

Microbes, microbes everywhere! (By G. Lopez-Castejon)

# DAY1:Microorganisms everywhere!

What are microorganisms? They are living creatures that cannot be seen with the naked eye. They can be bacteria, viruses or fungi.

**Bacteria:** are tiny, one-celled creatures that get nutrients from their environment in order to live. In some cases that environment is a human body. Bacteria can reproduce outside of the body or within the body where they cause infections.

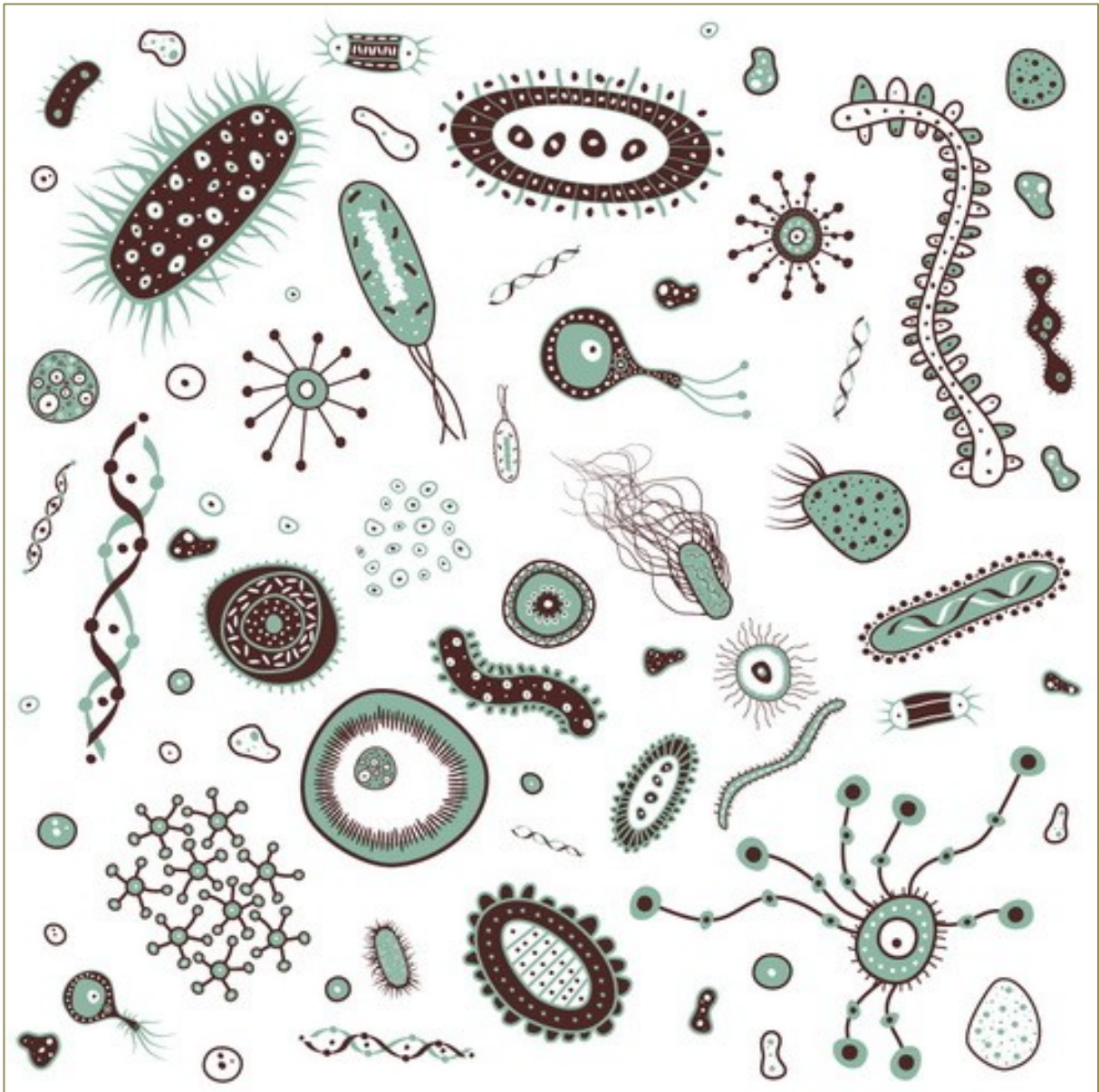
**Viruses:** need to be inside living cells to grow and reproduce. Most viruses don't survive very long if they're not inside a living thing like a plant, animal, or person. Whatever a virus lives in is called its host.

