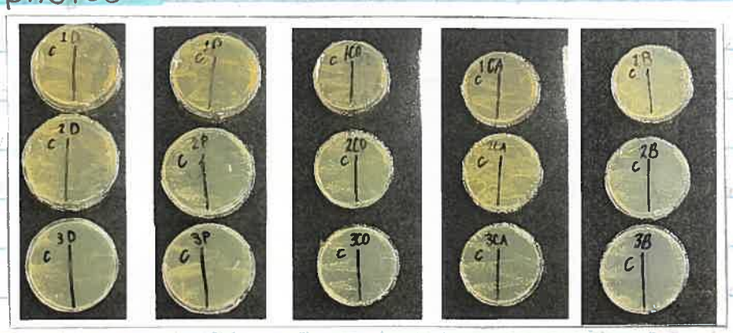
Palmolive: Palmolive produced min. results even on day one with the bacterial colonies visible on both sides of the agar plate. Trial two had minimal bacterial growth, however trial one / three did have a few bacterial colonies.

Carex: carex did not show effective results, despite it being the first day of observations. Trial 2 has clusters of large bacterial colonies spread all over the agar plate, trial 3 shows the bacterial streak clearly however it looks as if no soap has been applied to it, therefore indicating that it is not very effective.

Coles: After observing the three hand soap trials for coles, we can see that today there has been minimal bacteria growth, with only a few small bacterial colonies beginning to grow on all three trials.

Balnea: Balnea body company hand soap performed better than expected; seen on all 3 trials. T1 currently has a few bacterial colonies, whereas T2 / T3 have not grown any bacteria colonies, yet.

Day 1 photos:



Dettol
Palmolive
Coles
Carex
Balnea

4/06/21

Day two (Friday, 4th June)

Dettol: The hand soap trials for Dettol look very similar to the previous day, and not much progression can be seen; which is good as there is not much bacteria growth.

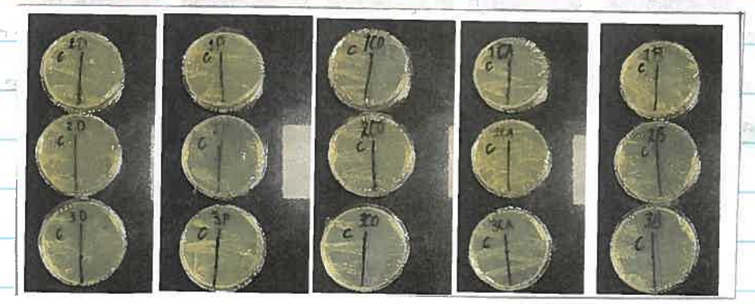
Palmolive: Day two for the palmolive hand soap trials shows minimal growth on T2 (once again), whereas T1 / 3 have a few small bacterial colonies. Something observed on T3 agar plate, is that visible bacterial colonies are seperated into smaller particles, compared to carex or coles brand of hand soap which has large clusters of bacterial colonies.

Carex: When carex handsoap was checked during today's observations, it could be seen that the bacterial colonies had not improved, instead they looked similar to day 1.

Coles: Day two of the coles hand soap trials, and T1 and T3 look the same as yesterday, however some new bacterial colonies can be noted in T2.

Balnea: The results look similar to the previous day, however T1 has grown a few more colonies towards the bottom of the Agar plate. Trials 2 / 3 have started to grow some small bacterial colonies.

Day 2 photos:



Dettol
Palmolive
Coles
Carex
Balnea

** Day 3 and Day 4 = Weekend (were unable to observe the results due to school being closed on the weekends)

7/06/21

Day Five (Monday, 7th June)

Dettol: Trial 3 has no bacterial growth, other than the slight bacterial migration near the seperation line. T1 / 2 are proving to be quite effective as well, with almost no bacterial growth over the weekend.

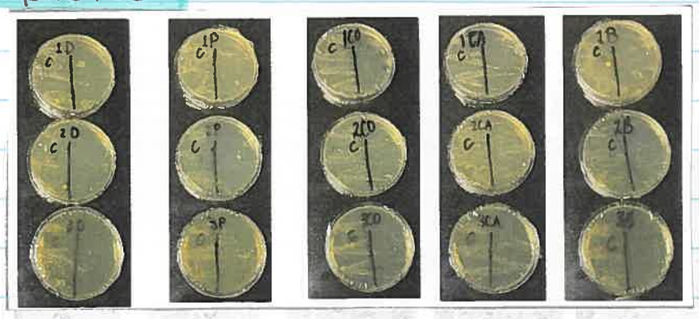
Palmolive: After being left in the incubator for the weekend, the palmolive handsoap trials did not undergo a dramatic change. They look the same as Friday the 4th of June, with minimal bacterial growth on T2 and small bacterial growth of trials 1 / 3.

