Microbiology Activity 1

Microbiology of Money

Introduction
Bacteria are in the kingdom Monera which is one of the simplest but most successful of all groups. They appeared on Earth over 3.5 billion years ago and form the first known fossils. They are to be found everywhere, sometimes living in very extreme environments where no other living creatures can survive. They are found in soil, seawater, freshwater, ice, and on the surface of roots and leaves of plants. They are found on the surface of the skin (about 100,000 on every square cm) and in your intestine in enormous numbers (about a hundred trillion!) – there are more bacteria living in your large intestine than you have cells in your body!
A small proportion of bacteria cause diseases such as sore throat, food poisoning, stomach ulcers and the bacterial form of meningitis but most bacteria are not harmful and in fact benefit us enormously. They are very important in recycling nutrients through the biosphere – they make nitrogen from dead plants and animals and from the atmosphere available for plants at the base of food chains on which we depend. It is bacteria that make cheese and yoghurt and antibiotics like streptomycin.

See how many of these bacteria you can match up to what they do! Some you know and others are obvious from the name –guess the rest! Connect the name box to what it does!

Bacillus anthracis	Causes serious infection. Drug resistant strains	**Rhizobia**
Live in gut, produce vitamin K	**Streptococcus**	Heat loving. Source of enzymes for DNA profiling
Live in water, produce large amount of O_2	**Lactobacillus**	**Thermus aquaticus**
Causes TB, an antibiotic resistant strain is present	Causes anthrax a deadly disease in cattle, humans	**Cyanobacteria**
Escherichia coli	Converts free N_2 into a form plants can use	Help turn milk into cheese, yoghurt
Causes strep throat, meningitis,pneumonia	**Staphylococcus**	**Mycobacterium tuberculosis**

Microbiology of Money Worksheet

Name: ……..

In this activity you are going to investigate the microorganisms present on money.

1. You can't see the bacteria on the coins because they are so small. In the right conditions each bacterium multiplies rapidly by dividing to make a colony of cells – this can be seen with the naked eye. What conditions do bacteria and fungi need in order to grow and reproduce rapidly?

   ……

2. Microorganisms are found everywhere. They are killed by heat and by irradiation. It is important to know that all the bacteria you grow come from the coins. You are going to use 2 sterile agar plates. How do you think they were sterilised?

   …….

3. Melt 1 or 2 tubes of sterile agar in a beaker of hot water. How do you think that the agar was sterilised?

   ……

4. Pour 2 or more plates. How did you pour the plates so that as few microorganisms as possible from the air get in?

   ……

5. While the plates are cooling **plan** your investigation.There are many variables which might affect the numbers of bacteria on a coin – the age of the coin, the material the coin is made of, the pattern on one side of the coin may have more places for bacteria to attach than the other, how the coin has been stored/handled. You may be able to think of others! Choose to investigate

   either A - Do older coins have more microorganisms than newer ones?
   or B - Do copper coins have more microorganisms than silver ones?
   or C - Do antiseptic wipes work?

   Which have you chosen? ……

6. What **variable** (or factor) are you going to **change**?

   ……..

7. What **variable**s (or factors) are you going to keep the **same** to make it a fair experiment. This is very important – you won't be able to come to any conclusions about the effect of the variable you are varying deliberately if other variables are changing too! You may not be able to keep all of them exactly the same but think how you can as far as possible – and bear this in mind in the evaluation!

   Variable: kept the same by:

   .....

   .....

8. What are you going to **measure**? (e.g the number of bacterial colonies) How?

   ……..

9. How are you going to sterilise the forceps in order to move the coins? Why was it better to use tongs than your hands to transfer the coins?

   …….

10. Set up your plates. Place the coin on the plate for a minute or so and then remove. Use sellotape to tape closed. Where are you going to put them to optimise the growth of the bacteria?