**Fungi:** are multi-celled (made of many cells), plant-like organisms. Unlike other plants, fungi cannot make their own food from soil, water and air. Instead, fungi get their nutrition from plants, people, and animals. They love to live in damp, warm places, and many fungi are not dangerous in healthy people.

Microorganisms are very useful in our lives. We use them to make bread, beer, wine or yogurt. They also degrade organic material and so are good for recycling waste.



Did you know that a single gram of soil can contain more than a billion microorganisms!



## A. **Microorganisms around us.**

Microorganisms are all around us although we cannot see them. Here there are a couple of examples of where they can be found.

- **Decaying leaves:** Inside a pile of dead leaves there are millions of bacteria that feed on the leaves breaking them down into their components. Rotten leaves then mix with the soil and are recycled through the food chain and plants. These bacteria are called "decomposing bacteria"
  - Walk around the school and look for evidence of material that are or are not decaying:

Decay	Not decay

- Collect some leaves and place them into a sample bag and write your name on it. **Observe the bag over the week.** What is happening?

Date	Observation

- **Why does food become mouldy?** The air is full of tiny mould spores. When they land in food they grow very quickly and that is why we see blue or white blotches. Mould is a type of fungus. Fungus prefers growing in dark and wet environments.

**Prepare a mould culture from bread. How?**

- ***Culture A:***
    1. Take a small piece of bread and wet it in water.
    2. Place it into a plastic pot and put the lid on.
    3. Wrap with aluminium foil and write your name on it.
  - ***Culture B:***
    4. Take another piece of bread and place it directly in the pot. **DO NOT WET.**
    5. **DO NOT WRAP IT.** Label your pot.
- Compare what happens in both of them. Is there any mould growing over the week? Are there any differences? Fill in the table on the next page.

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Date	Culture A	Culture B

## **B. Yeast races!!**

**Yeast:** is a microorganism added to dough to make bread rise. Yeast turns the sugar in the dough into alcohol and a gas called carbon dioxide. As the dough heats up the bubbles of gas get bigger and the bread rises.

*Do you know what else yeast can be used for?*

For the yeast races you will have to:

- 1) Label one of your plastic cups **A** and one **B**.
- 2) Add 1 sachet of yeast and 25 ml of water to each cup. Mix.
- 3) Add 2 spoons of flour to each of your cups. Mix well.
- 4) Add 1 spoon of sugar to plastic cup **B**. **Not to cup A!!**
- 5) Pour the contents of cup **A** into graduated cylinder **A** until it reaches about 30ml.
- 6) Pour the contents of cup **B** into graduated cylinder **B** until it reaches about 30ml.



