SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Scientific Inquiry

Year 3-4

Jack Williams

Immanuel Primary School

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Australian Government
Department of Defence

Government of South Australia
Department for Education

SASTA South Australian Science Teachers Association

Scientific Inquiry: The importance of hand washing

Jack Williams

Introduction

Around the world today, people are experiencing a virus pandemic. There has been a lot of information in the media from health professionals about simple ways to reduce the risk of spreading, with one of these being hand washing. There has also been alcohol hand gel which is being sold out in many shops. The question being investigated is whether alcohol hand gel is effective in preventing bacteria growing. It is acknowledged that bacteria is different to a virus, but explains that bacteria lives on all surfaces and a petri dish is a way to investigate this inquiry. The prediction is that the petri dishes with alcohol hand gel will not grow as much bacteria as those without.

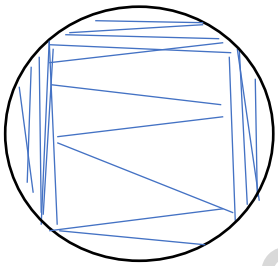
Planning and Research

Bacteria are tiny and cant be seen with human eyes. Often millions of bacteria are in a small spot and using a nutrient agar plate is a good way to see bacteria because each one becomes a colony of thousands of bacteria. The agar is a food for the bacteria. There are many different colours, sizes and shapes of bacteria that can grow. Alcohol hand gel is used to clean hands often so it should stop the bacteria from growing. I am wondering if the alcohol gel lasts for the entire investigation or if the effectiveness wears off after an amount of time. There are good and bad types of bacteria and it is all around us in the world. Places where lots of people tough are called high touch surfaces, and I would expect that there would be lots of bacteria on these surfaces. It is important to label our dishes so that we can keep track of the surfaces which grow the most bacteria. Bacteria grows best at around 35 degrees celcuis according to my research (gift of curiosity) but it can still grow in cooler temperatures it might just take longer. If the temperature is too hot some bacteria might not be able to survive.

Conducting the investigation

The steps below show how to conduct the investigation.

1. Prepare the agar as per instructions (included in log book below).
2. Once firm, store dishes in the fridge until ready to use. Store upside down to prevent condensation.
3. Using x2 cotton buds, swab a surface. Make sure all parts of each cotton bud comes in contact with the surface. This will pick up bacteria on the surface.
4. Gently use x1 cotton bud to swab over the agar on a petri dish. Be careful not to break the agar. The way the cotton bud is wiped over the agar is pictured below. Label the dish.



5. Repeat step 4 for the second cotton bud on a new petri dish. Place a small amount of alcohol hand gel into the centre of the agar and using a clean cotton bud, gently spread the alcohol gel into a circle . Label this as the alcohol gel dish for that surface.
6. Replace lids of swabbed petri dishes.
7. Use a strip of parafilm and stretch it around the edge of the dish. Store them upside down to prevent condensation.
8. Repeat 3 – 8 for different surfaces. Label as you go.
9. Store petri dishes in a dark, warm location. Observe for changes. Do not open the dishes.
10. When ready to dispose: wear gloves and carefully remove parafilm
11. Place closed dishes into a snap lock bag
12. Pour bleach into bag and seal firmly
13. Ensure bleach enters the dishes, observe bacteria disappearing.

Second investigation

1. Repeat steps 3 – 9 as above, but use the pre filled nutrient agar dishes. At step 7, use sticky tape to secure the lids at the top, bottom and both edges.
2. For disposal, repeat steps 10-13 as above.

Managing Variables

This method of investigation was chosen because it would provide a visual way to see the changes and the difference between the petri dishes. Variables for this investigation are things that might make the results inconsistent or unreliable. For this investigation, one variable has been changed and all other conditions kept the same. The changed variable for each pair of dishes is the alcohol gel, this is the independent variable. The other variables that are kept the same for each pair (temperature, dark environment, method of swabbing surface) and they are called the controlled variable. Using a independent and controlled variable means that what is measured is the dependent variable – the alcohol gel. It is called a fair test because only one variable is changed, for each pair of dishes for a surface.

The table below shows ways variables have been managed in the investigation.

Variable	**Management**
Agar differences	The powder agar was mixed and boiled in one batch to make sure all agar in all dishes was the same.
Agar contamination	A test dish without any surface rub on top was kept clean and left in the same environment (cardboard box) as other dishes. This shouldn't grow anything if it is sterilised.
Showing effectiveness	Two agar dishes were used for each surface, only one dish for each surface had alcohol gel to show the difference it makes.
Incubation	All dishes were kept in the same box, a dark environment. They were kept by the gas heater to create a warm environment. We did not test the temperature, but all dishes were kept together.

