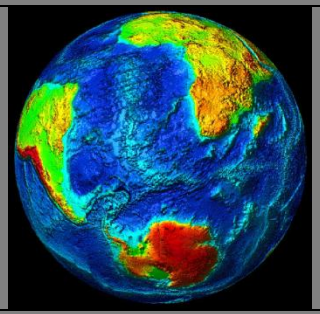
Kingdom Archaea

Scientists believe that Archaea are the first living things on Earth because…



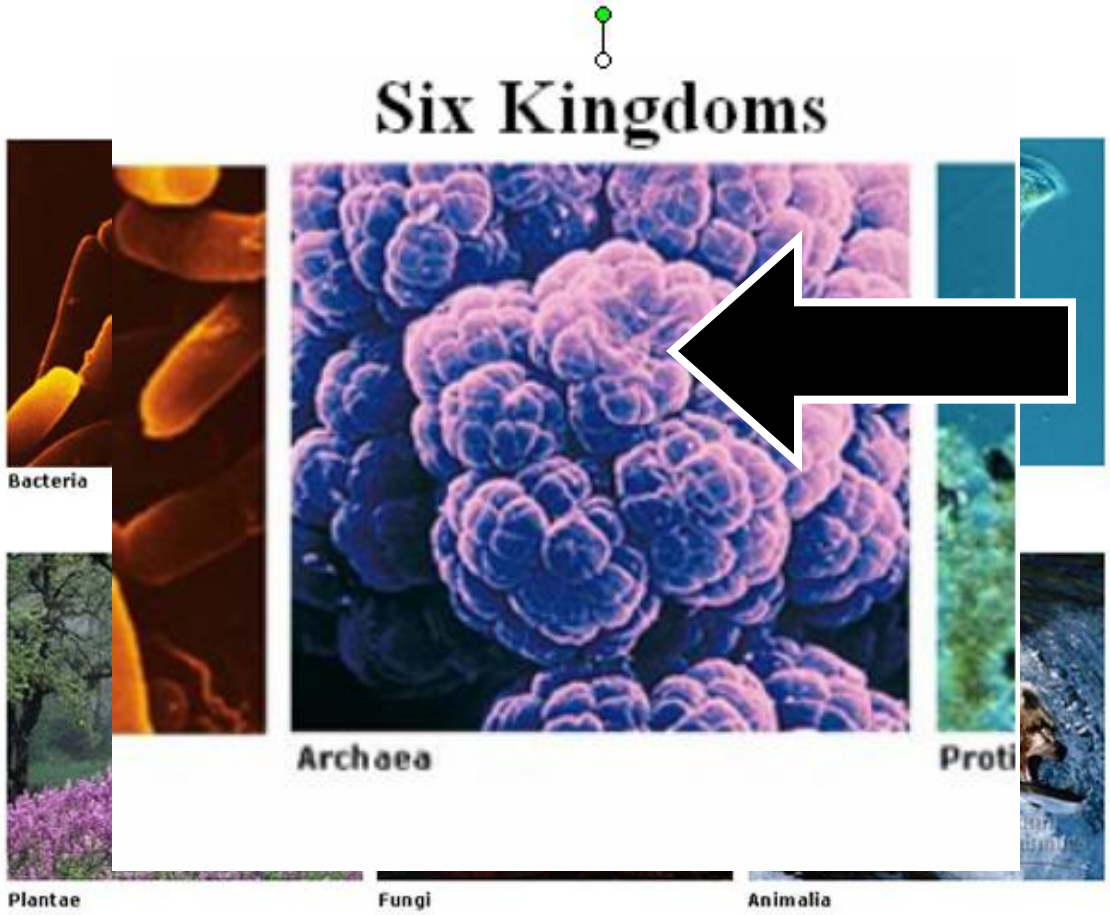
They thrive in extreme conditions that mimic the Earth's early atmosphere

Kingdom Archaea

Examples of extreme conditions:

- boiling/acidic water
- hydrothermal vents
- super-salty pools
- Antarctic permanent ice

These are conditions that would normally kill other creatures, thus Archaea are classified by the type of environment they thrive in.



Kingdom Archaea

Examples of extreme conditions:

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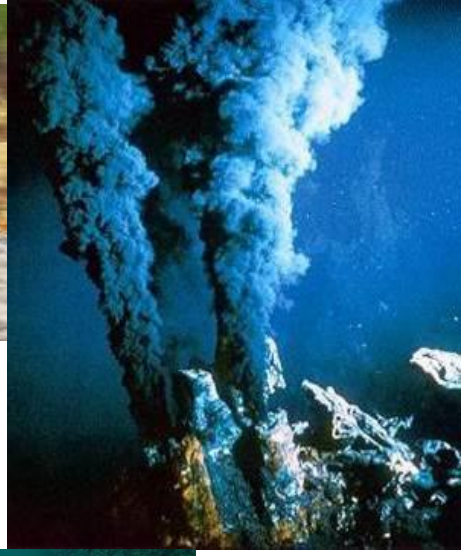


Three Groups of Archaea

Thermoacidophiles

Able to tolerate extreme temperature & acidity
Example: volcanoes, hot springs
Energy obtained from sulfur

Halophiles

Thrives in high salt environments
Example: Dead Sea
Energy obtained from organic food molecules and light

Methanogens

Lives in oxygen free environments
Example: swamp, marsh, sewage
Energy obtained by converting inorganic molecules leaving methane gas as a waste product

Kingdom Bacteria

Beneficial Bacteria

Nitrogen cycle: bacteria critical to soil fertility, converts ammonia to usable compounds:
ammonia → nitrite → nitrate

Certain bacteria makes foods edible:
vinegar, butter, cheese, yogurt, and sour-dough bread

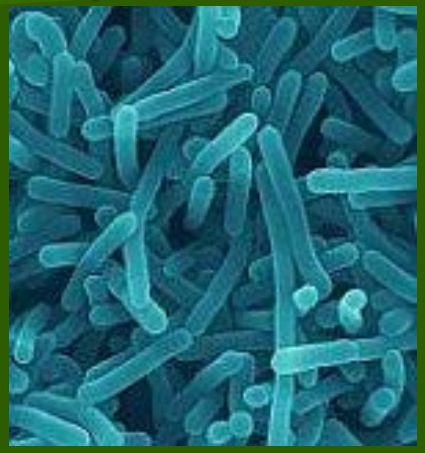
Bacteria in Industry

Bacteria used in sewage treatment, odor control, and septic tank maintenance:
digests organic matter and waste

