EASTER BUSH SCIENCE OUTREACH CENTRE

Get hands-on with real-life science

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Science Outreach Centre

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Farm Detectives

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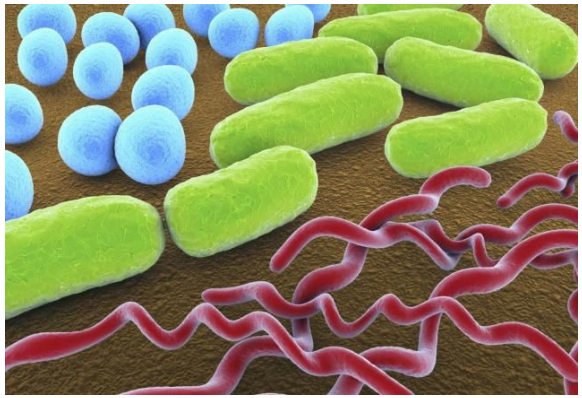
What are microorganisms?

microorganism

tiny

a living thing



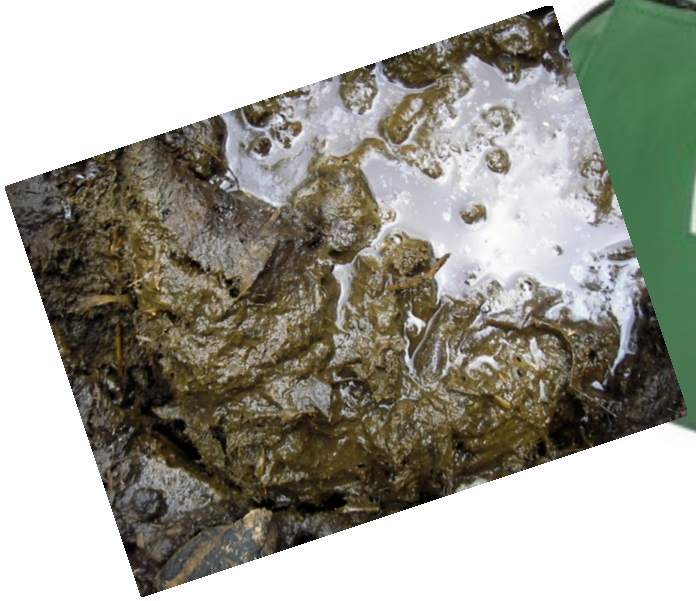
Bacteria

Fungi

Viruses

There's trouble on the farm!

Call the vet!



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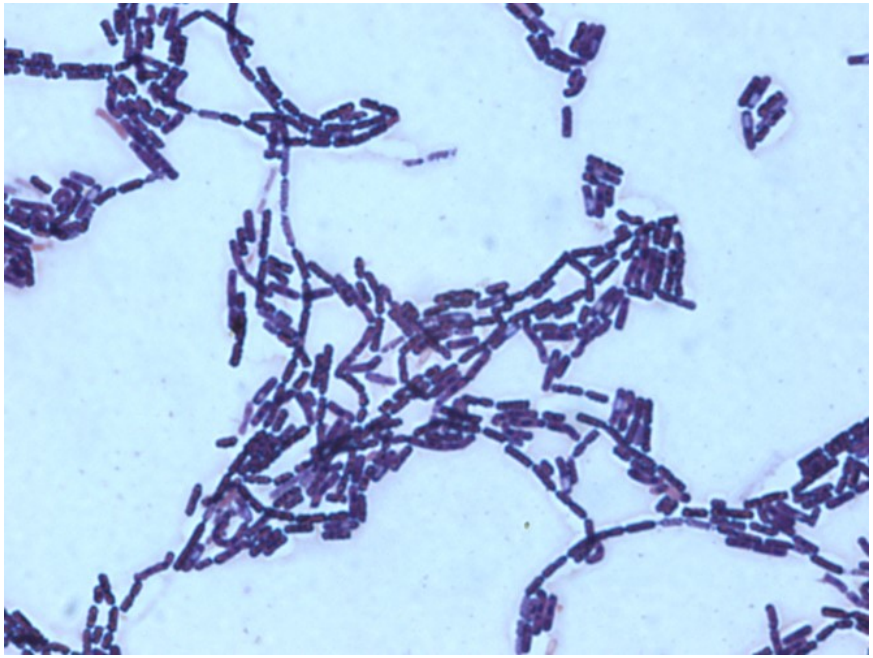
Bacteria Culture

We will grow the bacteria for a few hours at

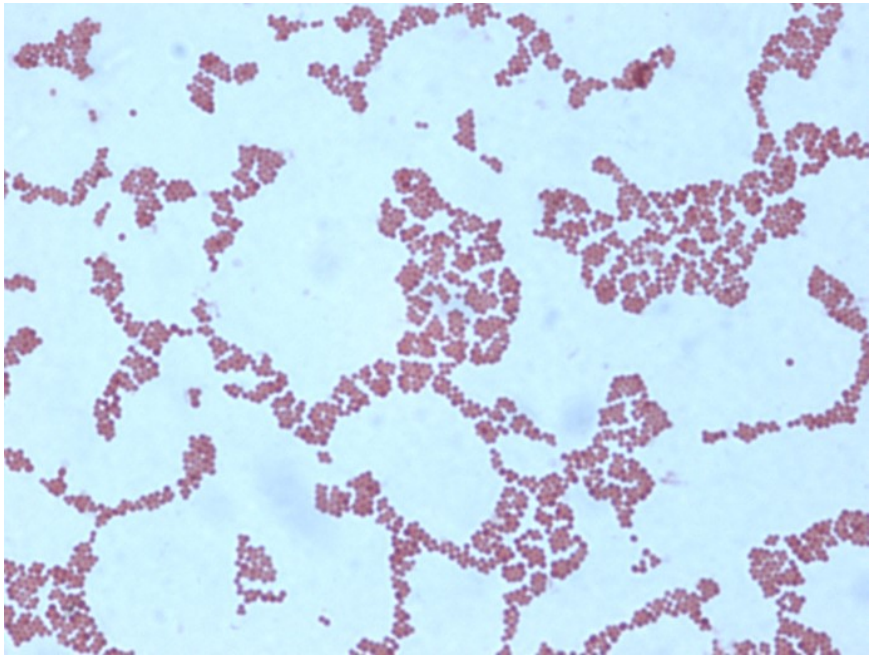
We need your help!

- What caused the illness?

Bacteria Identification- rod or cocci?



