SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Scientific Inquiry

Year 3-4

Viaan Prakash

St Peter's College

Does the type of food and brushing effect germs on teeth?

Viaan Prakash

Year 3

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St Peters, South Australia 5069

CONTENTS:

QUESTIONING AND PREDICTING:

Question:

Does eating sweets at bedtime lead to more germs on your teeth in the morning as compared to eating savoury at bedtime?

Prediction:

Eating sweets at bedtime will lead to more germs growing on our teeth as compared to eating savoury at bedtime.

PLANNING AND CONDUCTING:

Explain why you chose the particular method for your investigation.

Bacteria is the main type of germ on teeth.

Bacteria are difficult to see and will need powerful microscope.

I learned that scientist grow bacteria on agar plate at body temperature. The bacteria grow into large colonies that we can see with naked eyes.

At body temperature they can grow into large colonies within 48 hours.

By counting and describing the colonies we can then find out the change in the bacteria on our teeth.

What are the possible variables?

1. Time
2. Bacterial colonies
3. Type of food – sweet vs savoury
4. Incubation temperature

Which variables will be changed?

1. Food
2. Time

Which variables will be measured?

1. Bacterial colonies
2. Incubation temperature

Is your investigation a 'fair test'?

It is a fair test as the methods of taking swab and spreading on agar plates and method of incubation will be exactly same.

The method of analysis will be same.

I will use control.

I will make sure there is no contamination.

Describe all the steps of your investigation so that someone else could do it again exactly as you did it.

1. Clean hand thoroughly with soap and alcohol rub.
2. Open and keep the agar plate on flat surface. Make sure you don't touch the agar. I am using a Columbia horse blood agar plate (Image 1).
3. Use a clean swab (Image 2) to scrub my teeth for 30 seconds.
4. Immediately rub the swab on the agar plates in a zigzag method – same for all tests (image 3).
5. Put back the cover and secure it with two tapes (image 4).
6. Label the back side of plate.
7. Keep the plate upside down in incubator. For each sample, I will also keep an agar plate with no sample, as a control. Label it 'control'.
8. Take it out after 48 hours for analysis.

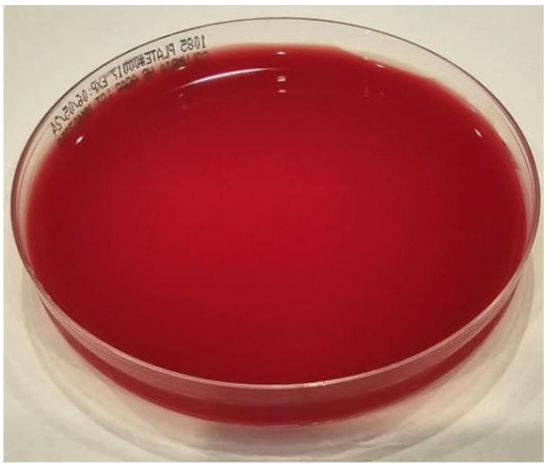
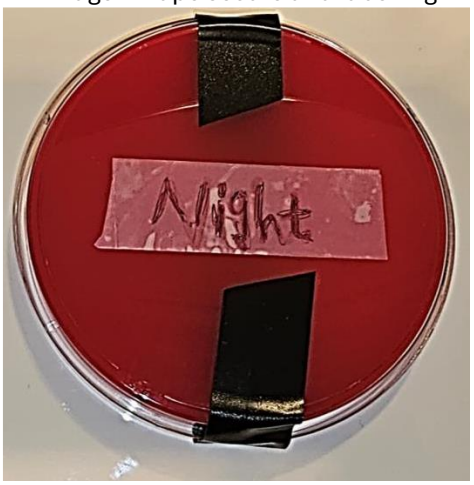


Image 2: Clean swab to take specimen.

Image 3: Zigzag method – 3 peaks

Image 4: Tape secure and labelling



When will I measure:

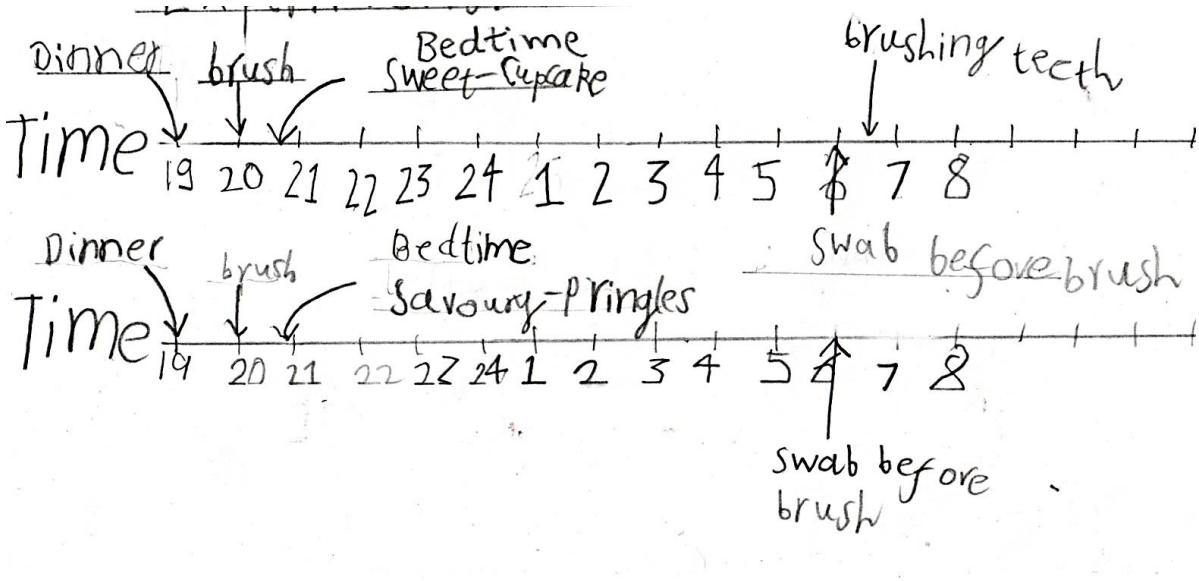
Time	Condition	Name of sample	Sample number
Next Morning 6am before brush	Sweet snack before going to bed 8:30pm (after brushing)	Morning Sweet	1
Next Morning 6am before brush	Savoury snack before going to bed 8:30pm (after brushing)	Morning Savoury	2

I will need to make sure that I will have the same type of dinner at 7 pm on the two days.

For sweet I will eat a sweet cupcake

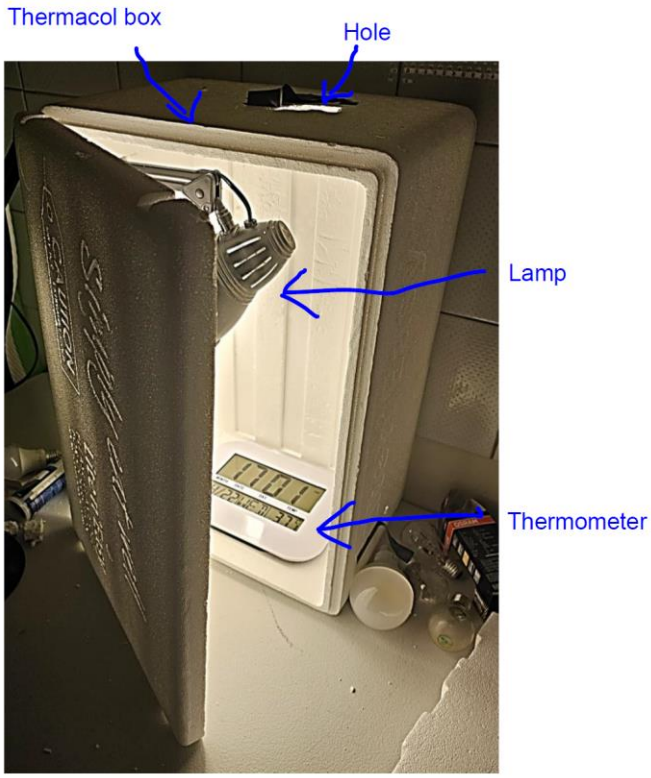
For savoury I will eat a bowl of salty pringles chips

I will use Colgate toothpaste

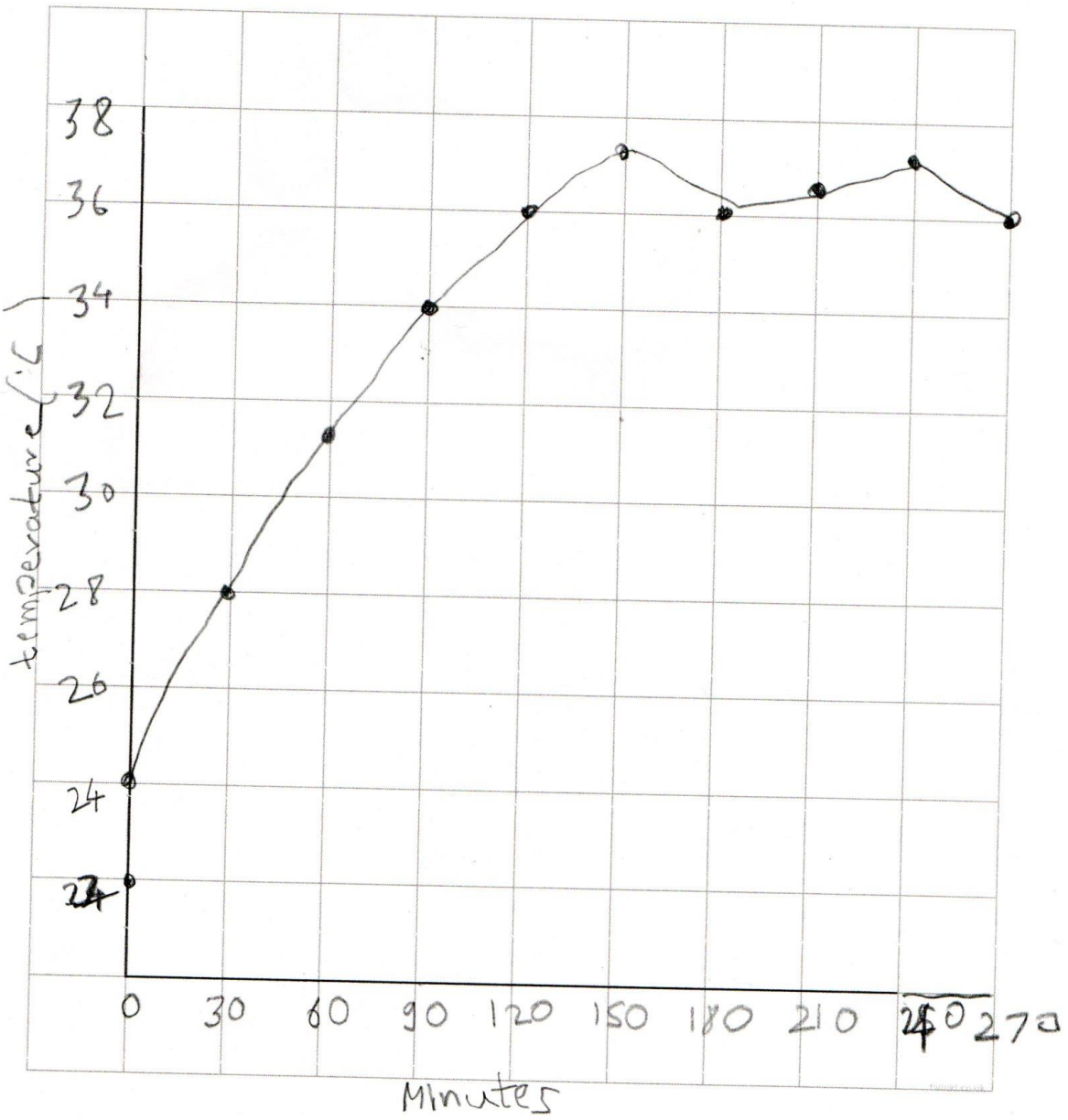


Incubator:

We used thermocol box with table lamp inside. See image 5. I made a hole at the top for hot air to escape. I used my clock with thermometer to measure the temperature inside. With help of parent, we tried bulbs of different power. We went for 23 W bulb. The temperature graph is shown in the image 6. Temperature was stable between 34-38 degrees C.