Bacteria in Disease

Tuberculosis

Lysteriosis



Lyme disease

Gonorrhea

Meningitis

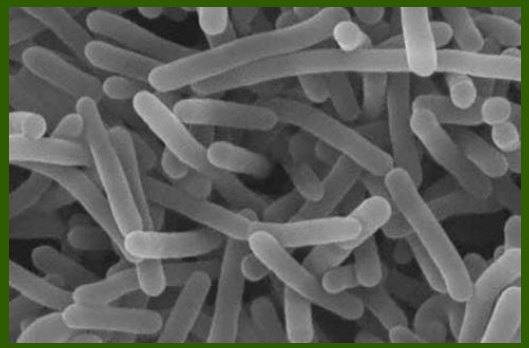
- *Streptococcus mutans* → tooth decay
- *Clostridium botulinum* → food poisoning
- *Treponema pallidum* → syphilis

Bacterial Classification

- Shape – 3 types (more details to follow)
- Cell Wall – 2 types (more details to follow)
- Energy Source – 2 types
  - Photosynthetic: obtain energy from light
  - Chemosynthetic: obtain energy from inorganic compounds

Bacterial Shapes - general

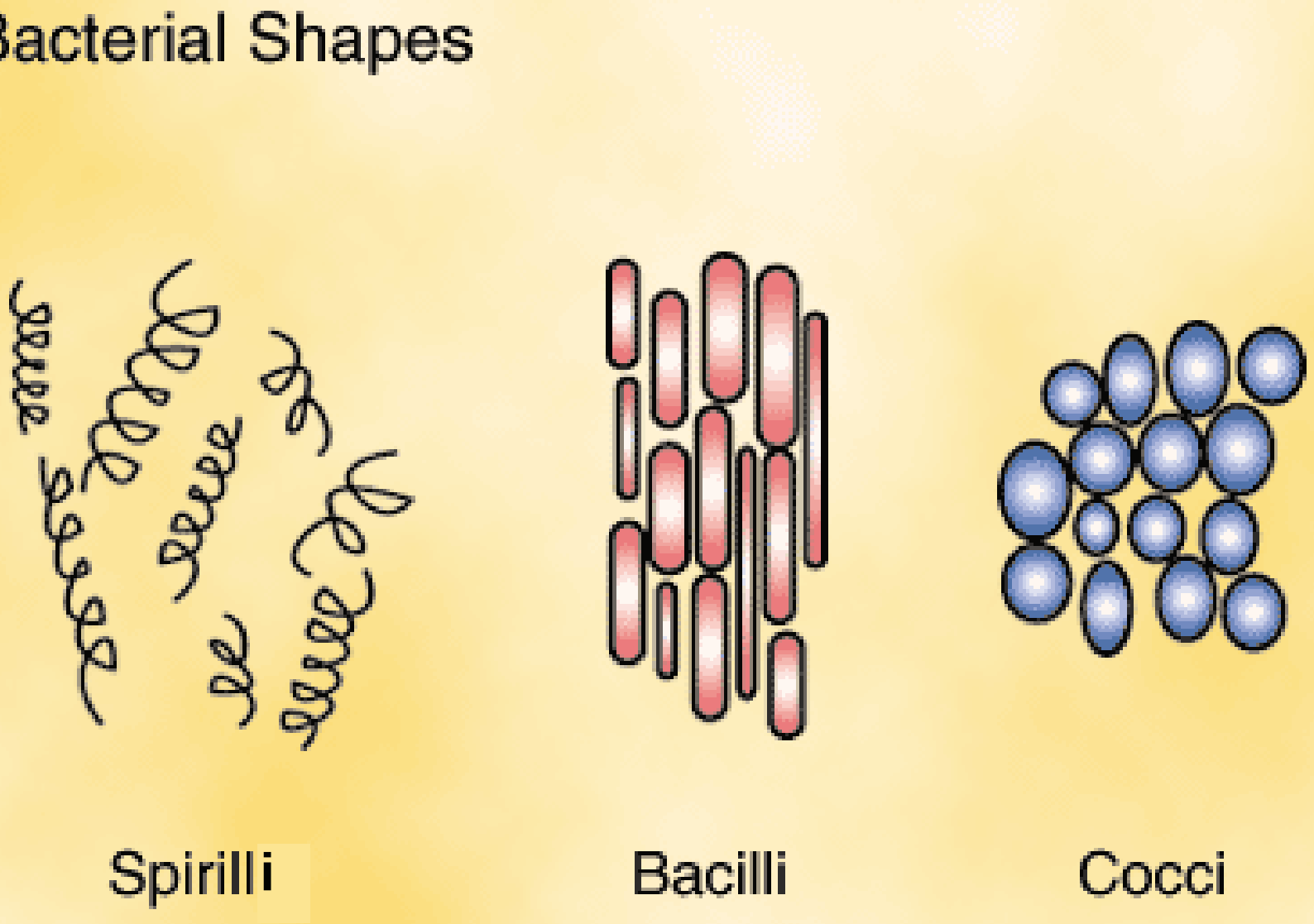
- Cocci (*singl.* coccus) – round
- Resists drying



- Bacilli (bacillus) – rod-shaped
- Absorbs more nutrients due to greater surface area

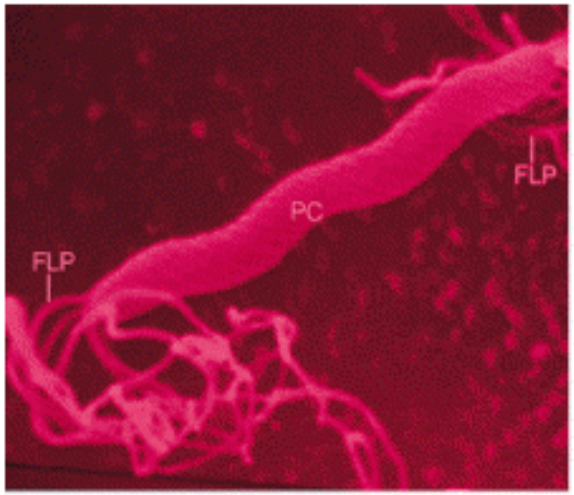
- Spirilli (spirillum) – spiral-shaped
- Moves through fluids with the least resistance

Bacterial Shapes



Bacterial Shapes

Diversity of bacteria



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a. A spirillum with flagella