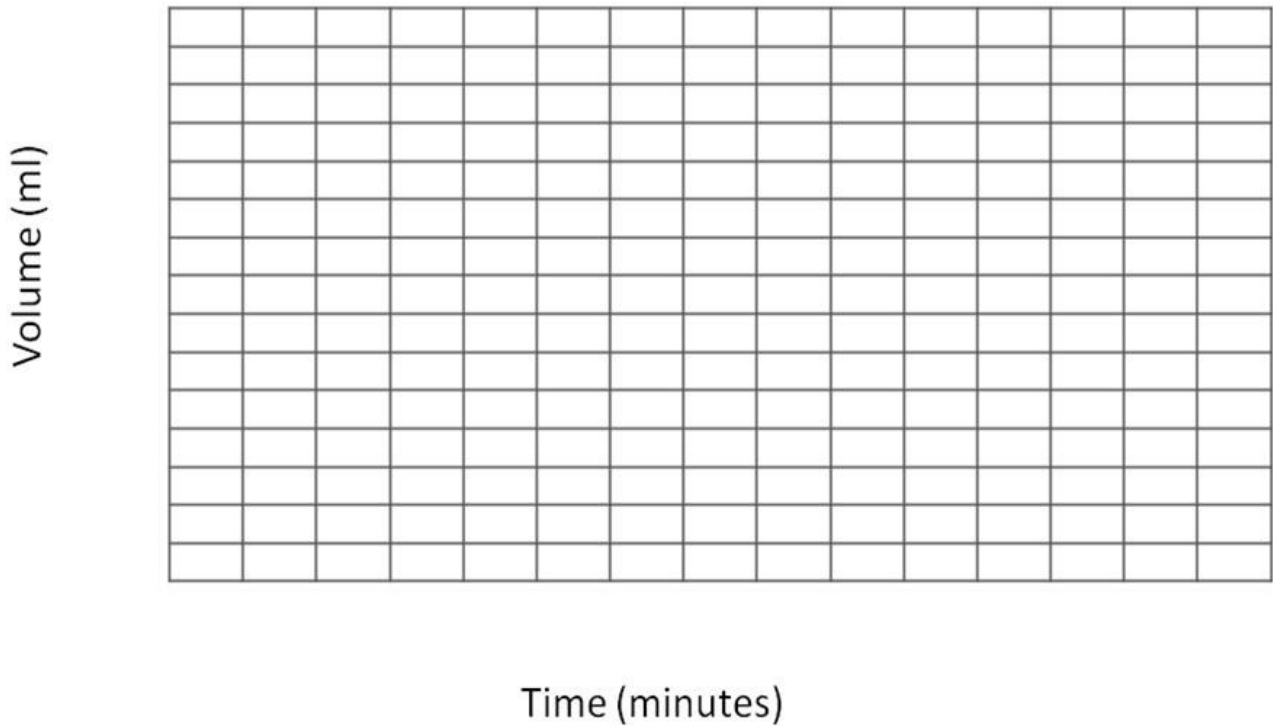
7) Record the exact height of the dough in each.

8) Place both measuring cylinders into a basin of hot water.

9) Measure the height of the dough every 5 minutes for 30 minutes and write it down in the table below.

<b>Time (minutes)</b>	<b>Measurement (ml)</b>

## Graph for yeast races



- How quick was your yeast mix?
- Why did A and B rise differently?

### ***C. Growing Lactobacillus.***

Did you know yogurt is made out of good bacteria and milk? Bacteria turn the sugar in the milk into acid. The acid makes the milk go thick and stops any harmful bacteria from growing. The name of these bacteria is *Lactobacillus acidophilus*.

To grow *Lactobacillus*, you will need:


- UHT milk
- Unpasteurised natural yoghurt or bio-yoghurt
- Dried milk powder
- Sterilised cups

- How to preapre:

**(DO NOT EAT THIS YOGURT as it might be contaminated!)**

- 1) Heat the UHT milk to 43 °C. The lactobacillus bacteria grow best at this temperature. Take care not to overheat or the bacteria will be killed.
- 2) Add two teaspoons of powdered milk (30 ml) and 1-2 teaspoons (5-10 ml) of yogurt in the milk mixture
- 3) Stir this mixture well using a spoon.
- 4) Pour the mixture into sterilised cups and cover them with a lid.
- 5) Incubate the mixture at 32-43° C for 9-15 hours.

How has the mixture changed over the time?

A large, empty rectangular box with a thin black border, intended for the student to write their answer to the question above.

## DAY2. Microorganisms: friends or foes?

Microorganisms can be very useful to us, but are they always good?

Can microorganisms make us sick? YES! Here there are some examples:



Bacteria can cause sore throats (tonsillitis or strep throat), ear infections, cavities, stomach upset or pneumonia.

Fungi causes: athlete's foot, an itchy rash between the toes.

Viruses can get inside people's bodies, and they can spread and make people sick. Viruses cause chickenpox, measles, flu, and many other diseases. Viruses can live on doorknobs, countertops and many other surfaces!!



Dr Winkle Weinberg, an infectious diseases expert, reckons that when we have a cold and cough the virus particles can travel at 320 kilometres an hour and up to 900 metres. That is faster than a passenger jet at takeoff!

## A. How do bacteria spread?

- Can you think of how bacteria spread? How can we avoid it?

