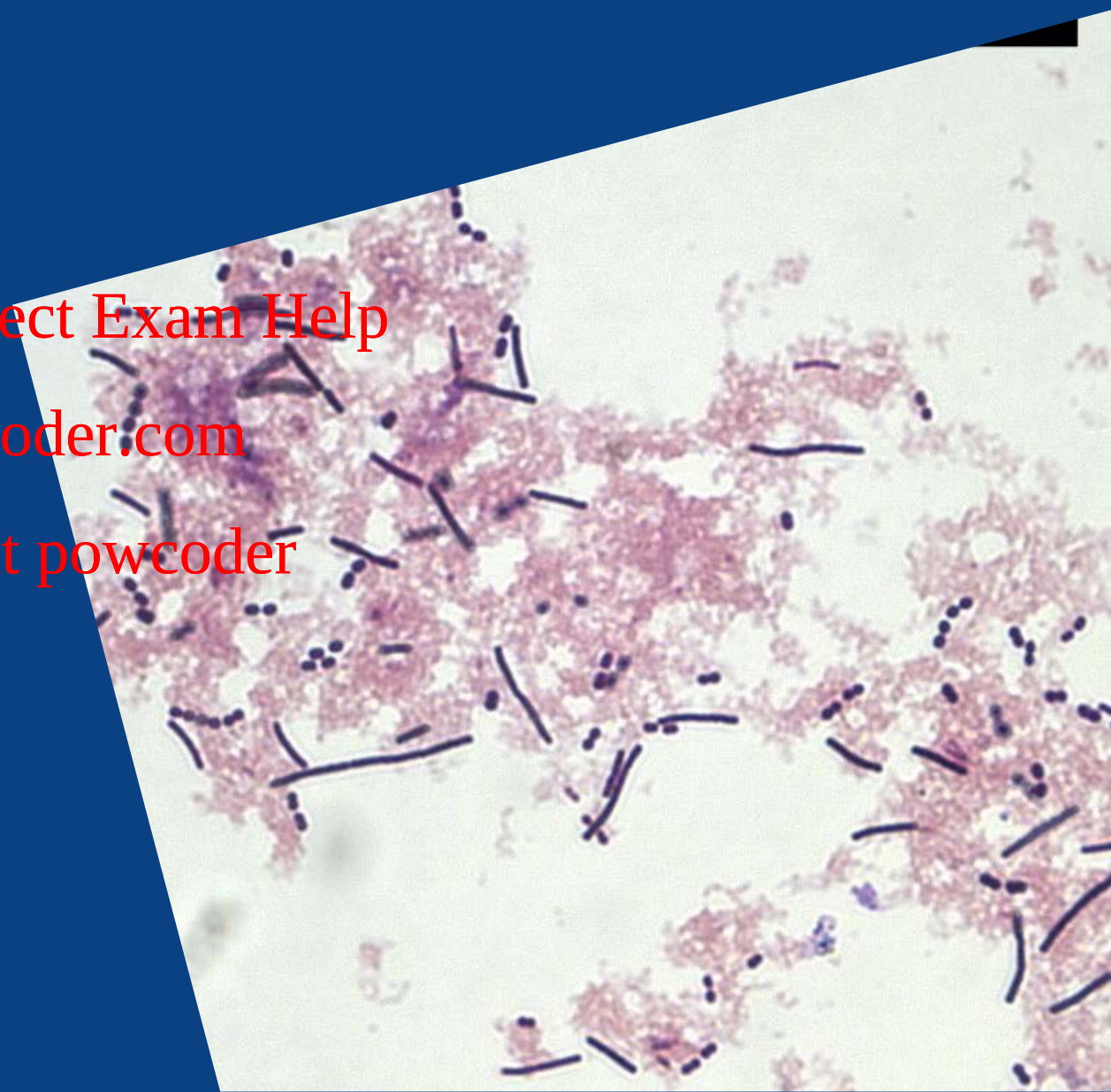
THE UNIVERSITY OF MELBOURNE

FOOD20006

Food Microbiology & Safety

Helen Billman-Jacobe



Introduction to microorganisms in food-Bacteria

Ray and Bhunia Ch 2

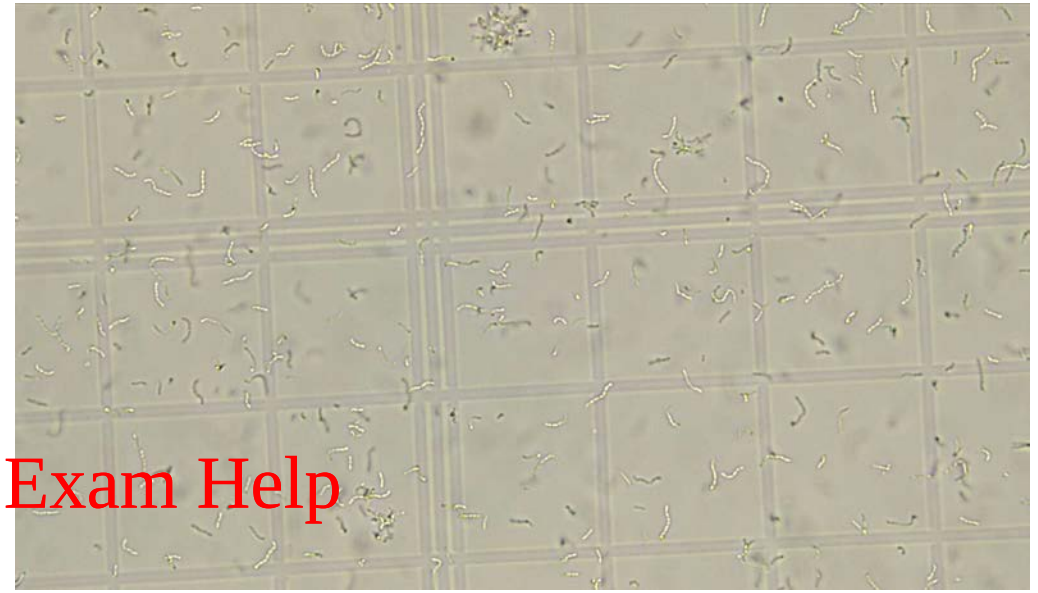
Intended learning outcomes

Use the correct format for writing the names of microorganisms

Use the terms which describe the morphology and structures of bacteria

Give examples of genera of bacteria that are important in food microbiology

Morphology and structure: bacteria



Bacteria are prokaryotes

They are small single cells, approximately 1 x 2-10µm in size

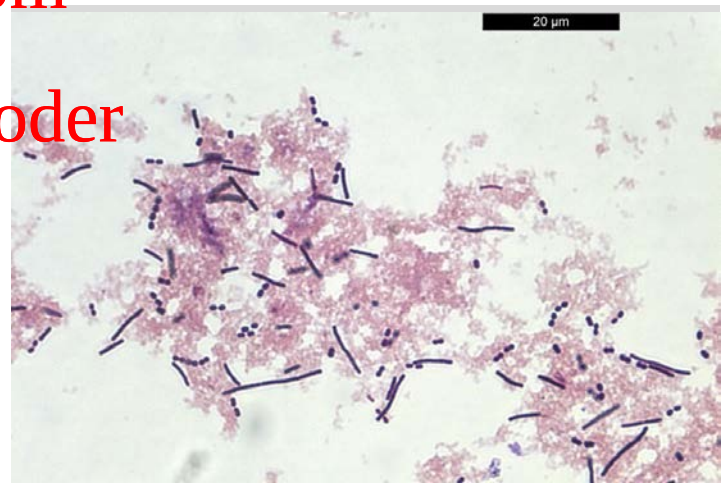
Usually have a single, circular DNA chromosome, 3-4 Mbp

Genome sits in the cytoplasm, so replication, transcription and translation all occur in cytoplasm

