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{{ مكتبة A to Z }}

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Prokaryotic Cells- The Simplest Kind of Life

The first cells that existed billions of years ago were much simpler than the cells that are present in all the plants and animals that are alive today.

These very first living things, the first earthlings in effect, were made of just one cell, and we can categorize these cells as being prokaryotic.

Let's go through the features of a prokaryotic cell now:

The membrane

First, any cell must have some kind of plasma membrane that separates what's inside the cell from what's outside of the cell.

This is the barrier between the organism and its environment, made of a phospholipid bilayer and the many different proteins floating around within it.

The membrane lets some things through and prevents others, so that the organism can take in food and energy and expel waste.

The cell wall

Beyond this membrane, most prokaryotes also have a rigid structure called the cell wall, made of peptidoglycan, a polymer of sugars and amino acids that creates a mesh-like layer around the cell.

The cytoplasm

The interior of the cell is generally called the cytoplasm, but the actual fluid present within the membrane is more specifically called the cytosol.

This is a jelly-like substance where all the cellular components float around.

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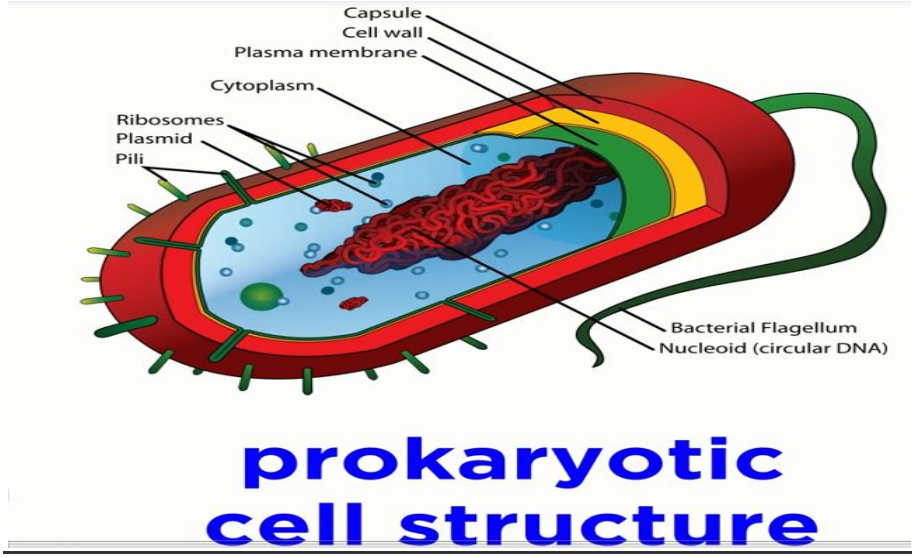

Nucleoid

These components include a nucleoid, which is the region where the genetic information for a prokaryotic cell can be found.

This genetic information is a chromosome or set of chromosomes, which are huge DNA molecules.

DNA, it's a nucleic acid made of millions of atoms, and certain portions of this molecule are called genes.

These are the parts that code for proteins.

During transcription and translation, molecules read these genes and deliver the instructions to ribosomes, complex macromolecules made of RNA and proteins, which also sit in the cell.

These ribosomes take the instructions and build all the different proteins that the cell needs to survive.

Enzymes

These include enzymes that copy DNA, as well as ones that float around in the cytosol and perform metabolic functions, producing the energy needed for the cell to be able to move around and reproduce.

Since these enzymatic functions require that certain substances be transferred into and out of the cell, and only a certain amount of these materials can pass through the plasma membrane at any given time, this gives us a clue as to why cells are the size that they are.

To best supply the cell with the necessary tools for survival, it ought to have a high surface area to volume ratio, to maximize exchange with the surroundings while minimizing the volume inside that has to be serviced.

This ratio shrinks as cells get bigger, depending on the type of cell we are looking at.

When we later examine larger organisms, these will not contain bigger cells, but simply more cells, since the rules that govern ideal cell size apply to all life on earth.

Speaking of larger organisms, the cells of a human are not prokaryotic.

Any prokaryotic cell will be a unicellular organism, meaning it is made of just one cell, like bacteria and archaea, and although these are so tiny, they are incredibly numerous.

They are literally everywhere, including inside your body.