© David M. Phillips/Visuals Unlimited

b. Bacilli in pairs

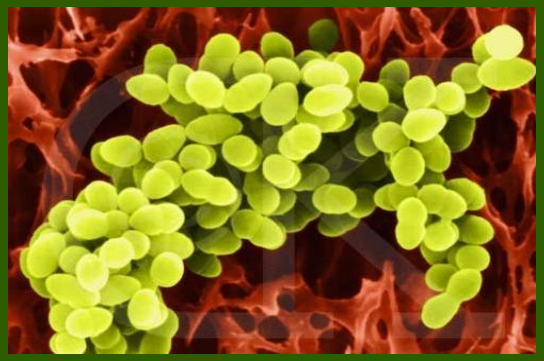
© David M. Phillips/Visuals Unlimited

250 nm

c. Cocci in chains

Groupings

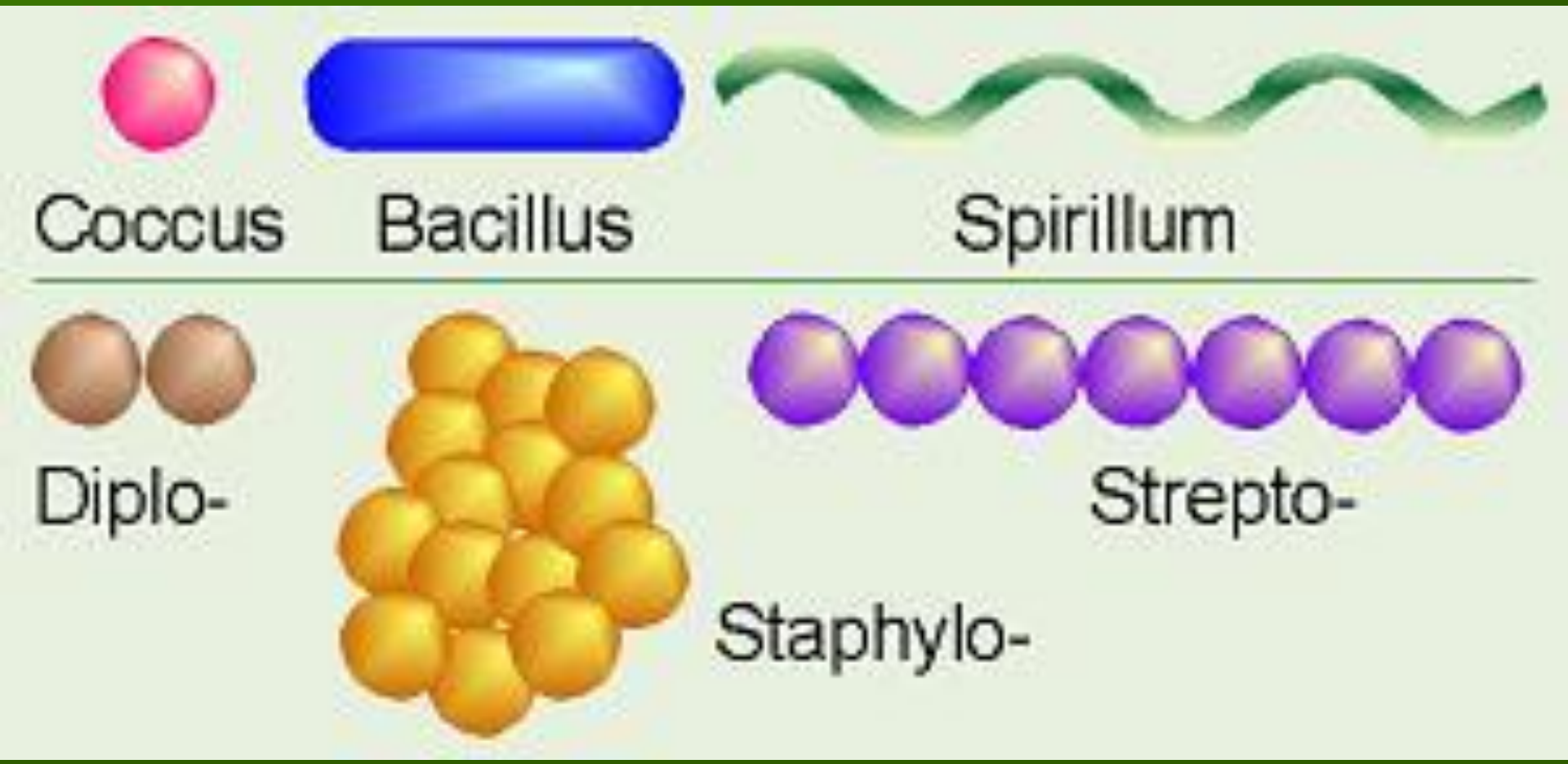
- Prefix *diplo-*
- Arranged in pairs



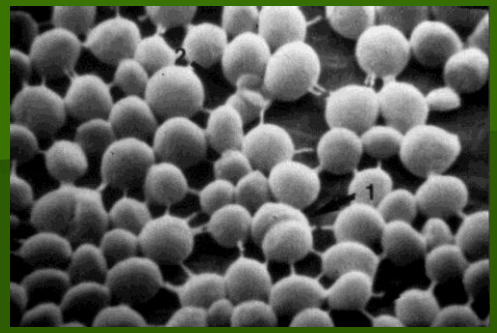
- Prefix *staphylo-*
- Arranged in clusters (like grapes)