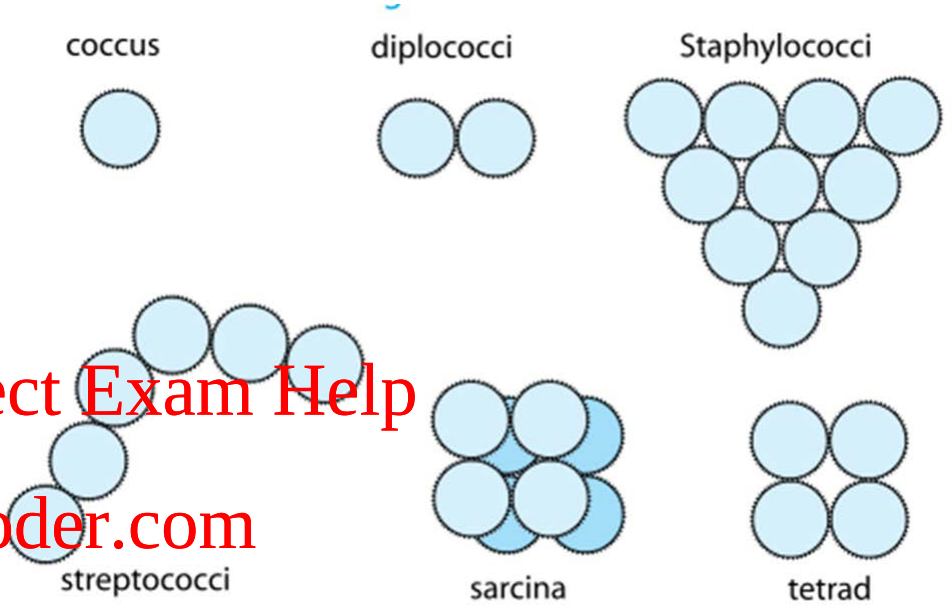
Some genetic information may also be contained in smaller circles of DNA, called plasmids (often able to transferred to other cells)

No organelles (ie. no nucleus, no mitochondria, no chloroplasts, no Golgi, etc).

Bacterial ribosomes are present but simpler than eukaryotes



Morphology and structure: bacteria



Bacterial cells have three morphological forms

Cocci spherical

Bacilli rod shaped

Comma curved

The cells can be in groups such as

Tetrad a group of four

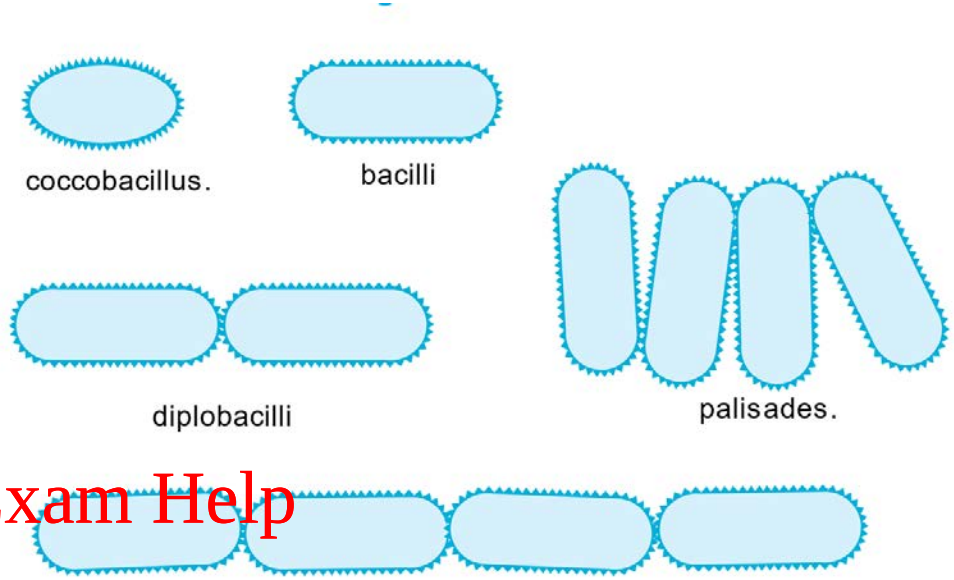
Clusters as illustrated by the staphylococci

chains of two or more cells

Chains of cocci are called streptococci

Bacilli aligned on their long side are described as palisades

Morphology and structure: bacteria



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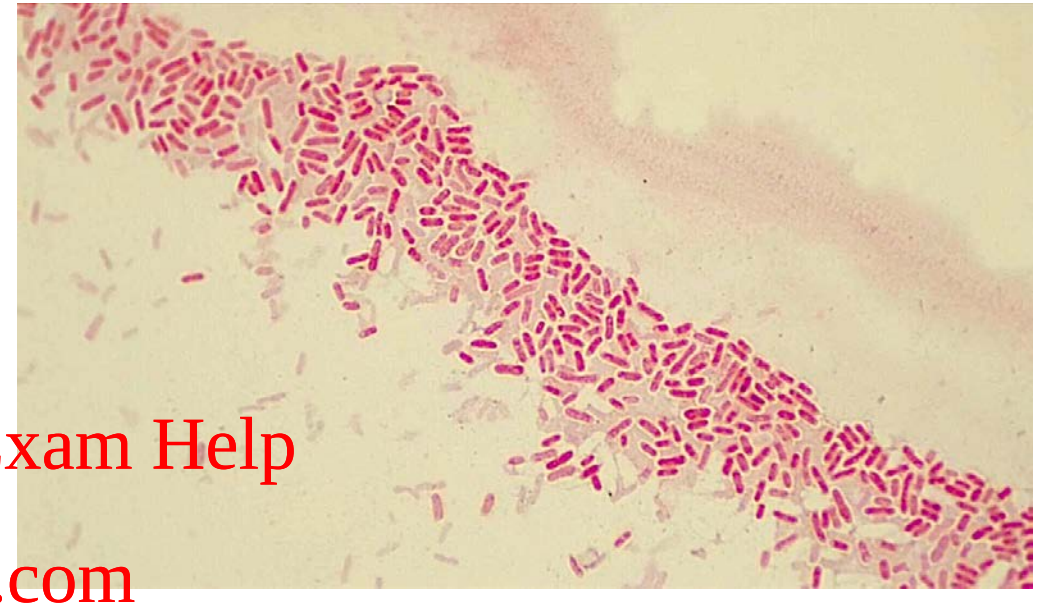
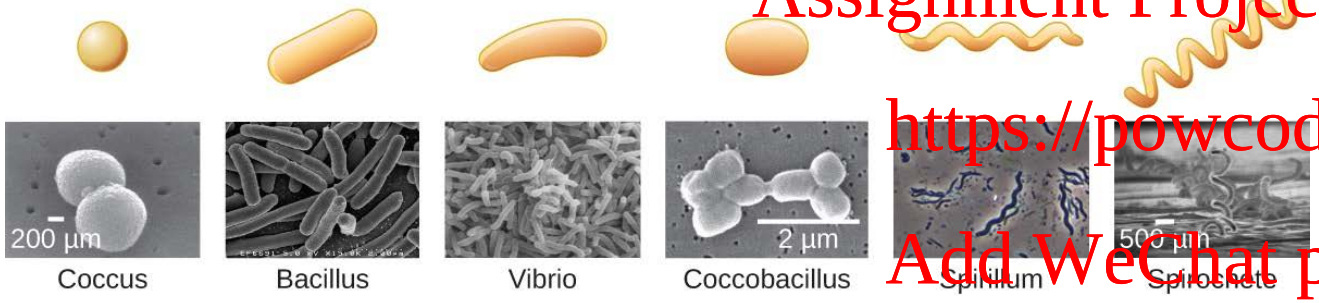
Morphology and structure: bacteria

How would you describe the shape and arrangement of the bacterial cells in the image on the right?