Carex: After the weekend, we anticipated that carex hand soap trials would grow more bacterial colonies; however it reached a stunt in its growth. It (or they) remained the same as the previous days, despite the weekend in the incubator.

Coles: It has been noticed that on day 5, almost all the hand soap trials including coles looked similar to the previous recording date, as we are getting to the end of the 7 - day period.

Bainea: A large bacterial colony has been noted to progressively get larger between June 4th and June 7th, located on the trial 1 controlled side. Other than that, the agar plate for this handsoap looks the same.

Day 5 photos:



Dettol Palmolive Colex Carex Bainea

8/06/21

Day Six (Tuesday, 8th June)

Dettol: The results from all 3 trials look almost identical to the previous day and no more bacteria grew overnight.

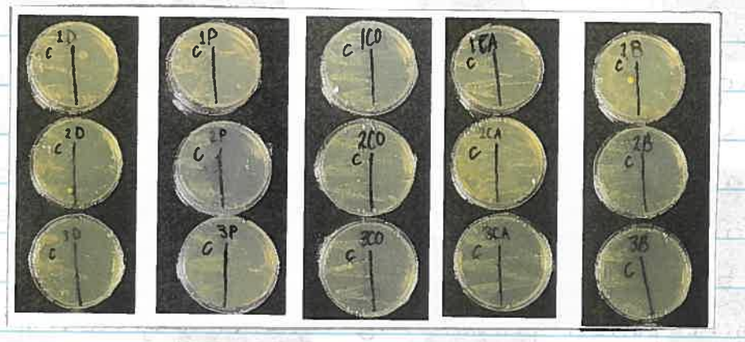
Palmolive: The small bacterial colonies in trial 3 look like they have moved to the right slightly, which may be due to the way the picture has been taken, or due to bacterial migration.

Carex: Unlike the other hand soap trials, carex did not progress much over the last few days, the number of bacterial colonies stayed the same as you could see from observation.

Coles: The coles brand hand soap trials have looked similar for the past 2 days which indicates that there will be no more bacterial growth.

Bainea: Todays results for bainea body company show some bacterial growth near the seperation line in T2, and a few small bacterial growths on the third trial.

Day 6 photos:



Dettol Palmolive Coles Carex Bainea

9/06/21

Day Seven (Weanesday 9th June)

Dettol: The handsoap trials for Dettol proved to be the most effective in preventing bacteria growth as we observed over the 7-day period. T3 was the most successful as the agar is clear on the right side, however T1 has a few bacterial colonies near the centre of the agar dish, which may be due to cross contamination.

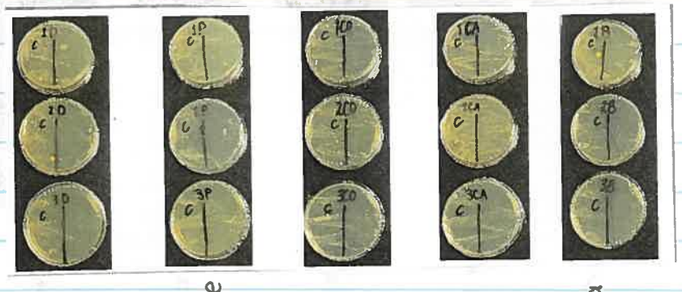
Palmolive: Overall the hand soap trialls for palmolive proved to be the second best at preventing bacterial growth, as they did have a few bacterial colonies in T1 | 3. However, T2 was very effective and palmolive was successful in preventing most bacterial growth over the 7-days.

Carex: Over the 7-day course where the Carex handsoap trials were left in the incubator at 36-37°C, they did not progress much and looked very similar each day. To conclude, carex did not perform as effectively compared to the other 4 hand soaps.

Coles: The coles brand handsoap trials performed similar to balnea; they were effective however still grew bacterial colonies over the seven days.

Balnea: Balnea body company performed better than we anticipated, especially T3. However, T1 | 2 did have some bacterial growth, but overall, Balnea is still quite effective when preventing microbial growth.