Hands are one of the first "modes of transport" bacteria use to spread.

How many things have you touched today?



What other things did you touch today?



There are more microbes on one person's hand than people on the planet.

- **So, how clean do you think your hands are?**

Using a glow gel and a blacklight lamp we will reveal how clean your hands are.

How you should wash your hands:

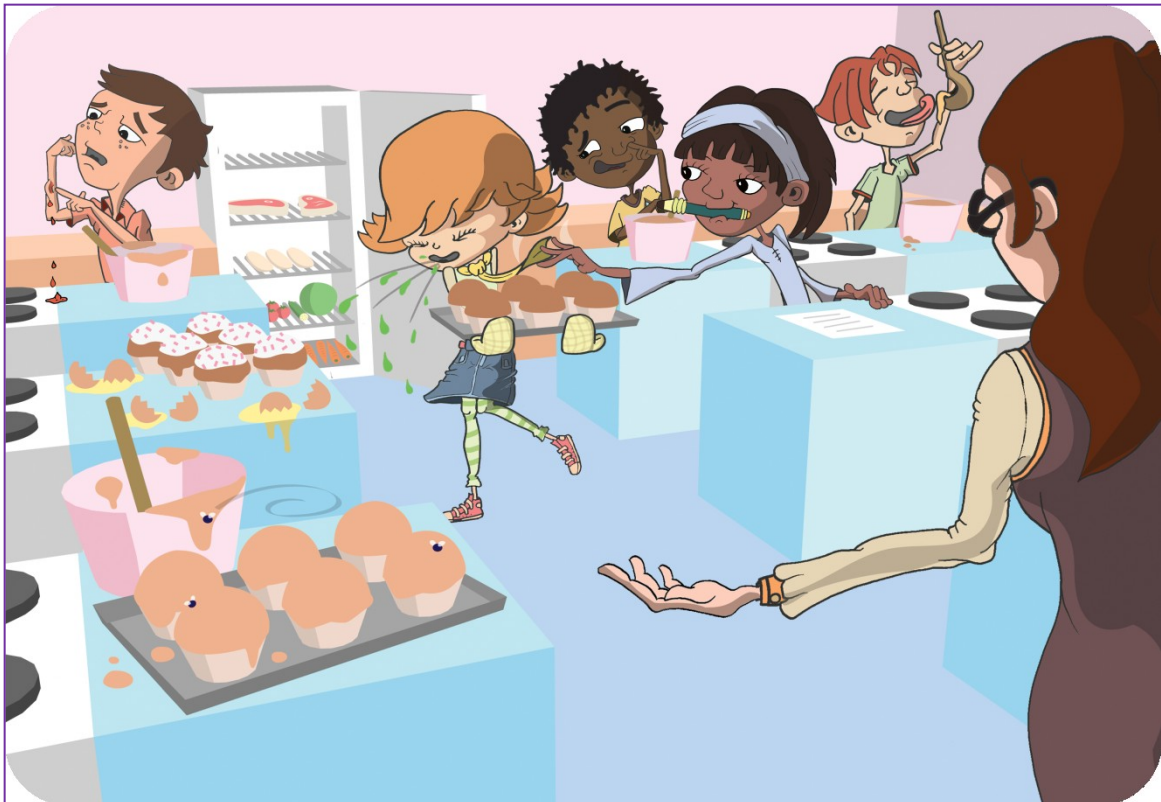
- A. Use warm water (not cold or hot) when you wash your hands.
- B. Use whatever soap you like.
- C. Work up some lather on both sides of your hands, your wrists, and between your fingers. Don't forget to wash around your nails. This is one place germs like to hide. Wash for about 10 to 15 seconds — about how long it takes to sing "Happy Birthday." (Sing it quickly two times or just once if you go nice and slow.)

- **Are there bad bacteria on food? YES!!**

Uncooked food can contain bacteria that are usually killed when the food is cooked. If it is not killed it can go into your gut, multiply there and make you ill. One type of bacteria is called *Listeria* and causes a disease called listeriosis.