Microbiology, OpenStax

Morphology and structure: bacteria

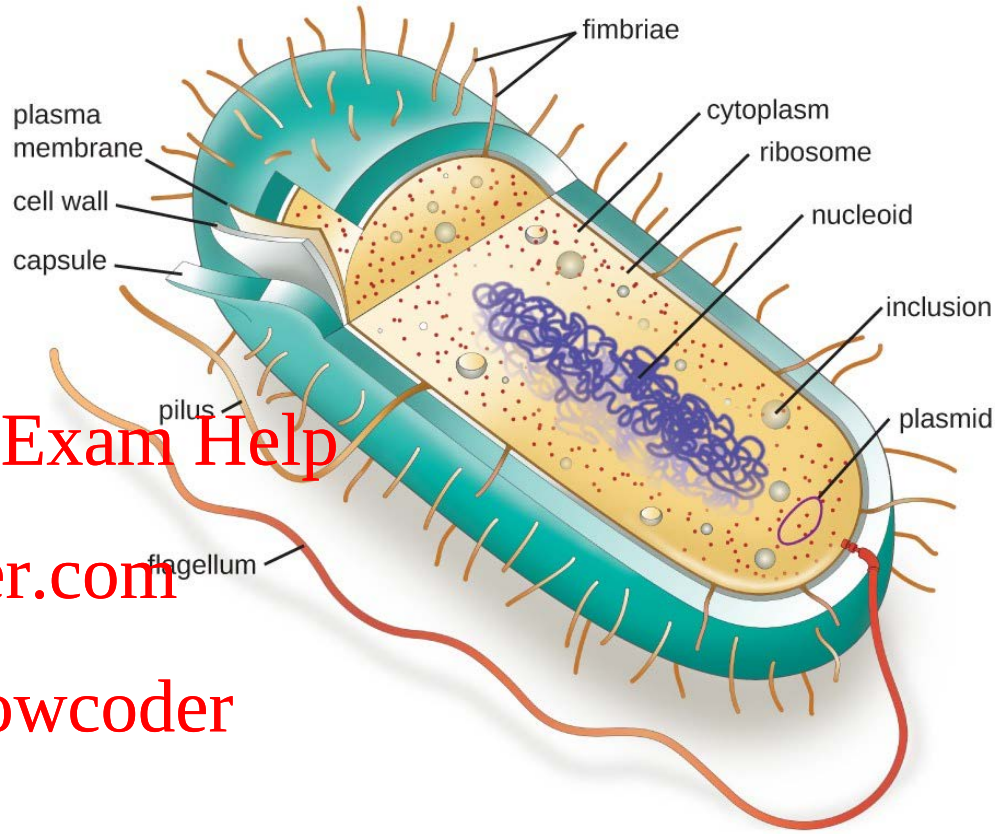
The bacterial cytoplasm is encased in a rigid cell wall on the surface and an inner plasma membrane

They may have hair like fimbriae which they used to attach to surfaces

The pilus is used as a channel to exchange genetic information between mating pairs of bacteria

Some bacteria are able to swim and they are called motile cells

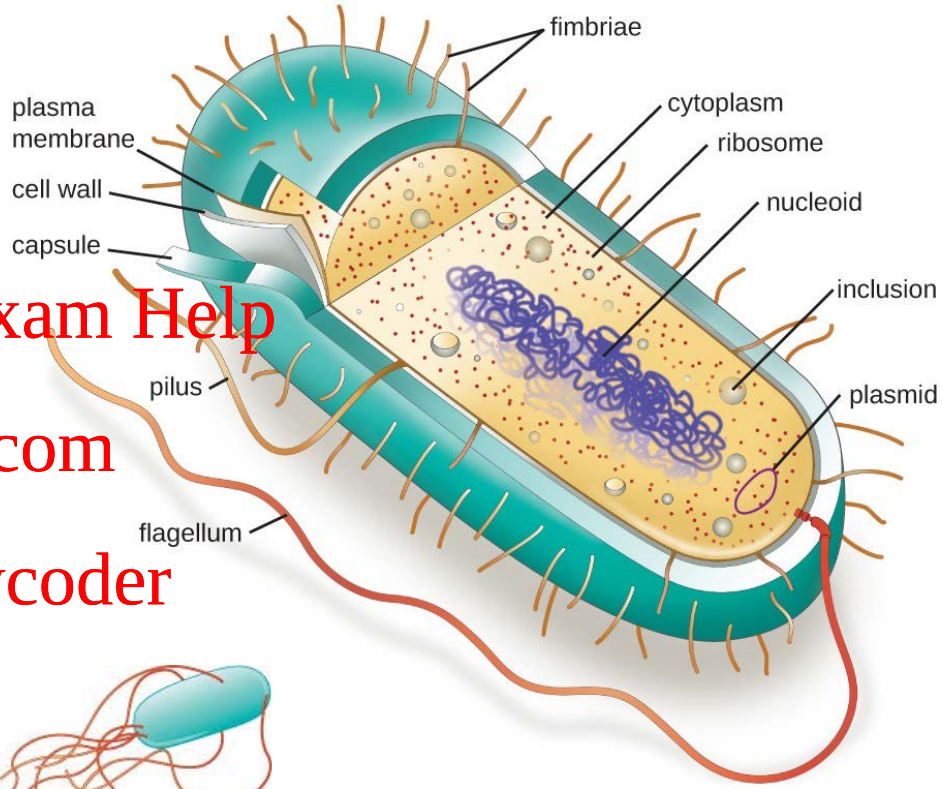
Motile bacteria have flagella which propel them through liquid

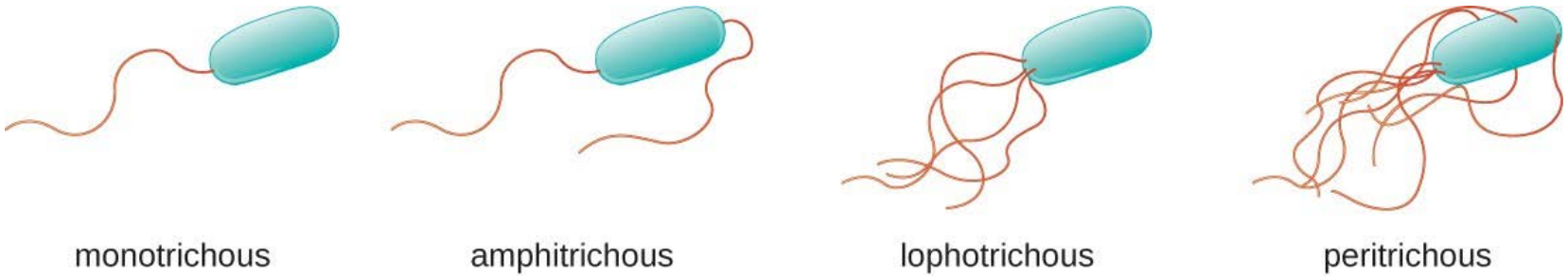


Morphology and structure: bacteria

Bacteria that have flagella possess a special hook structure to anchor the flagella to the cell wall that this still allows the filament to rotate and act like propeller to push cells through liquid.

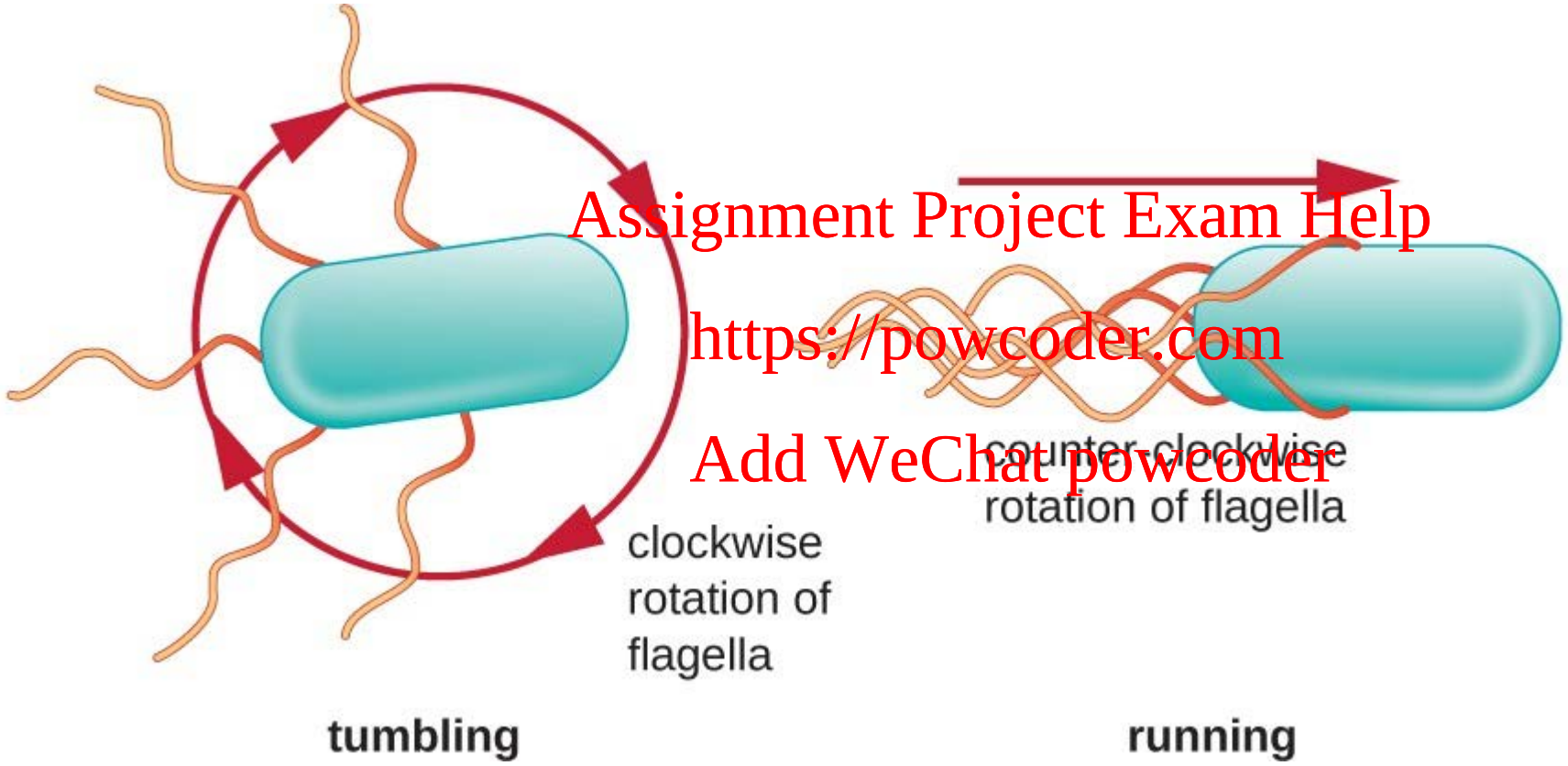
Motile bacteria use flagella to swim towards nutrients and away from toxic compounds