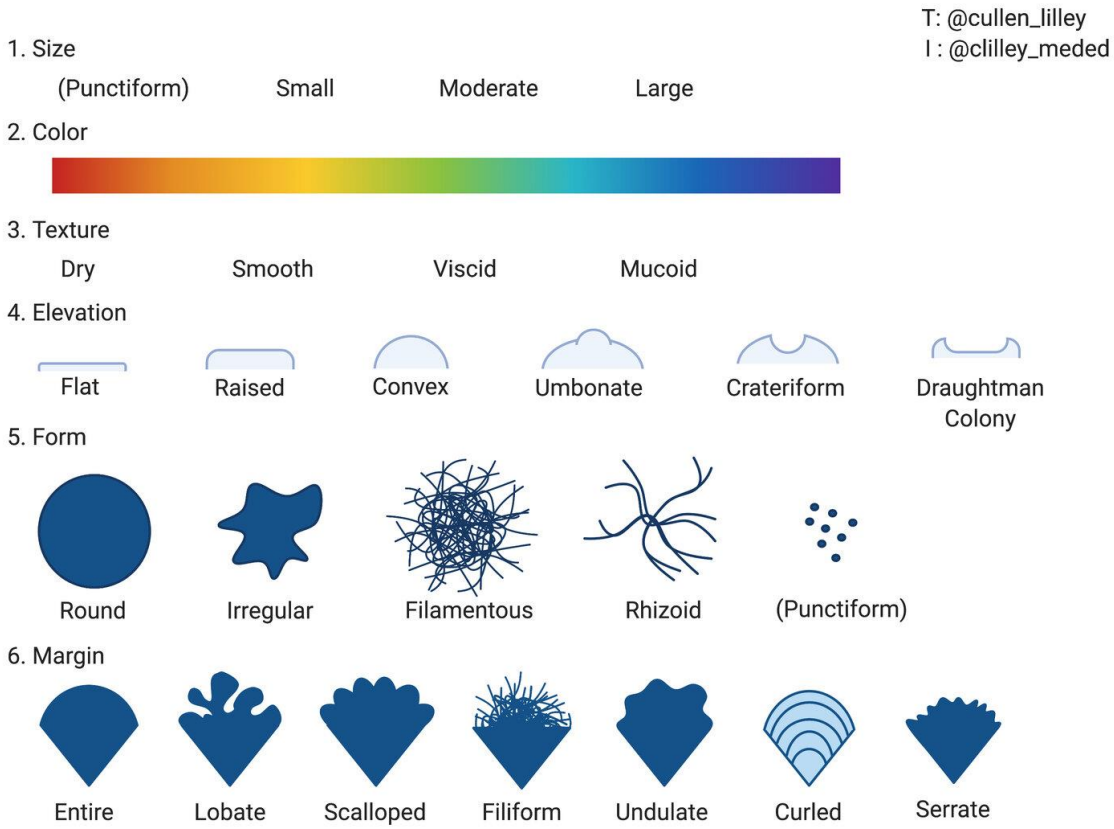


A line graph to show Incubator temperature with 23°C bulb



Measuring germs:

I will use the following template to analyze the germ colonies on agar plates.



https://www.pathelective.com/micromeded/bacterial-colony-morphologies

For counting number of colonies, I will keep agar plate on a dim light. Take photo. Make a grid of 20 rows and 20 columns. Randomly choose 10 squares to count colonies and take an average.

Equipment and Material:

Incubator: thermocol box, table lamp, bulbs 7W, 13W, 23W, thermometer.
Swab
Gloves
Horse blood agar plates
Gloves, goggles, N95 mask, alcohol hand rub
Bleach, biohazard bags
Stationary, computer and ipad
Adult
Sweet and Savoury food
Toothpaste and brush

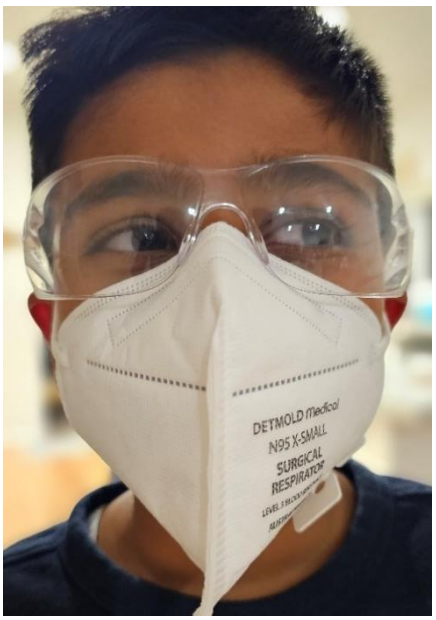
Risks:

Risk to me:

1. Germs: using gloves, mask, goggles. Don't open the lid. Disposal of used plates by adult in biohazard bag.
2. Shock or heat from incubator: using adult to change and operate bulb. Stay away from bulb. Using low watt desk lamp.

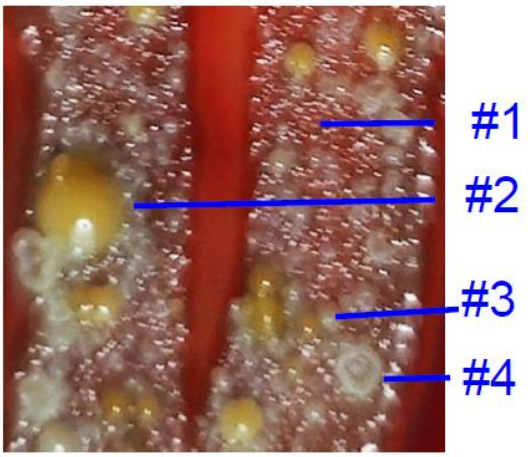
Risk to experiment:

1. Contamination: thorough clean of hands, not touching the agar or swab, use of control, keeping unused agar plates in fridge.



PROCESSING & ANALYSING DATA & INFORMATION

PHOTO OF ‘SWEET AT BEDTIME’ AGAR PLATE



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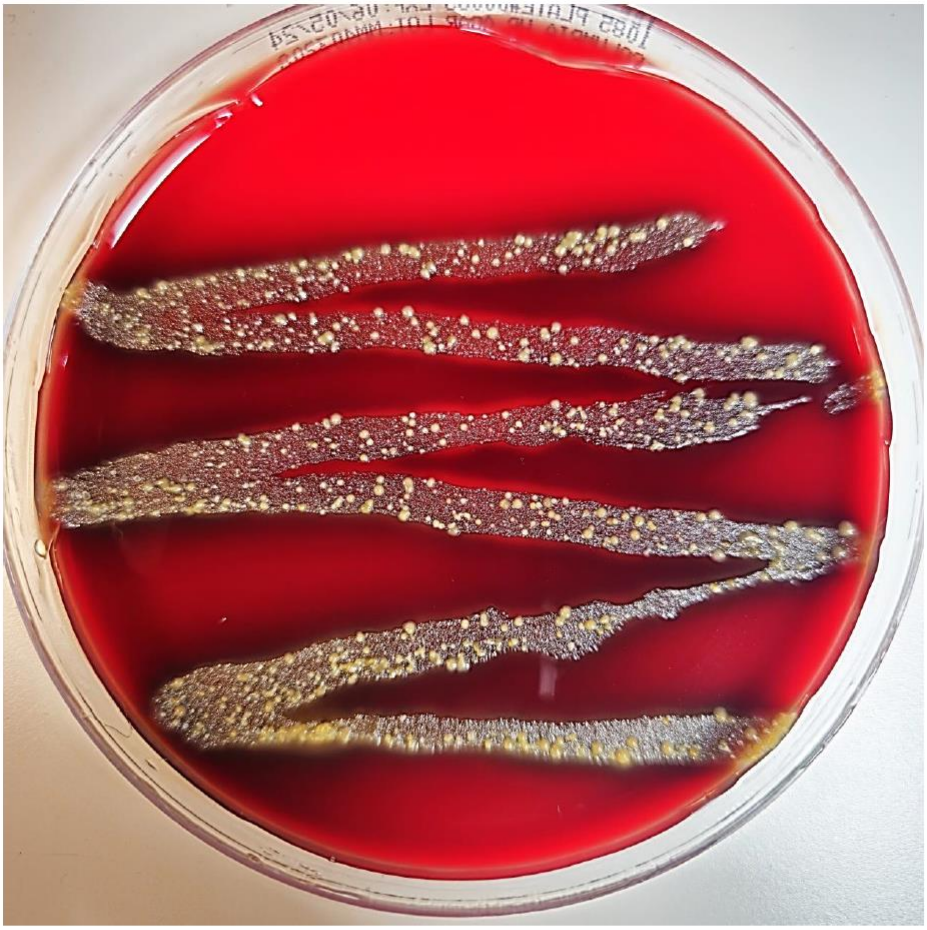


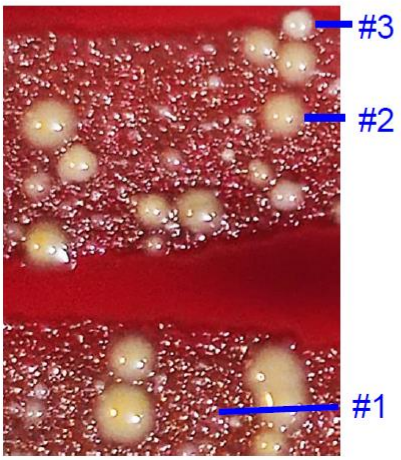
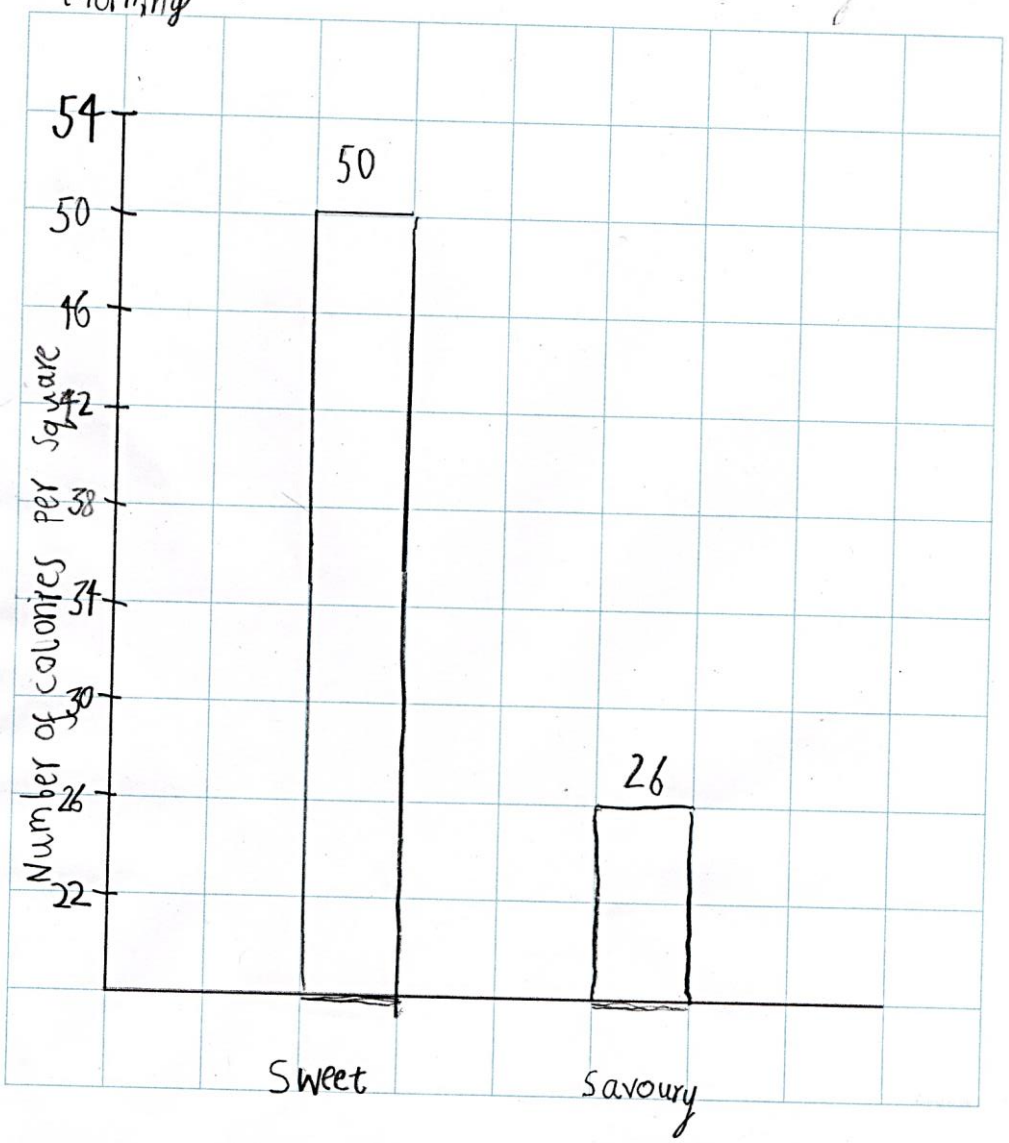
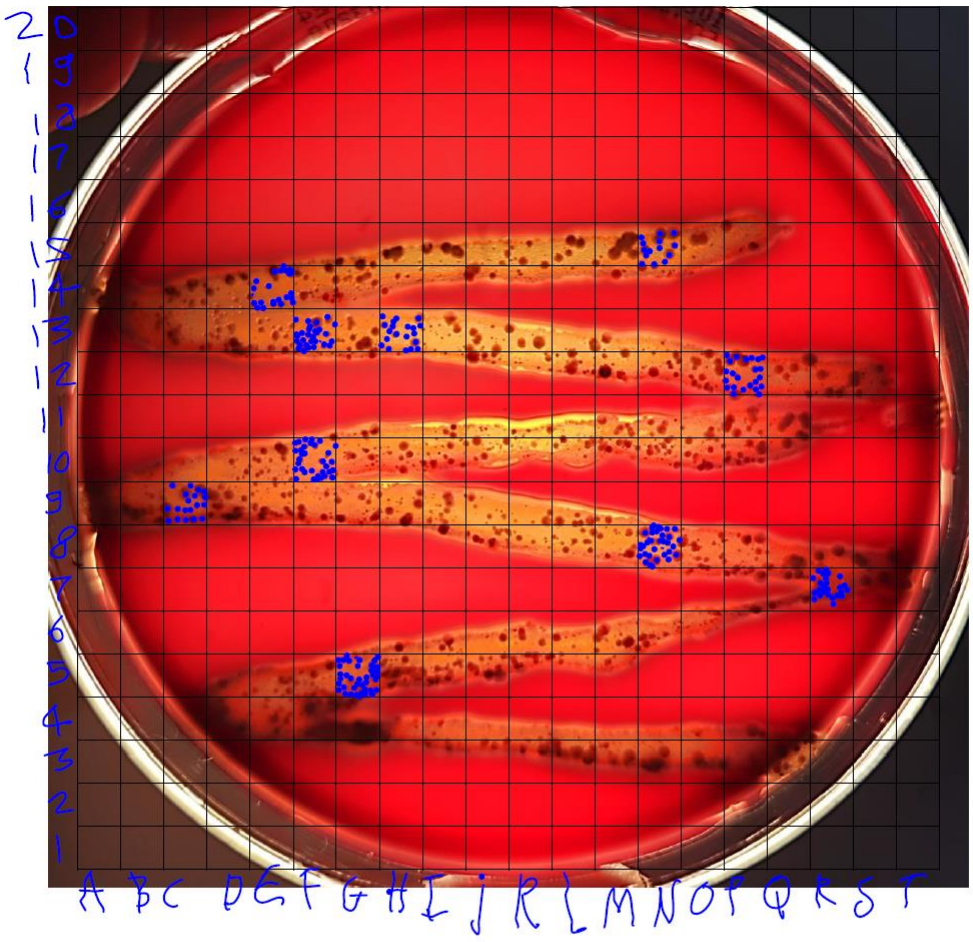


