Overall grade: C

Performance Standards for Stage 2 Scientific Studies

	Investigation, Analysis, and Evaluation	Knowledge and Application
A	Critically deconstructs a problem and designs a logical and coherent scientific investigation with detailed justification. Obtains, records, and represents data, using appropriate procedures, conventions and formats accurately and highly effectively. Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification. Critically and logically evaluates procedures and their effect on data. Critically and perceptively evaluates the effectiveness of collaboration and its impact on results/outcomes.	Demonstrates deep and broad knowledge and understanding of a range of science inquiry skills and scientific concepts. Applies science inquiry skills and scientific concepts highly effectively in new and familiar contexts. Critically explores and understands in depth the interaction between science and society. Communicates knowledge and understanding of science concepts coherently, with highly effective use of appropriate terms, conventions, and representations.
B	Logically deconstructs a problem and designs a well-considered and clear scientific investigation with reasonable justification. Obtains, records, and represents data, using appropriate procedures, conventions and formats mostly accurately and effectively. Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification. Logically evaluates procedures and their effect on data. Critically evaluates the effectiveness of collaboration and its impact on results/outcomes.	Demonstrates some depth and breadth of knowledge and understanding of a range of science inquiry skills and scientific concepts. Applies science inquiry skills and scientific concepts mostly effectively in new and familiar contexts. Logically explores and understands in some depth the interaction between science and society. Communicates knowledge and understanding of science concepts with mostly coherent and effective use of appropriate terms, conventions, and representations.
C	Deconstructs a problem and designs a considered and generally clear scientific investigation with some justification. Obtains, records, and represents data, using generally appropriate procedures, conventions and formats with some errors but generally accurately and effectively. Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification. Evaluates procedures and some of their effect on data. Evaluates the effectiveness of collaboration and its impact on results/outcomes.	Demonstrates knowledge and understanding of a general range of science inquiry skills and scientific concepts. Applies science inquiry skills and scientific concepts generally effectively in new or familiar contexts. Explores and understands aspects of the interaction between science and society. Communicates knowledge and understanding of science concepts with generally effective use of appropriate terms, conventions, and representations.
D	Prepares a basic deconstruction of a problem and an outline of a scientific investigation. Obtains, records, and represents data, using procedures, conventions, and formats inconsistently, with occasional accuracy and effectiveness. Describes data and undertakes some basic interpretation to formulate a basic conclusion. Attempts to evaluate procedures or suggest an effect on data. Attempts to evaluate the effectiveness of collaboration and its impact on results/outcomes.	Demonstrates some basic knowledge and partial understanding of science inquiry skills and scientific concepts. Applies some science inquiry skills and scientific concepts in familiar contexts. Partially explores and recognises aspects of the interaction between science and society. Communicates basic scientific information, using some appropriate terms, conventions, and/or representations.
E	Attempts a simple deconstruction of a problem and a procedure for a scientific investigation. Attempts to use some procedures and record and represent some data, with limited accuracy or effectiveness. Attempts to describe results and/or interpret data to formulate a basic conclusion. Acknowledges that procedures affect data. Acknowledges the effectiveness of collaboration and its impact on results/outcomes.	Demonstrates limited recognition and awareness of science inquiry skills and/or scientific concepts. Attempts to apply science inquiry skills and/or scientific concepts in familiar contexts. Attempts to explore and identify an aspect of the interaction between science and society. Attempts to communicate information about science.

Please note:
- This is one task taken from a folio comprising of five tasks and may not be representative of the overall Folio grade.
- Notes in coloured text boxes are added to provide infromation and support for teachers. Parts of the student report have been highlighted with the colour that corresponds to the colour of the relevant text box.

Inquiry Folio - Design Proposal

Does price impact the effectiveness of antibacterial hand sanitisers?

IAE1 - An investigable question is provided, supported by an appropriate hypothesis that is linked to the introduction. The outcome is uncertain.

Introduction

There is a wide range of antibacterial hand sanitisers on the market. Consumers associate a higher price with a better product. Companies use consumer psychology to trick consumers in to buying products. Comparative pricing is when two of the same items are placed next to each other, each with a different price- a higher cost and a lower cost. On average a consumer will purchase the more expensive product as they think a higher cost equals a better product (Entrepreneur Asia Pacific, 2016). Hand sanitiser's work by using isopropyl alcohol, also known as rubbing alcohol to kill microbial cells (Remedy Grove, 2017). Rubbing alcohol contains water and makes it easier for the skin to absorb (University of Toronto, 2012). Since there is no need to rinse or dry your hand's, consumers are drawn to the convenience of the product and are more than likely to purchase anything that would make life easy. This practical will test whether there is a link between cost and effectiveness.

KA1 - Shows an understanding of the active ingredients and how it is absorbed into the skin

KA4 - Uses conventional in-text referencing to communicate the source of her information when outlining the reason for the investigation

Hypothesis

If the cost of antibacterial hand sanitiser is higher, than it is more effective at killing germs.

Deconstruction of problem

Mind Map-

IAE1 - A deconstruction is provided that considers aspects of the investigation, although only a small amount is relevant to the design of the method e.g. what factors might affect the growth of microbes? How many samples might be needed?

Price

Through the eyes of a consumer, a higher price means higher quality. When purchasing an antibacterial product, you want to get the best product you can, meaning you are more likely to purchase a high cost product to ensure you get a good brand.

