Colony Morphology

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Colonial morphology

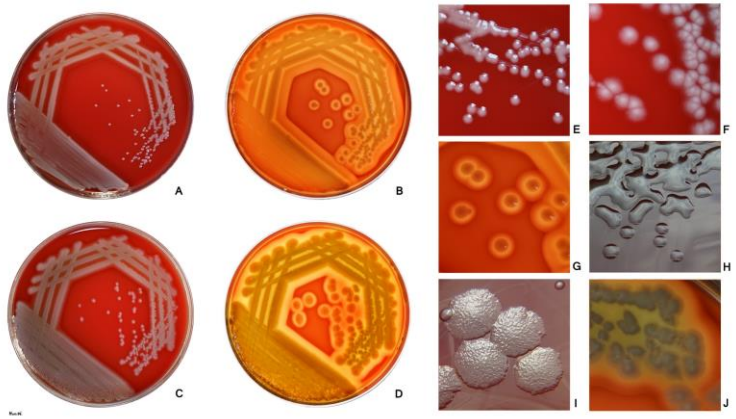
•Bacteria grow as colonies on solid media. A colony is a visible mas of microorganism that originated from a single mother cell. Hence, a colony of bacteria is a clone of genetically alike bacteria.

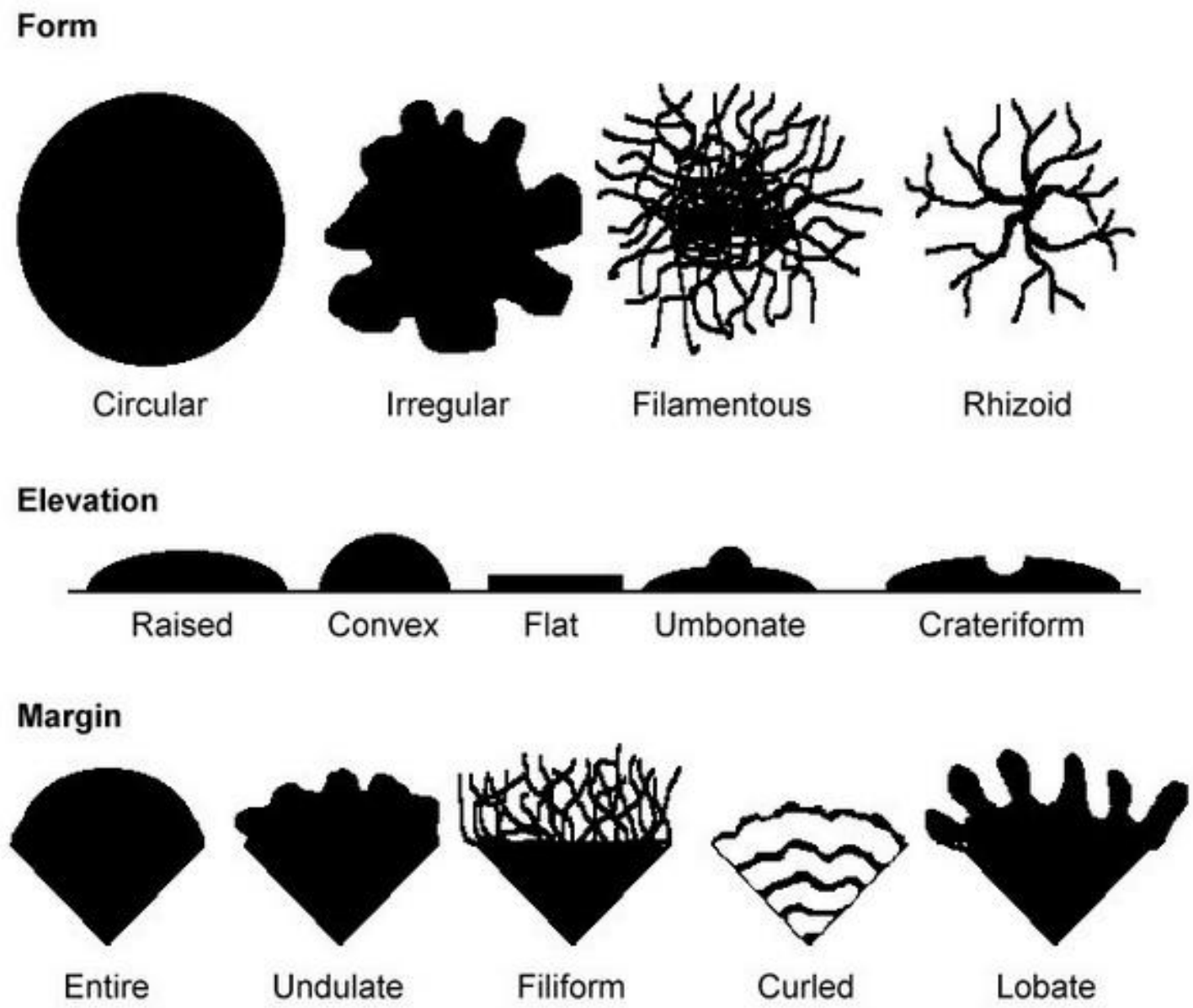
•There are various types of **bacteria and each type produces differently looking colonies**. They vary in color, share, pigmentation, and other characteristics.

•Colony morphology is a way **of identifying bacteria.** By observing the colony of bacteria, the identity of bacteria will be determined.

Colonial morphology

In microbiology, **colonial morphology** refers to the visual appearance of bacterial or fungal colonies on an agar plate. Examining colonial morphology is the first step in the identification of an unknown microbe. The systematic assessment of the colonies appearance, focusing on aspects **like size, shape, colour, opacity, and consistency, provides clues to the identity of the organism**, allowing microbiologists to select appropriate tests to provide a definitive identification.





The image shows the colony morphology of bacteria.