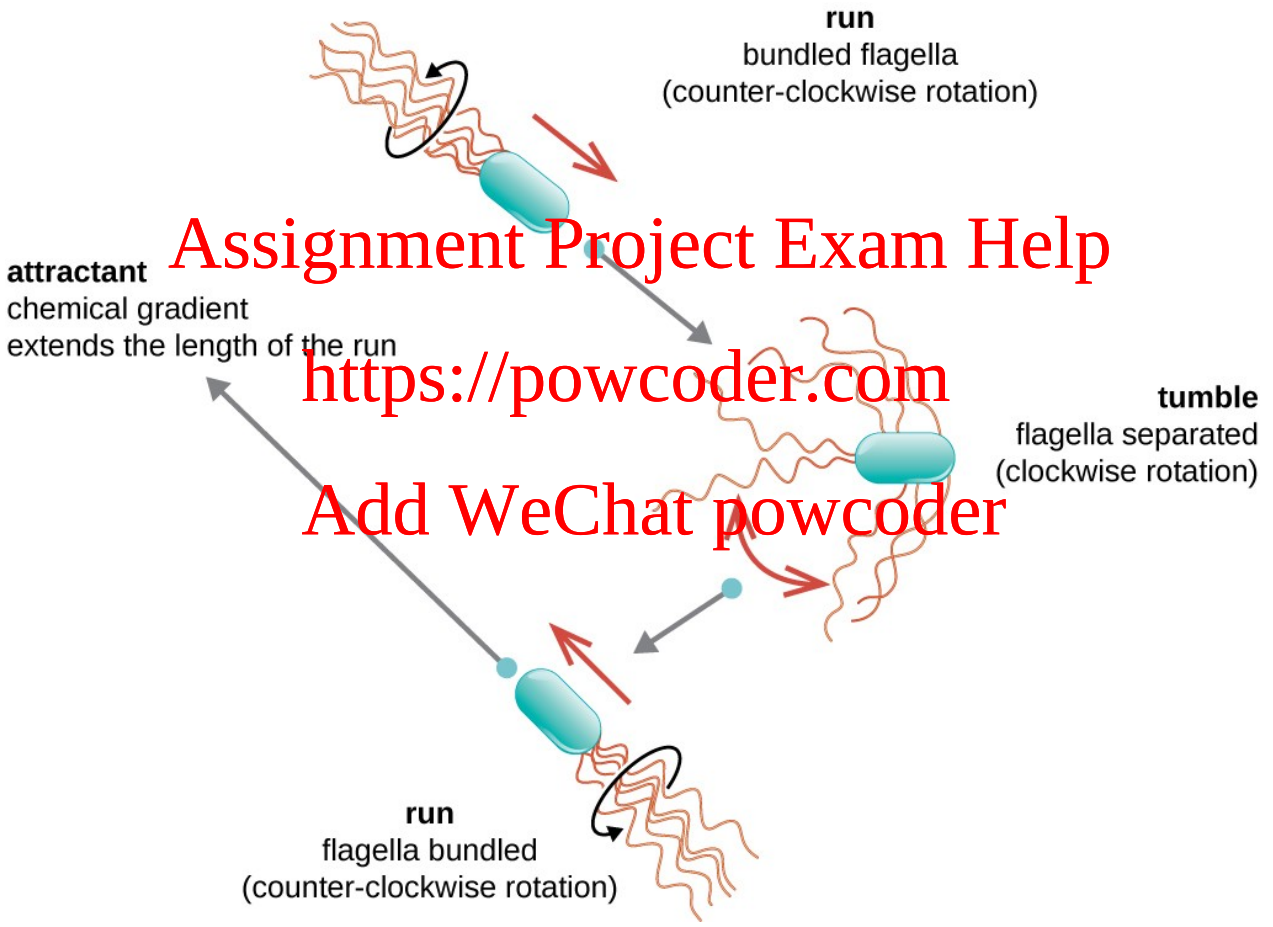


Microbiology, OpenStax

Directional movement



Microbiology, OpenStax



Morphology and structure: bacteria

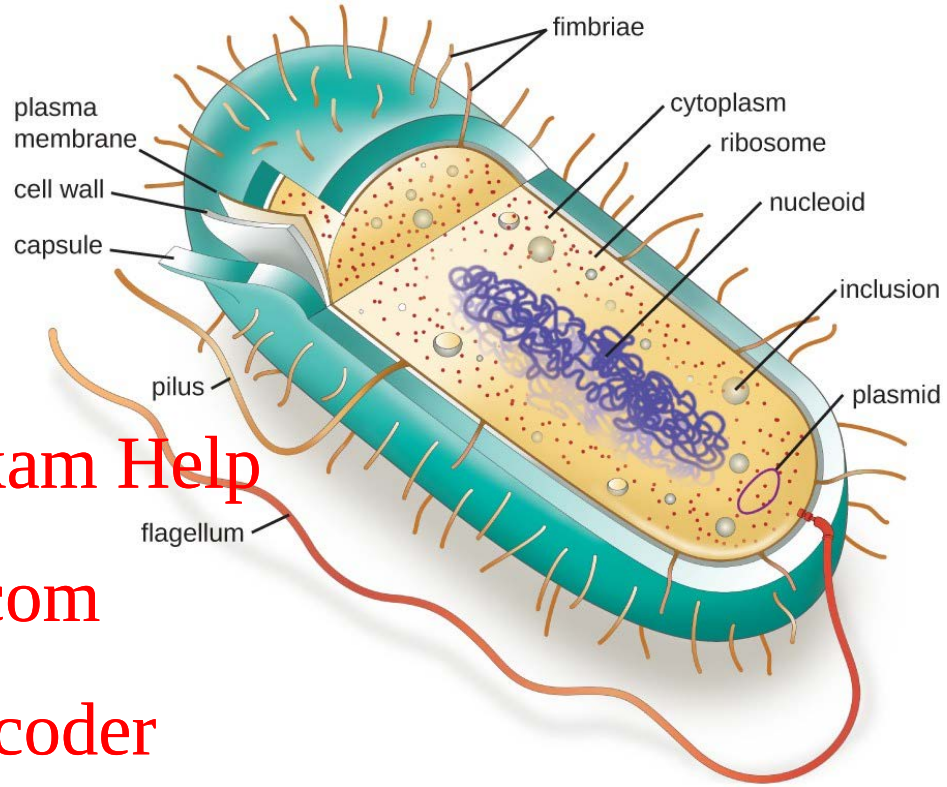
The bacterial cytoplasm does not contain organelles

Ribosomes are present

The chromosome occurs as a condensed mass of DNA called the nucleoid

The genetic material consists of a circular chromosome and plasmids

Some bacteria are able to form endospores



Morphology and structure: bacteria

Bacterial cells are surrounded by a cell wall.