PHOTO OF CONTROL

	Sample						
	Savoury at bedtime			Sweet at bedtime			
Approx No. of colonies	26 in each square			50 in each sqaure			
Types of colonies identified	3			4			
Colony Reference (See image)	#1	#2	#3	#1	#2	#3	#4
Size	punctiform	small	small	punctiform	small	small	small
Colour	Dark grey	Yellow	Cream	Dark grey	Yellow	Cream	Light green
Texture	smooth	Smooth	smooth	smooth	smooth	smooth	Viscid
elevation	Convex	Convex	Raised	Convex	Convex	Raised	Draughtman colony
Form	Round	Round	Irregular	Round	Round	Irregular	Irregular
Margin	Entire	Entire	Undulate	Entire	Entire	Undulate	Undulate

A bar graph to show difference between bedtime Sweet VS savoury snack on bacterial colonies in morning



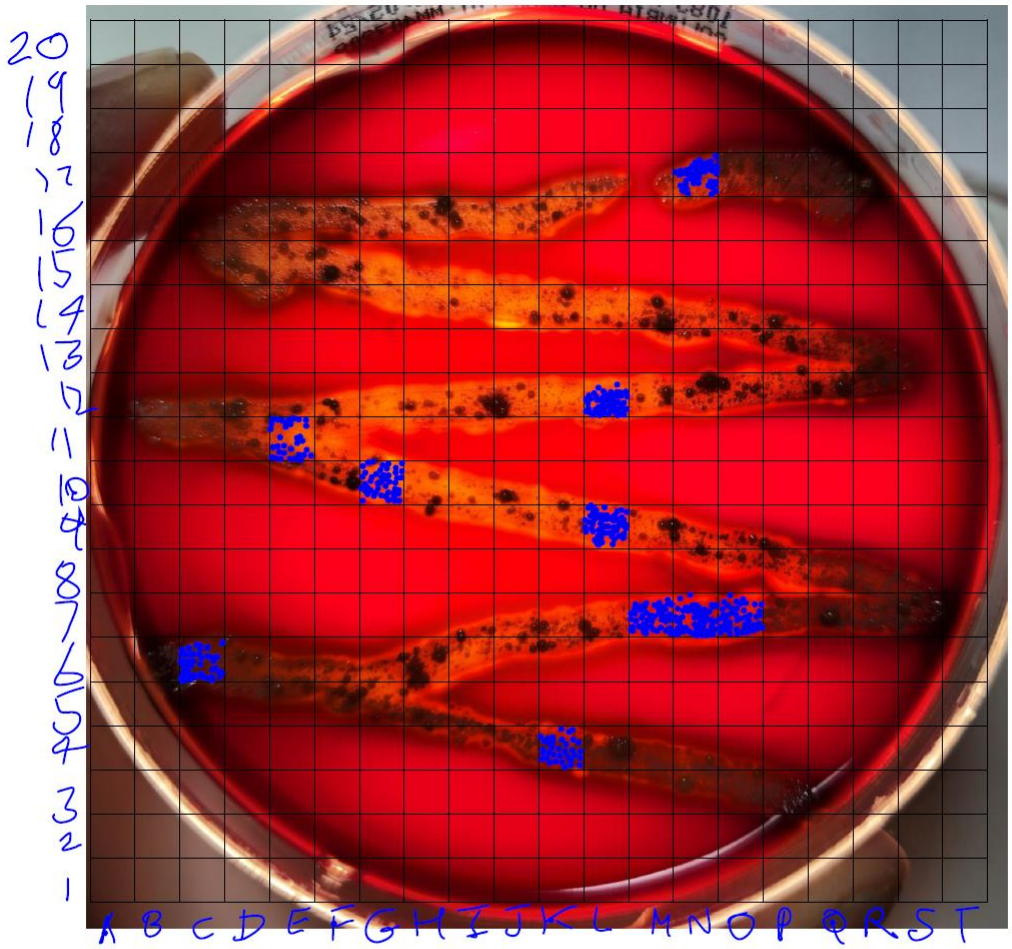


Morning growth after Savoury at bedtime

Squares selected for counting colonies: C9 (19 Colonies), H13 (20 Colonies), N8 (34 Colonies) F13 (30 Colonies), F10 (33 Colonies), E14 (23 Colonies), R7 (26 Colonies), P12 (23 Colonies) G5 (41 Colonies), N15 (14 Colonies)

Total colonies: 263, Cell counted 10

Average colonies in each cell: 263 divided by 10 = 26.3 or 26



Morning growth After sweet at bedtime

Squares selected for counting colonies: G10 (48 Colonies), N7 (59 Colonies), C6 (52 Colonies) O7 (48 Colonies), L12 (54 Colonies), N17 (51 Colonies), M7 (58 Colonies), E11 (34 Colonies) L9 (64 Colonies), K4 (35 Colonies)

Total colonies: 503, Cell counted 10

Average colonies in each cell: 503 divided by 10 = 50.3 or 50

Conclusions:

1. As compared to Savoury at bedtime, sweet at bedtime resulted in more types and number of bacterial colonies in morning.
2. There was a lot more white colonies and 'Draughtman Colony' when I ate sweet at bedtime

Findings are as I predicted but I did not predict increase in variety of bacterial colonies

EVALUATING:

We could improve our experiment by using a microscope and counting all squares, but we will need an expert. We could use an incubator with less variation in temperature. They are expensive.

This information helps us to understand the importance of brushing teeth both at bedtime and morning and also to avoid sweet stuff at bedtime.

It would be nice to know what type of bacteria are there. Are there any other types of germs? How exactly do these germs damage teeth?

References:

1. https://www.pathelective.com/micromeded/bacterial-colony-morphologies
2. Introduction to Bacterial Growth and Aseptic Techniques. https://bio.libretexts.org/Courses/North_Carolina_State_University/MB352_General_Microbiology_Laboratory_2021_(Lee)/02%3A_Cultivation_of_Microbes/2.02%3A_Introduction_to_Bacterial_Growth_and_Aseptic_Techniques
3. The Millions of Microbial Reasons You Need to Brush Your Teeth. https://kids.frontiersin.org/articles/10.3389/frym.2021.605224
4. Health Encyclopedia. The Best and Worst Foods for Your Teeth. https://www.urmc.rochester.edu/encyclopedia/content.aspx?contenttypeid=1&contentid=4062

Acknowledgement:

Parent helped with following:

1. Helping in typing, getting equipment
2. Build incubator
3. Making tables
4. Taking photos and pasting.
5. Making grid to help me count

Word count: 728

Photos of online reading:

Abstract

Millions of tiny critters called microorganisms live in your mouth. Each one is unique and has a specific job. For instance, some microorganisms help with digesting food and others protect you from dangerous infections. Some microorganisms come from your parents, some from the foods you eat, and some from not brushing your teeth. All these microorganisms need food. The good microorganisms that help your mouth stay healthy enjoy eating vegetables, fruits, and grains; the bad ones like sugar. When you eat too much sugar, the bad microorganisms can cause painful problems in your mouth. They may even cause you to lose your teeth or make your gums bleed. Fortunately, brushing your teeth helps remove these rogue bacteria. While we know some things about the microorganisms in the mouth, there is still much we do not know and are still working to discover.

The Best and Worst Foods for Your Teeth

If you are what you eat, that's even more true for your teeth and gums. When you drink and eat starchy or sugary foods, you're not only feeding yourself. You're also feeding the germs (bacteria) that can cause tooth decay and gum disease in your mouth. Plaque is a thin, invisible, sticky film of bacteria and other materials. It covers all the surfaces of all your teeth. When sugars or starches in your mouth come in contact with plaque, acids form. These acids can attack your teeth after you finish eating. Repeated attacks can break down the hard enamel on the surface of teeth. This leads to tooth decay. Bacteria in plaque also sets off an inflammatory response. This causes the breakdown of the gums, bone, and other supporting structures of your teeth.

Some foods invite tooth decay. Other foods help fight plaque buildup. Here are some foods to seek out and some to stay away from.

Handwritten notes

Does the type of food and brushing effect germs on teeth?

Questioning and predicting:

Question:

Does eating sweets at bedtime lead to lead to more germs on your teeth in the morning as compared to eating savoury at bedtime?

Prediction:

Eating sweets at bedtime will lead to more germs growing on our teeth as compared to eating savoury at bedtime

Planning and conducting

Explain why you chose the particular method for your investigation

Bacteria is the main type of germ on teeth.

Bacteria are difficult to see and will need a powerful microscope.

I learned that scientist grow bacteria on agar plate at body temperature. The bacteria grow into large colonies that we can see with naked eyes.

At body temperature they can grow in to large colonies within 48 hours.

By counting and describing the colonies we can then find out the change in the bacteria on our teeth.

What are the possible variables?

1. Time
2. Bacterial colonies
3. Type of food - sweet vs savoury
4. Incubation temperature

Which variables will be changed?