- **What can we do to avoid it?**
  - Clean your hands and cooking utensils
  - Use different knives...for cooked and raw food.
  - Cook food thoroughly.
  - Don't mix cooked and uncooked food. **WHY?**

Can you circle things that the students in this cookery class should not be doing and why?





## B. Growing bacteria: How do scientists do it?

- Scientists need to grow bacteria in the laboratory to use them in their research. How do they do it?
- Bacteria grow really fast:

Bacteria, which cannot be seen individually with the naked eye, need moisture and warmth to feed and breathe. Scientists place bacterial cells in agar plates into an incubator to provide the right growth environment.

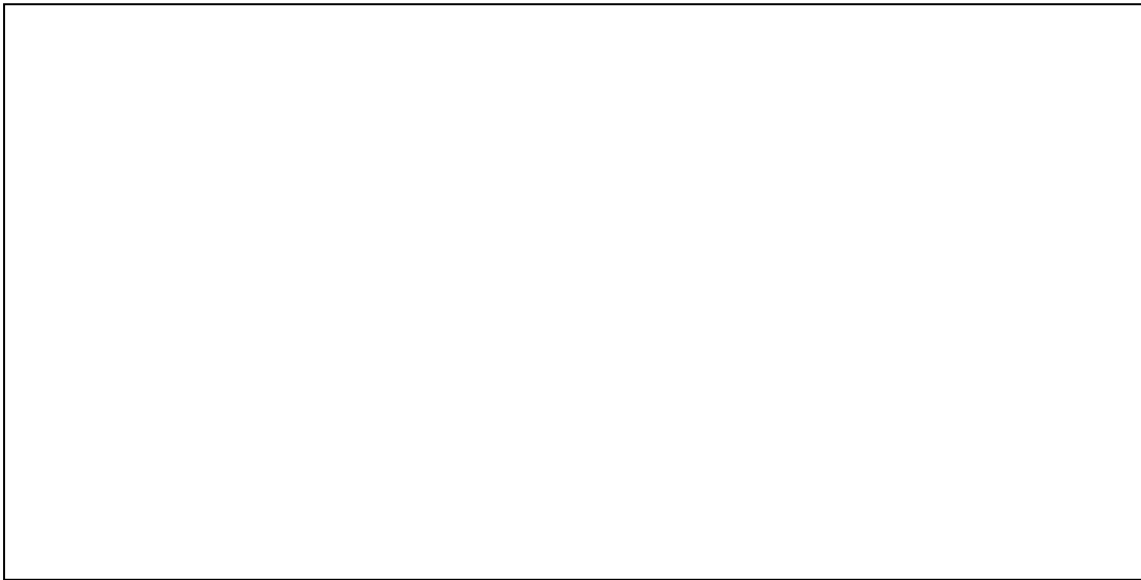
- Protocol:

- 1) **Wash your hands** very well with "antibacterial" soap.
- 2) Wash table surface with the antibacterial solution.
- 3) Put **gloves on**.
- 4) Take a **sterile cotton swab** and wet it in solution A.
- 5) Take a petri dish and open carefully.
- 6) Strike the cotton swab on the plate.
- 7) Quickly put the **lid on**.
- 8) Label your plate and take a picture.