Day 7 photos:



P1.pg

13/06/21

Results

Before (vs) After (the 7-day period):

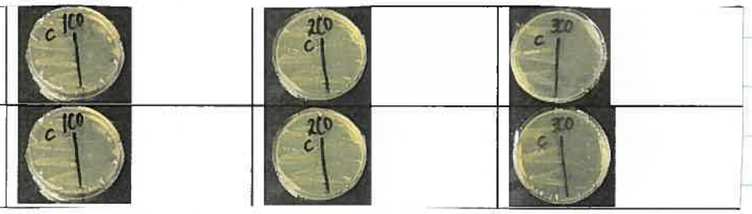
Dettol:

Before: 1 (3rd June, Thursday)	
After: 5 (9th June, Wednesday)	

Palmolive:

Before: 1 (3rd June, Thursday)	
After: 5 (9th June, Wednesday)	

Coles:

Before: 1 (3rd June, Thursday)	
After: 5 (9th June, Wednesday)	

Carex:

Before: 1 (3rd June, Thursday)	
After: 5 (9th June, Wednesday)	

Balnea:

Before: 1 (3rd June, Thursday)	
After: 5 (9th June, Wednesday)	

Pg.21

17/06/21

Relation

This investigation is directly related to the current global pandemic; COVID-19. This virus has been around for almost 2 years and medical experts have proven that the most effective way to prevent COVID-19 is to avoid bacteria spread. Furthermore, it has been advised for everyone to wash their hands and clean sufaces to "stop the spread", which is where hand soap plays a vital role. All over the world, it has been advised / advertised that you must wash your hands for 20, or more seconds to kill bacteria on your hands. Despite this, individuals still do not do this, which results in bacterial growth on their hands. Although hand soaps such as Dettol and palmolive kill most bacteria, our investigation shows that there is still a slight bacterial growth which indicates the importance of washing our hands for more than 20 seconds.

21/06/21

Results Explained

After closely examining 20 agar plates over a 7-day period, the results have been shown using before and after pictures as well as tables. Before performing the practical, we set a hypothesis based on the 2021 Finder Awards. They recognised dettol as the best rated handsoap brand for effectiveness, scent, and packaging design, based on customer feedback on different retail product categories as well as consulting companies, reviewing data and insights.

66

Both hand soaps and sanitizers from Dettol promise to kill 99.99% of bacteria. The brands products are made with active sustances that are bactericidal. Dettol also offers products with plant based active ingredients the effectively fight germs.

99

- Finder Awards 2021

15.09

23/06/21

[continued]

Results Explained

- Our hypothesis was correct as Dettol was the most effective in preventing microbe growth on the agar plates as it had the least number of bacterial colonies on the right side of the agar plate. Palmolive followed closely behind Dettol, as it was also quite effective with only a few bacteria colonies on the right side of the agar plates.
- Balnea Body company and coles brand hand soaps were not as efficient at preventing bacterial growth and produced more bacterial colonies then Dettol and palmolive.
- Carex concluded with the greatest number of bacterial colonies in all three trials, resulting in the least effective brand of hand soap that prevents microbial growth. However, an aspect that may affected the results of this particular hand soap trial is bacterial migration or cross contamination. This is when the bacteria travels from the left side of the agar plate, onto the right side, which makes the handsoap seem less effective, but, the bacteria has simply travelled over the course of 7-days. To avoid this mistake and present precise results, there could be two solutions;
  1. create a small barrier between the left and right side of the agar plate
  2. Use seperate agar dishes for the controls and the hand soap trials.

27/06/21

Concluding Results

- The aim was successfully achieved, by conducting this investigation with the correct equipment and progressive methods.
- Supported hypothesis of Dettol's soft of skin liquid hand wash will be the most effective hand soap.
- We investigated 5 handsoaps, over a 7-day period, and placed into an incubator at 37°C to examine bacterial growth
- Dettol and palmolive were the most effective at preventing microbe transmissions and growth on the agar plate.
- As noted in all 3 trials, Dettol proved to have the least no. of bacterial colonies (on the right side) making the bacterial streak appear almost clear.
  - there are still some visible bacterial colonies, proving antibacterial handsoap does not kill all germs (unless used correctly), hence why medical experts advise hands to be washed for 20+ seconds.
- Bainea Body and Coles were not as effective, with more bacterial growth, which may been caused due to cross-contamination.
  - were quite effective, but slight bacterial growth over 7-day course.
- Penultimately, evidence suggests Carex was least efficient, with observations noting numerous bacterial colonies growing on agar plate.
  - T2 may have had cross-contamination, but still least successfull in comparison.
  - ∴ when selecting future handsoaps, Dettol and palmolive liquid handwashes are advised.
- Observational methods were used for collecting data
  - includes possible environmental errors; but was successful in manner the most bacterial growth on agar = least effective
- Trials with less growth = more effective, and 3 trials provided an average. Quantative methods could have been used (i.e., counting chamber)
  - producing more viable results.

ES.09

1/07/21

ThankyOU

- This investigation was a great opportunity for us to explore an area of science that we were intrigued about due to the current situation in the world, with the pandemic, and it allowed us to enhance our knowledge.
- However, it would not have been possible without the caring support of our DSA coorinator, Ms. Beekman, as well as Ms. Anderson, who arranged times and materials, guided our practical and method selection and most of all inspired us with their encourging words.

- Madison Gurney-White: mgw
- Sahibjot Kaur