Procedure

•When a specimen arrives in the microbiology laboratory, it is inoculated into an agar plate and placed in an incubator to encourage microbial growth. Because the appearance of microbial colonies **changes as they grow, colonial morphology is examined at a specific time after the plate is inoculated**. Usually, the plate is read at **18–24 hours post-inoculation**, but times may differ for slower-growing organisms like fungi. The microbiologist examines the appearance of the colony, noting specific features such **as size, colour, shape, consistency, and opacity**. A hand lens or magnifying glass may be used to view colonies in greater detail.

Whole colony:

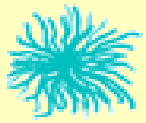
Punctiform

Circular

Rhizoid

Irregular

Filamentous



Edge:

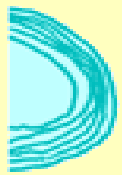
Entire

Undulate

Lobate

Filamentous

Curled



Surface:

Smooth, glistening

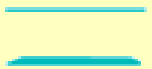
Rough

Wrinkled

Dry, powdery

Elevation:

Flat



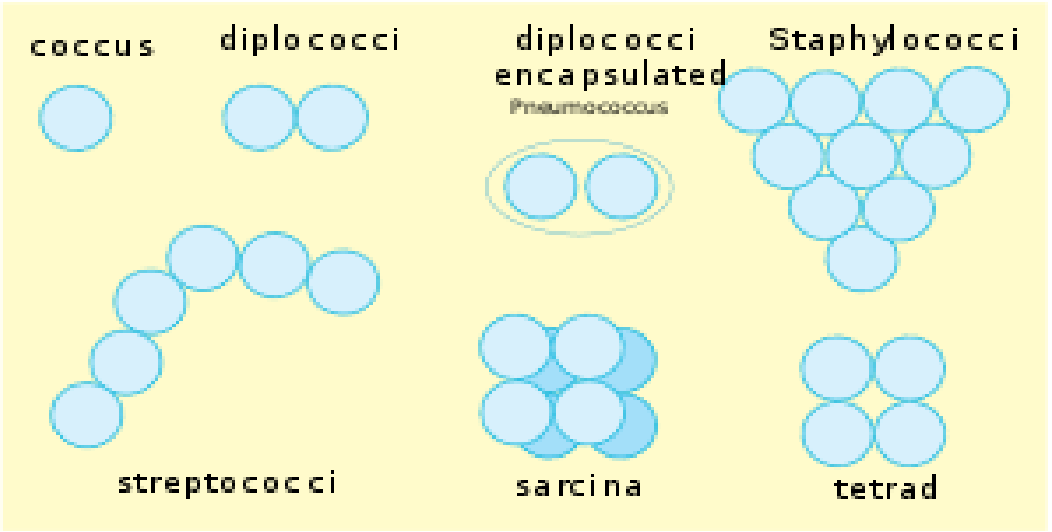
Raised

Convex

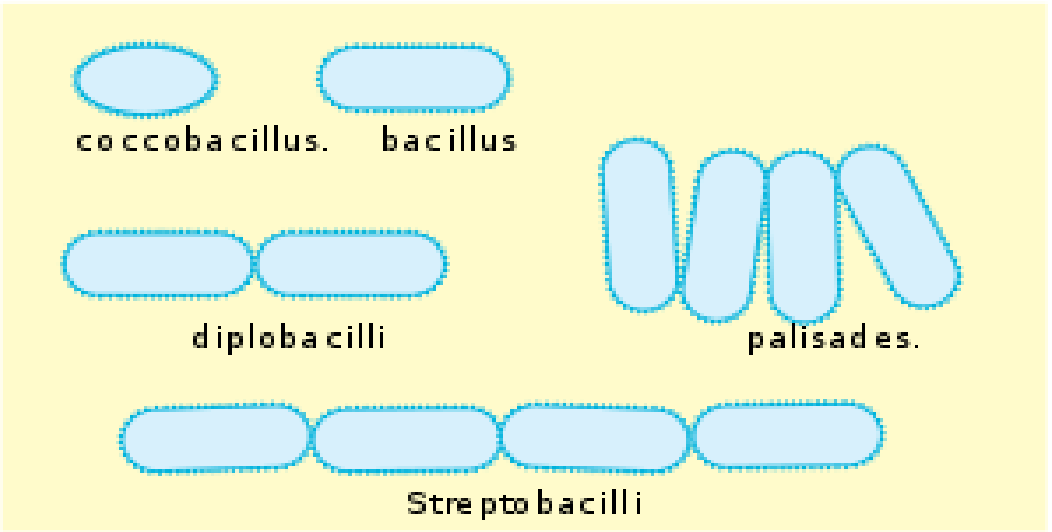
Pulvinate

Umbonate

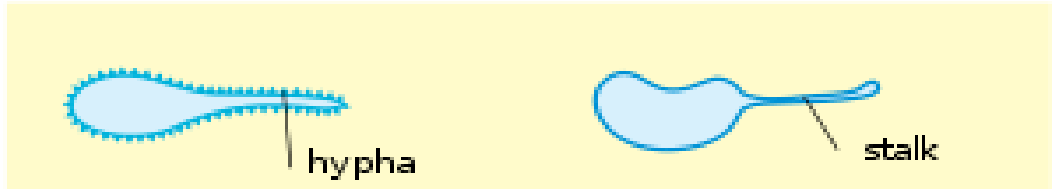
