

Bacteria: Microscopic Marvels



Introduction to bacteria

General impact:

The **Good** and The **Bad**

Deep dive into one Bacillus:

The **Ugly**

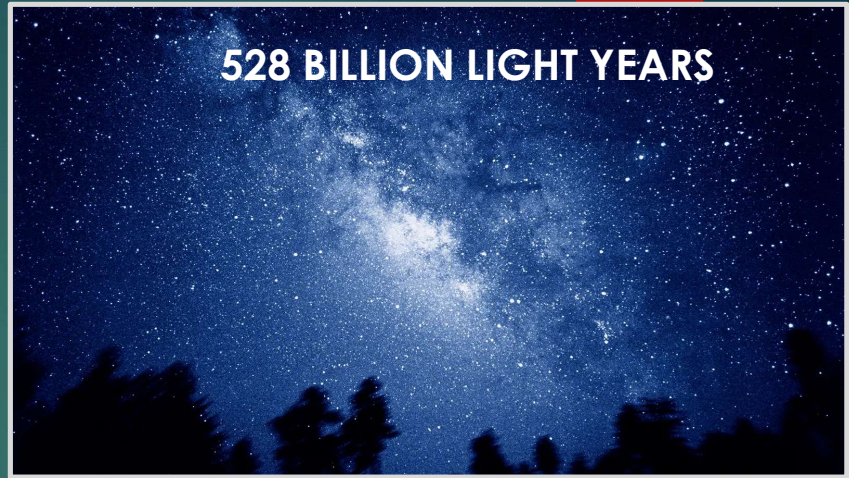
Introduction

Estimated number
5 nonillion:

5 followed by 30 zeros (UK)

5,000,000,000,000,000,000,000,000,000,000

1 million on a pin head



Introduction

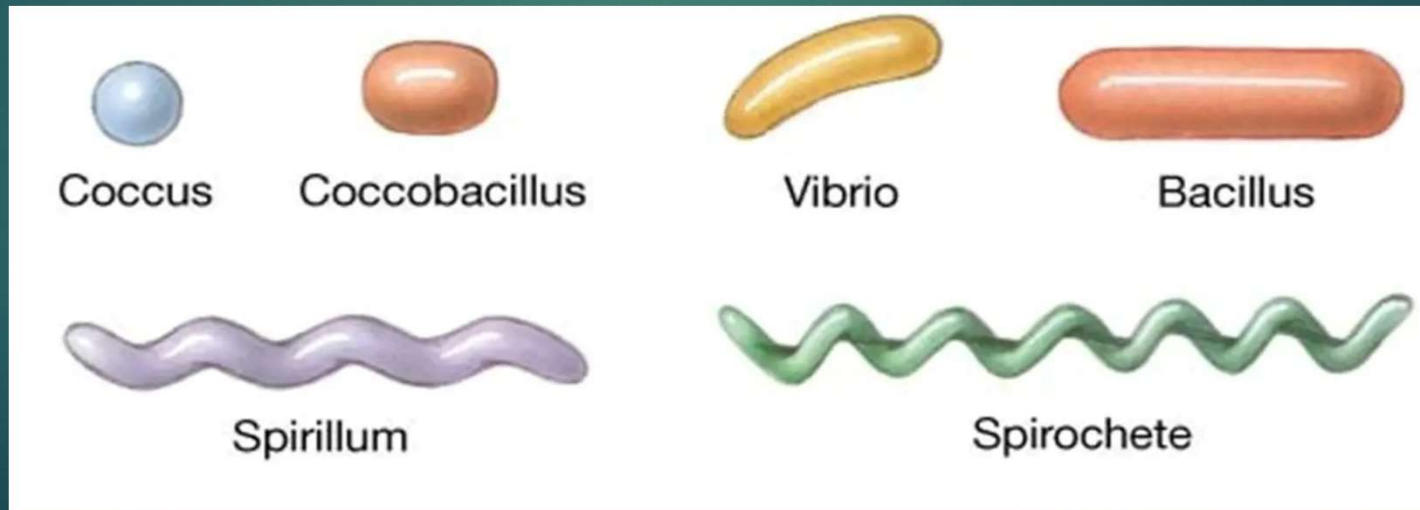
Found everywhere on earth



Introduction

Single cell organism

- **Prokaryotic:** Lack a nucleus and other membrane-bound organelles
- **Diverse shapes:** Cocci (spherical), bacilli (rod-shaped), spirilla (spiral), and more