Equipment and Materials

The equipment and materials used for this inquiry include:

- Cotton buds
- Alcohol hand gel (70% alcohol)
- Petri dishes x30
- Powder Agar
- Parafilm
- Caster sugar
- Cardboard shoe box
- Black sharpie
- Sticky tape
- Bleach
- Snap lock bags

The risk assessment has been attached to this report. When using boiling water to mix and sterilise the powder agar, an adult has assisted and has also assisted in pouring the boiling solution into petri dishes. To prevent bacteria being exposed to the environment and making people sick, the Petri dishes have been sealed with parafilm. They will not be opened. They will be handled using gloves and only when absolutely necessary. The second group of petri dishes will be sealed shut with sticky tape at the top, bottom, and both side positions to seal the edges.

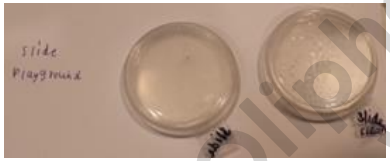
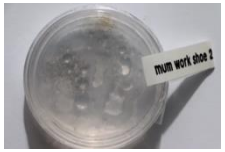
To dispose of the dishes once complete, an adult assisted with carefully removing the parafilm and sticky tape without opening the dishes, placing them closed into a snap lock bag and pouring bleach into the bags. Gloves were worn.

My mum has helped me with the layout of this report, using tables and adding the photos. She will submit it electronically for me.

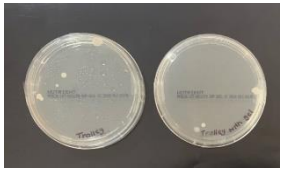
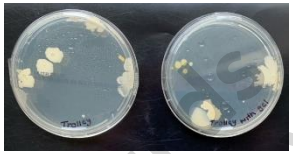
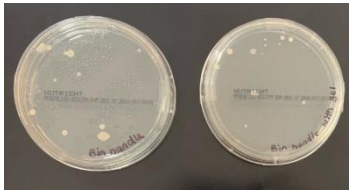
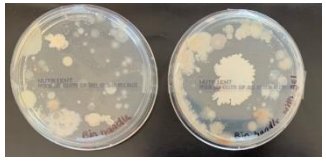
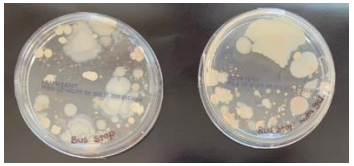
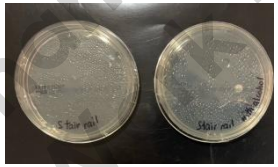
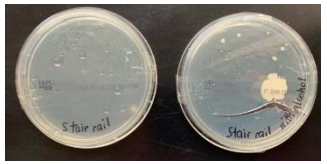
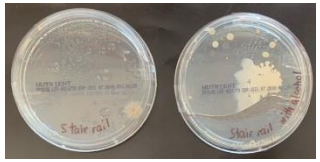
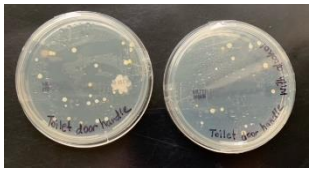
Data and information

For the first group of dishes, we used a kit purchased online. We followed the instructions to mix the agar on the stove. It was boiled for 15 minutes to sterilize and remove any contamination. After 10 days there was not a lot of growth and I was very disappointed. I was expecting there to be a lot of different types of things growing to observe. This investigation has not worked. We still had some time so we decided to try again if we could find pre filled nutrient agar dishes. The tables below show the progress of bacteria growing.

Investigation 1 – Our own agar dishes

	Day 1	*Day 10 – no gel*	*Day 10 with gel*	*Comments*
School Bin				Some patches of brown on the dishes with no alcohol gel. The alcohol gel has nothing growing
School Toilet Door				Lots of condensation - I think the agar has gotten wet. No growth on either dish.
Stair Rail				Condensation and air bubbles in agar. Small circles of growth
Playground slide				Lots of condensation. Air bubbles in agar. Small amount of circles
Hospital work shoe				Brown patches of growth on the alcohol gel dish.