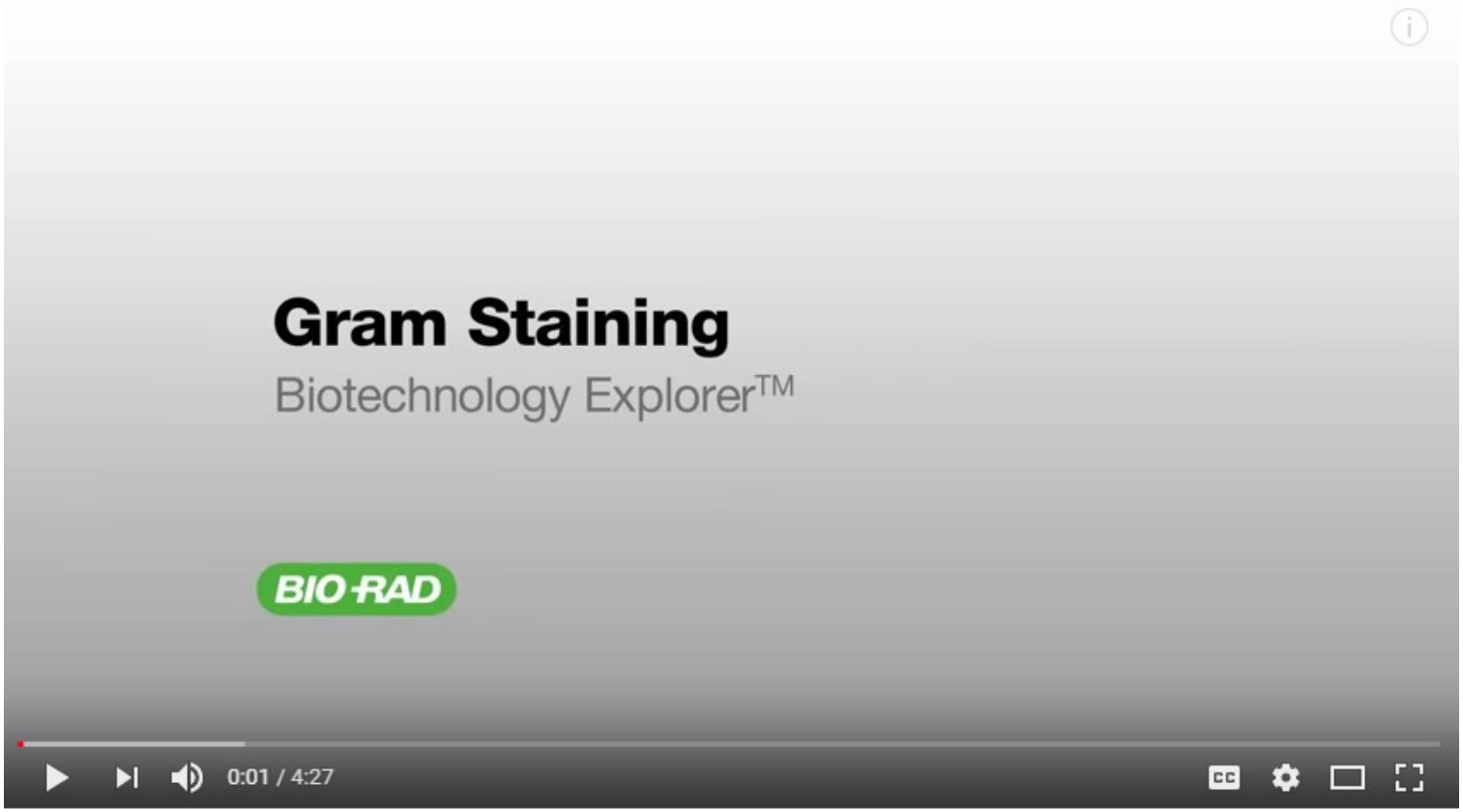
Rod



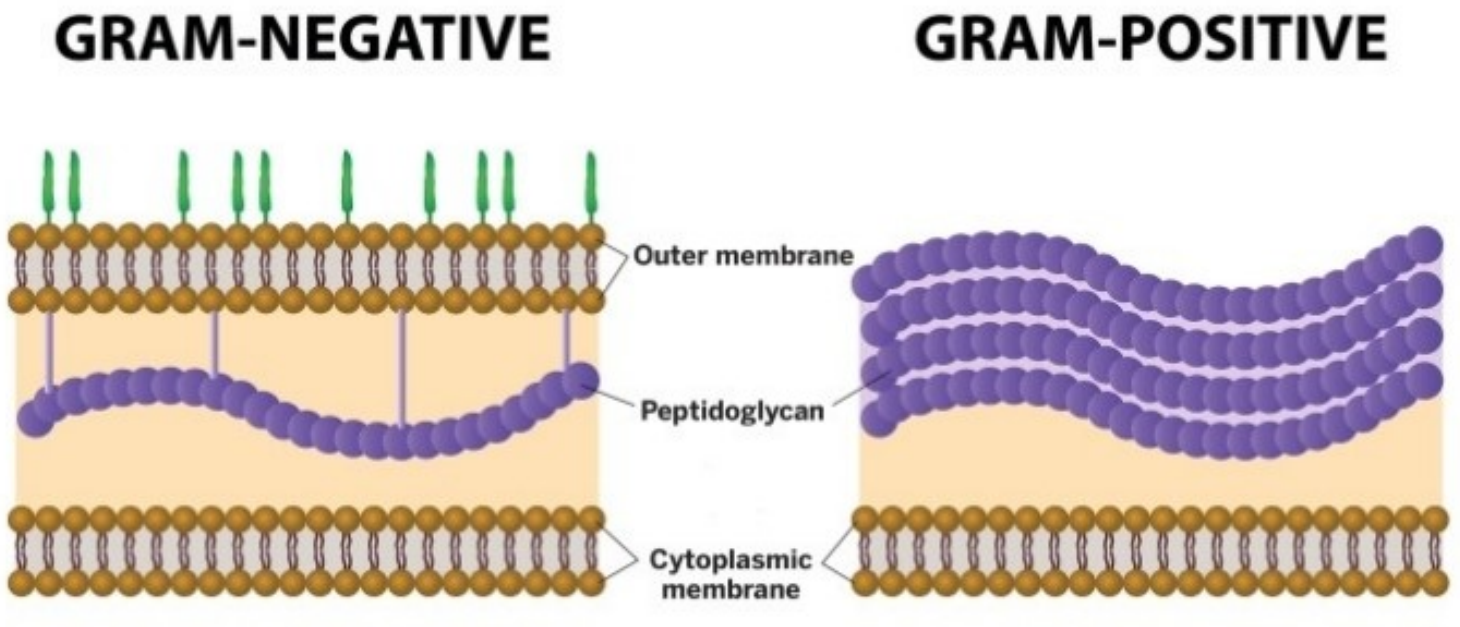
Cocci (round)

Bacteria come in all shapes and sizes. This can sometimes help us tell them apart.

Gram Staining

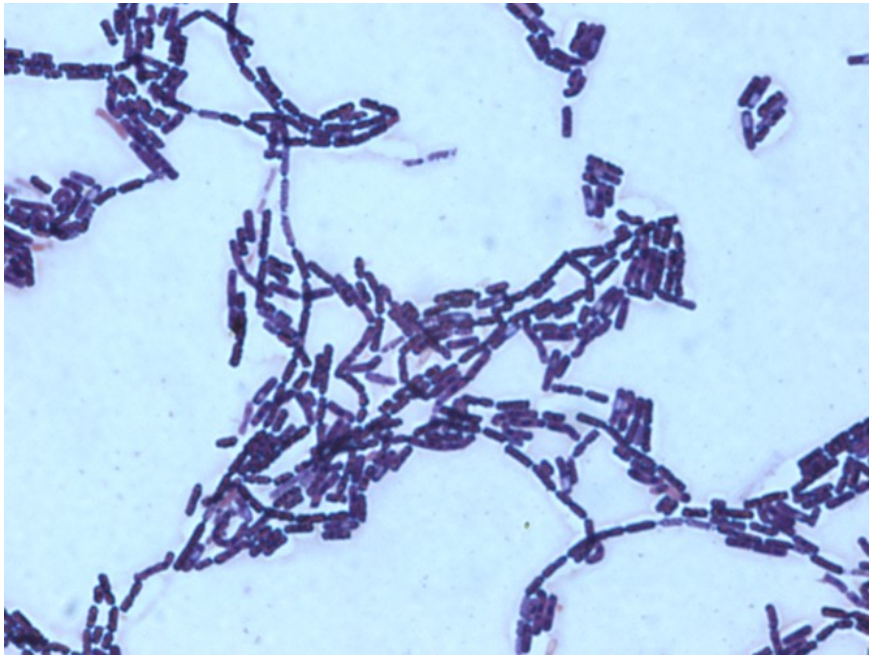


Gram staining

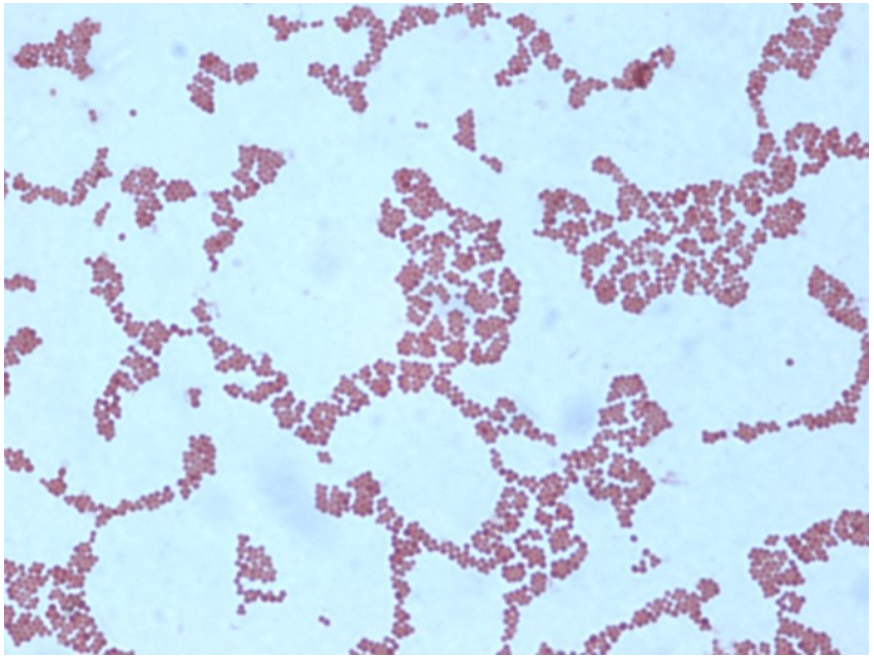


Gram staining is a technique scientists use tell identify different bacteria.

Bacteria Identification- Gram + or - ?



Gram positive



Gram negative

Bacteria Identification

Match the what you see down microscope with the descriptions.

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Bacillus subtilis

Bacillus subtilis bacteria are rod-shaped and Gram-positive, so they stain purple in a Gram test.

B.subtilis often grows in long chains.

Streptococcus equi

Streptococcus equi bacteria are round (cocci) and Gram-positive, so they stain purple in a Gram test.

S.equi grows in long chains, but these are often broken up during staining so they may appear as single cells.

Staphylococcus aureus

Staphylococcus aureus bacteria are round (cocci) and Gram-negative, so they stain pink in a Gram test.

S.aureus grows in clusters like bunches of grapes.

Salmonella

Salmonella bacteria are rod-shaped and Gram-negative, so they stain pink in a Gram stain test.

They often are seen growing separately.

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Name .....

Lab number .....

Farm Detectives

Bacteria Identification

	Slide 1	Slide 2	Slide 3	Slide 4
Draw what you see				
What shape is it?				
Is it Gram positive or Gram negative?				

Write the number of slide that matches the description:

Salmonella ☐

Salmonella bacteria are rod-shaped and Gram-negative, so they stain pink in a Gram stain test. They often are seen growing separately.

Bacillus subtilis ☐

Bacillus subtilis bacteria are rod-shaped and Gram-positive, so they stain purple in a Gram test.

B.subtilis often grows in long chains.

Staphylococcus aureus ☐

Staphylococcus aureus bacteria are round (cocci) and Gram-negative, so they stain pink in a Gram test.
S.aureus grows in clusters like bunches of grapes.

Streptococcus equi ☐

Streptococcus equi bacteria are round (cocci) and Gram-positive, so they stain purple in a Gram test.

S.equi grows in long chains, but these are often broken up during staining so they may appear as single cells.

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Record your answers in your worksheet.