1. Food
2. Time

Which variables will be measured?

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Is your investigation a 'fair test'?

It is a fair test as the methods of taking swab and spreading on agar plates and method of incubation will be exactly same.

The method of analysis will be same.

I will use control

I will make there is no contamination.

Describe all the steps of your investigation so that someone else could do it again. exactly as you did it.

1. Clean hand thoroughly with soap and alcohol rub.

2. Open and Keep the agar plate on flat surface. Make sure you dont touch the agar. I am using a columbia horse blood agar plate. (Image 1)

3. Use a clean swab (Image 2) to scrub my teeth for 30 secs

4. Immediately rub the swabs on the agar plates In a Zig Zag method - Same for all test (Image 3)

5. Put back the cover and secure it with 2 tapes (Image 4)

6. Label the back side of plate.

7. Keep the plate upside down in the Incubator For each sample I will also keep an agar plate with no sample. Lable it as control

8. Take it out after 48 hours for analysis

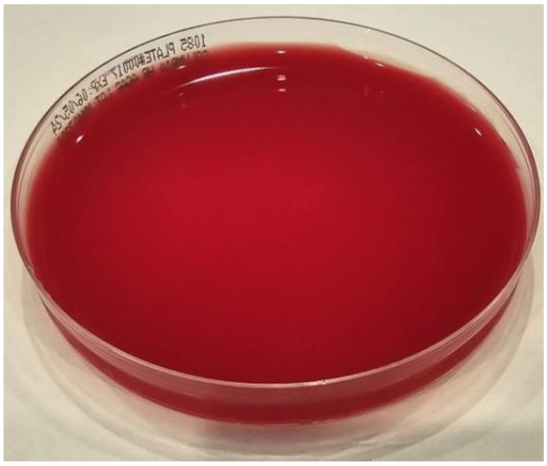
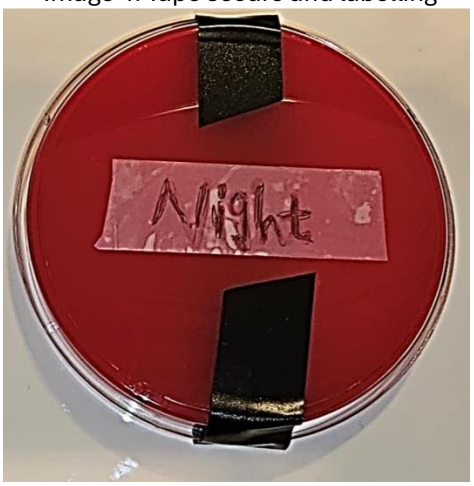


Image 2: Clean swab to take specimen

Image 3: Zigzag method – 3 peaks

Image 4: Tape secure and labelling



When will I measure?

Time	Conditon	Name of Sample	Sample Number
Next Morning 6am before brushing	Sweet Snack before going to bed 8:30pm (after brushing)	Morning Sweet	1
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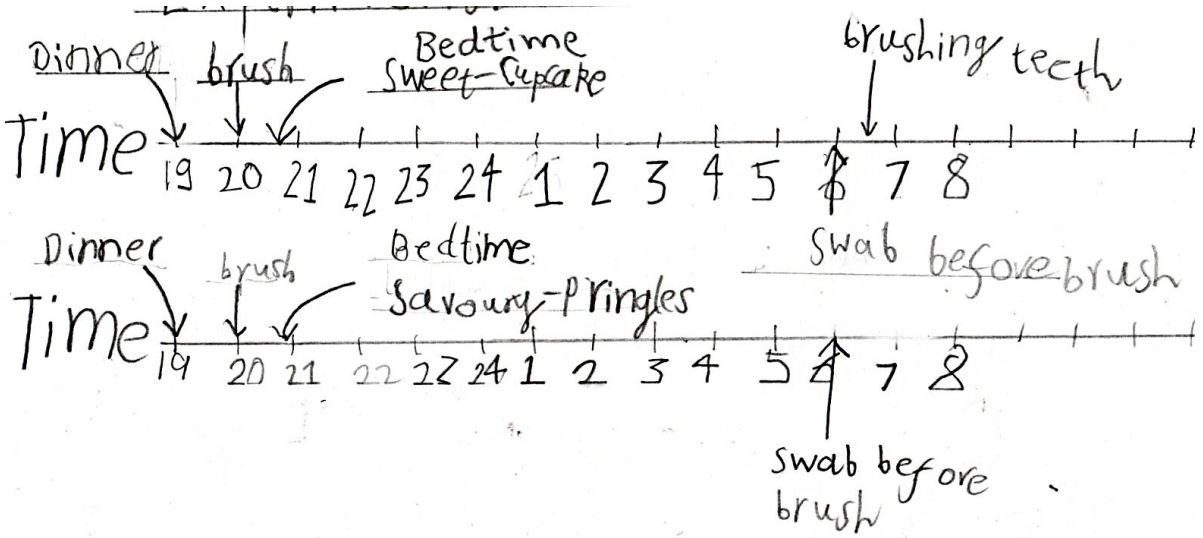
I will need to make sure that I will have the same type of dinner at 7:00pm on the two days.

For sweet I will eat a sweet cupcake.

For Savoury I will eat a bowl of pringles chips.

I will use colgate tooth paste



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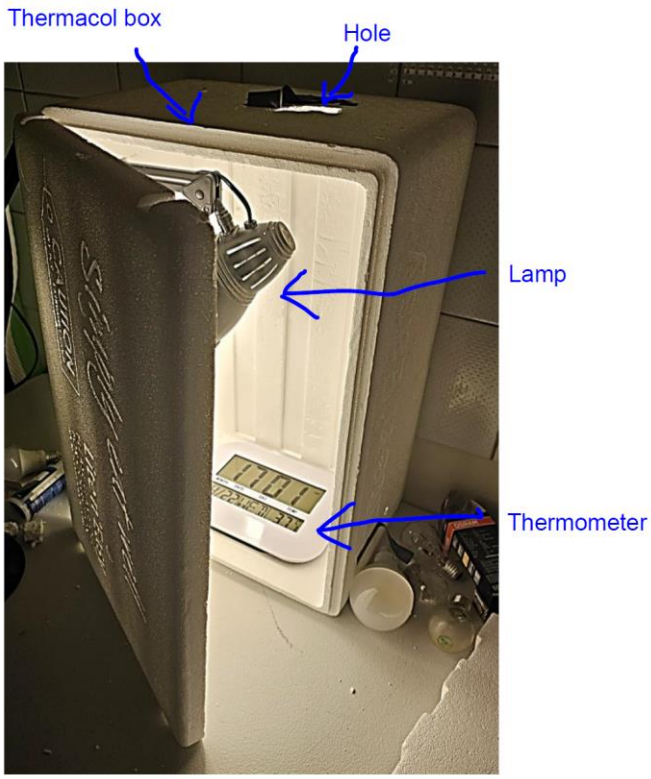
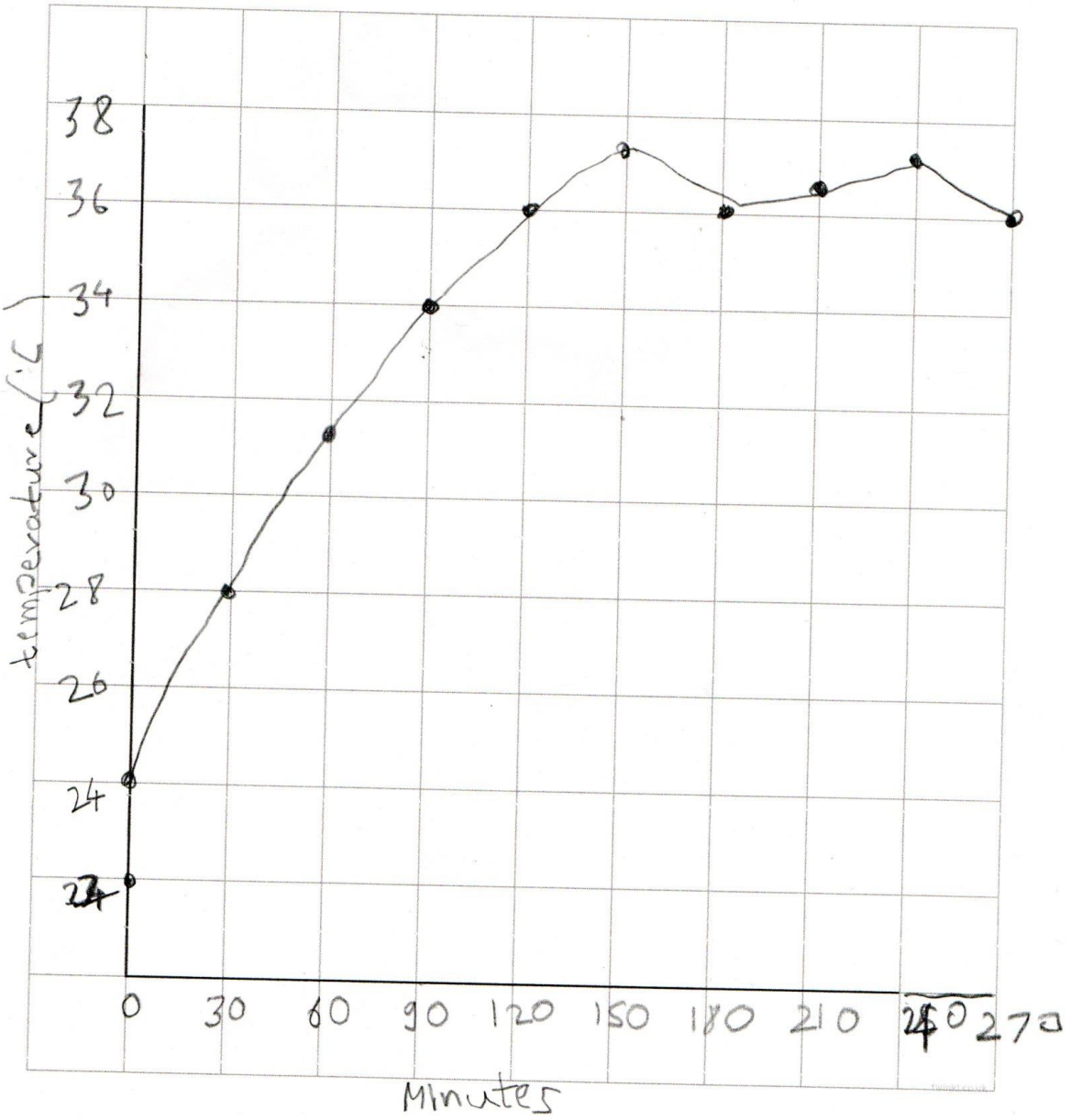
we used thermocol box with table lamp inside (Image5). I made a hole at the top for hot air to escape. I used my clock with thermometer to measure the temperature inside. With help of a parent, we tried bulbs of different power. We went for 23W bulb. The temperature graph is shown in image6. Temperature was always between 34-38 °C.