- Prefix *strepto-*
- Arranged in chains

Groupings



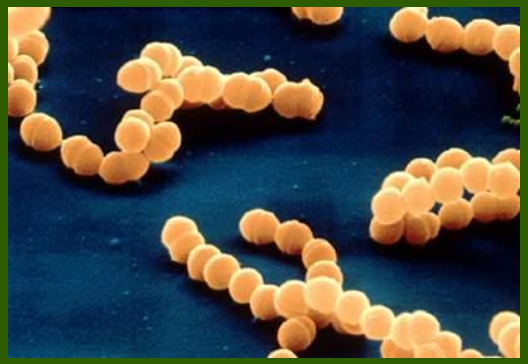
Practice Naming Bacteria

A 

B 

C 

D 

E 

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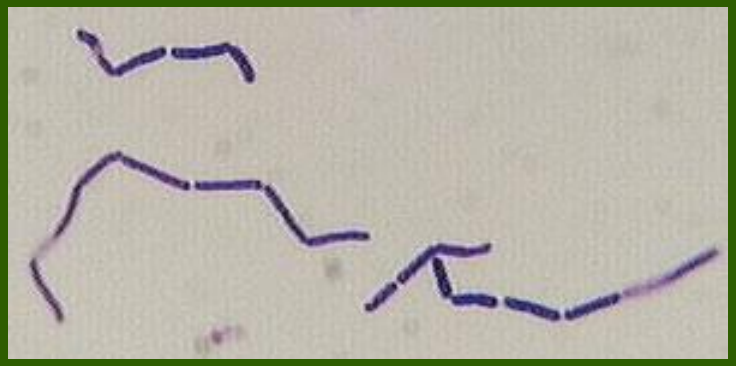
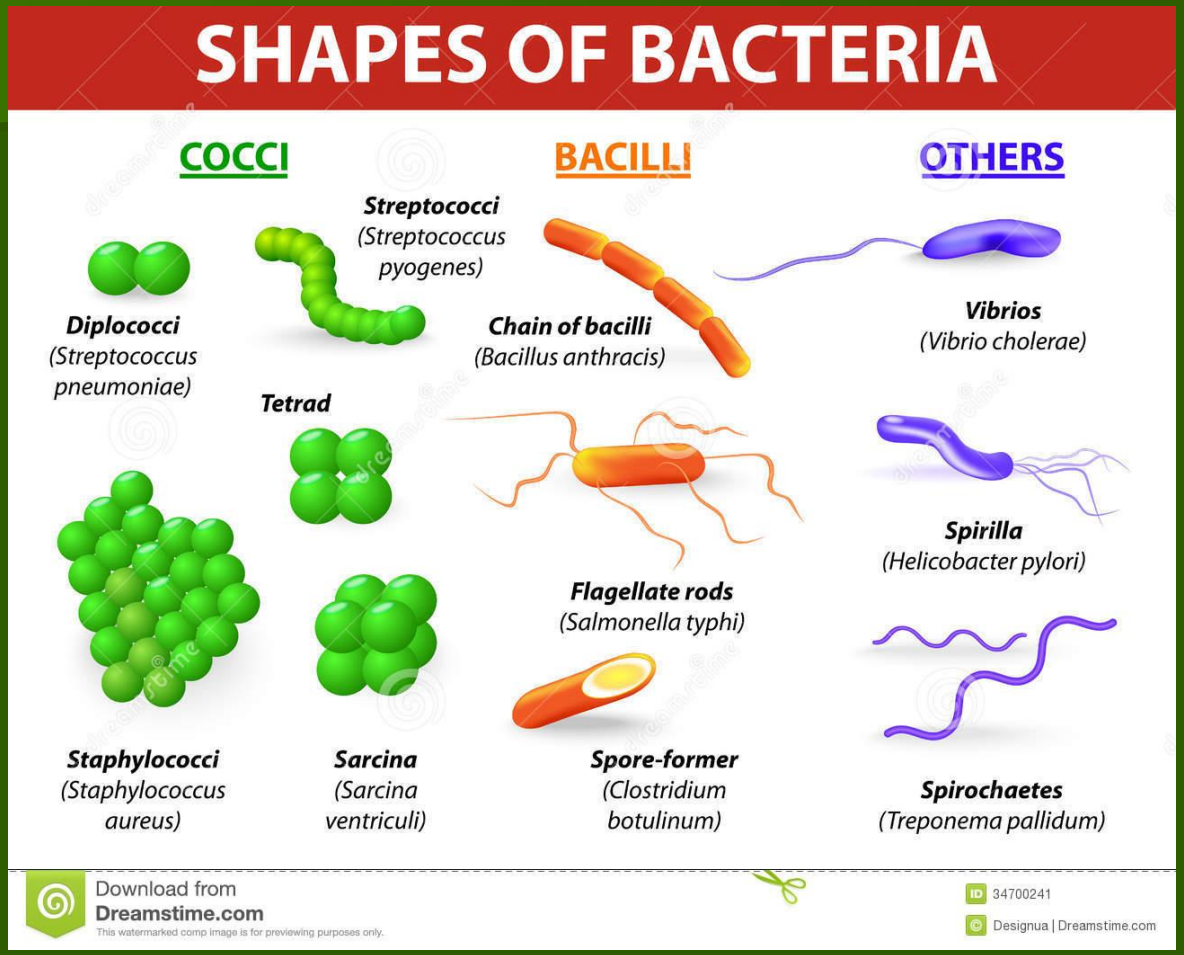
G 

Answers:

A. Staphylococci
B. Streptococci
C. Diplobacilli
D. Streptobacilli
E. Streptococci
F. Diplospirilli
G. Streptobacilli

Diversity within shapes – getting more specific



Bacterial Cell Wall Structure

1884: Hans Grams discovered a method of classifying bacteria using what is now named the

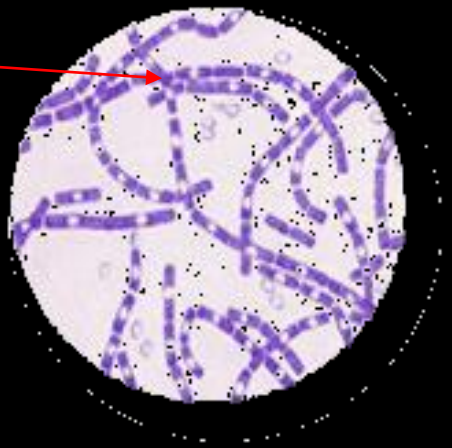
"Gram Stain."

What is Gram Stain?

A dye that highlights basic differences in the arrangements of molecules in bacterial cell walls