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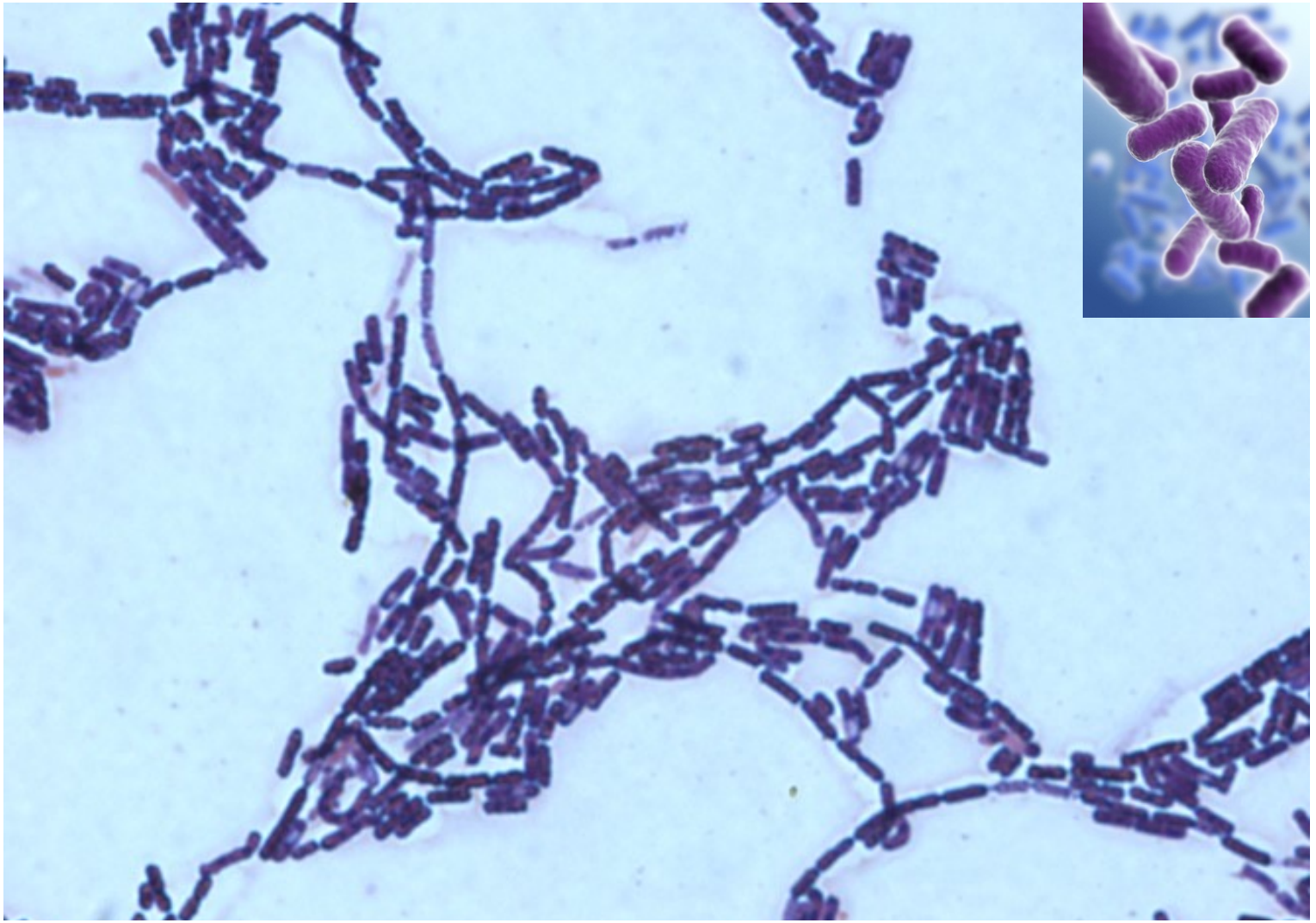
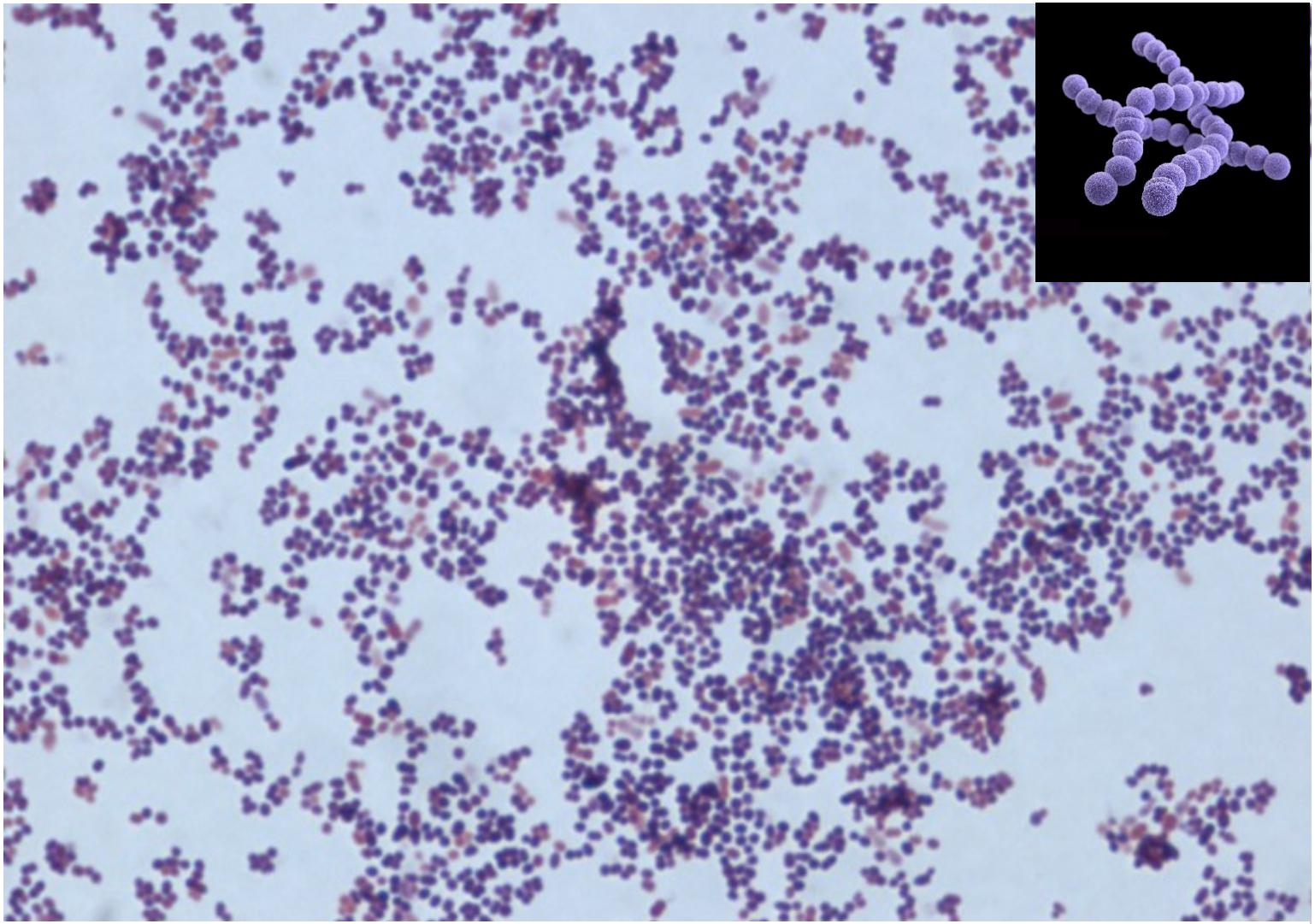
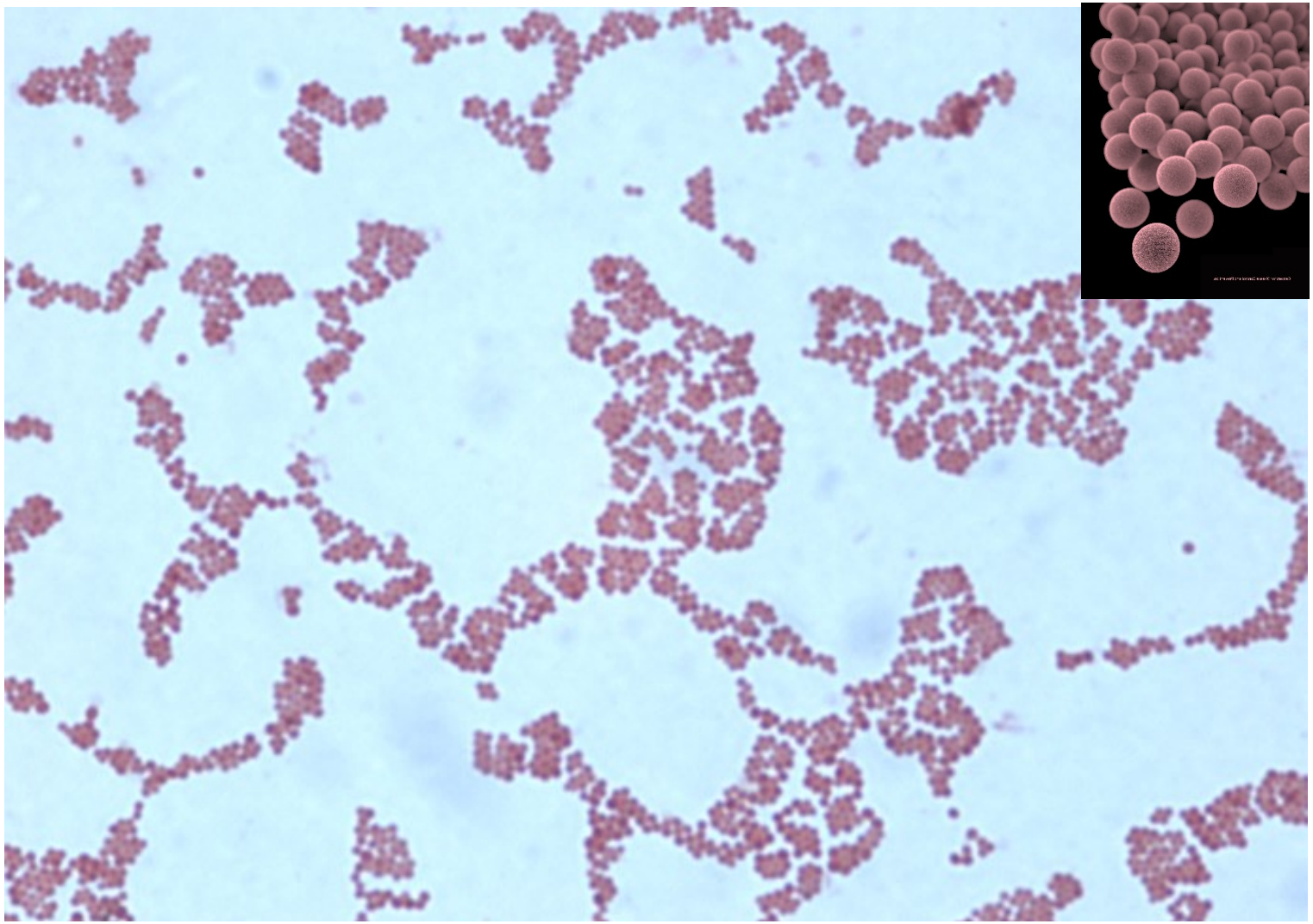