Thermacol box
Hole
Lamp
Thermometer

A line graph to show Incubator temperature with 23°C bulb



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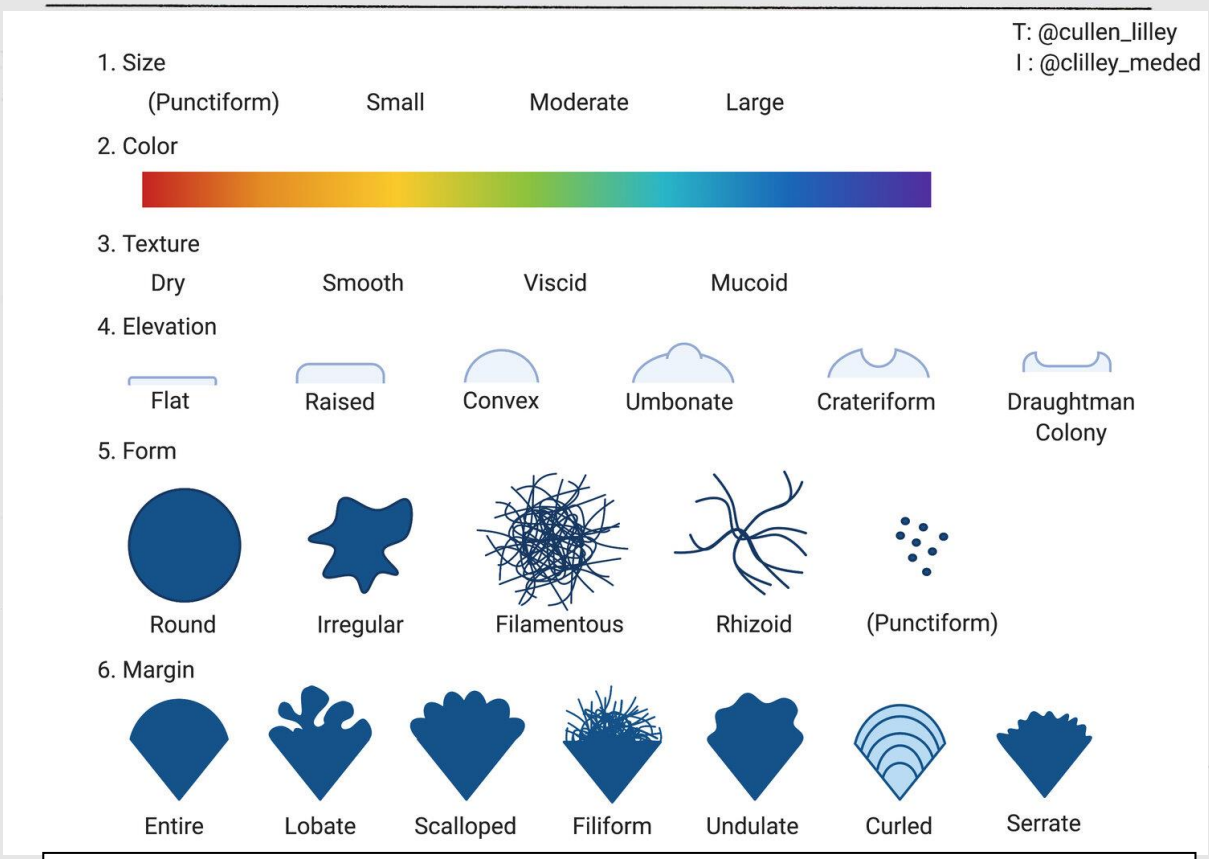

https://www.pathelective.com/micromeded/bacterial-colony-morphologies

For counting number of colonies, I will keep the agar plates on a dim light. Take photo. Make a grid of 20 rows and 20 colums. Randomly choose 10 squares to count colonies and take an average.

Equipment and material:

Incubator: thermocol box, table lamp, bulbs 7w, 13w, 23w, thermometer,

Swab
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Horse blood agar plates
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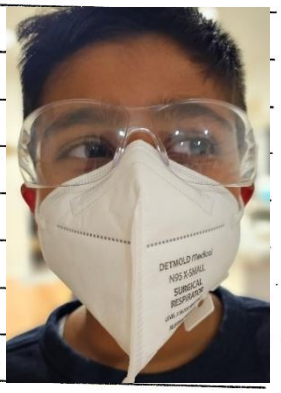
Adult
Sweet and savoury food
Toothpaste and brush



Risks:

Risks to me:

1. Germs: Using gloves mask, goggles. Don't open the lid. Disposal of used plates by an adult in biohazard bag.
2. Shock or heat from incubator: using an adult to change and operate bulb. Stay away from bulb. Using low watt desk lamp.

Risk to experiment:

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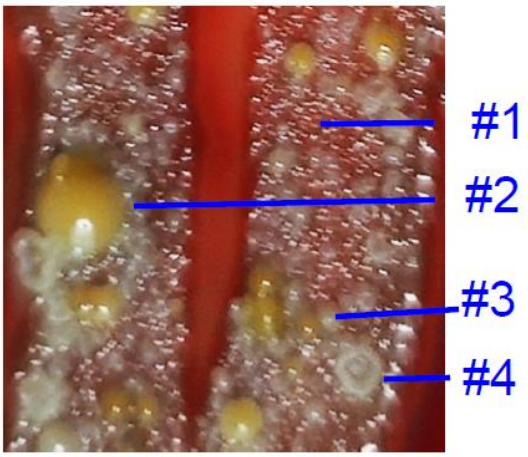
PROCESSING & ANALYSING DATA & INFORMATION

PHOTO OF SWEET AT BEDTIME AGAR PLATE



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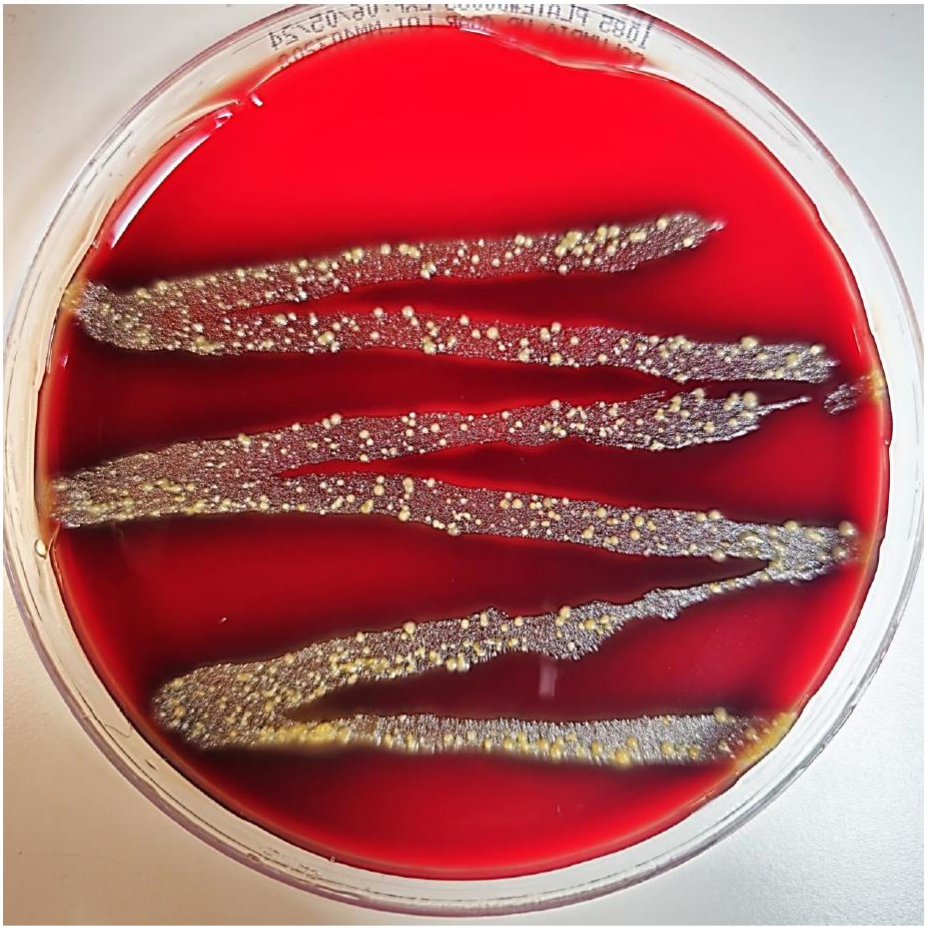

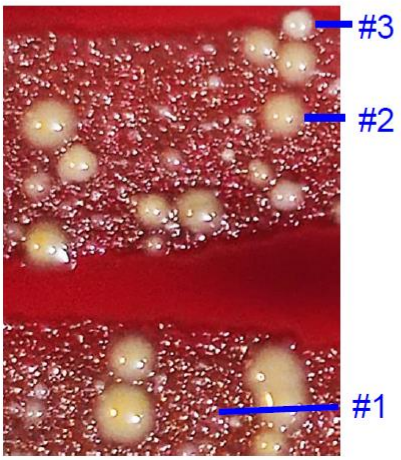

PHOTO OF CONTROL

	Sample						
	Savoury at bedtime			Sweet at bedtime			
Approx No. of colonies	26 in each squdre			50 in each square			
Types of colonies identified	3			4			
Colony Reference (See image)	#1	#2	#3	#1	#2	#3	#4
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Colour	dark grey	Yellow	Cream	dark-grey	yellow	cream	light-green
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elevation	convex	raised		convex	raised		Draughtman colony
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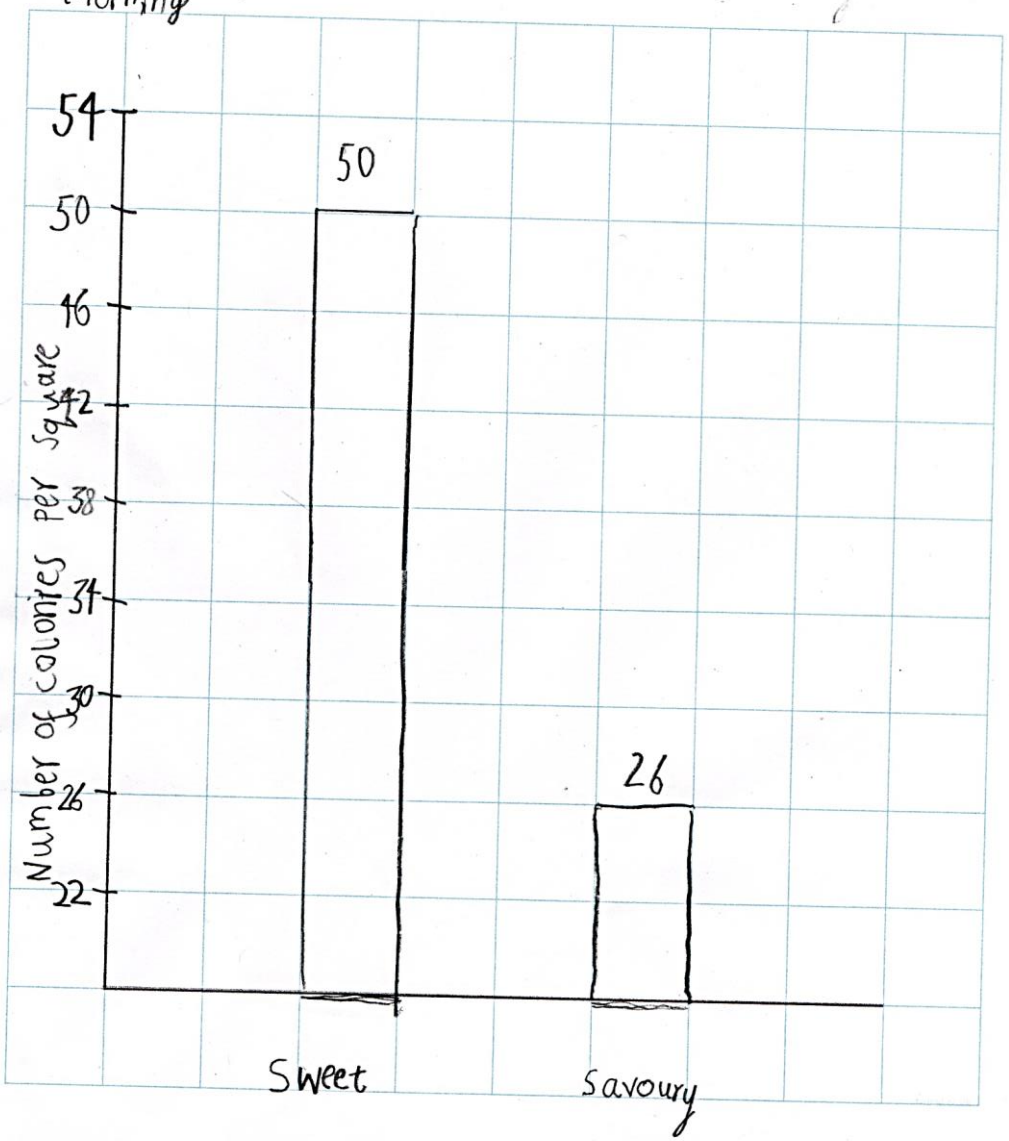
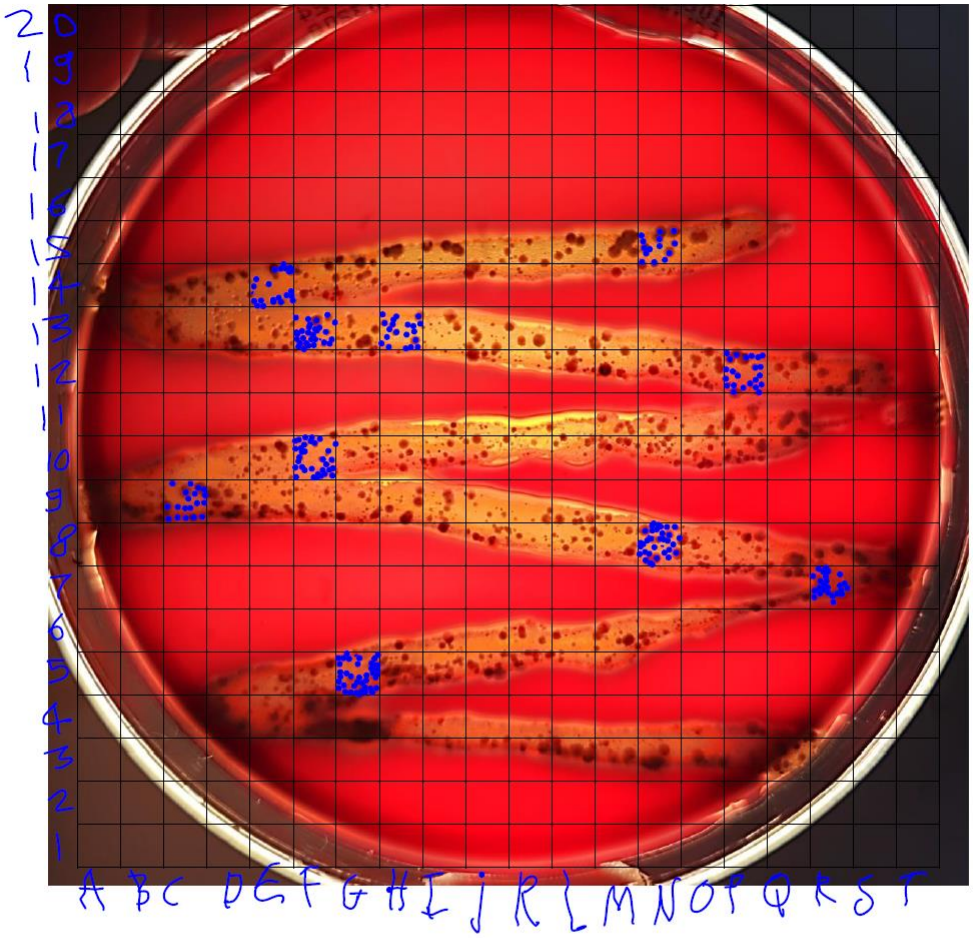
A bar graph to show difference between bedtime Sweet VS savoury snack on bacterial colonies in morning