Cocci



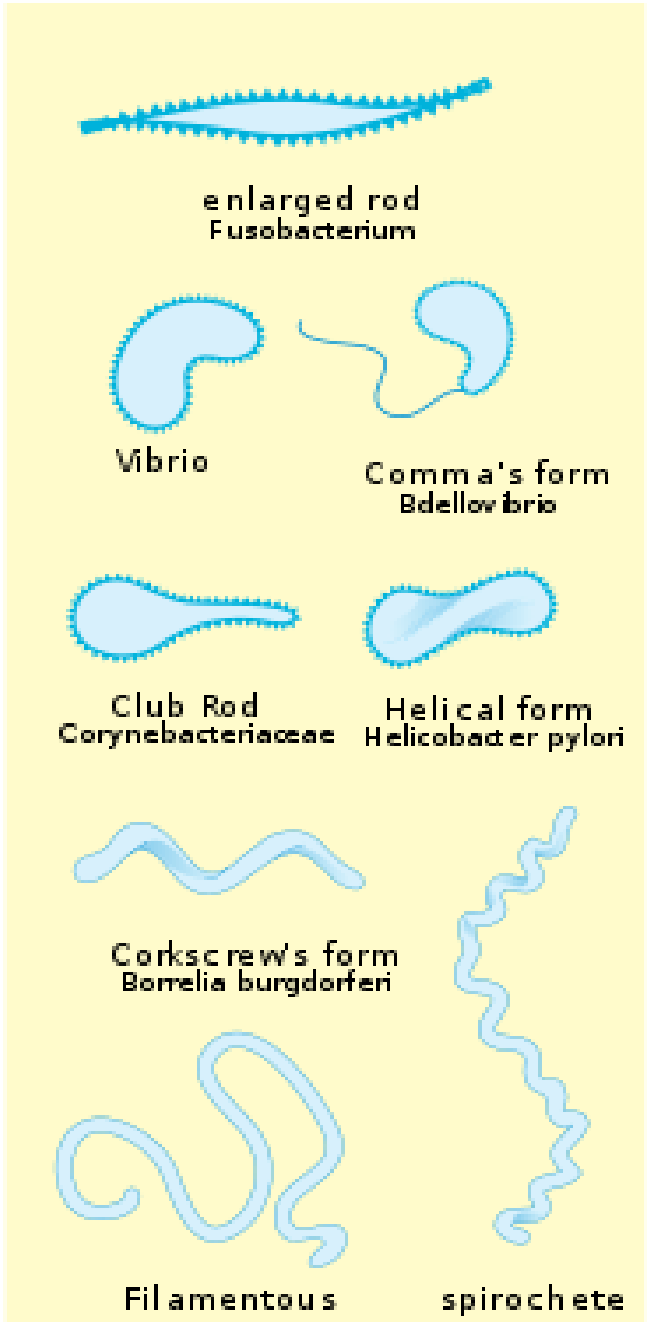
Bacili

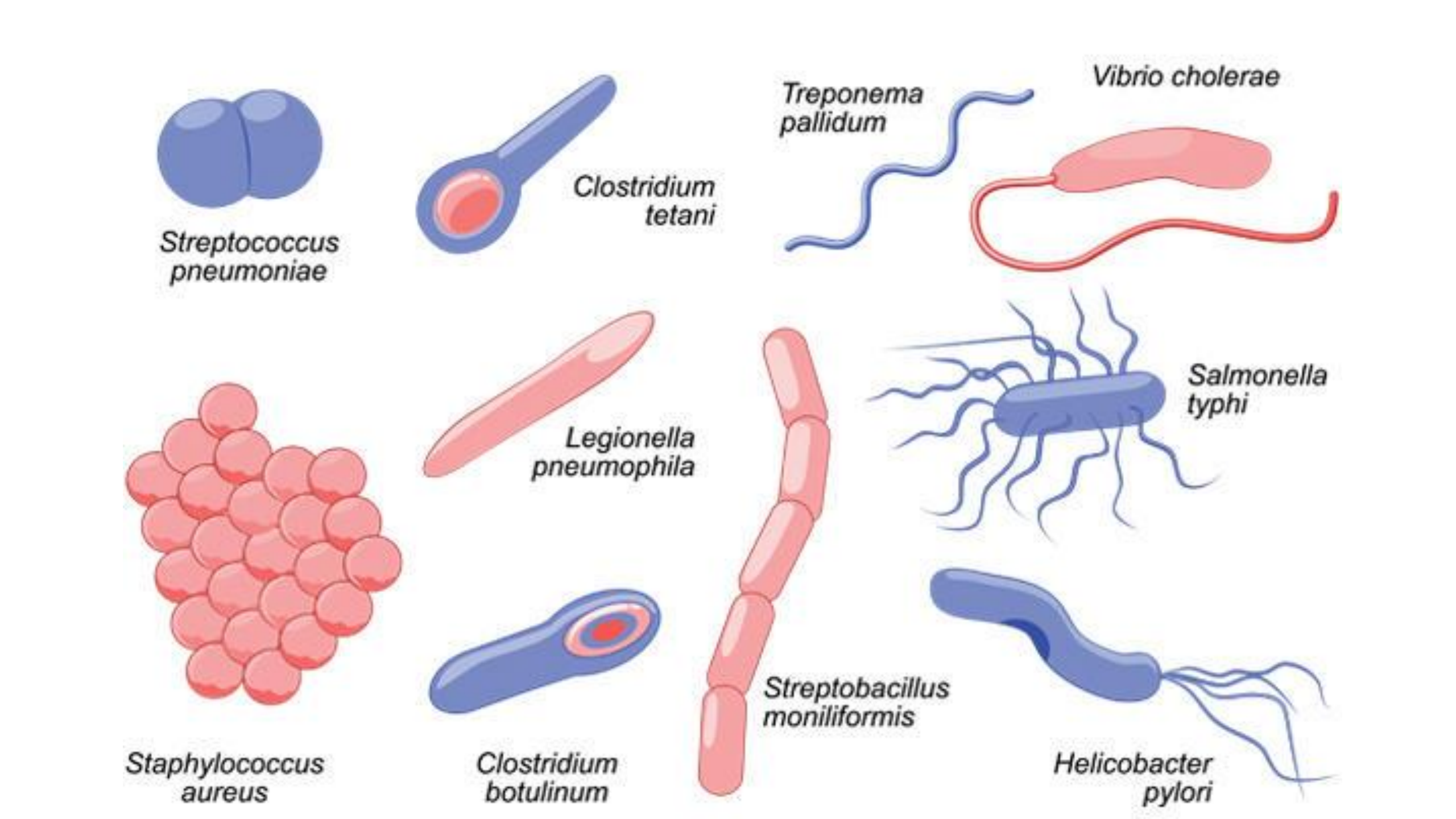


Budding and appendaged bacteria



Others

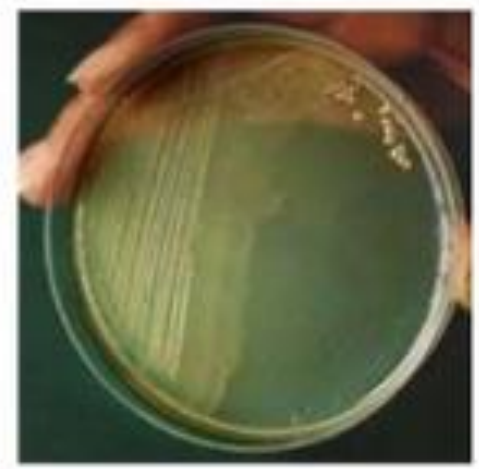


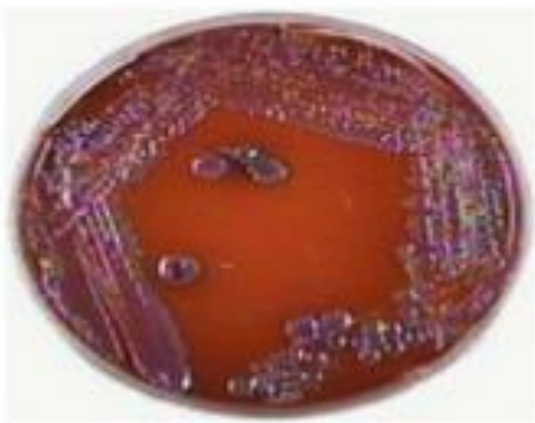

Streptococcus pneumoniae
Clostridium tetani
Treponema pallidum
Vibrio cholerae
Salmonella typhi
Legionella pneumophila
Staphylococcus aureus
Clostridium botulinum
Streptobacillus moniliformis
Helicobacter pylori

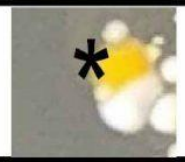
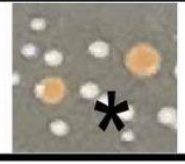
- The **opacity** of a microbial colony can be described as **transparent, translucent, or opaque**. Staphylococci are usually **opaque**, while many *Streptococcus* species are **translucent.** The overall shape of the colony may be characterized as **circular, irregular, or punctiform (like pinpoints).** The vertical growth or elevation of the colony, another identifying characteristic, is assessed by tilting the agar plate to the side and is denoted as **flat, raised, convex, pulvinate (very convex), umbilicate (having a depression in the centre) or umbonate (having a bump in the centre).** The edge of the colony may be separately described using terms like **smooth, rough, irregular and filamentous**. *Bacillus anthracis* is notable for its **filamentous appearance**, which is sometimes described as resembling Medusa's head.

- **Opacity of the bacterial colony**

- Opaque (not clear)
- Translucent (clear)
- Iridescent(shine)





	shape	size	surface	color	opacity	elevation	margin
	circular	medium	smooth	white	translucent	flat	even
	circular	small	smooth	white	opaque	umbonate	even
	filamentous	large	rough	white	opaque	flat	filamentous
	circular	large	rough	white	translucent	flat	even
	circular	medium	shiny	light yellow	translucent	flat	even
	circular	small	smooth	bright yellow	translucent	flat	even
	circular	small	shiny	orange	translucent	flat	even
	punctiform	small	smooth	white	opaque	flat	even

shape	size	surface	color	opacity	elevation	margin
 circular	 small	smooth	 white	transparent	 flat	 even
 punctiform		glistening	 creamy-white	translucent	 umbonate	 wavy
 filamentous	 medium	rough		opaque	 raised	 filamentous
 irregular	 large	wrinkle	 yellow		 convex	
 rhizoid		dull	 orange		 pulvinate	 lobate
			 green			 curled