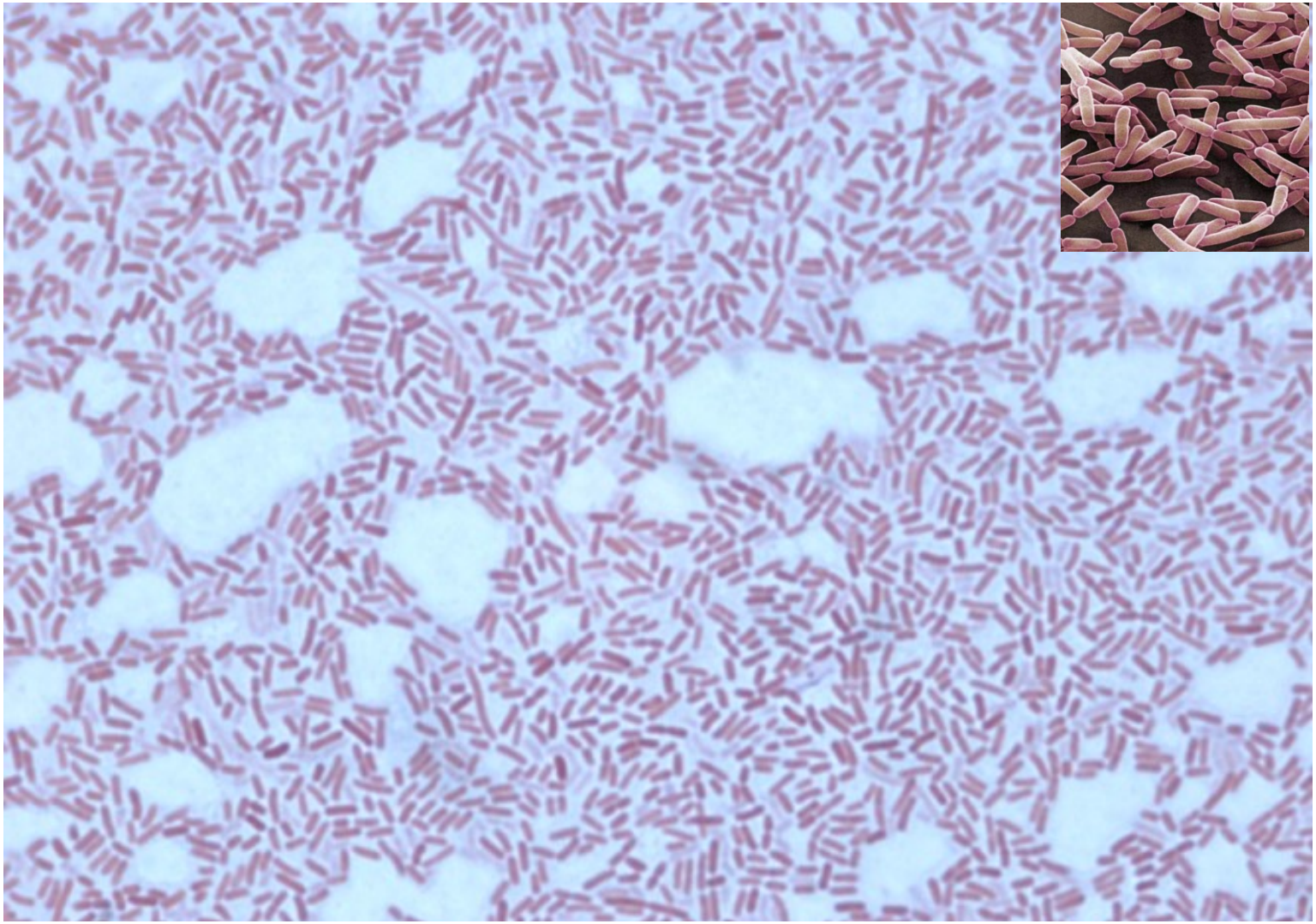
Bacillus subtilis



Streptococcus equi



Staphylococcus aureus



Salmonella

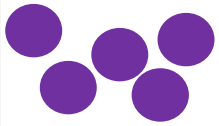
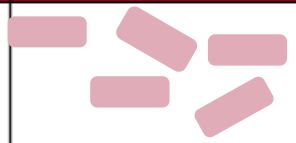
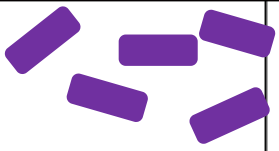
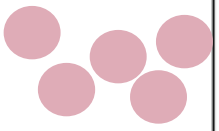
Name .....

Lab number .....

Did you identify the bacteria?

Farm Detectives

Bacteria Identification

	Slide 1	Slide 2	Slide 3	Slide 4
Draw what you see				
What shape is it?	cocci	rod	rod	cocci
Is it Gram positive or Gram negative?	positive	negative	positive	negative

Write the number of slide that matches the description:

Salmonella 2

Salmonella bacteria are rod-shaped and Gram-negative, so they stain pink in a Gram stain test.
They often are seen growing separately.

Bacillus subtilis 3

Bacillus subtilis bacteria are rod-shaped and Gram-positive, so they stain purple in a Gram test.

B.subtilis often grows in long chains.

Staphylococcus aureus 4

Staphylococcus aureus bacteria are round (cocci) and Gram-negative, so they stain pink in a Gram test.
S.aureus grows in clusters like bunches of grapes.

Streptococcus equi 1

Streptococcus equi bacteria are round (cocci) and Gram-positive, so they stain purple in a Gram test.

S.equi grows in long chains, but these are often broken up during staining so they may appear as single cells.

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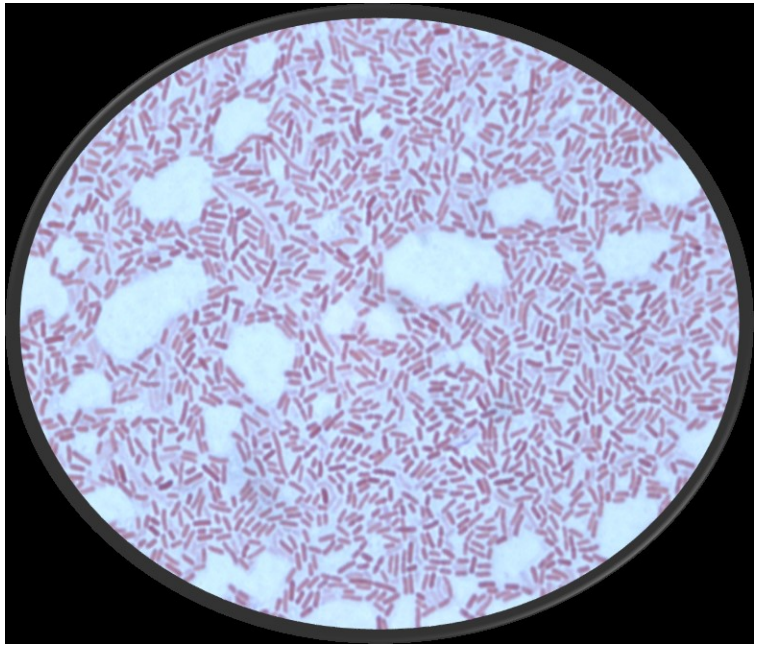
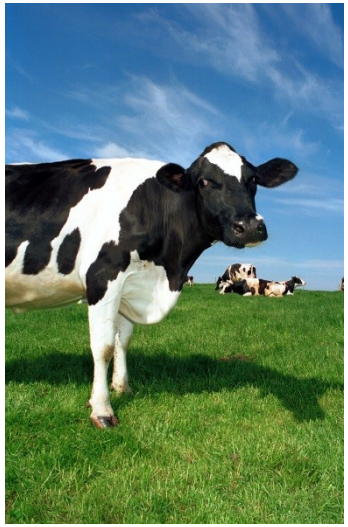
What caused our cow's illness?

Bacteria on slide 2 came from our sick cows.

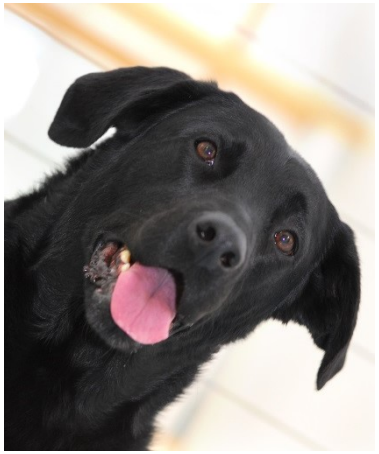


The diagnosis

- Salmonellosis
- Caused by *Salmonella* bacteria
- Infects:



and humans!