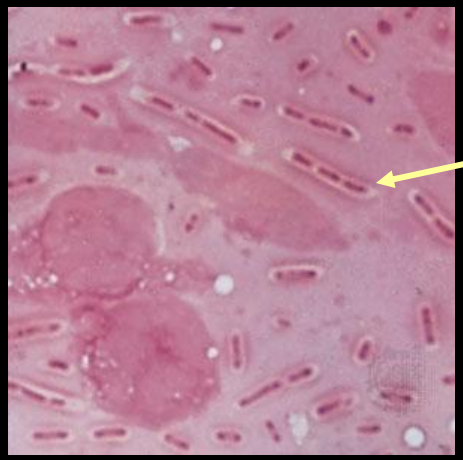
Gram-positive

Purple stain



Thick protein layer

Gram-negative



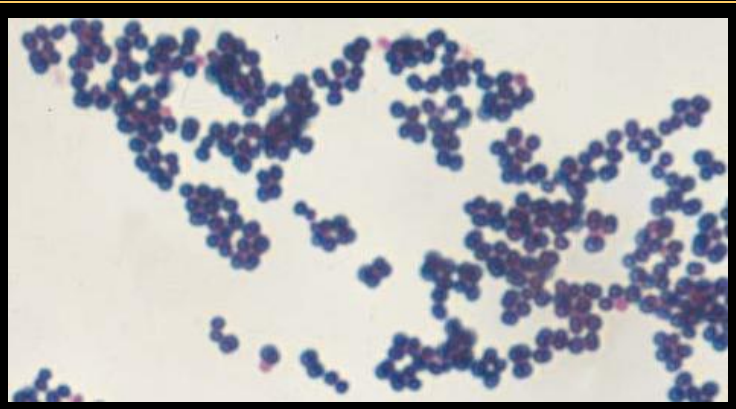
Pink stain

Thin protein layer

Gram-negative bacilli from a pneumonia infected lung

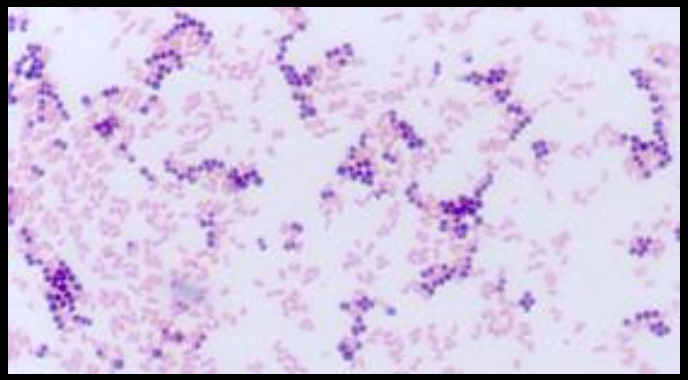
Examples of Gram Stains

A



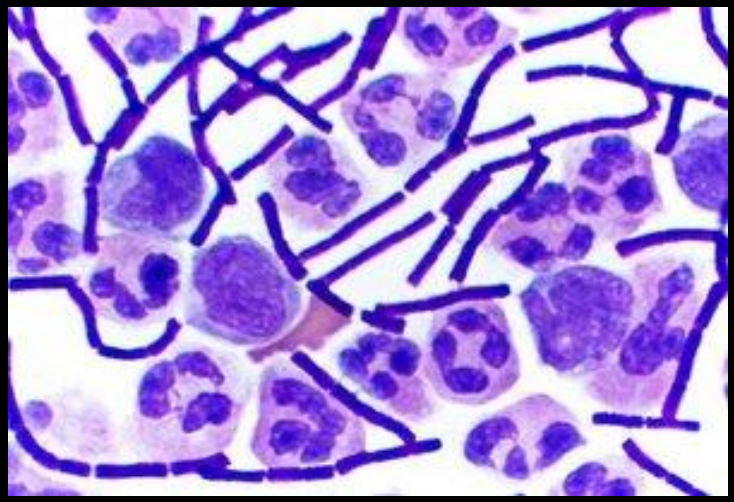
Gram-positive Staphylococcus aureus

B



Mixture: gram-negative (pink) bacilli and gram-positive (purple) cocci

C



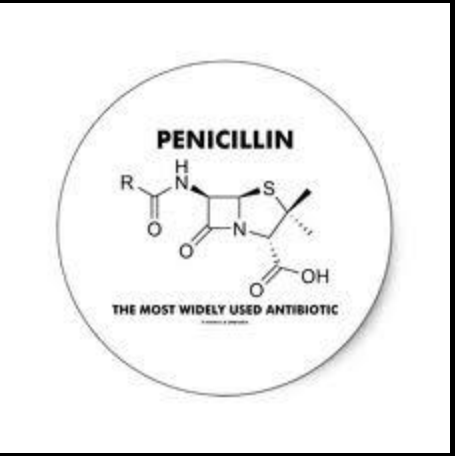
Gram-positive anthrax bacteria (bacilli) in cerebrospinal fluid sample. If present. (The other cells are white blood cells).

Antibiotics and Antibiotic Resistance

Antibiotics are extremely useful in curing diseases and saving lives

Antibiotics kill bacteria by weakening its cell wall

Some bacteria develop resistance to antibiotic and can therefore survive and reproduce. Therefore the overuse of antibiotics can cause bacteria to adapt and become resistant



Asexual Reproduction

(no mixing of genetic material between organisms)

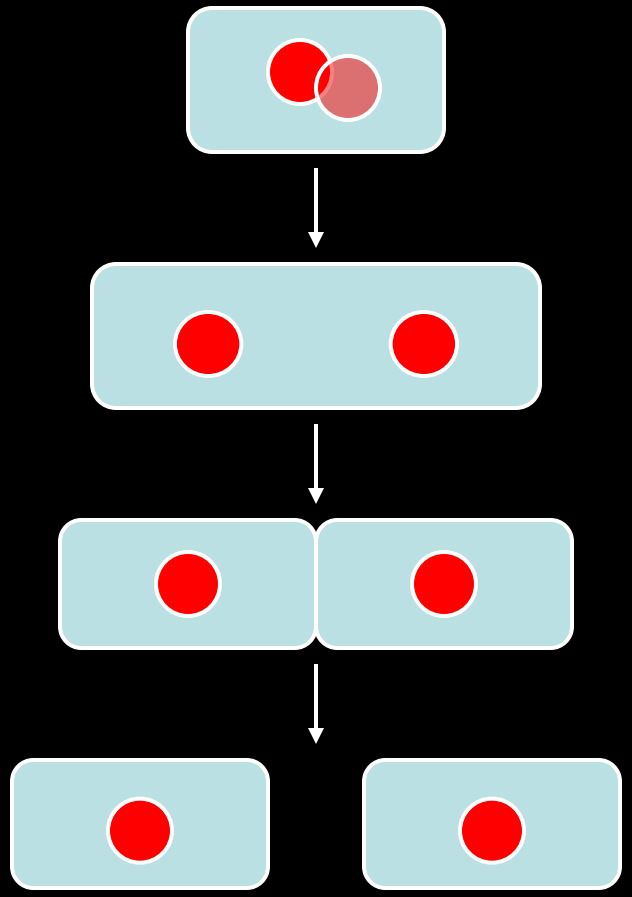
through…
BINARY FISSION

Binary = 2
Fission = division / split

A type of cell division where 2 genetically identical products of the same size are formed

Occurs when conditions are favourable and constant (predictable).

But why?…



1. Duplicate genetic material
2. Cell elongates
3. Septum (wall) begins to form
4. Cells separate

Sexual Reproduction

(mixing of genetic material between organisms)