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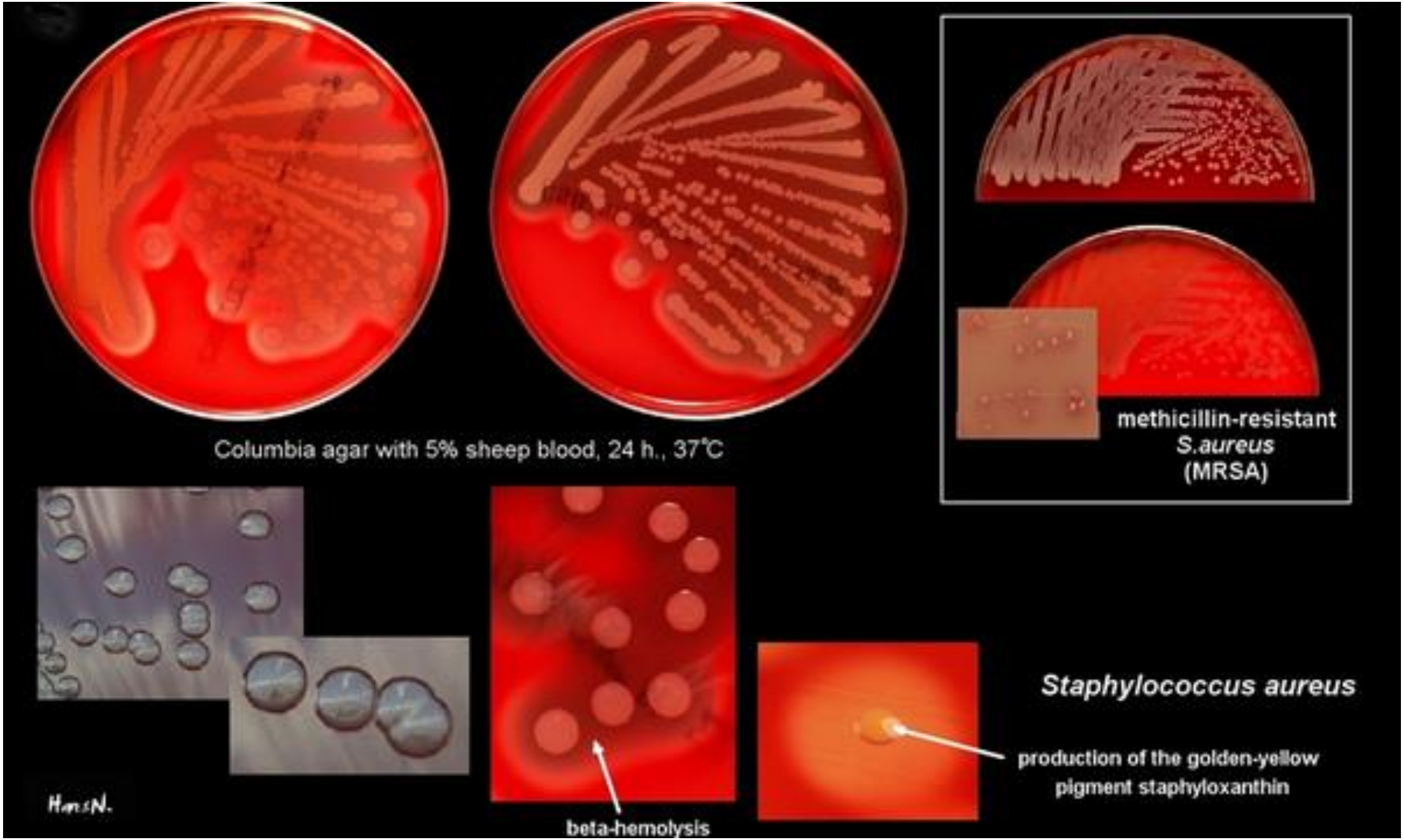
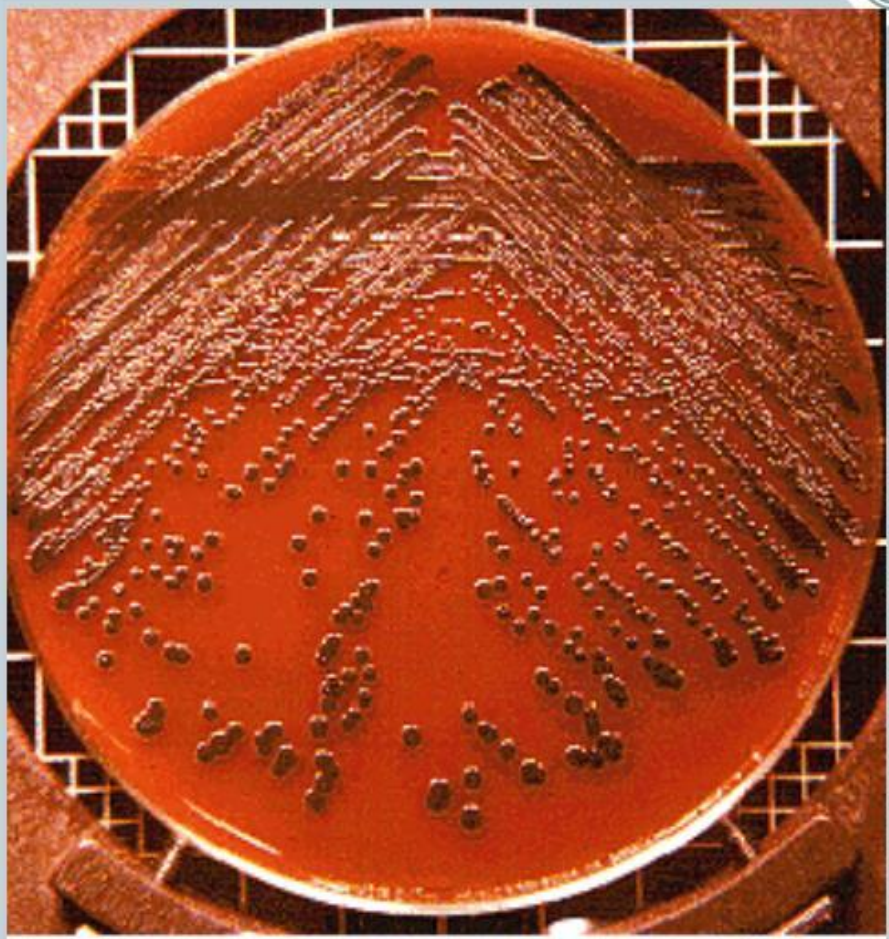
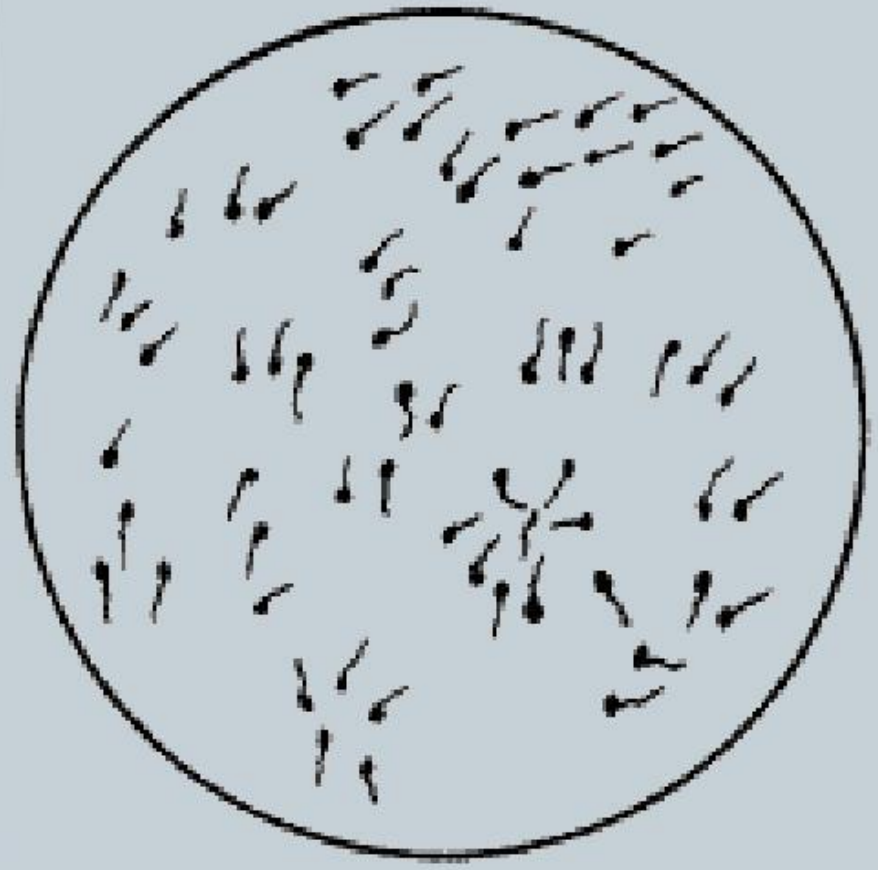
•**Consistency** is examined by physically manipulating the colony with a sterile instrument. It is described using terms like **brittle, creamy, sticky and dry.** ***Staphylococci*** are considered to have a **creamy consistency**, while some ***Neisseria species*** are **sticky**, and colonies of diphtheroid bacteria and beta-hemolytic **streptococci are typically dry**. Bacteria that produce capsules often have a **slimy (mucoid)** consistency.