Repeating the investigation using pre filled agar dishes

	Day 0 – swabbing dishes	*Day 1 - 12 hours*	*Day 2 – 30 hours*	*Day 4*
Trolley				
Bin Handle				
Bus Stop				
Stair Rail				
Toilet Door				
Comments	The method of swabbing can be seen in sun and shadows. The agar was broken on the ‘stair rail with gel’ dish.	Small white circles are beginning to grow. Centres of dishes are empty	Yellow circles, some areas have fuzzy edges and appear like fluff. Centres of dishes with alcohol have less growth	Dishes starting to smell. Orange, yellow and white growth. Overtaking most of all dishes

Evaluation

There were a number of unexpected results that happened during this investigation. The initial group of petri dishes did not grow anything. Reasons for this might be that the agar powder had an antibacterial aspect to it, or that it was not the correct nutrient agar needed for bacteria to grow. The cotton buds might not have been completely covered on each surface, but I would expect that something would still grow.

We didn't have access to the same incubators used in a science laboratory. The gas heater was not turned on at all hours of every day, so the temperature of the dishes was always changing and they did not get a warm environment in the first few days. We also did not monitor the temperature with a thermometer, which would be good to include in the results next time.

The pre filled nutrient agar dishes were a lot bigger than the first ones used, and we could have investigated further by drawing a line down the middle and using half as the independent variable – with alcohol gel, and the other half of the same dish as the control. The dish would still be swabbed in the same way, and that would remove any differences from using two different cotton buds for each surface.

The cotton buds used were not sterile and might have had bacteria of their own.

The alcohol gel might have a time frame for being effective in preventing or removing bacteria growth.

On the dishes where large colonies grew where the alcohol gel was, this could mean that the bacteria growing was not effected by the alcohol gel, or that the alcohol gel was contaminated when it was put onto the dish. It could also mean that the alcohol gel we used was not very high strength.

I was surprised that the bus stop and bin handle had more bacteria growing than the stair rails at school, but this could be because the stair rail wasn't swabbed enough by the cotton bud.

Conclusion

In conclusion, the second more successful group of petri dishes show that alcohol gel is effective in removing bacteria, but only for a period of time. Eventually, the bacteria grew where the alcohol gel had been. We did not investigate using soap for handwashing and the difference this made compared to alcohol gel. This would be a good next investigation to complete. After seeing how quickly bacteria grew on the dishes, it has reminded me that it is important to frequently wash hands after touching high touch surfaces.

References

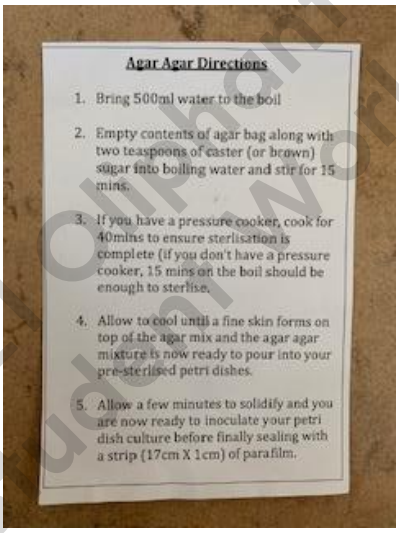
‘Growing bacteria in a petri dish (STEM activity for kids)’ by Katie, https://www.giftofcuriosity.com/growing-bacteria-in-a-petri-dish-stem-activity-for-kids/

‘Grow Bacteria on Homemade Agar Plates by Mini Beasts https://www.madaboutscience.com.au/shop/science-extra/post/grow-bacteria-on-homemade-agar-plates

‘How to grow bacteria in a petri dish’ by Meredith Junker, https://www.google.com.au/amp/s/www.wikihow.com/Grow-Bacteria-in-a-Petri-Dish%3famp=1

Science a children’s encyclopedia, Chris Woodford and Steve Parker, A penguin Random House Company, London .