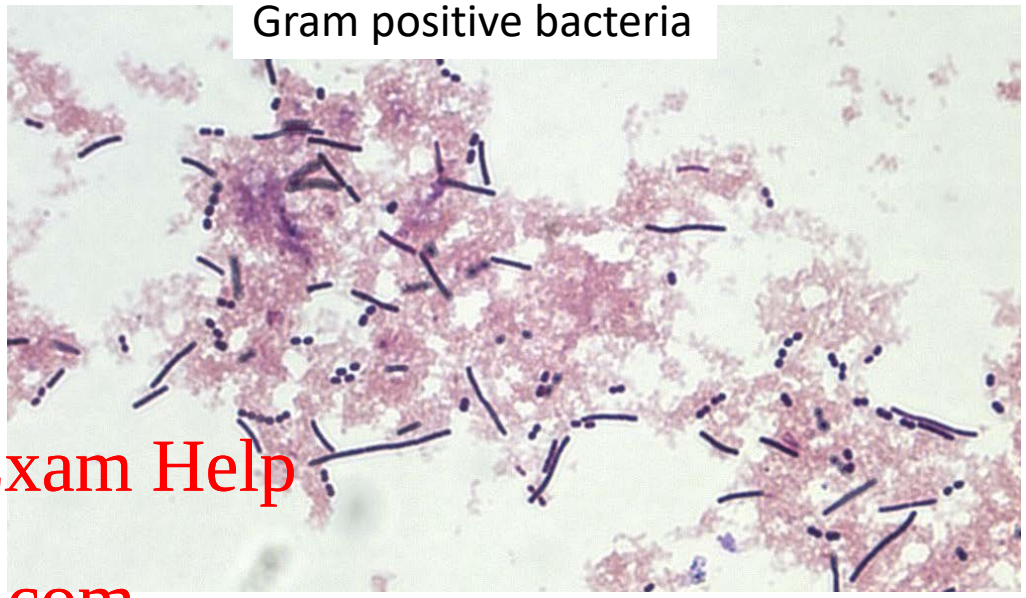
The wall is comprised of peptidoglycan of the cell wall determines cell shape

Bacteria are grouped together as Gram-negative or Gram-positive depending on their response to the Gram stain

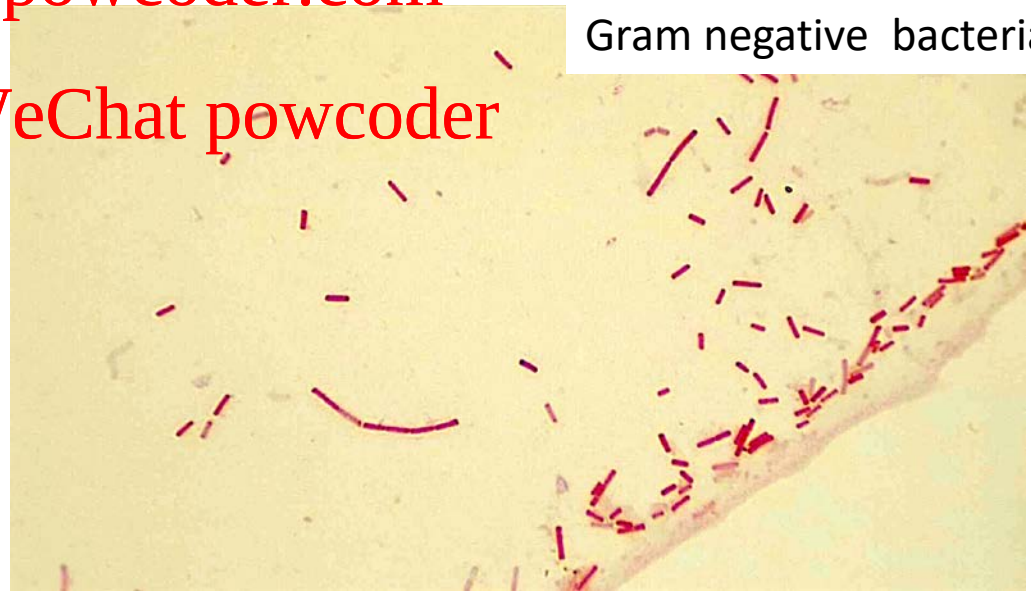
The structure of the cell wall differs markedly between Gram positive and Gram negative bacteria

This difference is one of the most important phenotypes used for classification and identification purposes, e.g. the Gram stain

Gram positive bacteria



Gram negative bacteria



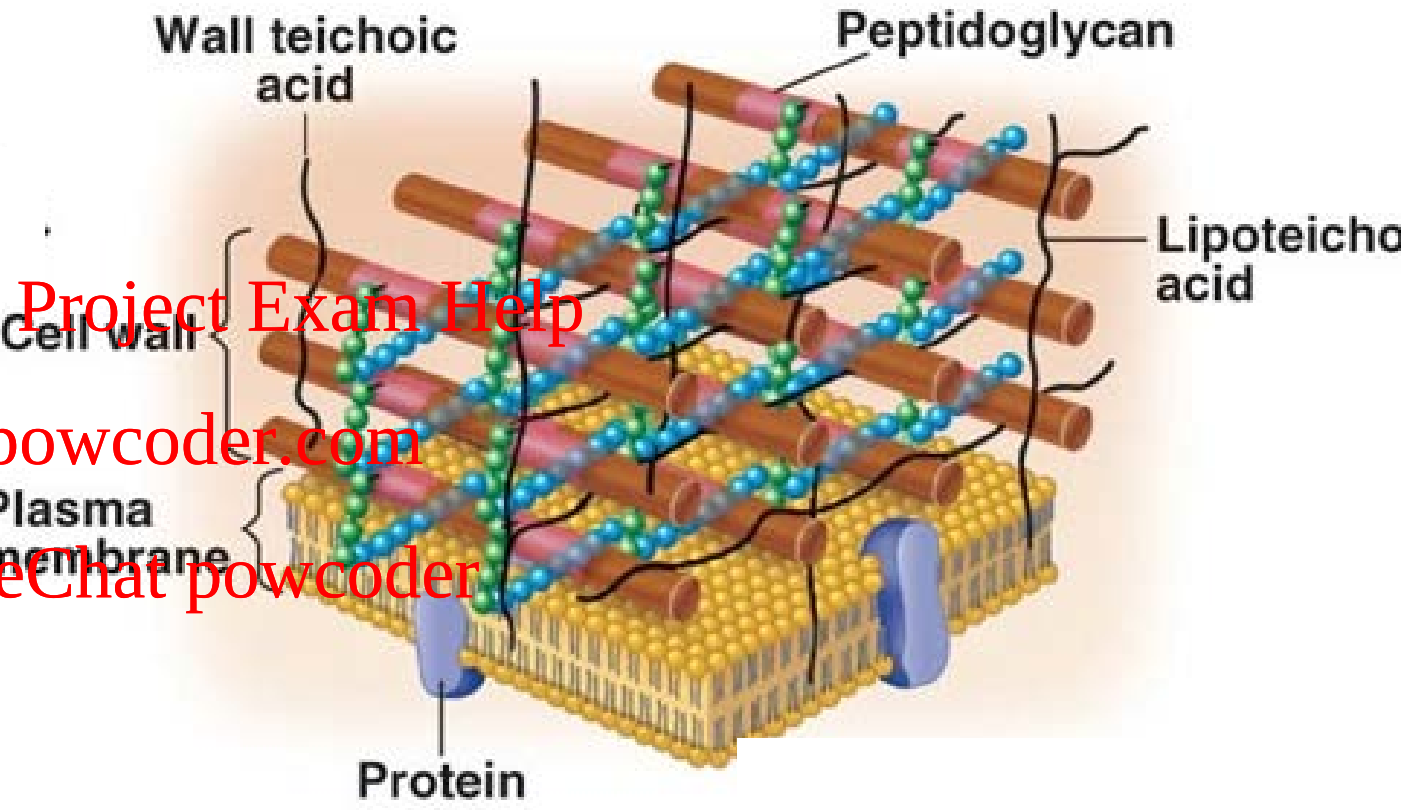
Morphology and structure: bacteria

Gram positive cell wall

Both Gram-positive and Gram-negative bacteria have an in a plasma membrane comprised of a phospholipid bilayer

Gram-positive cells have thick cell walls comprised of several layers of peptidoglycan and two types of teichoic acids.