Columbia agar with 5% sheep blood, 24 h., 37°C
methicillin-resistant
S.aureus
(MRSA)
beta-hemolysis
Staphylococcus aureus
production of the golden-yellow
pigment staphyloxanthin

Gram +ve Bacilli and Colonies



Corynebacterium diphtheriae, mitis
Chocolate tellurite agar



•When certain microorganisms are grown **on blood agar**, they may digest the blood in the medium, causing **visible hemolysis (destruction of red blood cells) on the agar** plate. In colonial morphology, hemolysis is classified into three types:

•**alpha**

•**beta**

•**and gamma-hemolysis.**

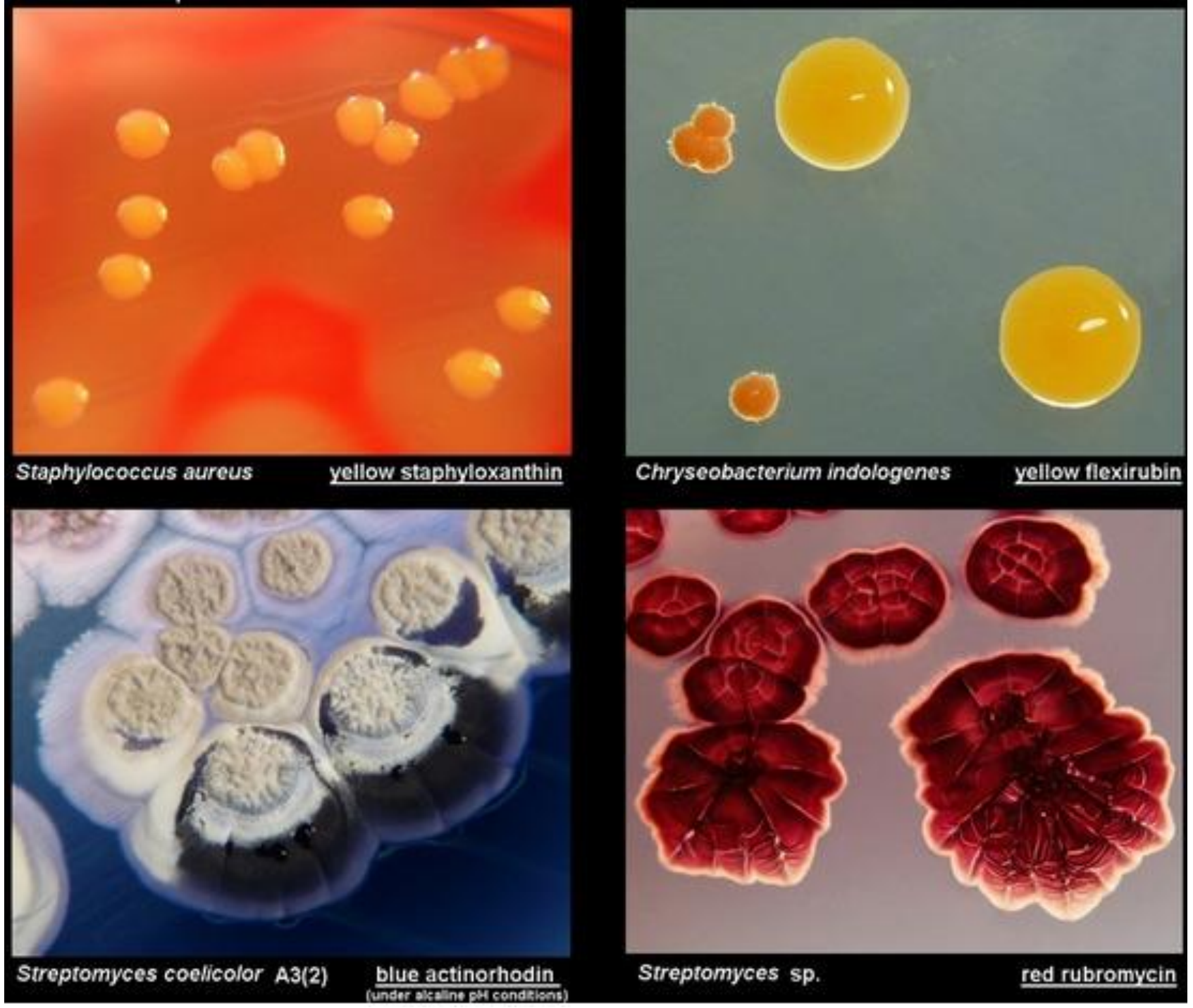
•**In alpha-hemolysis**, the blood is partially digested, causing the area around the colony to turn **green**. **In beta-hemolysis**, the organism digests the blood completely, leaving a **clear area around each colony**. Organisms that do not produce hemolysis are referred to as **gamma-hemolytic**. ***Clostridium perfringens***, which causes gas **gangrene**, is noteworthy for producing a **"double zone"** of both complete and incomplete hemolysis.