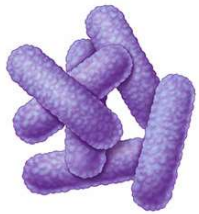
Introduction

Single cell organism

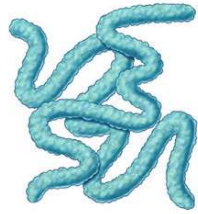
- Prokaryotic: Lack a nucleus and other membrane-bound organelles
- Diverse shapes: Cocci (spherical), bacilli (rod-shaped), spirilla (spiral), and more
- Reproduction: Asexual, often by binary fission (splitting in two), growth rates vary
- **Metabolism:** Vary greatly, with some using sunlight for energy (photosynthesis) and others breaking down organic matter (chemosynthesis)



Sphere-shaped
(cocci)



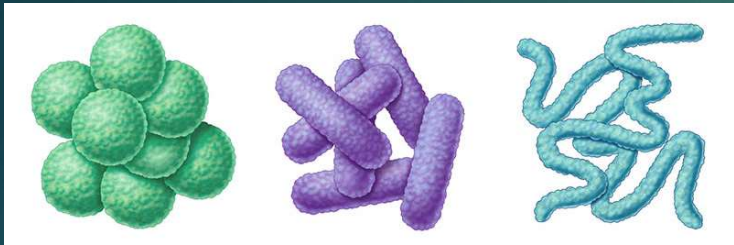
Rod-shaped
(bacilli)



Spiral-shaped
(spirochetes)

We need them!

Proscopic
Marvels



Bacteria:

THE GOOD

Saved us from the Martians



Saved Mark Watney (Matt Damon) on Mars



Examples of the GOOD bacteria do:

Oral microbiome

Stopping Bad Breath - Healthy mouth bacteria fight against germs that emit a foul odour

Fight pathogens that cause oral diseases

Examples of the GOOD bacteria do:

Gut microbiome

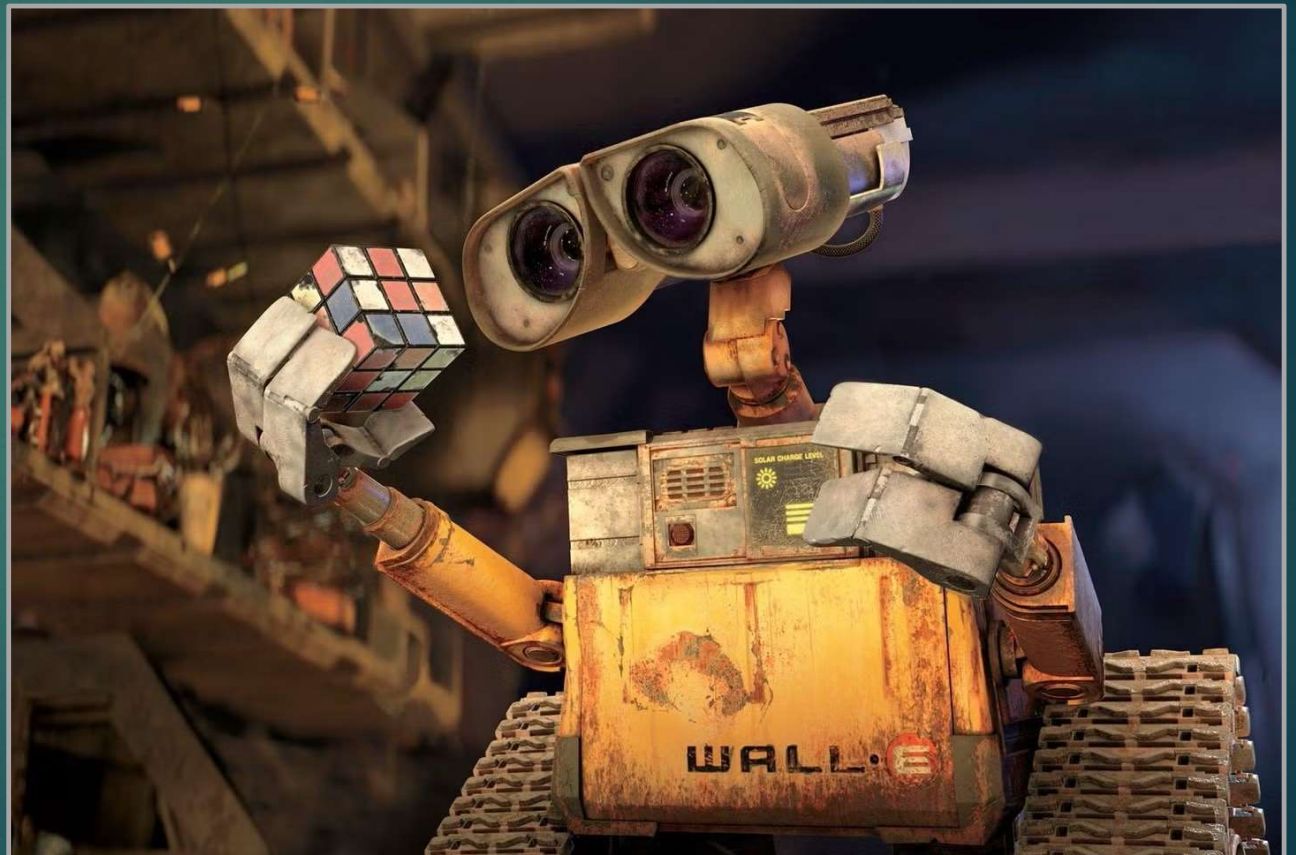
95% of the bacteria in/on us lives in the gut

Food Digestion: The stomach gets all the credit when it comes to digestion, but the actual breakdown of the proteins and sugar in our food starts in the mouth

Probiotic gut bacteria are crucial to our overall health

Examples of the GOOD bacteria do:

Eco system



Examples of the GOOD bacteria do:

Eco system

Decomposition:

Degrading organic matter



Examples of the GOOD bacteria do:

Eco system

Decomposition:

Degrading organic matter

**Re-Cycling nutrients (releasing chemicals –
Carbon, Nitrogen and Phosphorus et al)**

Examples of the GOOD bacteria do:

Eco system

Decomposition:

- Degrading organic matter

- Re-Cycling nutrients

- Keeping the environment clean – converting toxic elements into less toxic compounds**

Examples of the GOOD bacteria do:

Food production

Nitrogen fixation: Converting atmospheric nitrogen into a usable form for plants and other organisms – especially legume crops rely on specific bacteria

Examples of the GOOD bacteria do:

Food production

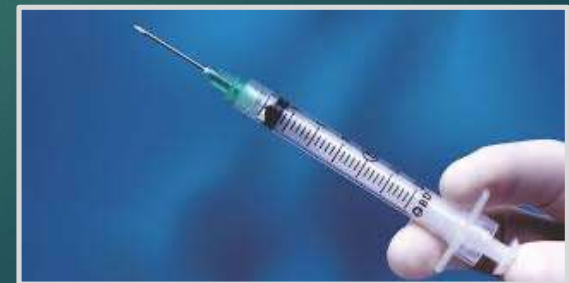
Fermentation processes (e.g., yogurt, cheese and some beers and wines)