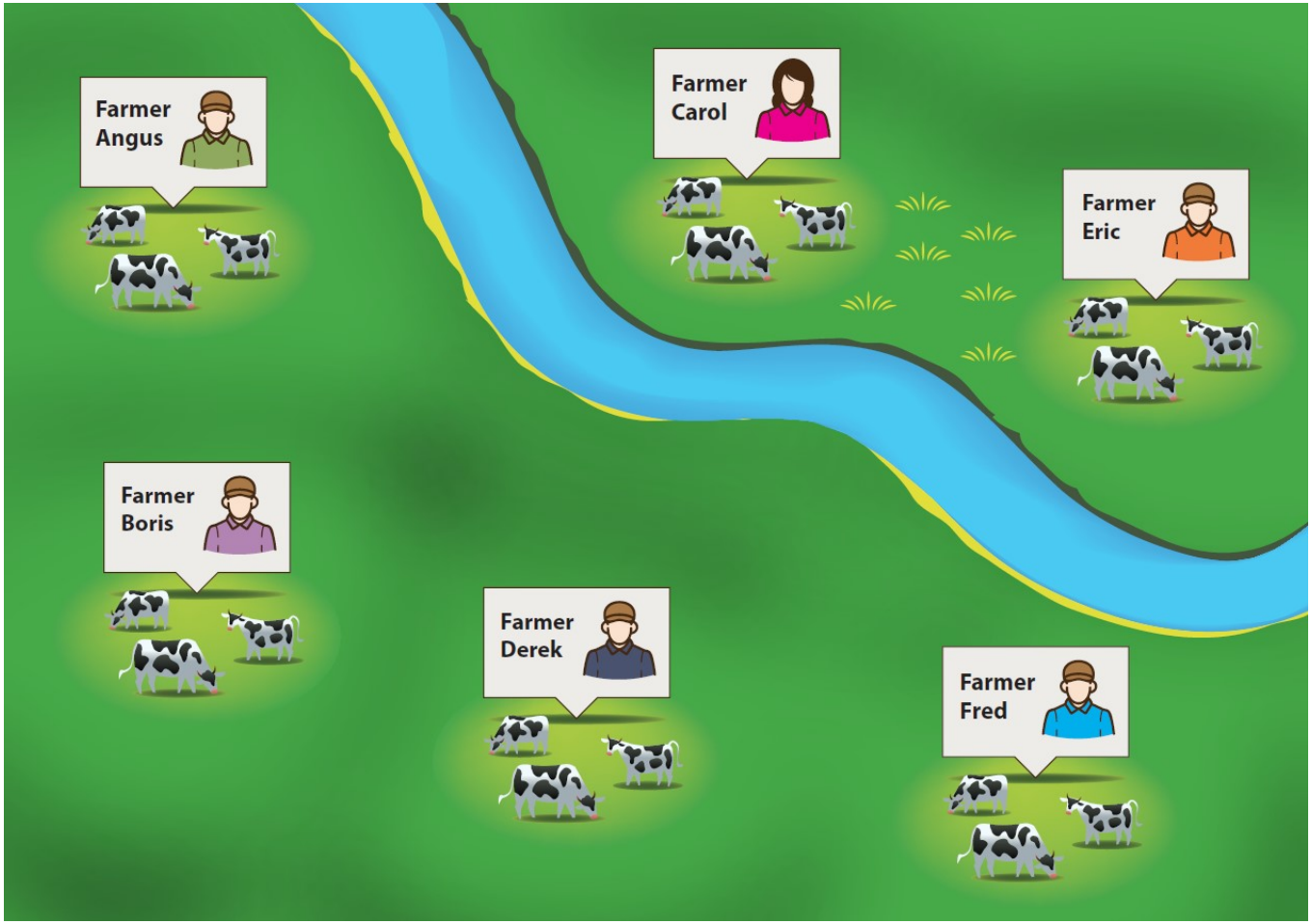
We need your help!

- What caused the illness?

- Where did it come from?
- How did it spread?

Track the Disease Spread

Farms and Farmers



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Public Health Investigators

Where did the disease come from?

COWS-4-LESS

THE HAPPY HEIFER CATTLE DEALERSHIP

Caledonian Cattle Company

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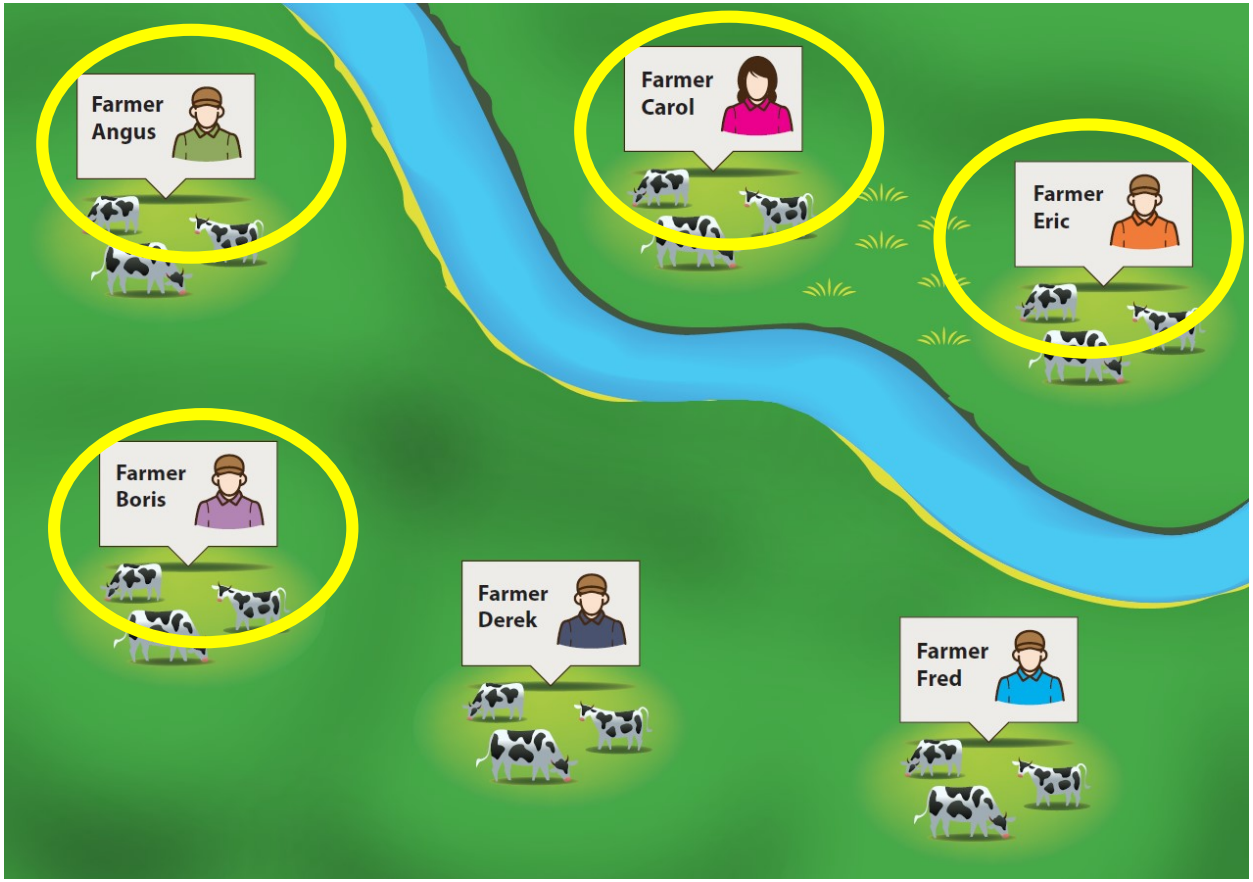
Which farmers have sick cows?



Use the farmers to help you.

I buy all my dairy cattle from Cows-4-Less, because they have the best prices, and I've never had any problems before. But now my cows are infected with a disease!

Farmer Angus

Place the action cards on the map!

COWS-4-LESS

THE HAPPY HEIFER CATTLE DEALERSHIP

Caledonian Cattle Company

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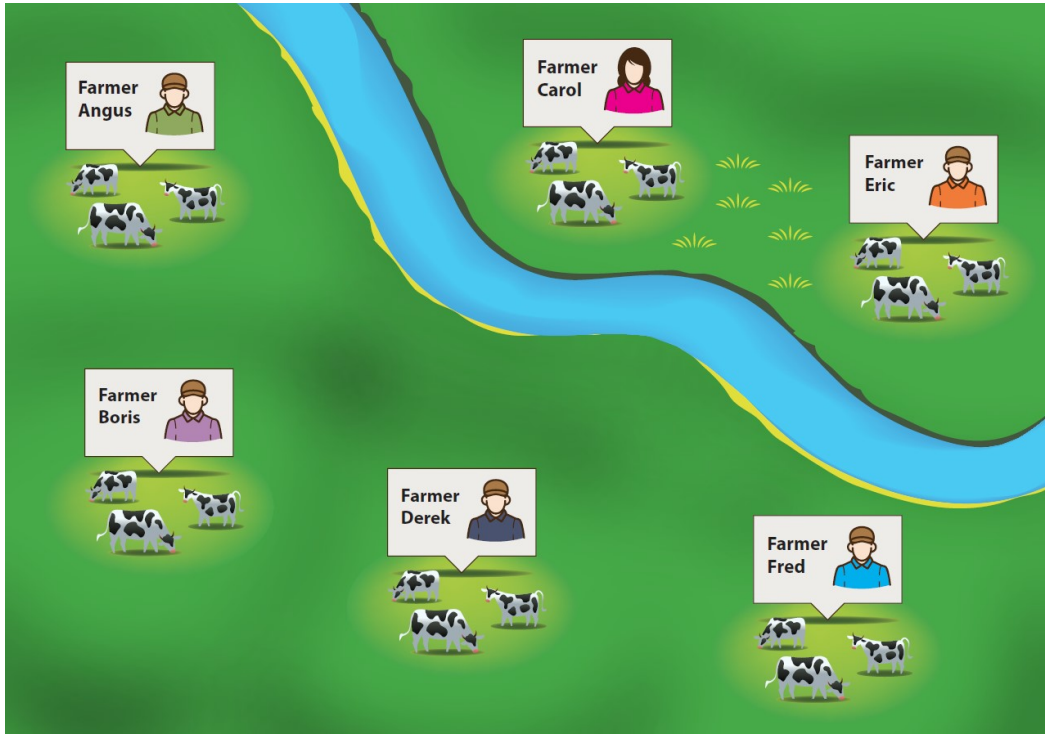
Where did the disease come from?