•The **odour** of a culture is sometimes considered part of **colonial morphology**.

While intentionally smelling microbial cultures is not advised, some organisms produce **distinctive odours** that can be detected during routine examination of the culture. Among these are ***Pseudomonas aeruginosa***, which has a **grape-like scent;** ***Staphylococcus aureus***, which is said to smell like old **socks;** and ***Proteus mirabilis***, whose scent is alternately described as **putrid** or like **chocolate cake**.

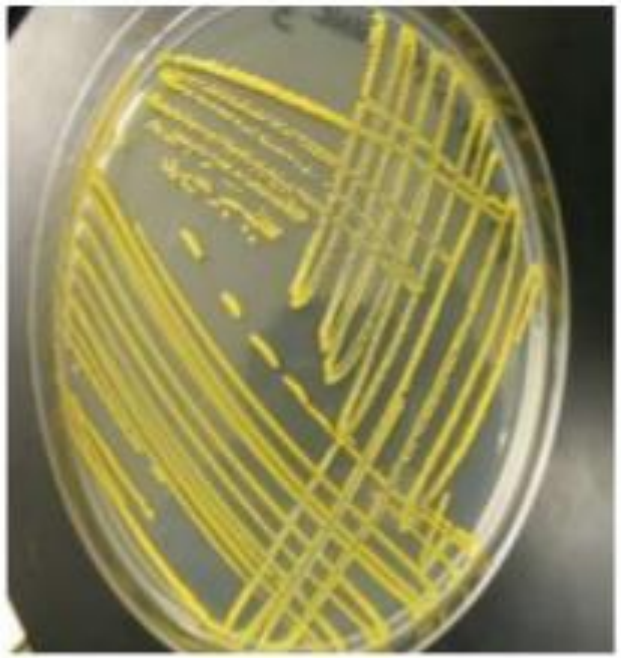
•Other distinctive features of colonial morphology include **motility and the production of pigments**. ***Pseudomonas aeruginosa*** produces the **pigments pyocyanin and pyoverdin**, which give the colonies a **greenish sheen**. Some specimens of ***Serratia marcescens*** produce an **orange-red pigment called prodigiosin**. Organisms with swarming motility, like ***Proteus species***, exhibit concentric waves of growth extending from the inoculation point.

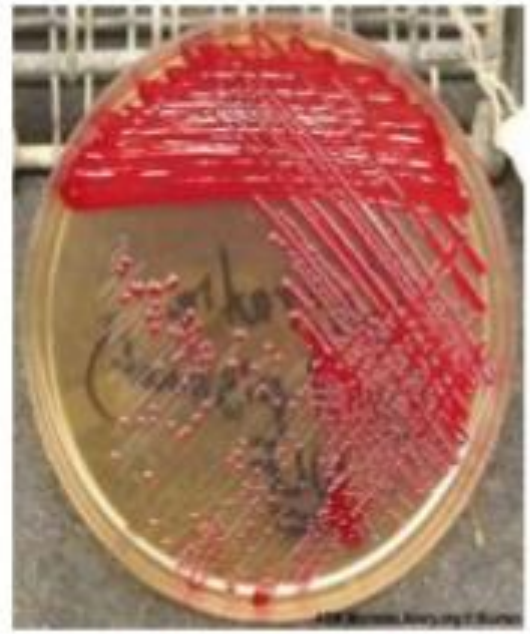
Images of the bacterial colony with a varying degree of pigmentation



- **Colour of the colonies (pigmentation)**

  Some bacteria produce pigment when they grow in the medium.





***Staphylococcus aureus*: large opaque, round, creamy, white to yellowish colonies displaying beta-hemolysis on blood agar**

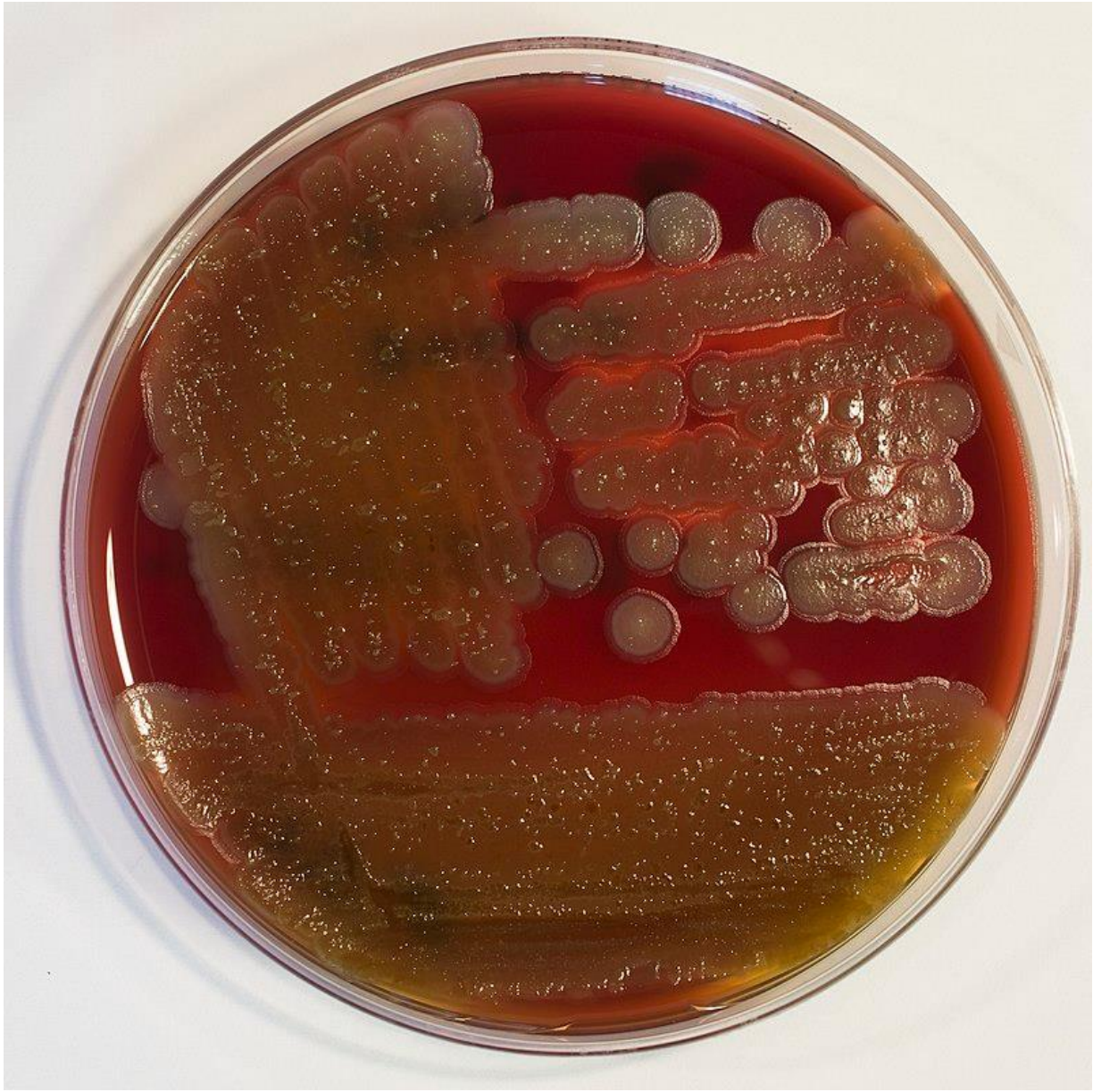
***Streptococcus pyogenes*: small translucent colonies displaying beta-hemolysis on blood agar**