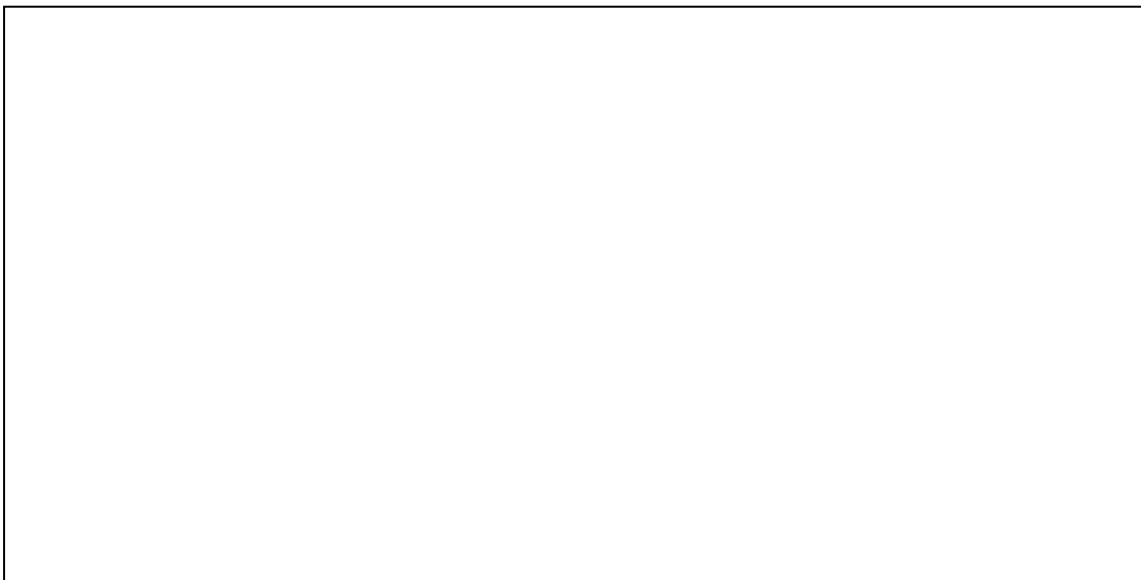
9) We will incubate them at 40°C (bacteria favourite temperature) in the lab. Grow them and take pictures to bring back later.

- Place the picture of your petri dish here. How has it changed?

Date:



Date:

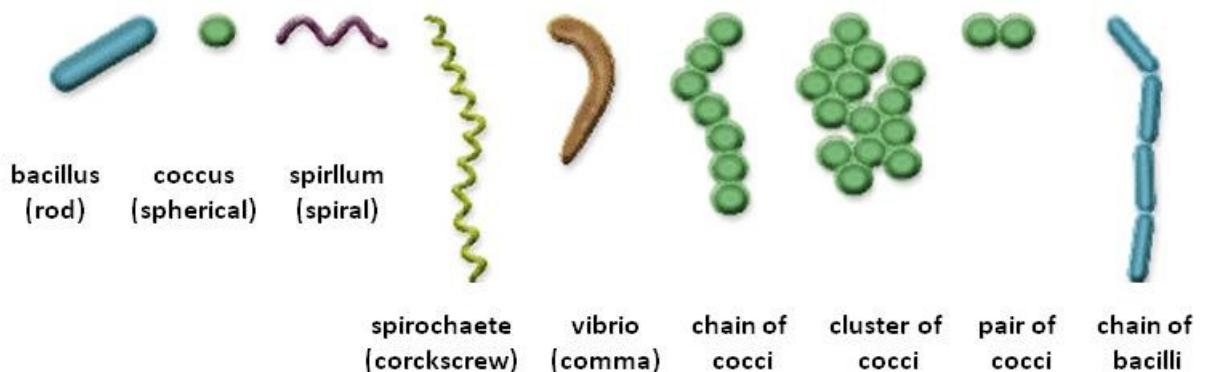


## C. Create your own microorganisms!

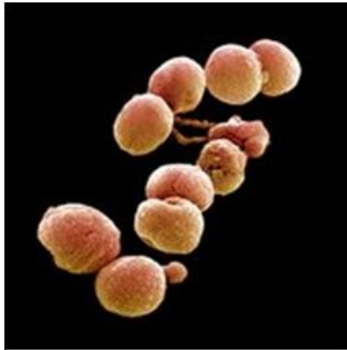
Like people all microorganisms are given a first name and a surname. Some examples are:

- a. *Listeria monocytogenes*
- b. *Staphylococcus aureus*
- c. *Salmonella typhi*
- d. *Shigella dysenteriae*
- e. *Streptococcus pneumonia*
- f. *Lactobacillus acidophilus*
- g. *Bacillus subtilis*
- h. *Saccharomyces cerevisiae*

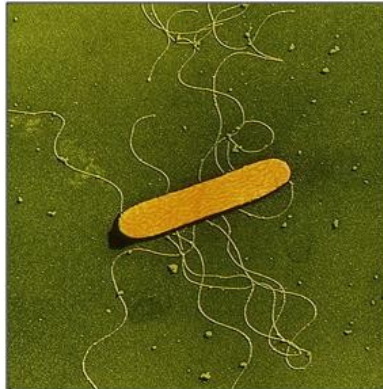
Bacteria shapes: Bacteria come in different shapes.