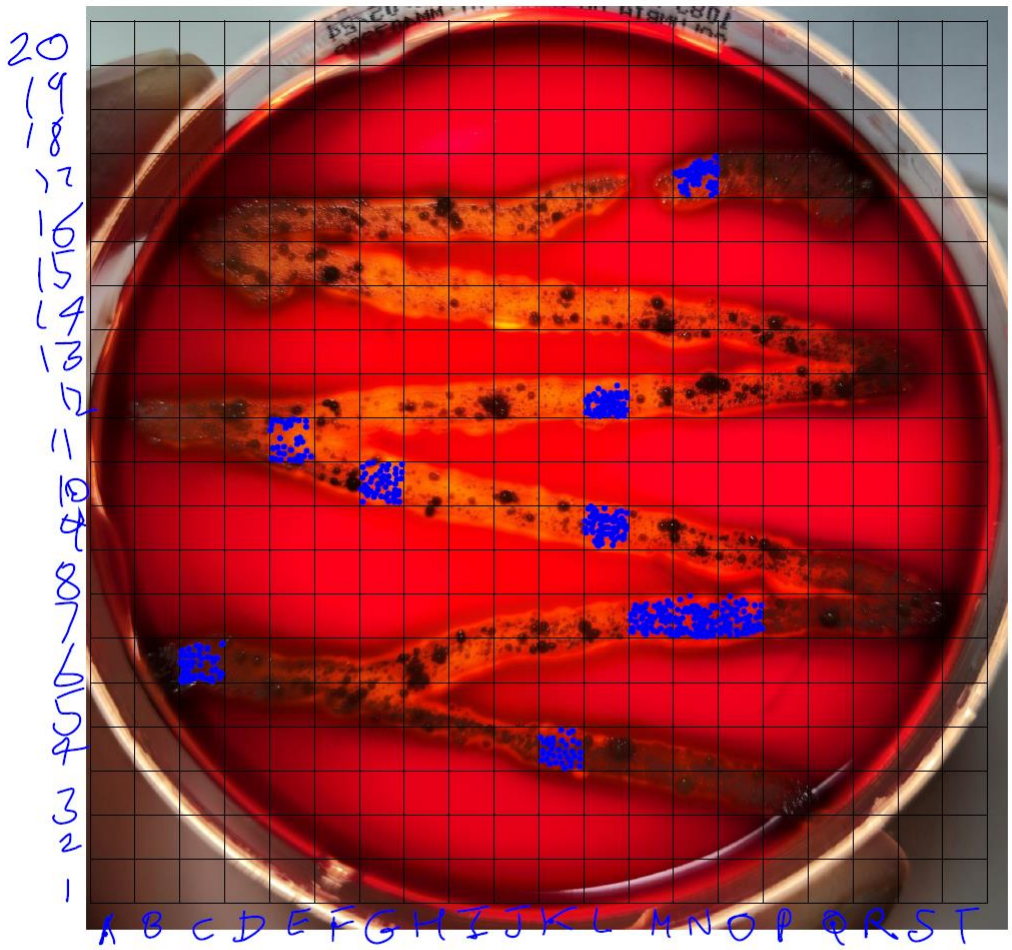


Morning growth after Savoury at bedtime

Squares selected for counting colonies: C9 (19 Colonies), H13 (20 Colonies), N8 (34 Colonies) F13 (30 Colonies), F10 (33 Colonies), E14 (23 Colonies), R7 (26 Colonies), P12 (23 Colonies) G5 (41 Colonies), N15 (14 Colonies)

Total colonies: 263, Cell counted 10

Average colonies in each cell: 263 divided by 10 = 26.3 or 26



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conclusions:

1. AS compared to savoury at bedtime, sweet at bedtime resulted in more types and number of bacterial colonies in the morning.

2. There were a lot more white colonies and draught man colony when I ate sweet at bedtime.

Findings are as I predicted but I did not predict increase in variety of bacterial colonies.

EVALUATING

We could improve our experiment by using a microscope and counting all squares, but we will need an expert.

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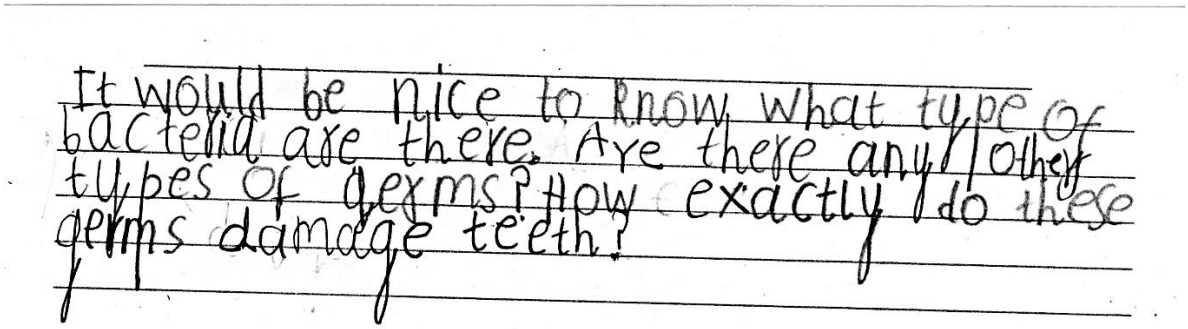

References:

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Parent helped with following:

1. Helping in typing and spelling
2. Buying equipment
3. Building incubator
4. Making tables
5. Making grid to help me count.
6. Searching online for method to describe colonies.

EXTRA WORK: Germs overnight and effect of brushing

Questions

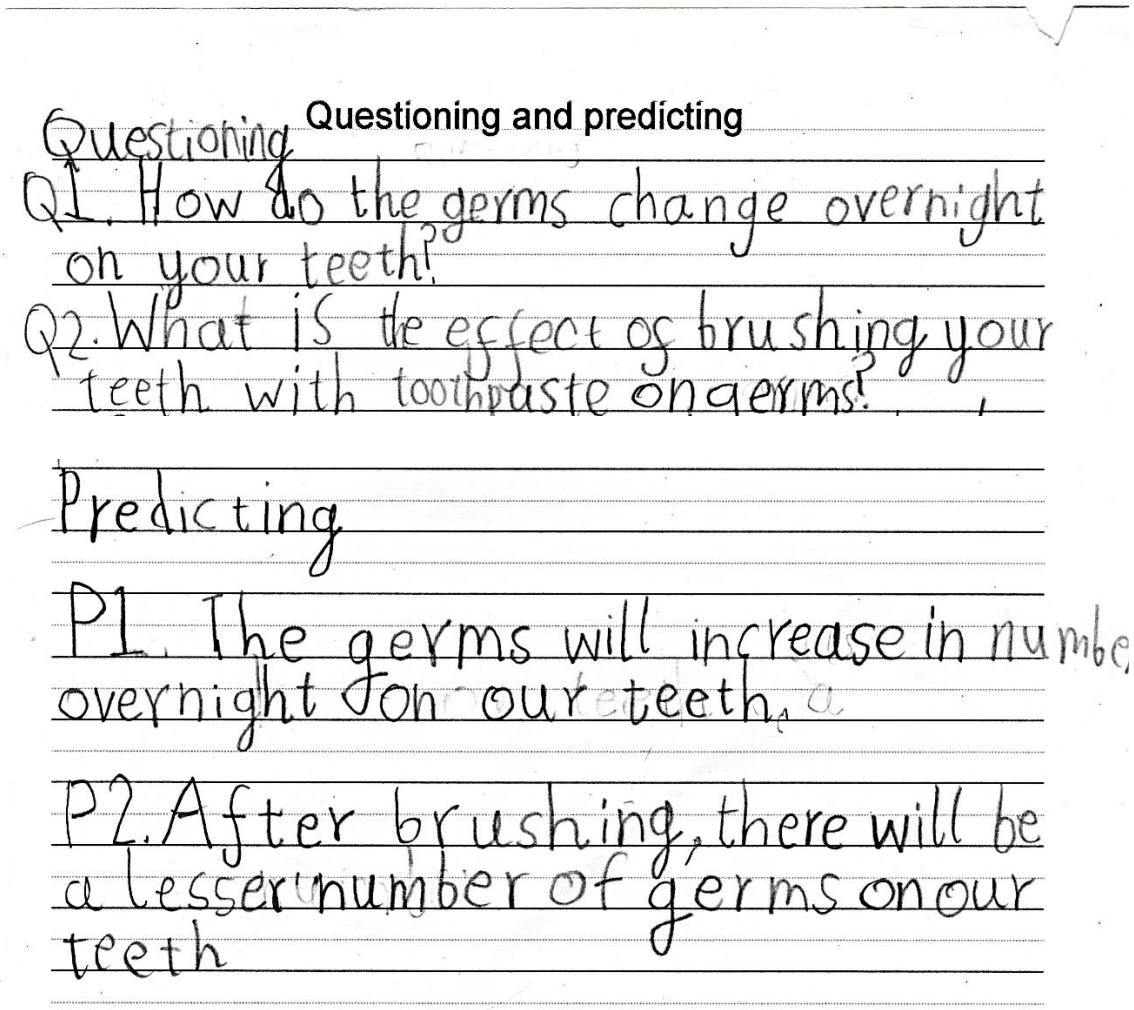
Q1. How do the germs change overnight on your teeth?

Q2. What is the effect of brushing your teeth with toothpaste on germs?