through…
CONJUGATION

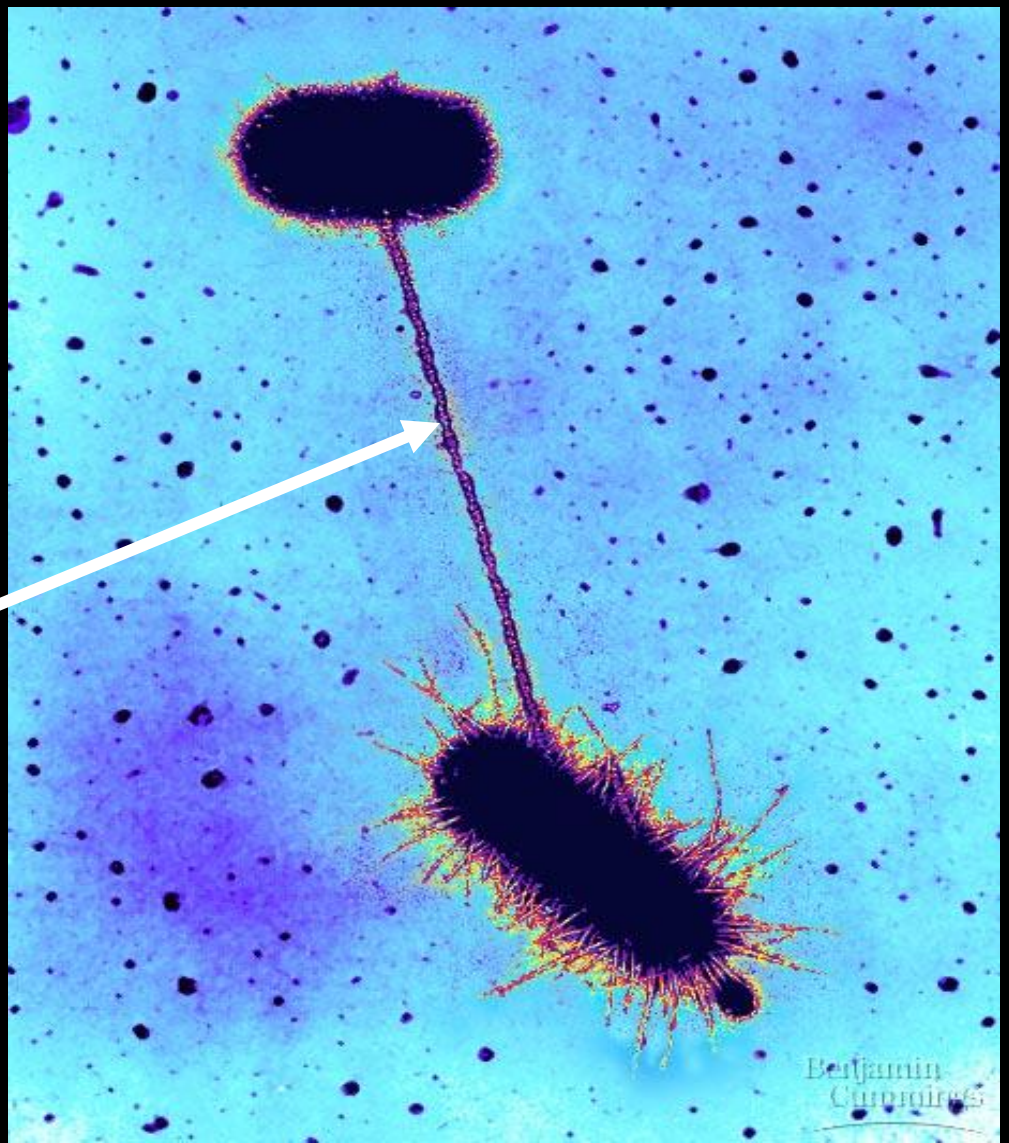
Occurs when conditions begin to alter such that it's less than ideal. What advantage does this have?…

1. Cells linked by a bridged structure called the pili (pilus)
2. Genetic information passes through pili from one cell to another
3. Receiving cell undergoes binary fission

Sexual Reproduction

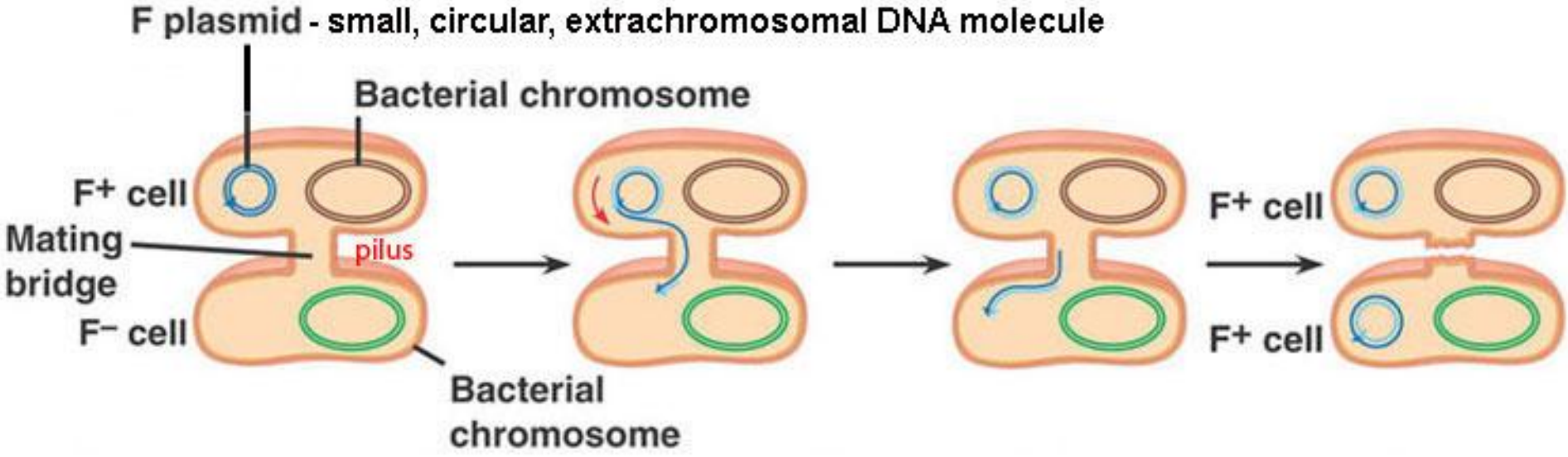
(mixing of genetic material between organisms)

through…
CONJUGATION



Sexual Reproduction

(mixing of genetic material between organisms)



(a) Conjugation and transfer of an F plasmid from an F+ donor to an F− recipient

(b) R-plasmid carries genes for antibiotic resistance

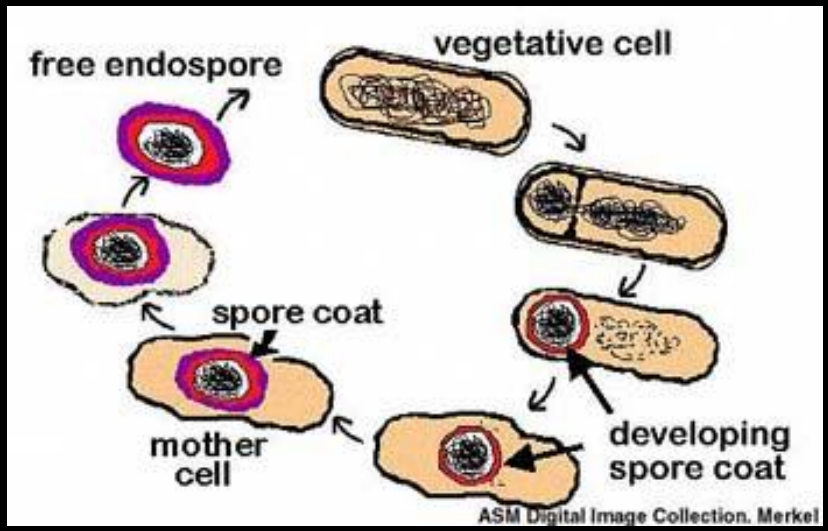
Spore Formation

(no growth, dormancy)

During unfavourable conditions, a bacteria enters a dormant phase to protect itself.