Gram-positive cells retain the dye of a Gram stain and appear purple under the microscope



Tortora et al 2014

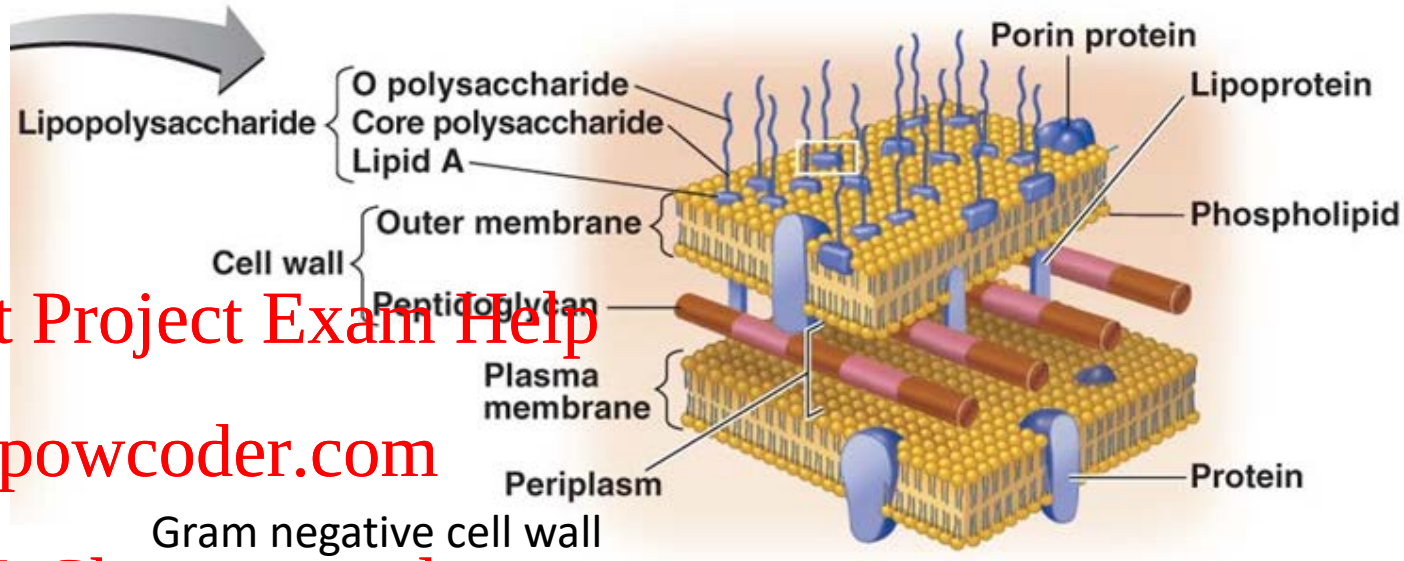
Morphology and structure: bacteria

Both Gram-positive and Gram-negative bacteria have an in a plasma membrane comprised of a phospholipid bilayer

Gram-negative bacteria have walls comprised of a thin layer of peptidoglycan surrounded by an outer membrane.

The outer membrane provides an extra barrier property to gram negative cells

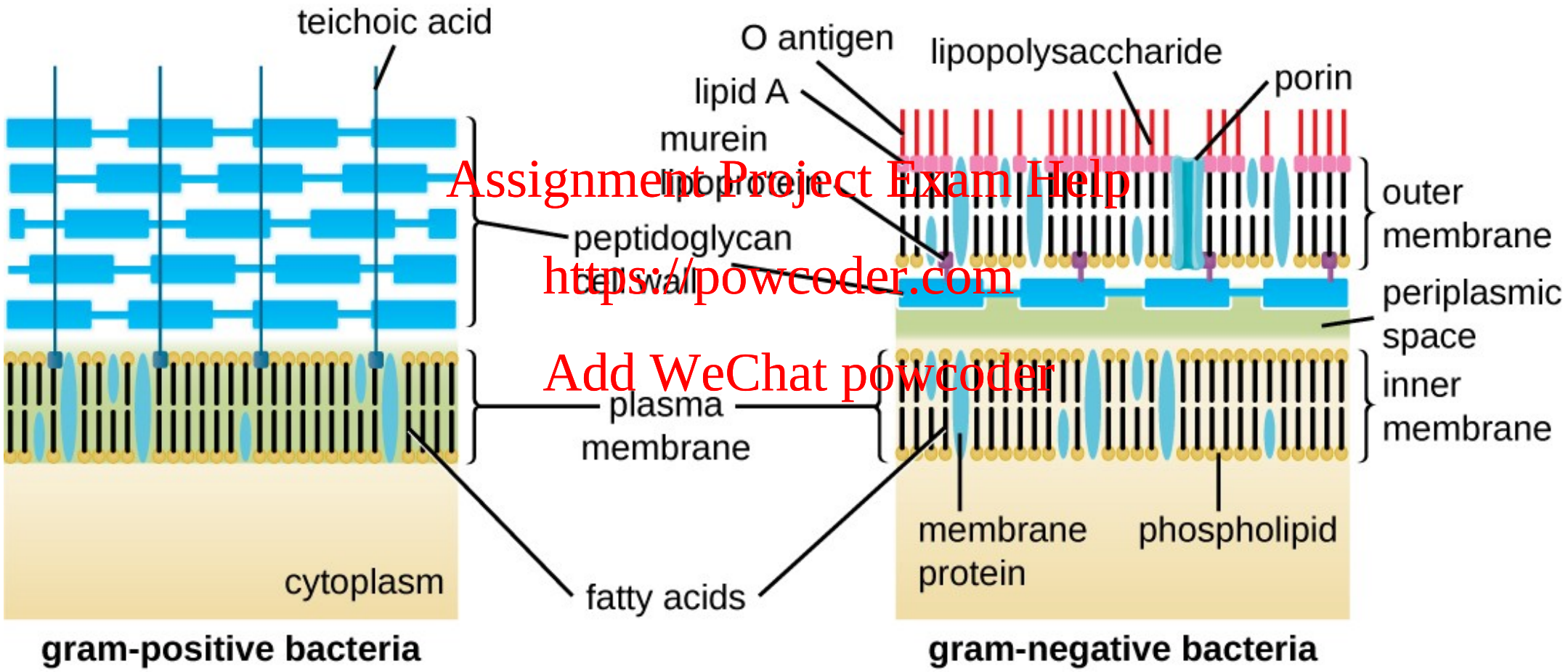
The thin layer of peptidoglycan is insufficient to retain the die of a Gram stain and the cells need to be counter stained. They appear pink under the microscope