Use the clue cards to help you:

Heavy rainfall has caused the river to flood some of the cow's grazing fields.

Some bacteria which cause illness can be found in raw meat. Cooking meat properly kills bacteria, however, making the food safe to eat.

Where did the disease come from?

It came from Cows-4-Less.

How did it spread?

It spread to Farmer Eric's cows in the flood water.

We need your help!

- What caused the illness?
- Where did it come from?
- How did it spread?
- What type of *Salmonella* is it?

How do bacteria grow and reproduce?

It reproduces by splitting in half.

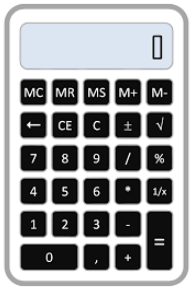
mitosis

How fast to bacteria reproduce?

It reproduces every 20 minutes.

Can you work out how many there will be?

You will need

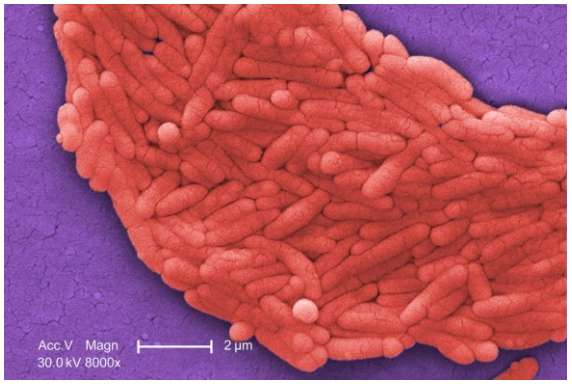


Time Passed (minutes)	Number of Bacteria
0	1
20	2
40	4
60	8
80	16
100	32

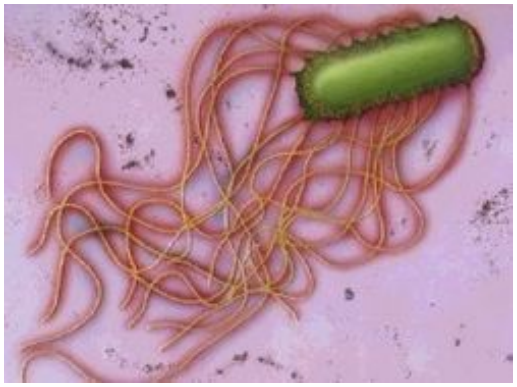
300	32, 768

Are all *salmonella* bacteria the same?

Salmonella typhi



Salmonella gallinarium



Salmonella dublin

Salmonella typhimurium

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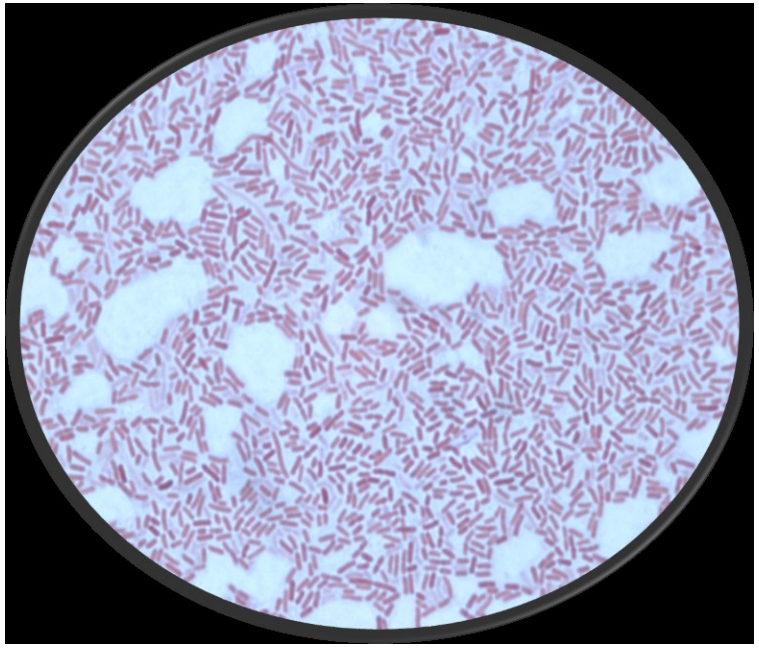
Which type of *salmonella* do our cows have?



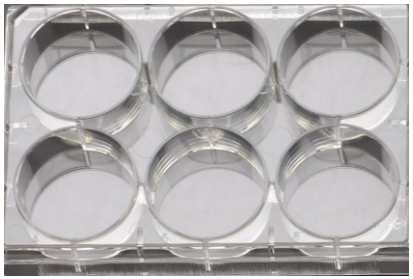
Salmonella

Safety first!

Agglutination (stick-together) test

You will need:

4 tubes of liquid



1 plate

1 tube of bacteria from a sick cow

1 pipette

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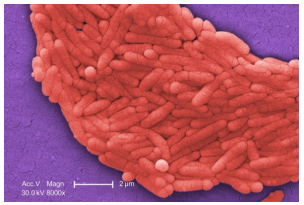
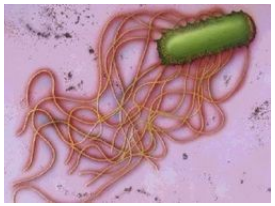
How does the test work?

Test liquids

Salmonella typhi

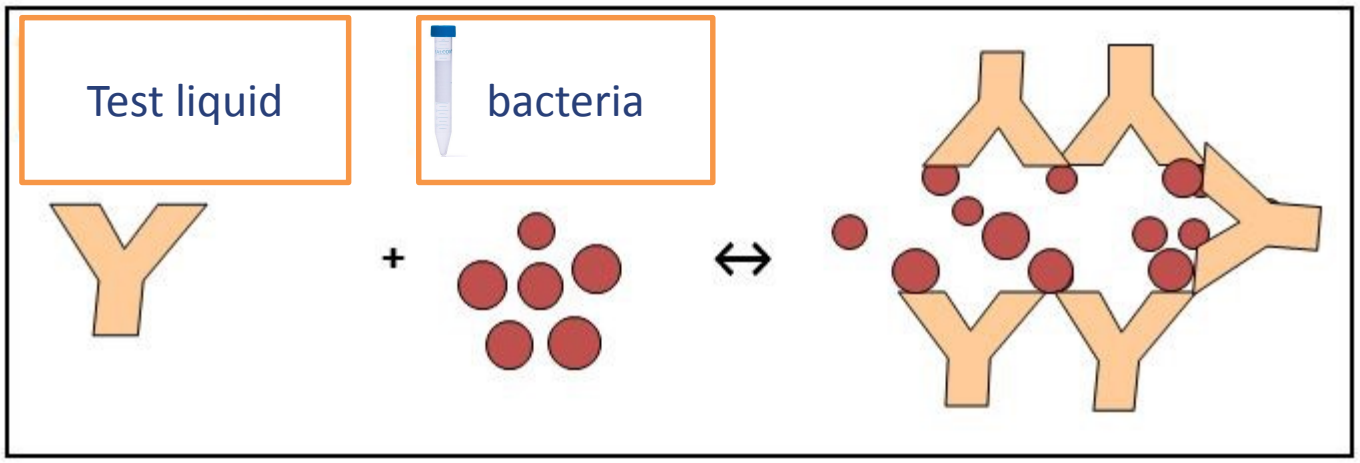


Salmonella gallinarium



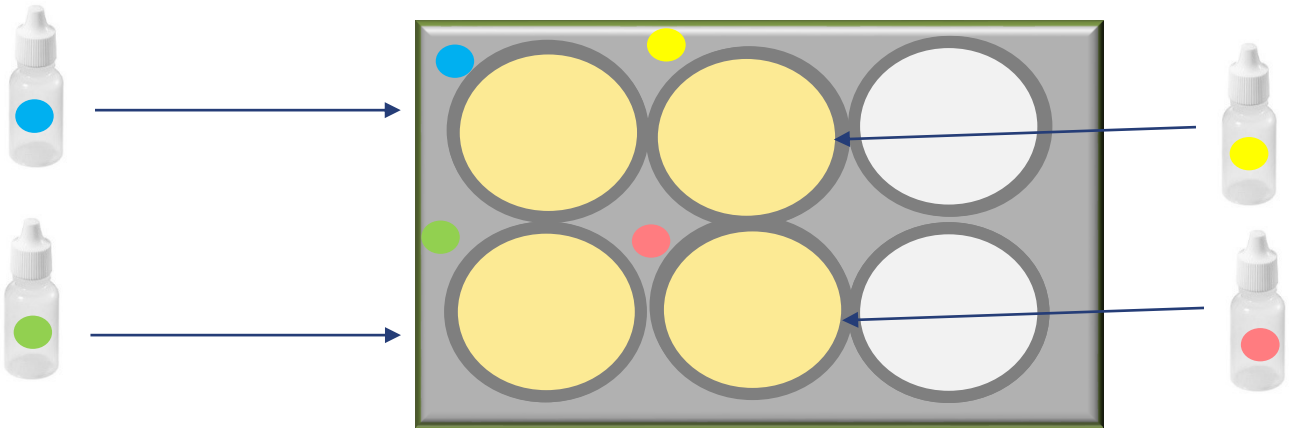
Salmonella dublin

Salmonella typhimurium



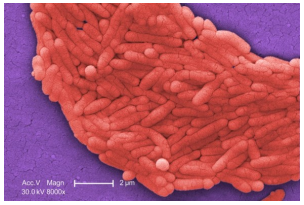
Agglutination (gloopy) test

2) Put 5 drops of each liquid into one well.