It forms a tough outer covering to enclose its DNA. The resulting product looks like a seed and is called an endospore.

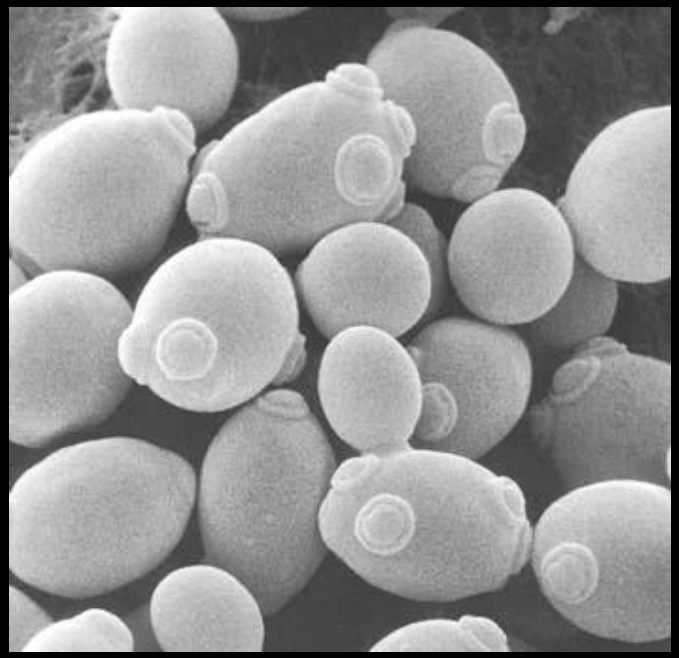
When favourable conditions return, endospore loses its outer coat allowing the bacteria to grow again.



Kingdom Fungi

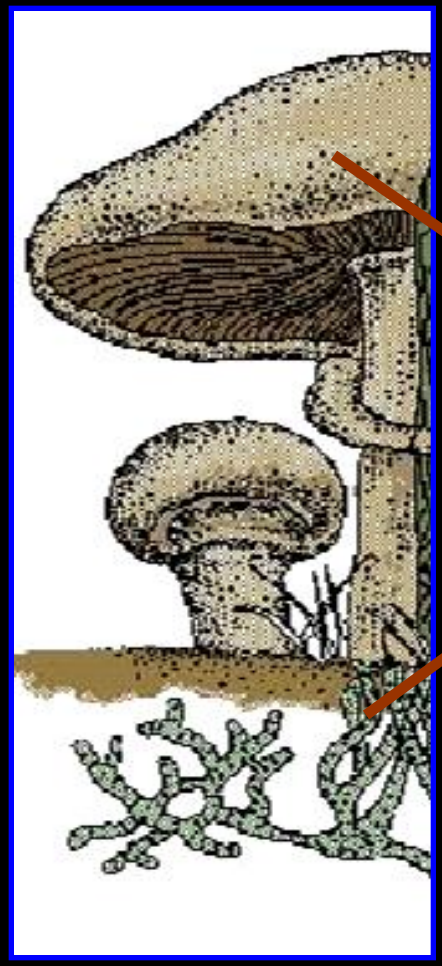
Mold

Yeast

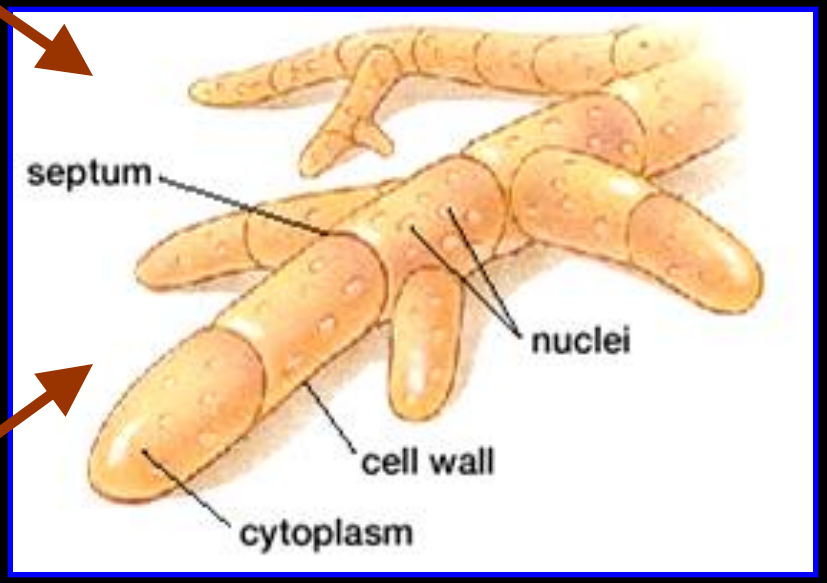


Mushroom

Fungi Structure



Mushroom: Specialized reproductive part of fungus



Hyphae: network of fine filaments

Septum: porous walls that divide the hyphae into cells

Chitin: material that forms the cell wall of fungi

Mycelium: loose, branching network of hyphae under the soil making up the main bulk of a fungus

Septum

The septa of a hyphae is often porous (pictured below)

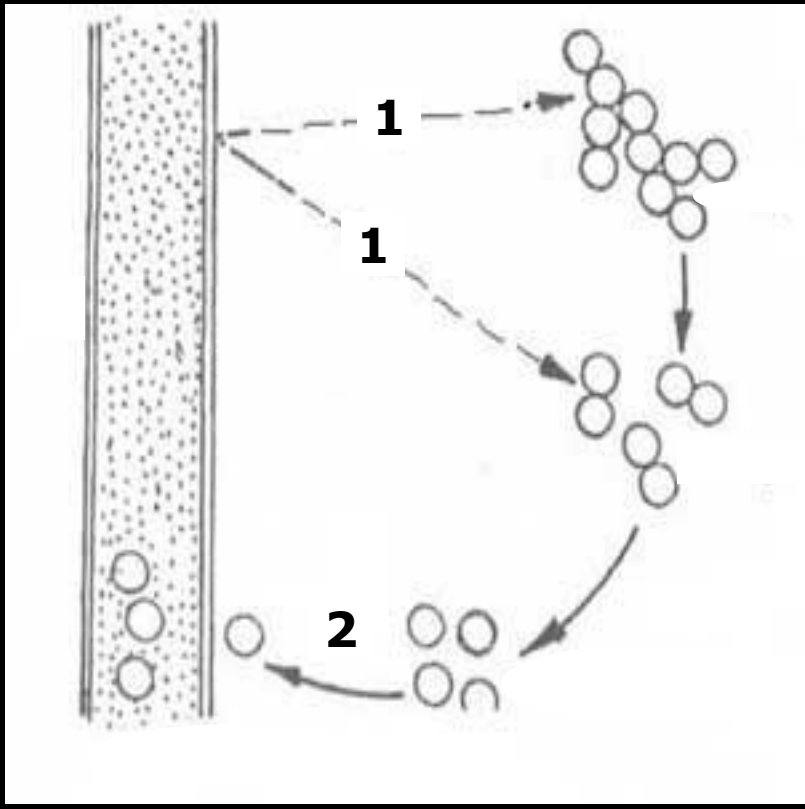
-this allows cytoplasm to travel through it