These are some examples of microorganisms and what they look like.



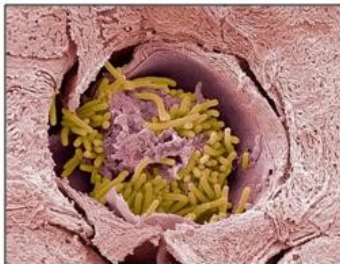
*Streptococcus pneumoniae*



*Listeria monocytogenes*



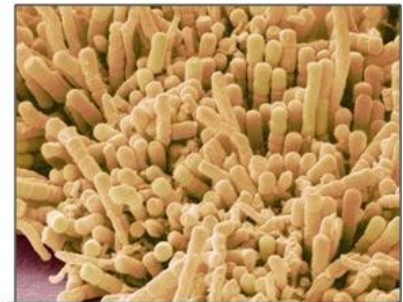
Stagnant water bacteria



Tongue bacteria



*Helicobacter pylori*



Plaque-forming bacteria



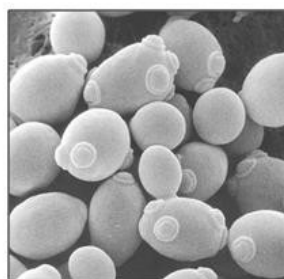
*Lactobacillus bulgaricus*



*Bacillus subtilis*



*Salmonella enterica*



Yeast



Mould

If you could choose your own microorganism, how would it look?

Would it be a good one? What would you use it for?

Would it be a bad one? What disease would it cause?

<b>Name:</b>
<b>Shape:</b>
<b>Characteristics:</b>

## Day 3. Microorganisms and the immune system.

Bad microbes are everywhere, so...why are we not sick all the time?

We have an immune system that protects us from the attack of all the bad microbes we come across.

What is the immune system? The immune system is formed by a lot of different cells that work together as an army to keep out any harmful germs and attack and destroy any that manage to get inside your body.

### Our research:

We study how the immune system works.

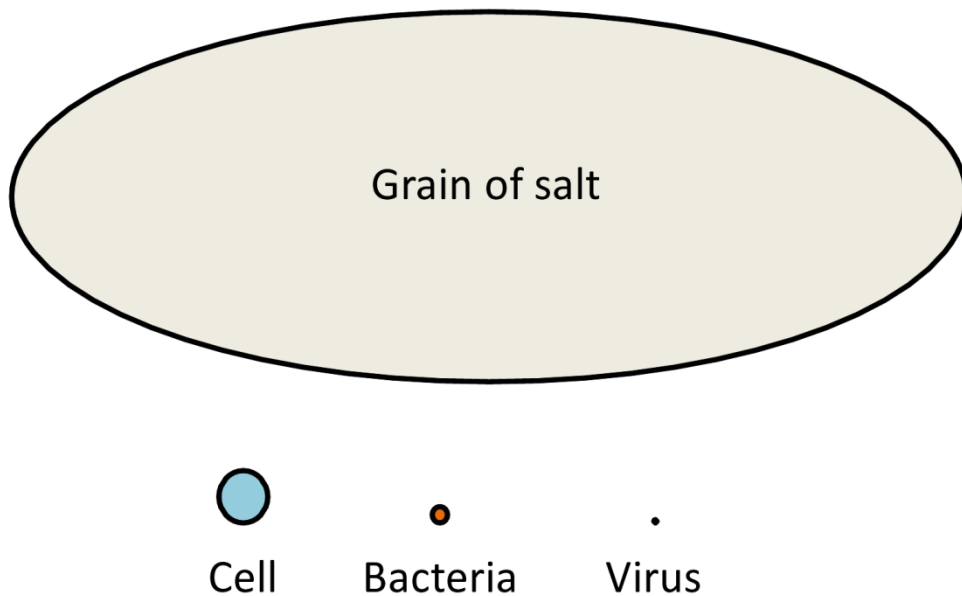
We study a type of cell from the immune system called macrophages.