Log Book

Date	
29 May	I would like to investigate how handwashing and using alcohol gel can prevent germs from spreading. I have researched that bacteria can live on surfaces all around us. I think that alcohol hand gel and soap will stop bacteria from growing on hands after touching areas, and that is how it helps keep people from getting sick.
30 May	I have found an example of an investigation where you can see bacteria growing by using a petri dish. These can be found in science supply stores and are also sold for growing mushrooms and testing wine. Nutrient agar gives the bacteria what it needs to grow. Growing bacteria is called colonies, and they can be seen in different colours, shapes and sized when they spread. I think it will be easier to investigate using hand gel by putting some ontop of a petri dish, so I will focus the investigation on hand gel instead of using soap as well.
1 June	My mum bought me a set of petri dishes which comes with parafilm to secure the dishes, and some powdered agar online from eBay. We have to wait for it to arrive.
6 June	The package arrived today.
8 June	My mum helped me follow the instructions that came with our petri dish kit to mix the agar. As there was boiling water, my mum did the part on the stove and I took the pictures below. I have also attached the instructions which came with the agar powder.  Agar Agar Directions 1. Bring 500ml water to the boil 2. Empty contents of agar bag along with two teaspoons of caster (or brown) sugar into boiling water and stir for 15 mins. 3. If you have a pressure cooker, cook for 40mins to ensure sterlisation is complete (if you don't have a pressure cooker, 15 mins on the boil should be enough to sterlise. 4. Allow to cool until a fine skin forms on top of the agar mix and the agar agar mixture is now ready to pour into your pre-sterlised petri dishes. 5. Allow a few minutes to solidify and you are now ready to inoculate your petri dish culture before finally sealing with a strip (17cm X 1cm) of parafilm.
10 June	We took the petri dishes out of the fridge and after school and Mum bought me the petri dishes. I swabbed some high touch places like the toilet door handle and the stair rails. I also swabbed a gate, the inside of my cheek, the bottom of mums hospital work shoes, a playground slide and a playground stair rail. Each surface had 2 dishes and we put some alcohol gel into the middle of one dish for each surface. They were labelled and we used parafilm to stretch around the edges to stop them

	opening. We took the dishes home upside down to stop condensation dripping on the dishes. At home we put the dishes in front of a heater in a dark box. I kept one dish as a test, because if anything grows on this test I know that my agar is not clean to begin with. I also was unable to use one dish because the lid was cracked.
11 June	No change to petri dishes.
12 June	No change to petri dishes.
13 June	No change to petri dishes.
16 June	Finally, a very small amount of bacteria or mould has grown but not on the dirty dishes, on the dishes with alcohol gel. My theory is that the alcohol gel has bacteria of its own. I am also surprised that it has taken so long. The growth is small circles, white, with clean edges.
18 June	There has been some small black lines grow on the 'work shoe' dishes. I was expecting more growth by now as it has been over a week since we began.
20 June	I am wondering why this investigation has not gone as expected. I have done some more research and I think that the agar powder used was not the correct nutrient agar needed for growing bacteria. As the petri dish set was meant to grow mushrooms, perhaps there is something in the powder that prevents bacteria growing. There is no information available from the seller to know if this is correct. My mum has helped me look online for a business that sells science equipment to the public, and we found a small business 'Aim Scientific'. We bought a set of 10 pre filled nutrient agar petri dishes.
21 June	I picked 5 new surfaces and used cotton balls to swab these in the same manner as earlier. I gently rubbed the cotton ball onto a petri dish and labelled it, then kept them upside down to prevent condensation. Each surface had 2 dishes, and on one of these we put a small amount of alcohol hand gel. I used a clean cotton bud to gently spread the alcohol gel out making a circle in the middle. The surfaces chosen are: bus stop, public bin lid handle, a trolley handle, school toilet door handle, and school stair rail. We used sticky tape at the top, bottom, and both sides to secure the lids shut and kept them in a cardboard box infront of our gas heater. I accidentally pressed too hard on one of the dishes and cracked the agar, but will keep using it to see what happens.
22 June	All dishes have started to grow small white circles. They look smooth and round.
23 June	More bacteria is growing on all dishes. It is mostly on the edges.

24 June	More bacteria is growing. On the dishes with the alcohol gel, there is no growth where the gel was put.
26 June	Even more growth. Some looks like it is furry, there are some yellow circles growing, and two of the dishes have a large amount growing where the alcohol gel was placed. This could mean that the bacteria is not effected by the alcohol gel, or it could mean that the alcohol gel or the cotton bud I used was contaminated too. The alcohol gel could also have a limit on the amount of time it is effective for.
28 June	The dishes are starting to become very smelly. There are a lot of colonies on every dish. My mum used gloves to gently undo the sticky tape on each dish and to put them into a sealed snaplock bag. We carefully poured some bleach into the bag, then sealed it again. We made sure the bleach got inside the dishes. It was interesting to see that after 1 hour, most of the bacteria colonies had disappeared.

Risk Assessment Form

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: Jack Williams ID: 025a-018

SCHOOL: Immaculate Primary School

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

We use petri dishes to see if any bacteria grows from different surfaces. We will also see if alcohol hand gel stops bacteria from the same surfaces from growing.

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 I will control/manage the risk
boiling water bacteria and mold bleach	a adult will help take lids show on Petri dishes/do not open lids a adult will use gloves

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Jack Williams

SIGNATURE(S): Jack Williams

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

TEACHER'S NAME: Sinead Duncan

SIGNATURE: [signature] DATE: 30/6/21