But we humans are multicellular, meaning one human is made of many cells, trillions in fact, and any multicellular organism is made of eukaryotic cells.

Unicellular Life – Bacteria

Bacteria are everywhere.

They’re in the air, they’re in the water, and they’re inside you.

If you grab a handful of dirt, there are more bacteria in there than all the humans that have ever lived.

And we didn’t even know they existed until the 19th century.

But once microscopy came about, the world of prokaryotes revealed itself.

As we examined these critters, we saw that they were much smaller and simpler than animal cells.

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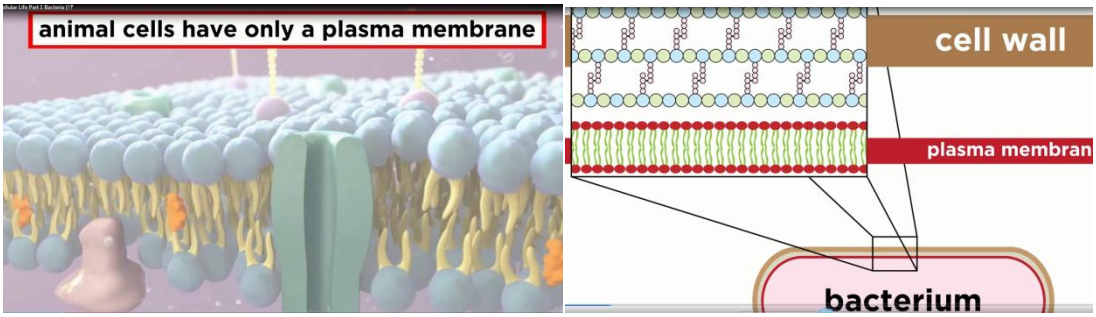
In terms of structure, animal cells have only a plasma membrane, while bacteria have a plasma membrane and a cell wall, which is typically made of peptidoglycan.



This is a polymer of sugars cross-linked by short polypeptides, and this material encloses and protects the bacterium.

Bacterial cell walls have some differences that can be differentiated with a technique called Gram staining.

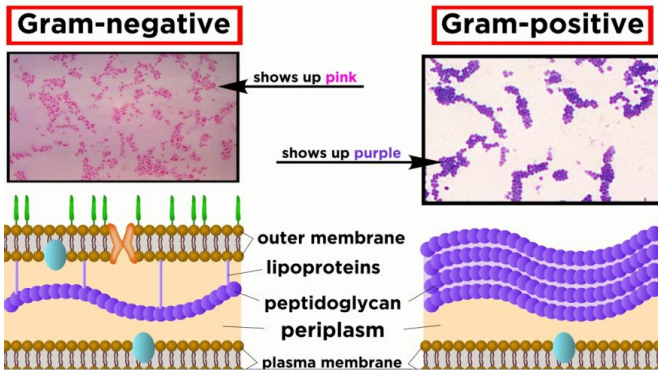
This is where a bacterial sample is stained with various dyes and then rinsed with alcohol, and the color that remains tells us about the structure of the cell wall.

Gram-positive and Gram-negative bacteria

Gram-positive bacteria have cell walls with lots of peptidoglycan, so they retain more of the violet stain and are thus easy to identify under a microscope.

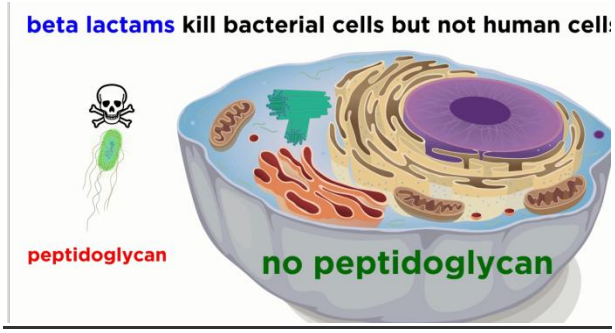
Gram-negative bacteria have cell walls with less peptidoglycan, and they have another outer membrane full of lipopolysaccharides.

These do not retain the stain very well, so they show up with more of a pink color.



These structures maintain cell shape and determine what comes in or out of the cell, and it is the cell wall that is the target of certain antibiotics, called beta-lactams, in killing certain pathogens.