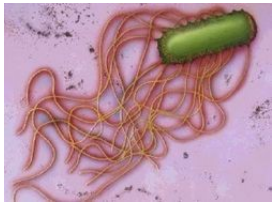


Which test liquid made the bacteria clumpy?

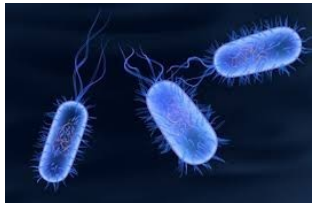
Salmonella typhi



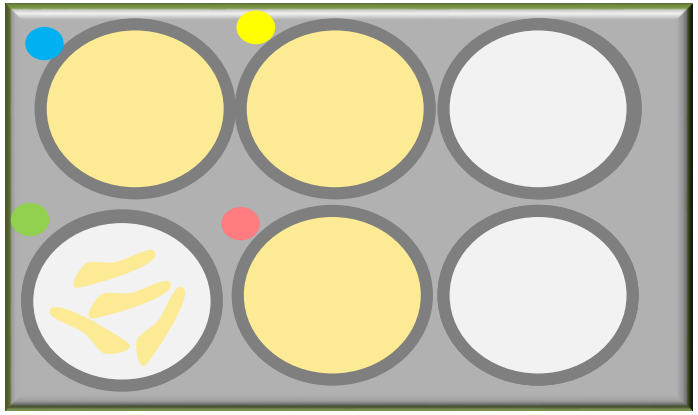
Salmonella gallinarium



Salmonella dublin



Salmonella typhimurium



Which type of *salmonella* do our cows have?

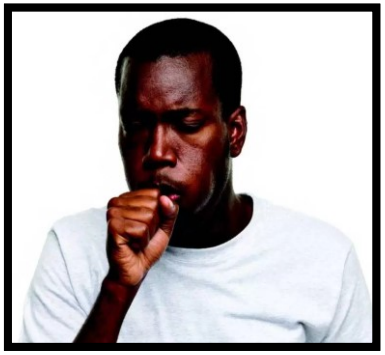
The agglutination test shows our sick cows have got..

Salmonella dublin

We need your help!

- What caused the illness?
- Where did it come from?
- How did it spread?
- What type of *Salmonella* is it?
- What can we do to stop the disease from spreading?

How do bacteria spread?





How would you stop the spread of *Salmonella dublin?*

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LUNCH

Meet the Scientists

We need your help!

- What caused the illness?
- Where did it come from?
- How did it spread?
- What type of *Salmonella* is it?
- What can we do to stop the disease from spreading?

Have you been contaminated?

Did you touch the giant bacteria?

Swab my School

AIM
What do we want to find out?

HYPOTHESIS
What do you think the result will be?

EXPERIMENTAL DESIGN
How did you do the experiment?
What do you need to do the experiment?
Is the experiment fair? What one thing are you changing?

RESULTS
What did you see?

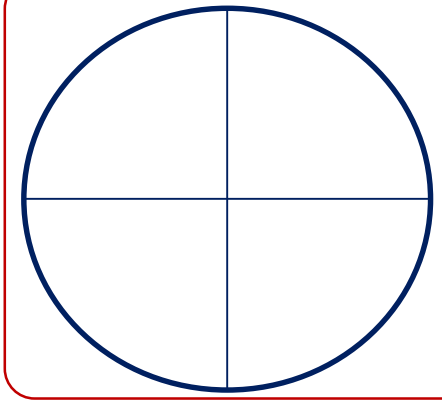

Plate section	Number of colonies
1	
2	
3	
4	

CONCLUSION
What did you find out? Was your hypothesis correct?

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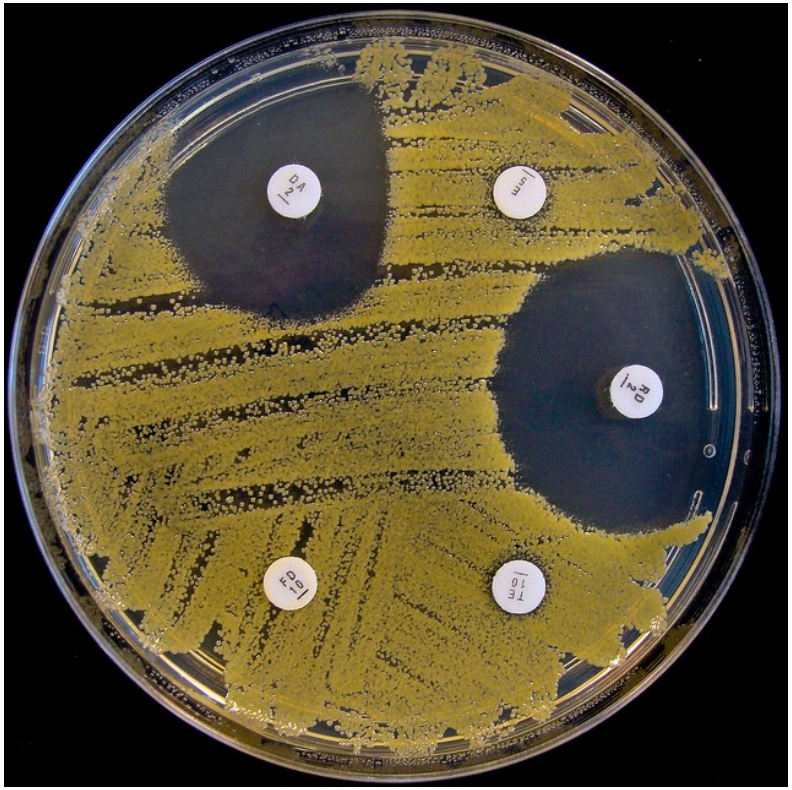
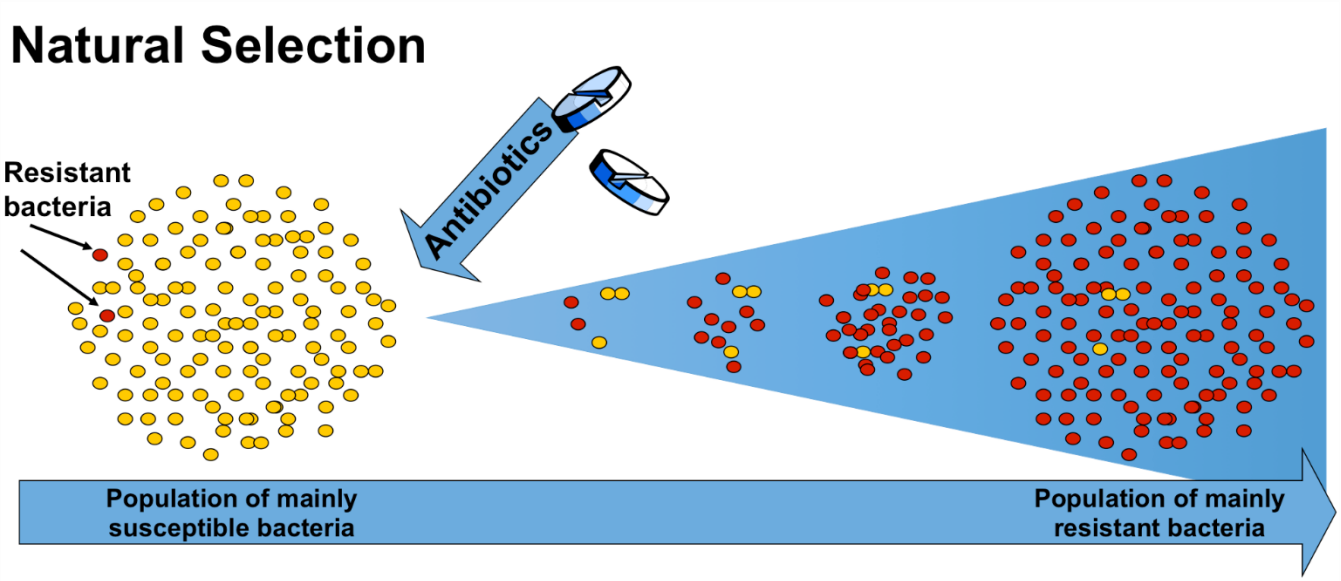
Count the colonies

How do you treat bacterial infections?