Process of Extracellular digestion

1. Hyphae releases digestive enzymes over its food

2. Molecules that are broken down outside the body then diffuse in

3. The more extensive the mycelium, the greater the surface area for absorption



Symbiotic Relationships

Mutualism	
Commensalism	
Parasitism	

Symbiotic Relationships

Mutualism + / +	
Commensalism	
Parasitism	

Symbiotic Relationships

Mutualism + / +	*E. Coli* in human intestine *E. Coli* receive food / shelter Humans receive vitamins
Commensalism	
Parasitism	

Symbiotic Relationships

Mutualism + / +	*E. Coli* in human intestine *E. Coli* receive food / shelter Humans receive vitamins
Commensalism + / 0	
Parasitism	

Symbiotic Relationships

Mutualism + / +	*E. Coli* in human intestine *E. Coli* receive food / shelter Humans receive vitamins
Commensalism + / 0	Barnacles on jaws of whale Barnacles eat food filtered by whale. No effect on whale.
Parasitism	

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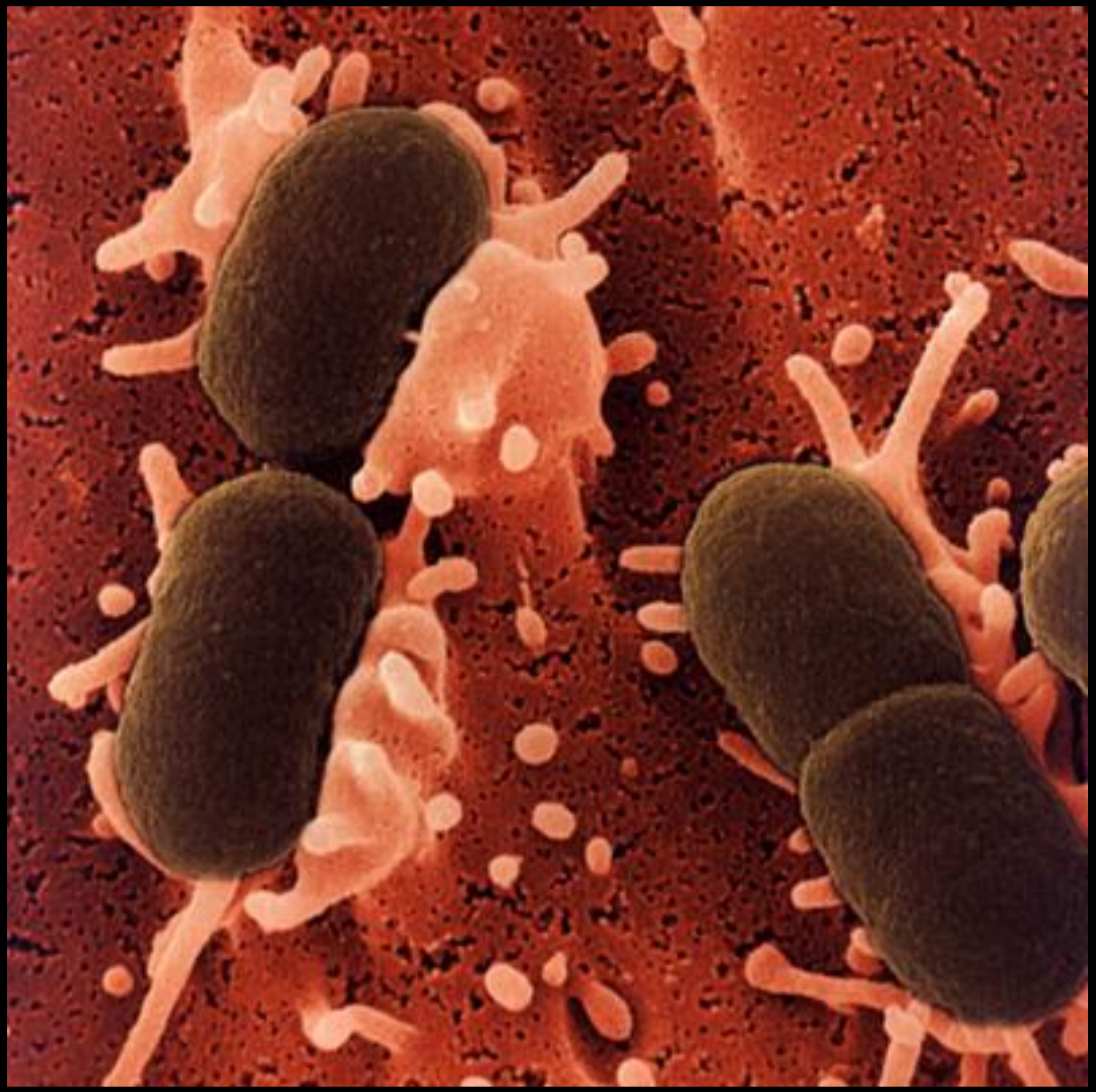
Parasitism + / -	

Symbiotic Relationships

Mutualism + / +	*E. Coli* in human intestine *E. Coli* receive food / shelter Humans receive vitamins
Commensalism + / 0	Barnacles on jaws of whale Barnacles eat food filtered by whale. No effect on whale.
Parasitism + / -	Many diseases: malaria, tetanus Mistletoe grow on host trees. Uses trees to obtain nutrients.

Symbiotic Relationships

Mutualism



Symbiotic Relationships

Commensalism

Symbiotic Relationships

Parasitism

Barnacles on whale

- ectocommensalism

Mistletoe on tree

- ectoparasitism

Symbiotic Associations

Ectosymbiosis	
Endosymbiosis	

Symbiotic Associations

Ectosymbiosis	One organism lives on the surface another organism (e.g. barnacles on whales, mistletoe on trees)
Endosymbiosis	

Symbiotic Associations

Ectosymbiosis	One organism lives on the surface another organism (e.g. barnacles on whales, mistletoe on trees)
Endosymbiosis	One organism lives within the tissue of another organism (e.g. *E. coli* in humans, malaria, tetanus)