Macrophages recognise bad bacteria and eat and destroy them. At the same time they "call" other cells from the immune system to let them know that there are intruders in the body and that the fight against them has started and that they need backup.

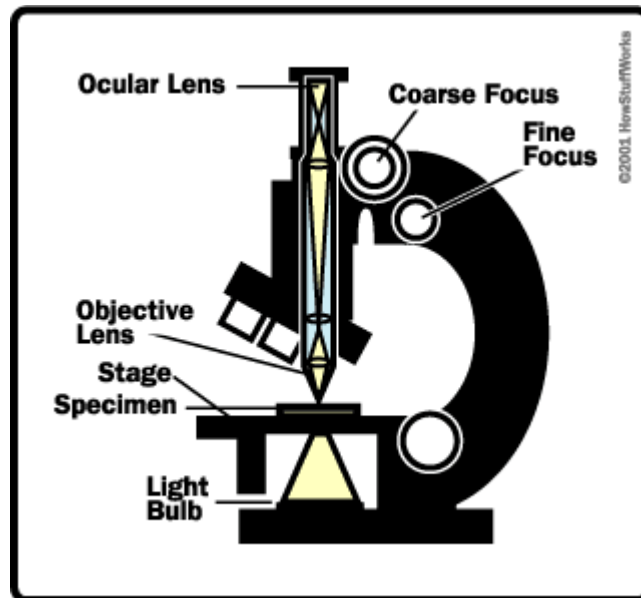
## A. Using a microscope.

The microscope is very useful for our research. Bacteria are so small that we need the microscope to see them. But we also use the microscope to see and study macrophages, as these are also very small.

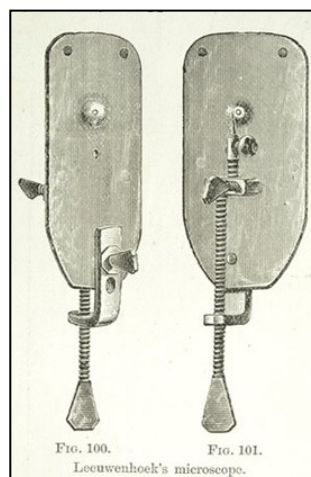
Imagine a grain of salt and how cells and microorganisms compare to its size:



So, what is a microscope? Microscopes are instruments that combine two or more magnifying lenses. They allow us to see things that are invisible to the naked eye.



Did you know the first microscope was built 300 years ago! And looked like this!





Today we are going to look at different samples under the microscope:

D. Cells (macrophages)

E. Fungi (Yeast)

F. Bacteria

When looking at samples you need to keep a record of what you see.

Date:
What sample is:
Objective/eyepiece used:
Observations:
Drawing of sample:

Date:

What sample is:

Objective/eyepiece used:

Observations:

Drawing of sample:

Date:

What sample is:

Objective/eyepiece used:

Observations:

Drawing of sample:

## **B. Friends or foes? Macrophages sense of touch.**

Not all bacteria are bad. Some bacteria are good for our bodies — they help keep things in balance.

Good bacteria live in our intestines and help us use the nutrients in the food we eat and make waste from what's left over. We couldn't make the most of a healthy meal without these important helper germs!

So, how do macrophages make sure they do not kill the wrong microorganisms?

Macrophages cannot see the microorganisms however they can get close to them and sense whether they are friends or foes. This is similar to how we distinguish different shapes and textures with touch.

If you were a macrophage, could you distinguish friends from foes? Let's try!

## **C. Cells from the immune system, do you know them?**

There many different cells in the immune system that work together to fight and control infection and disease. We study a particular type called macrophages, but there are many others.

So, let's learn about these cells and enter our card game competition.

After playing the game, do you remember the name of any cells of the immune system?

Which one was your favourite?

## References:

- [www.bbc.co.uk/schools/scienceclips](http://www.bbc.co.uk/schools/scienceclips)
- <http://www.e-bug.eu/>
- <http://www.sciencephoto.com/>
- <http://kidshealth.org/kid/talk/qa/germs.html>
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The University of Manchester



*(Immune cells card game has been kindly provided by Dr Sheena Cruickshank from the Manchester Immunology Group, University of Manchester)*

## Notes:



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