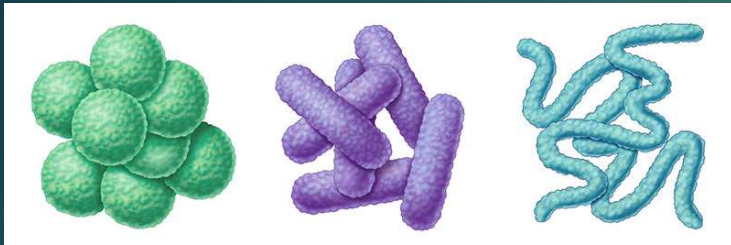


Examples of the GOOD bacteria do:

Vaccines

Weakened or inactive bacteria can train the immune system to recognize and fight off future infections, preventing diseases like tetanus and diphtheria





Bacteria:

THE BAD

Impacts of **BAD** bacteria:

Some bacteria:

- Produce toxins

- Negatively impact immune system

- Create imbalances

 - = chronic conditions and cancer

Impacts of **BAD** bacteria:

Pathogens

Tuberculous

Cholera

Botulism poisoning (paralysis)

Pneumonia, meningitis

Impacts of **BAD** bacteria:

Often food borne:

Poor handling / storage

Salmonella – E.Coli

Vomiting, diarrhoea, muscle cramps



Impacts of **BAD** bacteria: E.Coli STEC O145

Supermarket
sandwiches linked
to E. coli outbreak



Produces a Shiga Toxin

Wrap sold in WH Smith recalled over
E. coli fears



The product being recalled is only sold in WH Smith

James Gregory & Emily McGarvey
BBC News

Impacts of **BAD** bacteria:

Effect Auto-immune diseases

Trick immune system to attack healthy cells

Giant cell Myocarditis

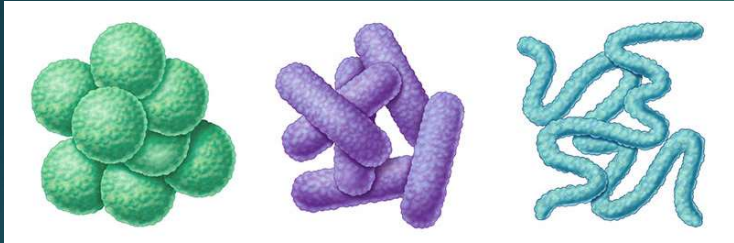
Vasculitis

Rheumatoid arthritis

Lupus

Multiple sclerosis

Bacteria:



THE
RESISTENT

The challenge of **RESISTENCE** to ANTIBIOTICS:

Genetic mutation

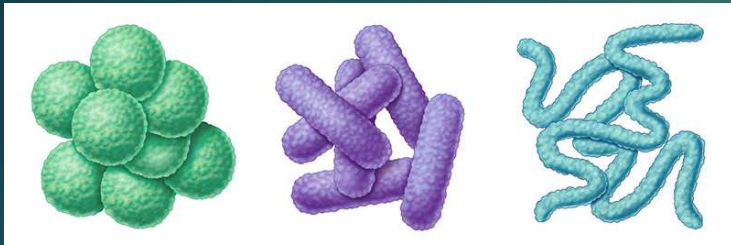
As bacteria reproduce mutations can occur

Gene transfer

Bacteria can also acquire resistance genes from other bacteria, even from different species

Selective Pressure

Antibiotics kill some bacteria, but some with innate or acquired resistance, survive, and they multiply