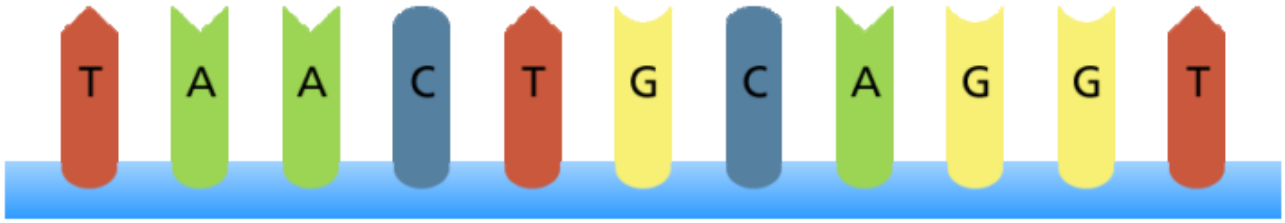


What is antibiotic resistance?

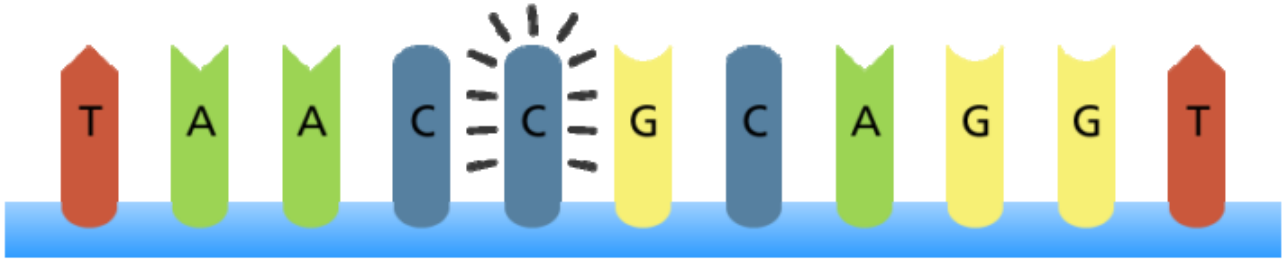


What are mutations?

Original sequence



Point mutation

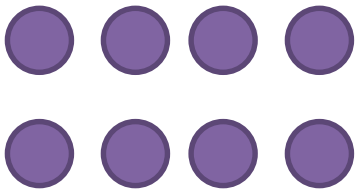


Bacteria Evolution

Neutral Mutation

Growth rate remains at 2x

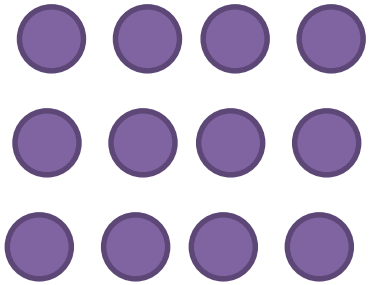
all of your bacteria reproduce each turn



Positive Mutation

Growth rate increased to 2.5x

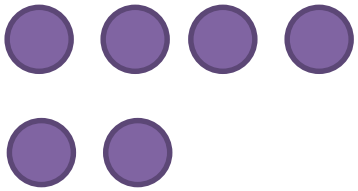
All of your bacteria triple



Negative Mutation

Growth rate reduced to 1.5x

only half of your bacteria reproduce each turn



Bacterial Evolution Game

Aim

- Be the player with the most bacteria at the end of the game.

Set up

Each group of four players will need:

- Mutation spinner
- Dice
- Counters each player should choose a colour and select 10 small counters (1 bacterium) and 10 square counters (10 bacteria) of that colour.
- Mutation cards – sort into piles and place on the table - positive, negative, neutral and antibiotic resistance
- Chance cards - shuffle and place *face down* on the table.

How to play

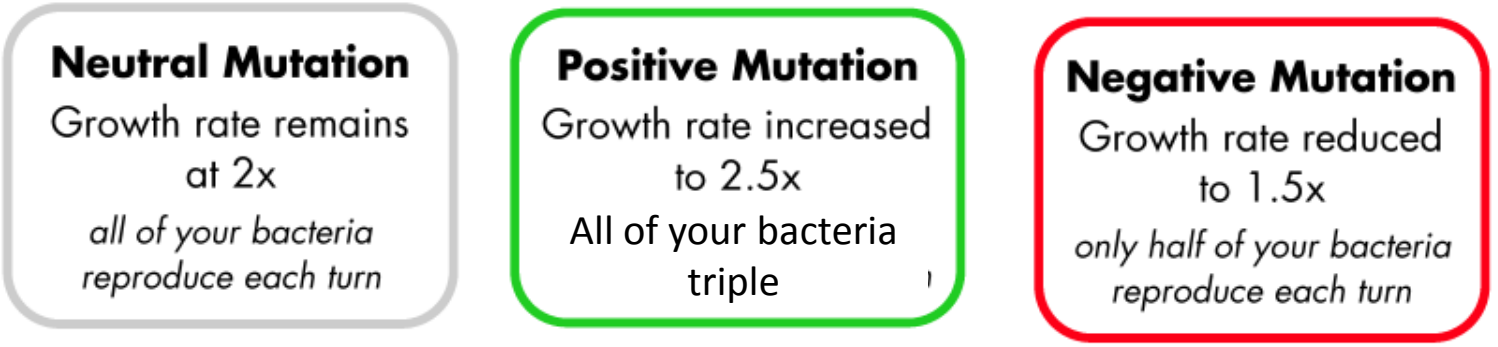
Each player starts the game with one counter (bacterium) of their chosen colour.

Each round has three phases:

1. **Mutation** Spin the spinner to decide your mutation type
2. **Reproduction** Multiply your bacteria
3. **Environmental Factors** One player rolls the dice to decide whether you draw a chance card

Phase 1- Mutation

1) Each player spins the spinner
2) Take mutation card that matches the colour– it will tell you what effect the mutation has on your future growth.

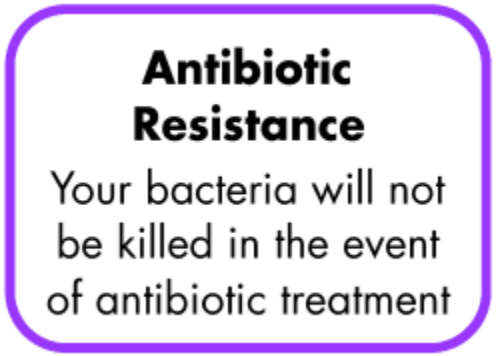


3) Once you have a mutation, you keep it and its effect on your growth rate for all following turns, unless you get another mutation

Phase 2 - Reproduction

- All players increase their bacterial populations, according to their mutation status

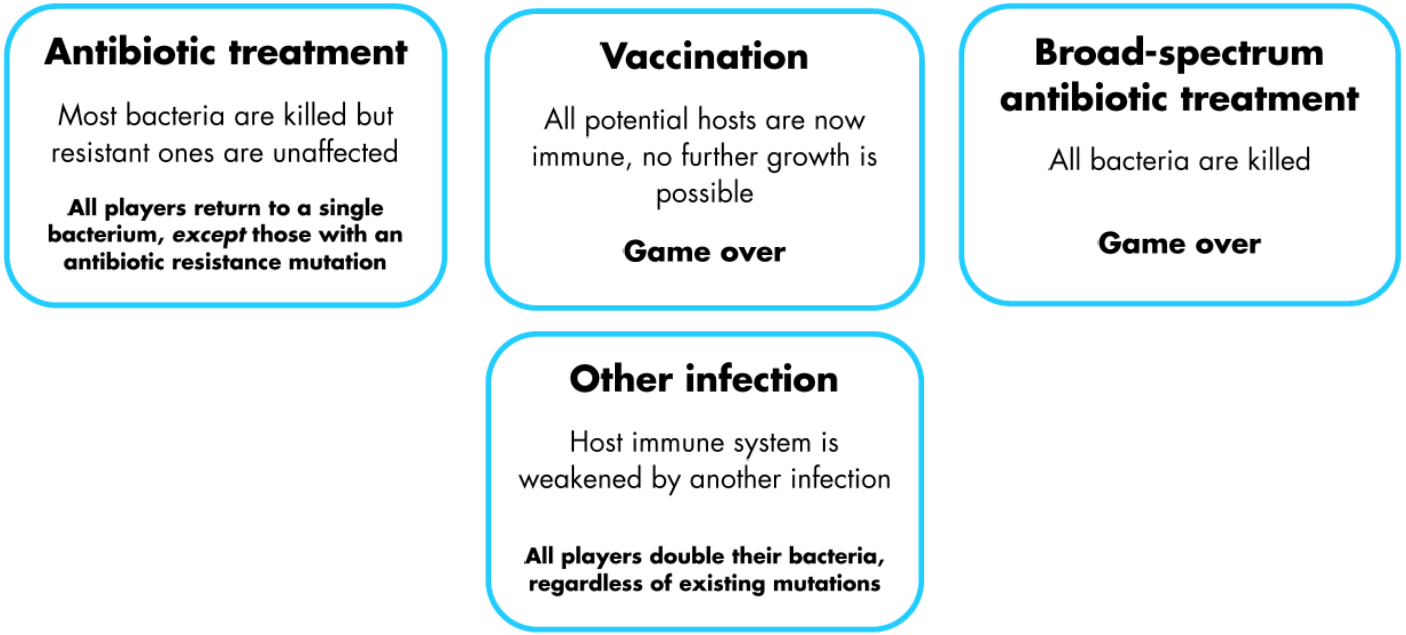
Antibiotic resistance mutation: Has no effect on growth, reproduce as for neutral mutation, 2x



As bacterial numbers increase, use large counters to represent ten bacteria.

Phase 3- Environmental phase

- One player rolls the dice – if 4, 5 or 6 is rolled, a chance card is taken from the top of the pack.



The winner is the player with the most bacteria at the end of the game.

What we do!

THE UNIVERSITY of EDINBURGH
The Royal (Dick) School of Veterinary Studies

ROSLIN

Thank You
Farm Detectives

THE UNIVERSITY of EDINBURGH
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Science Outreach Centre

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What did you think?

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