Gram negative cell wall

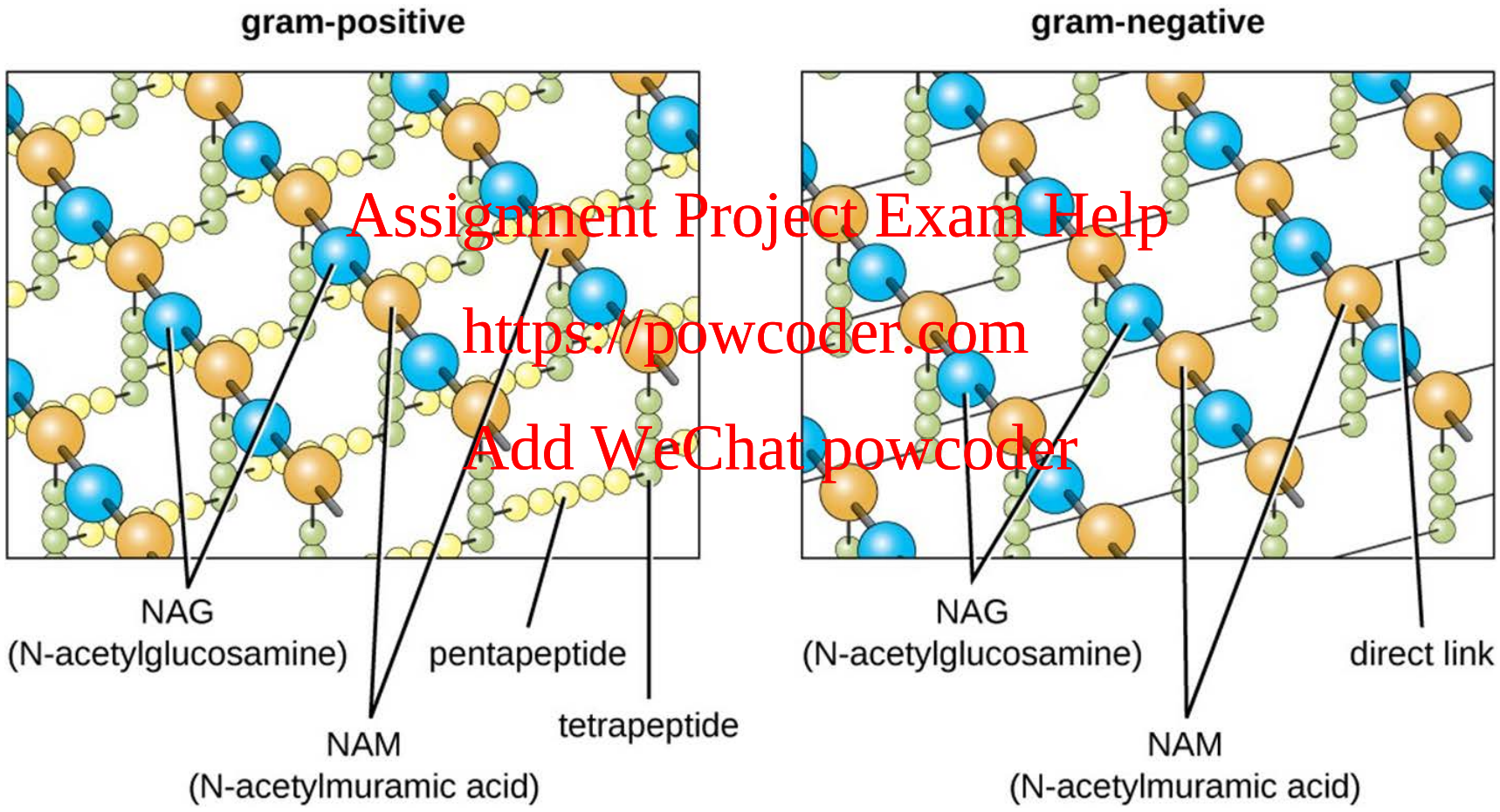
Tortora et al 2014

Difference between Gram positive and Gram negative cell walls



Gram-positive cells have a cell wall consisting of many layers of peptidoglycan totaling 30–100 nm in thickness.

Peptidoglycan

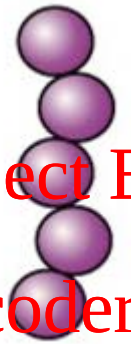


Microbiology, OpenStax

Principles of the Gram stain

Crystal violet stains cells purple

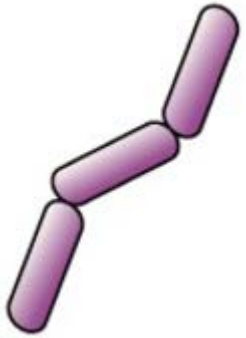
Iodine makes the CV less soluble so it sticks to cells walls

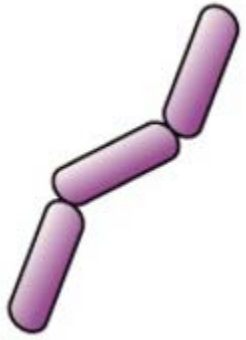


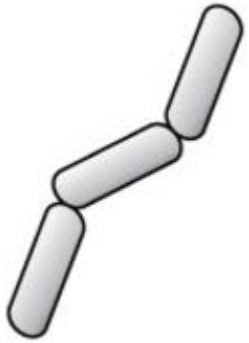
Alcohol washes stain out of Gram negative cells

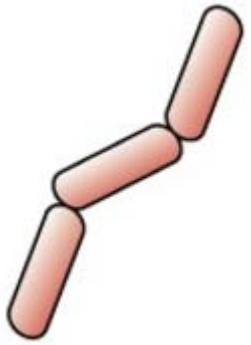
Safranin counterstain allows staining of Gram negative cells

Gram positive







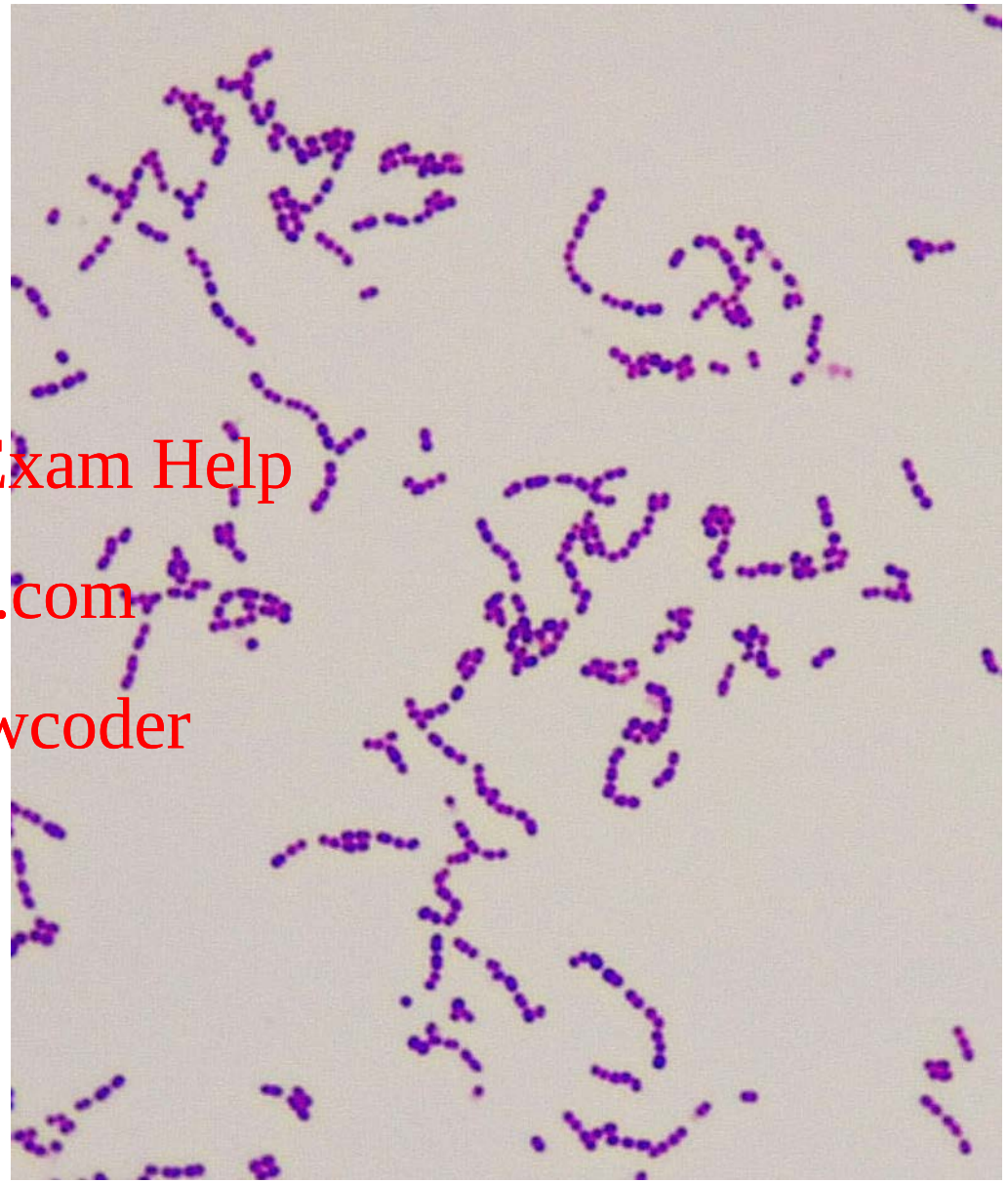


Gram negative

Gram stain

Examine the image of Gram stained bacteria

Use scientific terms to describe the shape and arrangement of the cells



Important genera of bacteria

description	Genera (examples)
Gram-negative, aerobic/microaerophilic, motile, helical	*Campylobacter*
Gram-negative, aerobic, rods and cocci	*Pseudomonas, Xanthomonas*
Gram-negative, facultative anaerobic, rods	*Escherichia, Klebsiella, Salmonella*
Gram-positive, cocci	*Staphylococcus*
Gram-positive endo- spore forming rods and cocci	*Bacillus, Clostridium*
Gram-positive, non-sporing, regular rods	*Lactobacillus, Listeria*
Gram positive, non-sporing, irregular rods	*Corynebacterium, Propionibacterium, Bifidobacterium*