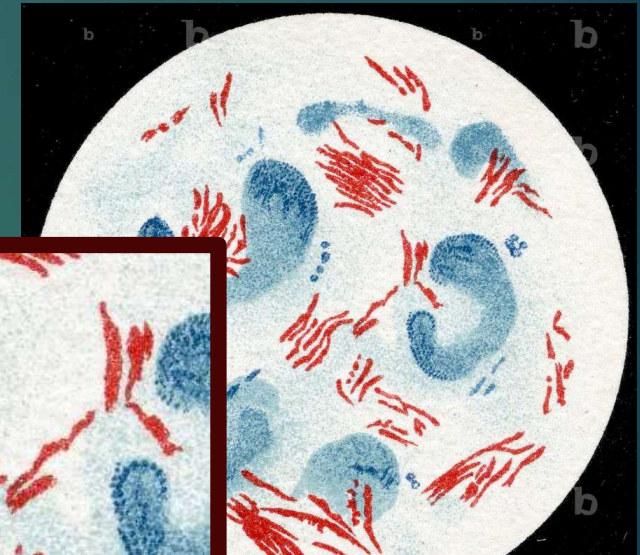
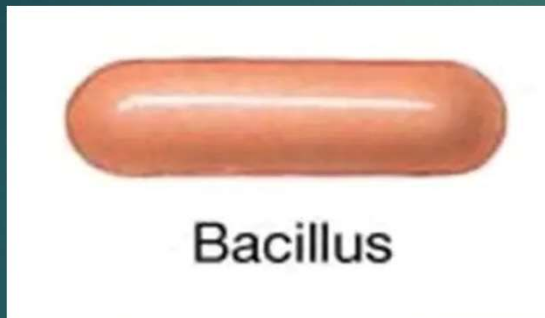


Bacteria:

THE UGLY

The impact of this tiny bacteria

Mycobacterium Leprae



- 
- ▶ A video about Leprosy can be found using the following link to YouTube.
 - ▶ https://www.youtube.com/watch?v=Tc8I_bv1-1Y&t=2s

Mycobacterium Leprae

Multiplies slowly in the body (thrives at 34C)

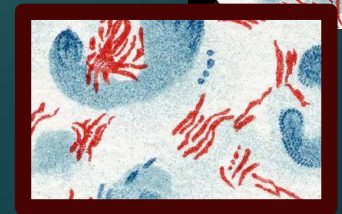
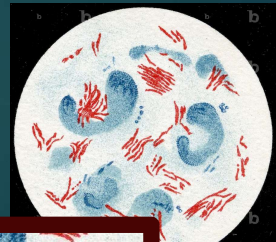
Manifests as hypoesthesia skin patch



Mycobacterium Leprae



Attacks the nervous system at the extremities (hands and feet) causing loss of sensation



Mycobacterium Leprae

Multiplies slowly in the body (thrives at 34C)

Manifests hypoesthesia skin patch

Attacks the nervous system at the extremities (hands and feet)

Transmission is unproven !



Mycobacterium Leprae

Transmission is unproven

Air borne as with tuberculosis ?
Wet and warm soil ?
Animal to human ?



Mycobacterium Leprae

Transmission is unproven

Why don't we know?

Bacteria slow cell multiplication

Unknown contagion place & time

Unable to grow bacteria in a laboratory



Mycobacterium Leprae

Cured by combining three antibiotics MDT

Dapsone

Clofazimine (most active)

Rifampicin



Mycobacterium Leprae Elimination

WHO declaration :

< 1 per 10,000 = Elimination

The future for *Mycobacterium Leprae*

Understanding transmission

Chemoprophylaxis

Single dose Rifampicin to family members and close contacts

TB response: resistance concerns

Vaccine?



Sources:

National Institutes of Health (NIH): <https://www.nih.gov/>

National Human Genome Research Institute (NHGRI):
<https://www.genome.gov/genetics-glossary/Bacteria>

Microbiology Society:
<https://microbiologysociety.org/>

American Society for Microbiology (ASM): <https://asm.org/>

Centers for Disease Control and Prevention (CDC): <https://www.cdc.gov/>

World Health Organization (WHO)

The Leprosy Mission: www.leprosymission.org.uk