These substances inhibit peptidoglycan cross-linking, which destroys the bacterial cell wall, so beta-lactams kill bacterial cells without harming human cells, since these don't have peptidoglycan.



Other types of antibiotics target other structures, by inhibiting translation or metabolism in bacterial cells.

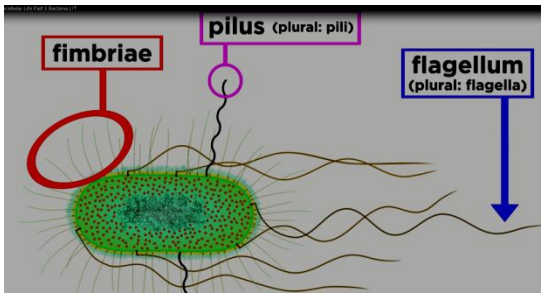
Shapes Of Bacteria

1- Many bacteria have protruding appendages such as fimbriae, which are like large sticky hairs that help that help them fasten to some substrate, as well as pili, which are larger appendages that facilitate the transfer of DNA from one bacterium to another.

2- Some bacteria have flagella, which are like tails that spin around to help the cell move.

When bacteria move, this is called taxis, and when this movement is in response to a chemical signal, it is called chemotaxis.

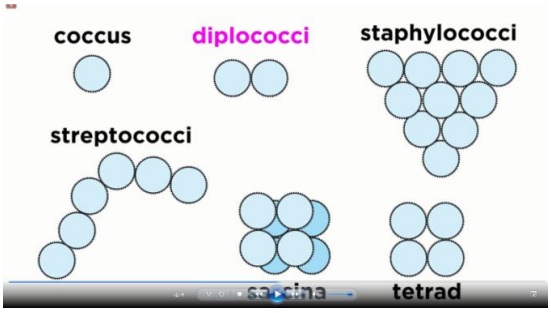
Chemotaxis can be positive, towards some kind of nutrient, or it can be negative, away from something toxic or dangerous.



3- Bacteria come in all kinds of shapes, but the most common are spherical ones called cocci.

One of these is a coccus, two stuck together are diplococci, a chain of them makes streptococci, and a bunch will be called staphylococci.

4- Rod-shaped bacteria are called bacilli, and these can exist as a lone bacillus, or a chain of streptobacilli.

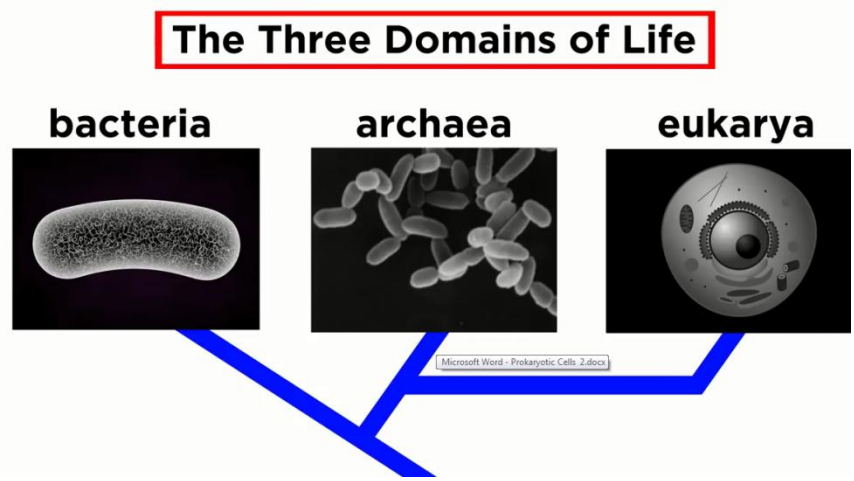


5- Then there are the spiral-shaped bacteria, like spirilla or spirochetes.

Regardless of the shape, they all house a certain amount of DNA in the nucleoid, an amount that is typically much less than a eukaryotic cell.

Unicellular Life- Archaea

Many of unicellular prokaryotic organisms are actually a little closer to eukaryotic cells than bacteria are, and we call these archaea.



While there are some similarities between the two, archaea have unique characteristics, in that they tend to be extremophiles.

This means that they thrive in extreme environments with temperatures, or pressures, or pH levels that are totally inhospitable to other forms of life.