Prediction

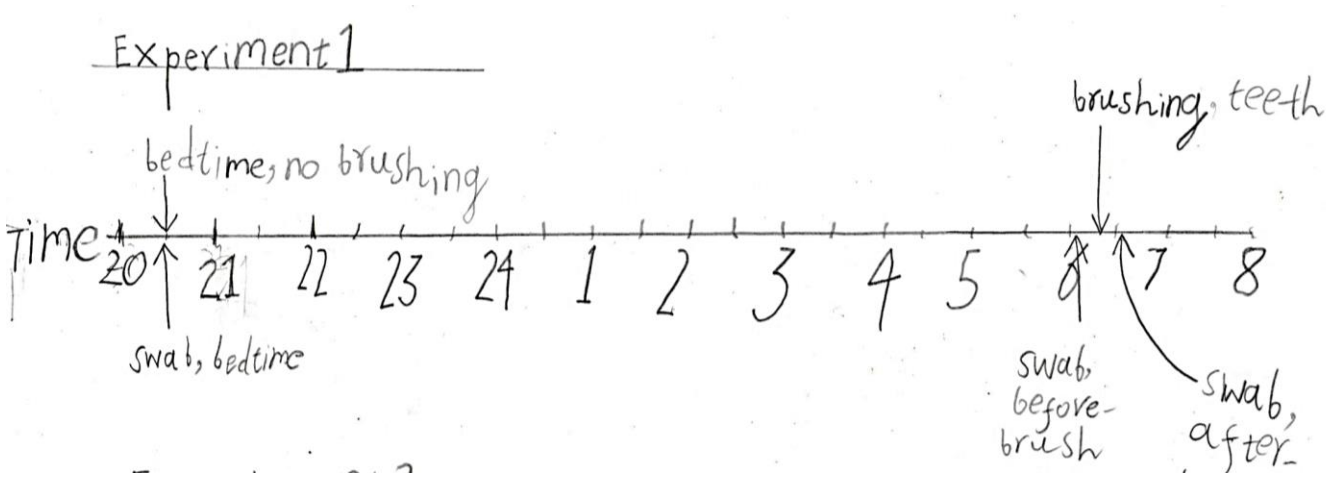
P1. The germs will increase in number overnight on our teeth

P2. After brushing, there will be a lesser number of germs on our teeth



Method:

Time	Condition	Name of sample	Sample number
8:30 pm	Before going to bed – no brushing	Night	1
Next morning 6am	immediately before brushing	Morning Before Brush	2
	Immediately after brushing for 1 minute	Morning After Brush	3



Results:

PHOTO OF ‘NIGHT’ AGAR PLATE

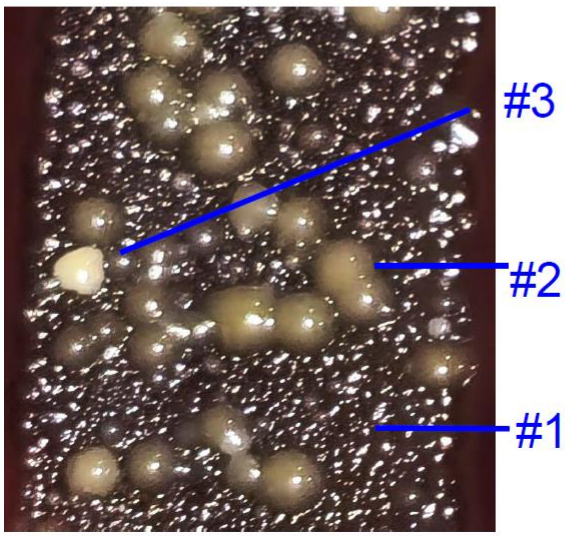
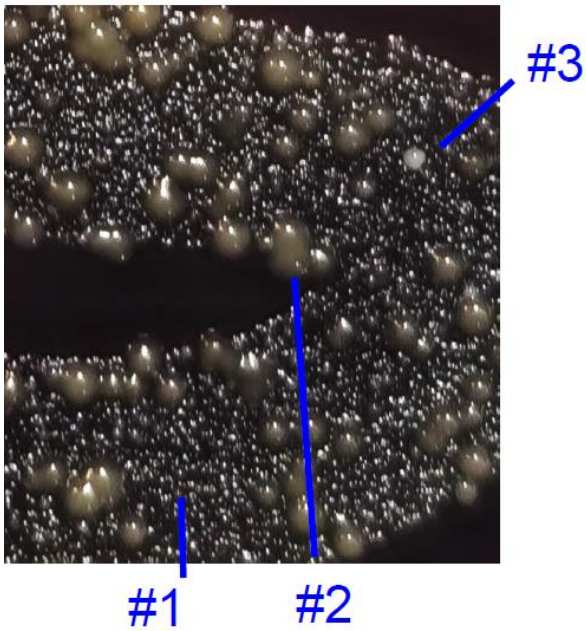


PHOTO OF ‘MORNING BEFORE BRUSHING’ AGAR PLATE



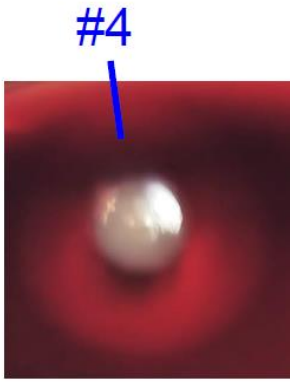
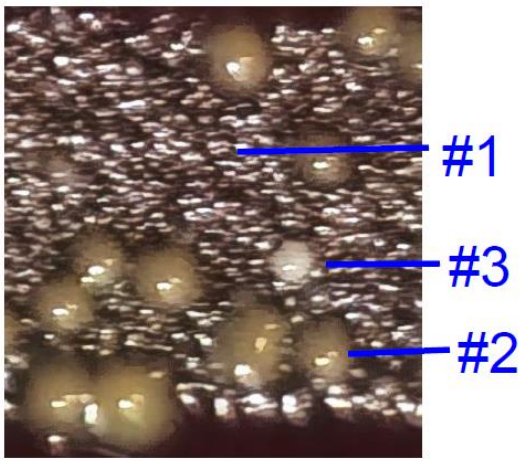


PHOTO OF ‘MORNING AFTER BRUSHING’ AGAR PLATE

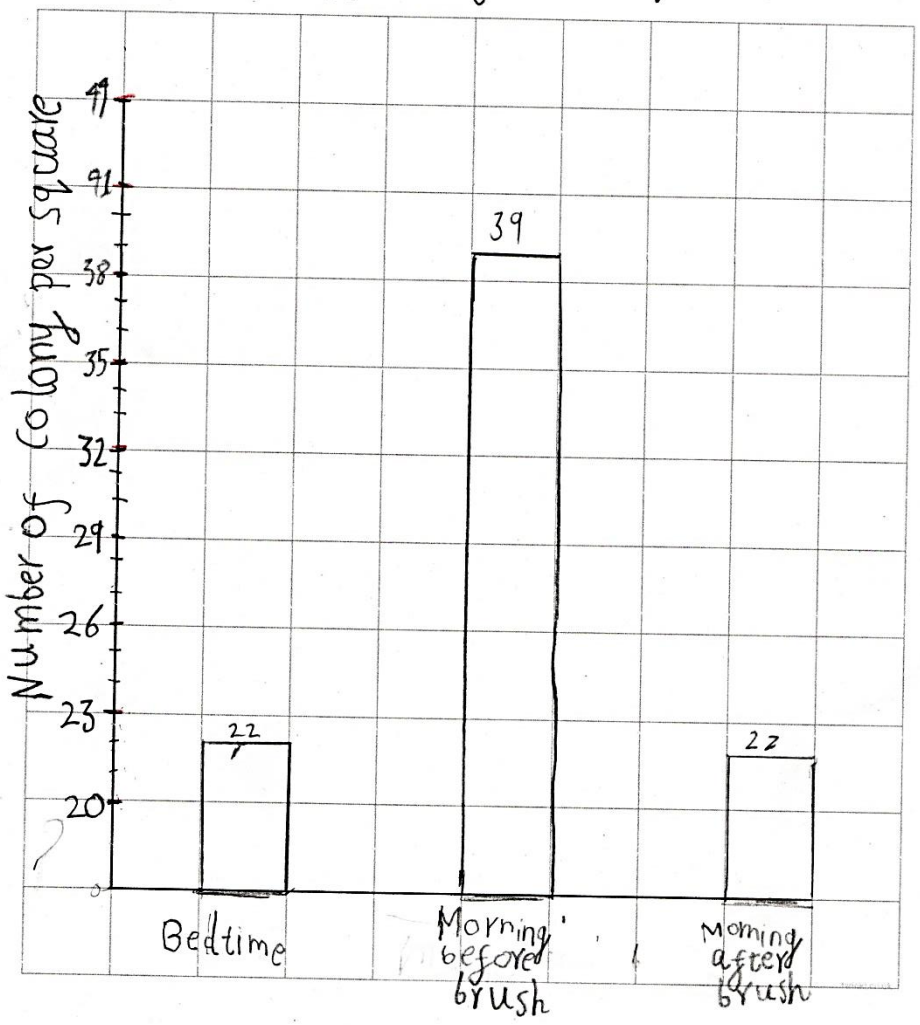


	Sample									
	Night			Morning before brushing				Morning after brushing		
Approx No. of colonies	22 in each square			39 in each square				22 in each square		
Types of colonies identified	3			4				3		
Colony Reference (See image)	#1	#2	#3	#1	#2	#3	#4	#1	#2	#3
Size	punctiform	small	small	punctiform	small	small	large	punctiform	small	small
Colour	Dark grey	yellow	cream	Dark grey	yellow	cream	cream	Dark grey	yellow	cream
Texture	smooth	smooth	smooth	smooth	smooth	smooth	smooth	smooth	smooth	smooth
elevation	convex	convex	raised	convex	convex	raised	raised	convex	convex	raised
Form	Round	Round	irregular	Round	Round	irregular	Round halo	Round	Round	irregular
Margin	Entire	Entire	Undulate	Entire	Entire	Undulate	Entire	Entire	Entire	Undulate

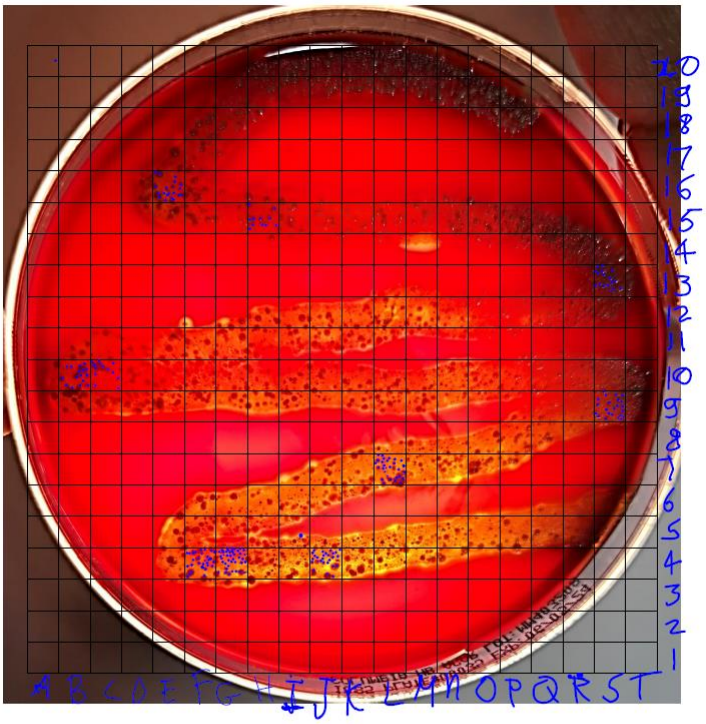
13 th may

	Sample									
	Night			Morning before brushing				Morning after brushing		
Approx No. of colonies	22 in each square			39 in each square				22 in each square		
Types of colonies identified	3			4				3		
Colony Reference (See image)	#1	#2	#3	#1	#2	#3	#4	#1	#2	#3
Size	Punctiform	Small	Small	Punctiform	Small		large	punctiform	small	
Colour	dark grey	Yellow	cream	dark grey	yellow	cream		dark grey	Yellow	cream
Texture	Smooth	Smooth	Smooth	Smooth				Smooth		
elevation	convex	Convex	raised	convex	raised			convex	raised	
Form	Round	Round	irregular	Round	Irregular		Round halo	round	Irregular	
Margin	Entire	Entire	undulate	Entire	undulate		entire	Entire	undulate	

A ~~line~~ bar graph to show change in bacterial colonies overnight and effect of brushing teeth