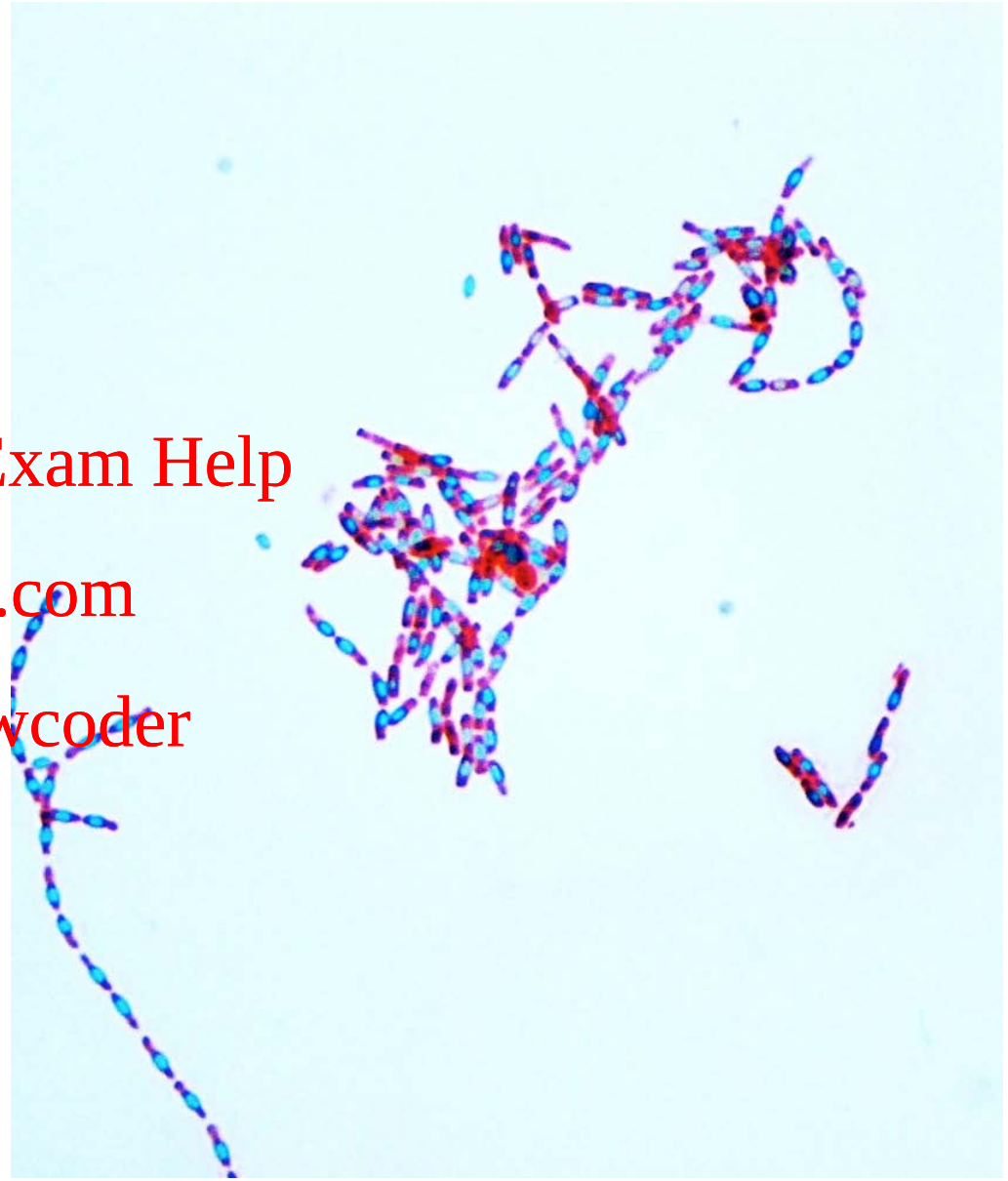
Morphology and structure: bacteria

Some bacteria are able to form endospores.

Endospore-forming bacteria are very important in food microbiology because the spores enable them to survive in the food environment

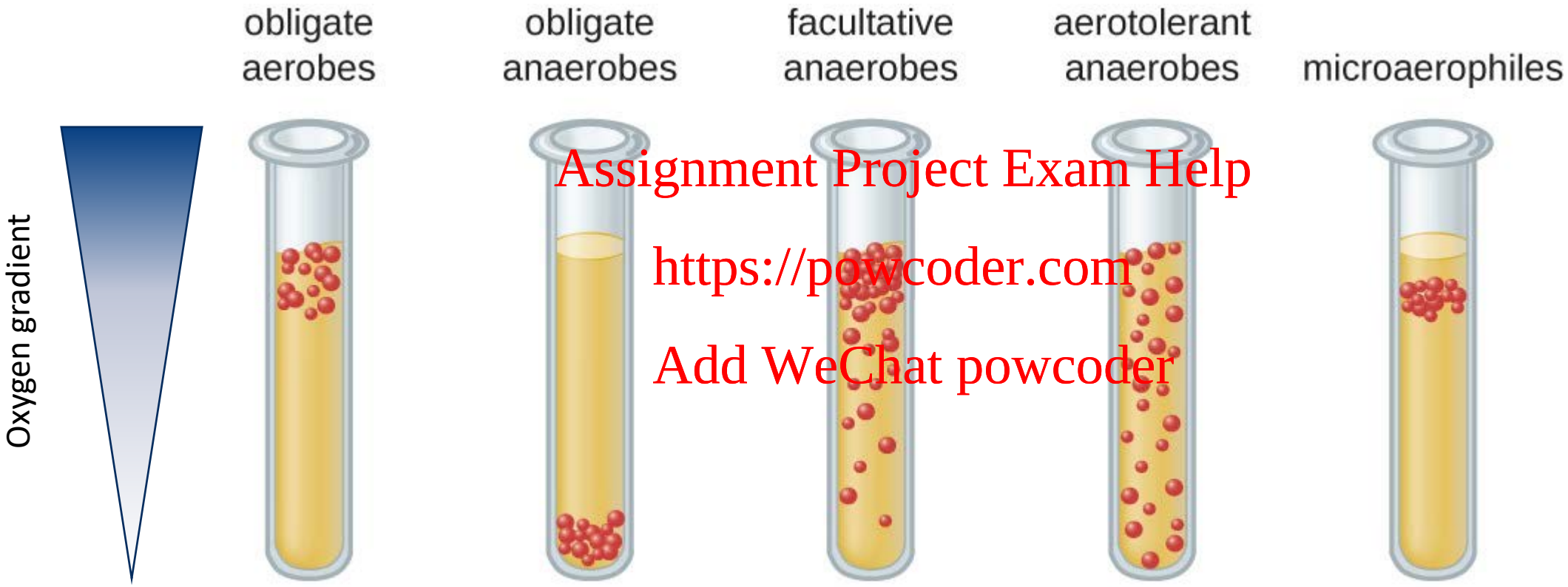
The image shows endospores in *Bacillus* staining bright blue

There is one endospores per cell



MDS/CSU. Gram stain of *Bacillus ciculans*

Optimum oxygen concentration



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Gram-negative, aerobic, rods and cocci	*Pseudomonas, Xanthomonas*
Gram-negative, facultative anaerobic, rods	*Escherichia, Klebsiella, Salmonella*
Gram-positive, cocci	*Staphylococcus*
Gram-positive endo- spore forming rods and cocci	*Bacillus, Clostridium*
Gram-positive, non-sporing, regular rods	*Lactobacillus, Listeria*
Gram positive, non-sporing, irregular rods	*Corynebacterium, Propionibacterium, Bifidobacterium*