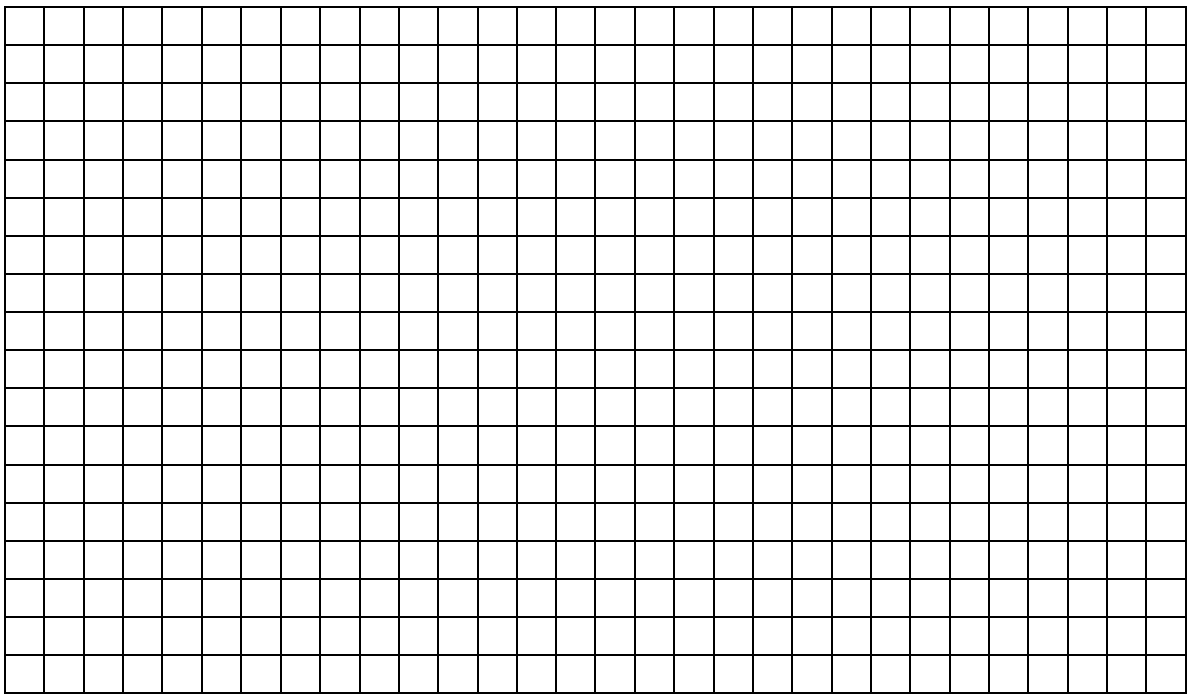
    ……

11. Draw up a table for your **results**.Enter the variable you chose to change and what you decided to measure.

Variable changed =	**Measurement =**

When you look at your plates why is it so vital that you DO NOT OPEN THEM but look at colonies through the lid?

12. Change the data to a picture which is easier to interpret. Plot a bar chart below. Put the variable you changed on the x axis, the horizontal axis. Put the measurement on the y axis, the vertical axis.



13. **Conclusion:** What did your investigation show?

……

14. **Evaluation:** Are the results what you expected? ……

15. Do you believe them? Are you sure that the pattern in the measurements you made is due **only** to the variable you changed? What else **could** have affected the measurements?

……

……**.....**

16. If you were planning the investigation again in the light of what you know now how could you improve your plan? (There is no such thing as a perfect experiment!!!)

……

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Microbiology of Money

Teacher's information sheet

This is an activity which enables students to engage in microbiology to conduct an investigation – a genuine investigation in which no one knows the answer before they start! The fact that they choose exactly what investigation to conduct means that with any luck they will take the 'ownership' of the investigation which is so important in motivation. There is also a health lesson to draw as regards handling of money and then food- they will be amazed at what they grow!

Risk Assessment:

Risk:	Minimised by:
Burns from bunsen burner	Care
Scalding boiling water	Allow to cool before dismantling
Cuts from glass	Handle with care
Burns from agar tube	Hold in tongs
Pathogenic bacteria	Only view through the lid – do not open petridishes, tape them shut

Apparatus and chemicals required:

For a class of 24

1. 24 petri dishes (or more if you have them!)
2. Nutrient agar.
3. 12 boiling tubes for agar, 12 tongs for the tubes
4. 12 bunsens, gauzes and beakers to heat agar
5. Appropriate coins provided by the students

Advance preparation:

1. Photocopy the Introduction and worksheet – (4 pages altogether, preferably on 2 sides of an A3 sheet) for each student or each pair
2. Warn students in advance that they will need a few coins with them.
3. Make up the nutrient agar and divide into tubes for each group. Dissolve ½ teaspoon of nutrient agar powder in a beaker containing about 200 ml of hot water . Bring to the boil with stirring until it is fully dissolved – the solution goes clear. Pour into 12 boiling tubes – each about ½ full will be enough agar for 2 petri dishes. Put a piece of paper towel or cotton wool in the top.

Suggested answers

Introduction:

Mycobacterium tuberculosis	-	Causes TB, an antibiotic resistant strain is present
Staphylococcus	-	Causes serious infection. Drug resistant strains
Escherichia coli	-	Live in gut, produce vitamin K
Lactobacillus	-	Help turn milk into cheese, yoghurt
Cyanobacteria	-	Live in water, produce large amount of O_2
Thermus aquaticus	-	Heat loving. Source of enzymes for DNA profiling
Rhizobia	-	Converts free N_2 into a form plants can use
Streptococcus	-	Causes strep throat, meningitis,pneumonia
Bacillus anthracis	-	Causes anthrax a deadly disease in cattle, humans

Worksheet:

1. Food, water, warmth
2. Irradiation is used for the plastic petridishes bought in sealed plastic bags
3. Heat. In industry/ hospitals the agar would be autoclaved, or heated under pressure ,to temperatures >100^{o}C but this is not necessary here.
4. Open the plates as little as possible for as short a time as possible.
5. –
6. A- age of the coin, B-metal the coin is made of C- whether or not the coin is wiped with an antiseptic wipe, or which type of antiseptic wipe is used.
7. A- use same type of coin, use same side of coin
   B- use same age of coins, use coins of as similar radius as possible
   C- use same type of coin, use same age of coin
8. Number of bacterial colonies
9. Sterilise forceps in the bunsen flame, hands are covered in bacteria(100,000 per cm^2)
10. The accepted ideal is in an incubator at 37^{o}C for 2 days but in practice they will grow fine on the window sill of the lab, although they might take a little longer.
11. e.g

Variable changed=	Measurement=
age of 5c coin	number of colonies
2002	18
2003	12
2004	10

    Fuzzy growths of fungus may also be present.
12. Graph
13. e.g A – older coins do/do not have more bacteria
14. Their results may or may not be what they expect
15. e.g.Variation in the history of the coins which they could not control, variation in the radius of the coin in B, vigour with which coin is rubbed in C
16. Tests their ingenuity in how these problems could be overcome to make a fairer experiment!