COLONY COUNTING

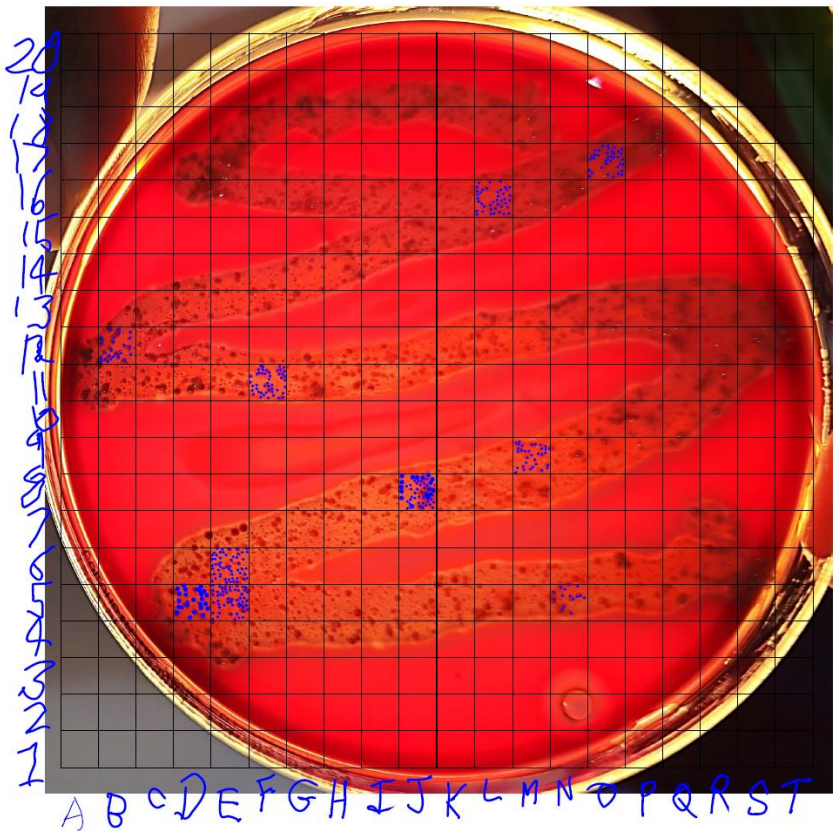


At Bedtime 8:30pm – no brushing teeth

Squares selected for counting: G4 (41 colonies), J4 (28 colonies)
C10 (13 colonies), S13 (17 colonies), L7 (30 colonies),
B10 (16 colonies), H15 (11 colonies), F4 (28 colonies),
E16 (19 colonies), S9 (20 colonies)

Total colonies: 223. Cells counted: 10

Average colonies in each cell: 223 divided by 10 = 22.3 or 22

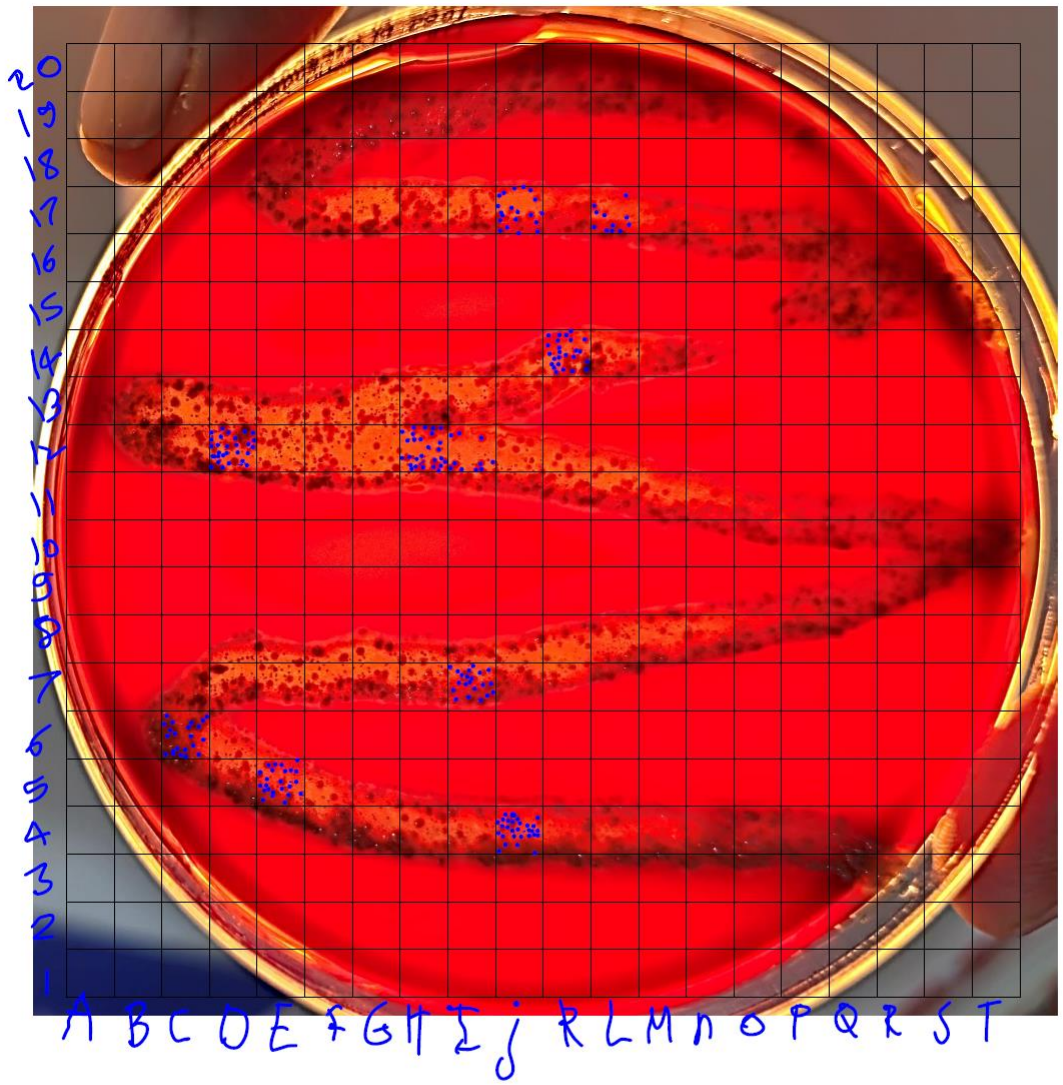


Squares selected for counting colonies: 5D (26 Colonies), J8 (53 Colonies), B12 (29 Colonies) E5 (55 Colonies), L16 (41 Colonies), N5 (15 Colonies), O17 (37 Colonies), F11 (48 Colonies) E6 (58 Colonies), M9 (33 Colonies)

Total colonies: 389, Cell counted 10

Average colonies in each cell: 395 divided by 10 = 39.5 or 39

Morning – Before brushing teeth



Morning – After brushing teeth

- Squares selected for counting colonies: D12 (29 Colonies), I12 (10 Colonies), E5 (25 Colonies) J4 (30 Colonies), I7 (24 Colonies), H12 (28 Colonies), K14 (25 Colonies), L17 (11 Colonies) C6 (21 Colonies), J17 (20 Colonies)

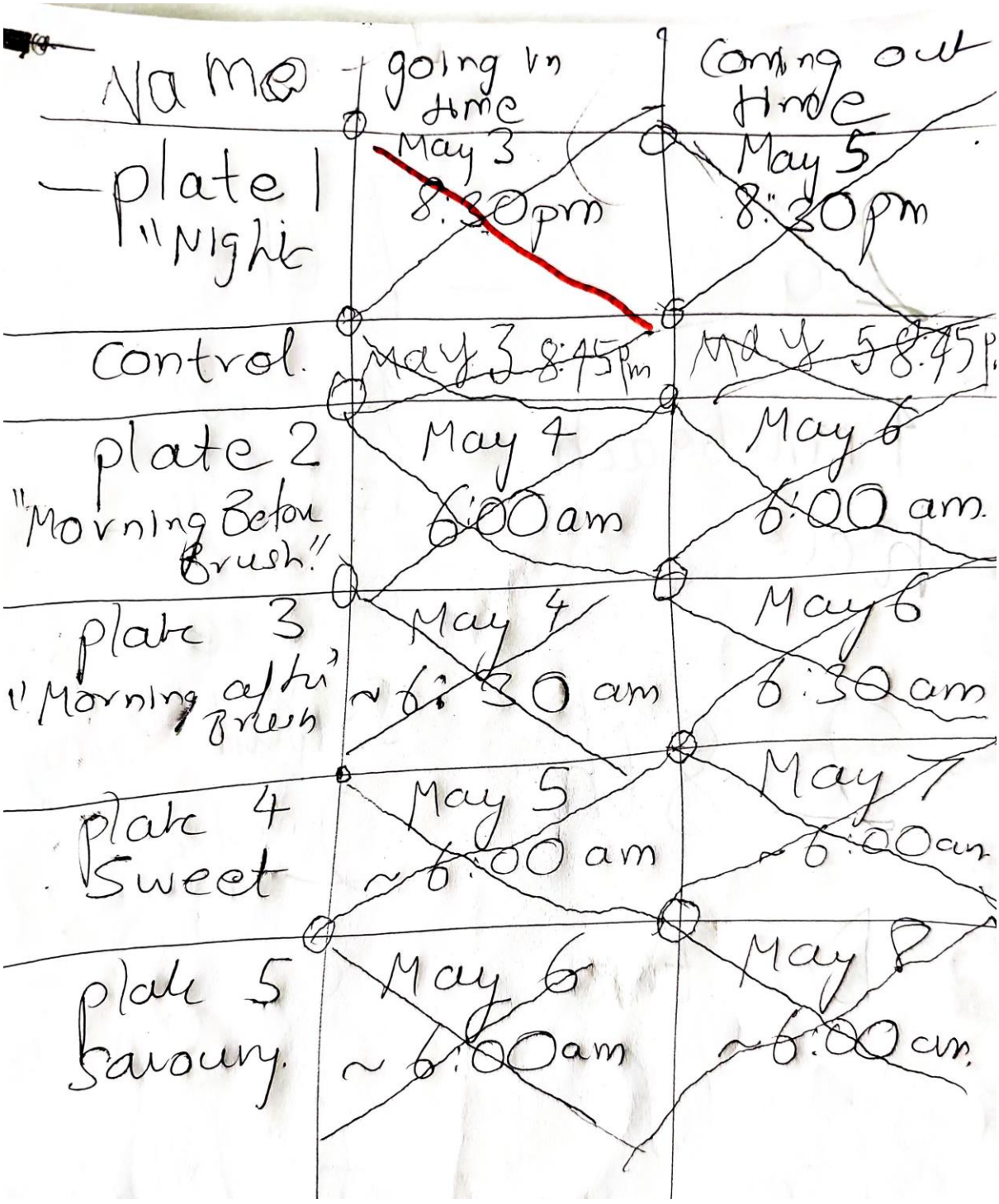
Total colonies: 223, Cell counted 10
Average colonies in each cell: 223 divided by 10 = 22.3 or 22

Conclusion:

1. Both number of colonies and types increased overnight.
2. There was a decrease in colonies after brushing.

Log book

9 APRIL	Idea on research question
16 April	Learn how to grow bacteria
18 April	Started to build incubator
21 April	Success building incubator
22-23 April	Designed methods
24 April	Bought agar plates and other equipment
5-8 May	Started experiment - See image of incubator log book
6-11 may:	colony counting and analysis of bacterial colonies - making tables and graphs
17-24 may:	writing methods, observation conclusions.


Name
going in time
Coming out time
plate 1 "Night
May 3 8:30pm
May 5 8:30pm
Control.
May 3 8:45pm
May 5 8:45p
plate 2 "Morning Befor Brush"
May 4 6:00 am
May 6 6:00 am.
plate 3 "Morning after Brush"
May 4 ~6:30 am
May 6 6:30 am
plate 4 Sweet
May 5 ~6:00 am
May 7 ~6:00 am
plate 5 Savoury.
May 6 ~6:00 am
May 8 ~6:00 am.

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.

STUDENT(S) NAME: Viaan Prakash ID: 0680-006

SCHOOL: St Peter's College

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

Growing germs from teeth on agar plates and looking at changes with food, sleeping overnight and brushing

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
Thermal & Electrical risk with incubator	Never touch the lamp. Use incubator under adult supervision
Biological risks: growing bacteria	Adult supervision. Using Mask, Goggles, Gloves. Tape to Secure the lid. Never open the lid. Analysis using a photo. Disposal by adult in biohazard bags. Hand wash with soap after use.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Viaan Prakash

SIGNATURE(S): Viaan Prakash

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

TEACHER'S NAME: Lisa Zollo

SIGNATURE: Lisa Zollo DATE: 28/5/24