For example:

1- Extreme halophiles live in very salty bodies of water.

2- Extreme thermophiles live in hot environments, like hot springs, or near volcanic ocean vents.

3- Other archaea live in sheets of ice, swamps, and even inside other organisms.

The variety of tolerances exhibited by archaea typically stem from unique features in their cell walls, which lack the peptidoglycan found in bacteria.

They instead have other components, some of which can even be inorganic.

Some of them have specific lipids in their membranes that make it a monolayer instead of a bilayer, which gives it greater thermal stability.

Wishing you the best of luck
Dr. Maissoun Ziadeh

Animal Biology
3rd Year
Biology Major

Lecture 2

Prokaryotic Cells-

The Simplest Kind of Life

Prokaryotic	بدائيات النواة	Substances	المواد
Grasp	فهم	Supply	تزويد
Primitive Cells	الخلايا البدائية	Tools	الأدوات
Existed	موجودة	Survival	البقاء على قيد الحياة
Present	موجودة	Ratio	نسبة
Barrier	حاجز	To Maximize	لزيادة
membrane	غشاء	Exchange	التبادل
Environment	بيئة	Shrinks	تتقلص
Floating Around	تطفو	Anchor Point	نقطة تثبيت
Lets	يسمح	Depending	اعتمادًا
Prevents	يمنع	Examine	نفحص
Expel	يطرد	Rules	القواعد
Rigid Structure	بنية صلبة	Govern	تحكم
Creates	يصنع	Apply	تنطبق
Mesh-like Layer	طبقة تشبه الشبكة	Unicellular	أحادي الخلية
The Interior	الجزء الداخلي	Archaea	العتائق
Actual Fluid	السائل الفعلي	Multicellular	متعدد خلايا
The Cytosol	العصارة الخلوية	Grab	التقط
Jelly-like Substance	مادة تشبه الهلام	Dirt	الأوساخ
Nucleoid	النواة	Revealed	كشف
Region	منطقة	Critters	المخلوقات
Genetic Information	المعلومات الوراثية	Cross-linked	متشابك
Nucleic Acid	حمض نووي	Gram staining	تلوين غرام
Deliver	تقدم	Stained	تلطيخ
Instructions	التعليمات	Dyes	أصباغ
Complex Macromolecules	الجزيئات الكبيرة المعقدة	Rinsed	شطف
Copy	تنسخ	Retain	تحتفظ
Metabolic Functions	وظائف التمثيل الغذائي	Maintain	تحافظ
Move Around	التحرك	Target	هدف
Reproduce	التكاثر	Antibiotics	المضادات الحيوية
Require	تتطلب	Pathogens	مسببات الأمراض

Substances	المواد	Protists	الطلائعيات
Inhibit	تمنع	Unique	فريدة
Destroys	يدمر	Characteristics	خصائص
Harming	الإضرار	Extremophiles	متطرفة
Protruding	بارزة	Thrive	يزدهر
Appendages	زوائد	Extreme Environments	البيئات القاسية
Sticky Hairs	الشعر اللزج	Pressures	الضغوط
Flagella	سوط	Inhospitable	غير المواتية
Tails	الذيول	Salty	الملوحة
Spin Around	يدور	Hot Springs	الينابيع الساخنة
Chemotaxis	الانجذاب الكيميائي	Volcanic	البركاني
Nutrient	المغذيات	Ocean Vents	فتحات المحيط
Toxic	سام	Sheets Of Ice	طبقات الجليد
Shapes	الأشكال	Swamps	المستنقعات
Cocci	المكورات	variety	تنوع
Diplococci,	المكورات المزدوجة	Tolerances	التّحملات
Chain	سلسلة	Stem	ينشأ
Streptococci	العقديات	Inorganic	غير عضوي
Bunch	حزمة	Specific Lipids	دهون معينة
Staphylococci	المكورات العنقودية.	Monolayer	أحادية الطبقة
Rod-shaped	على شكل عصا	Bilayer	ثنائية الطبقة
Bacilli	العصيات	Stability	ثبات
Streptobacilli	العصيات العقدية	Fasten to	الربط مع
Spiral-shaped	الشكل الحلزوني	Pili	الأهداب
Regardless	بغض النظر	Fimbriae	زغب
House	تحتوي		