Convenience

Antibacterial products like hand sanitisers offer the convenience of "on-the-go". Hand sanitiser doesn't require water or soap to clean all the germs off your hands. This product is appealing to consumers as it's quick and easy to use.

Brand

Consumer will buy products that they trust. A brand like Dettol is well know for making antibacterial products and is most likely to be a popular purchase within consumers..

Reduce spreading

Many people use antibacterial products to stop the spread of germs.

Effectiveness

Many brands state their product kills 99.9% of germs. Many consumers will buy higher priced items, but are higher priced products more effective?

Type

Antibacterial products come in different forms; liquids, gels, soaps, wipes, and sprays.

Amount used

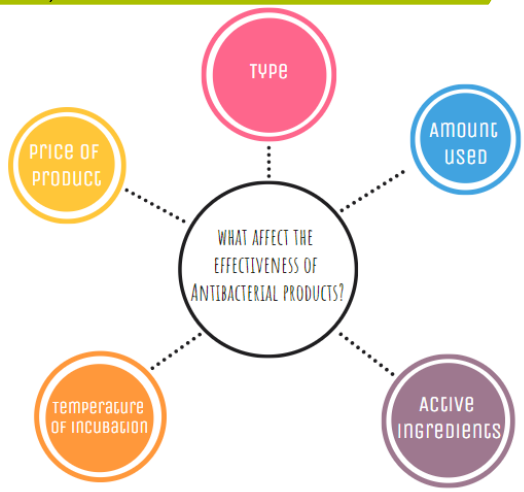
When using antibacterial products, you want to use a reasonable amount to ensure the product has the opportunity to work; if you only use a small amount of product, it won't work as effectively. If you use a large amount of product it could potential cause damage to the object as the ingredients could be corrosive.

Active ingredients

There are many ingredients and chemicals in antibacterial products. An ingredient like rubbing alcohol is active in killing germs. However, there is alcohol-free antibacterial products on the market.

Temperature of incubation

When testing the growth of bacteria, it is important to mimic the environment it most commonly grows in. for this practical 30 ℃ mimics the environment of hands that the bacteria will grow on.



KA1 - shows a knowledge of suitable growth conditions for microbes

Variables

Independent: cost of sanitiser (brand)

Dependent: bacterial growth

Controlled variables: type of product, amount of hand sanitiser, time collecting bacteria, amount of product used, time soaking filter paper in the sanitiser, size of filter paper, temperature of incubation

KA4 - variables are identified, although it is unclear how the dependent variable will be measured. A reasonable number of variables to be controlled is considered.

Safety considerations

Potential hazard	Control measure	Management
Germs spreading and resulting in the harm of myself and others.	Sealing the petri dish with Parafilm.	Sealing the petri dish with Parafilm as soon as possible and disposing of it correctly.

IAE1 - Safety has been considered, although basic

Brands

- Palmolive hand sanitiser- 200 ml $8.25
- Dettol- 200 ml $7.50
- Aqium- 200 ml $3.73
- Coles hand sanitiser- 200 ml $3.50

Materials

- Palmolive hand sanitiser
- Dettol hand sanitiser
- Aqium hand sanitiser
- Coles hand sanitiser
- 5x pre-prepared nutrient agar plates
- Bacteria, collected from air conditioning vent
- Tweezers
- Filter paper
- Hole punch
- Parafilm
- 1 cm squared grid paper
- Watch glasses

- Incubator
- Timer
- Permanent marker
- Set of scales to measure the amount of sanitiser

Method

1. Open one agar plate and hold up to an air vent. Using a timer, time for 30 seconds then remove and seal it using Parafilm to avoid contamination (stops bacteria getting in or our). Cut a thin strip of Parafilm, no wider than the petri place, and slowly hold it in position and stretch the Parafilm, pressing it down to make it stick. Label as 'Control'.
2. Using a hole punch, punch out 4 holes from the filter paper. Using the scales, pour 5 g of each hand sanitisers into a watch glass. Soak one hole in each of the hand sanitisers for 30 seconds (use timer).
3. Using tweezers remove and place one of the holes in the middle of an agar plate.
4. Repeat steps 1-3 with each of the other brand hand sanitisers.
5. Place the petri dishes in an incubator set at 30 ℃. Let sit for 5 days.
6. Using grid paper, measure the area of inhibition around the filter paper (hand sanitiser).

IAE1 - A generally clear and considered method is provided but lacks details on how to use the grid paper. Also, there is little justification for control variables used e.g. Why 30 seconds? 5 days?

Table

Hand Sanitiser Brands (price per 200 mls)	**Area of Inhibition**
Control plate	
Palmolive hand sanitiser ($8.25)	
Dettol ($7.50)	
Aqium ($3.73)	
Coles hand sanitiser ($3.50)	

IAE1 - Good to include a table to show the type of data you might collect. However, it is unclear from the table what units the area of inhibition will be measured in (and what might be plotted on the graph)

Those choosing investigations using an engineering design process for the Individual Inquiry should note that IAE2 "Obtaining and representing data" is one of the Performance Standards that must be assessed in the External component. Students need to consider what they will test for in their product or components, how they will measure this and how it will inform new iterations of the product.

Please be aware that changes to the assessment requirements for 2020 means that the 750 words writing limit has now been replaced by a limit of four A4 pages. For further information, please check the current Subject Outline on the SACE Board website.