Streptococcus pneumoniae: small colonies with raised edges displaying alpha-hemolysis on blood agar

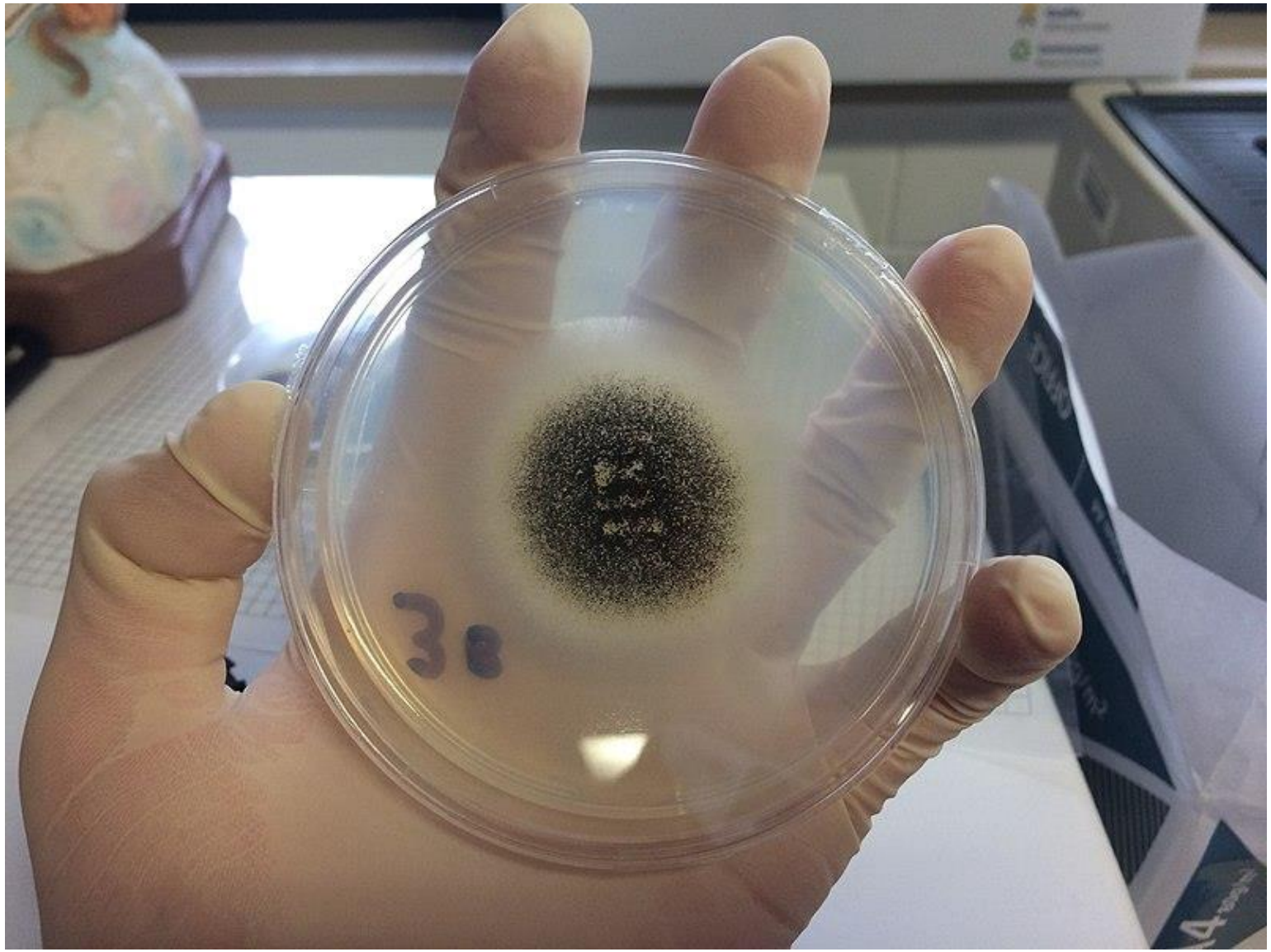
Proteus sp.: swarming behavior on blood agar

Serratia marcescens: red pigmentation: although considered characteristic of the species, only about 10% of specimens produce this pigment

Bacillus cereus: "ground-glass" colonies displaying beta-hemolysis on blood agar



***Aspergillus niger*:** granular colonies with a white edge and central black pigmentation



Escherichia coli

Enterobacter aerogenes

Proteus vulgaris

Salmonella typhimurium

Staphylococcus aureus

MacConkey's Agar

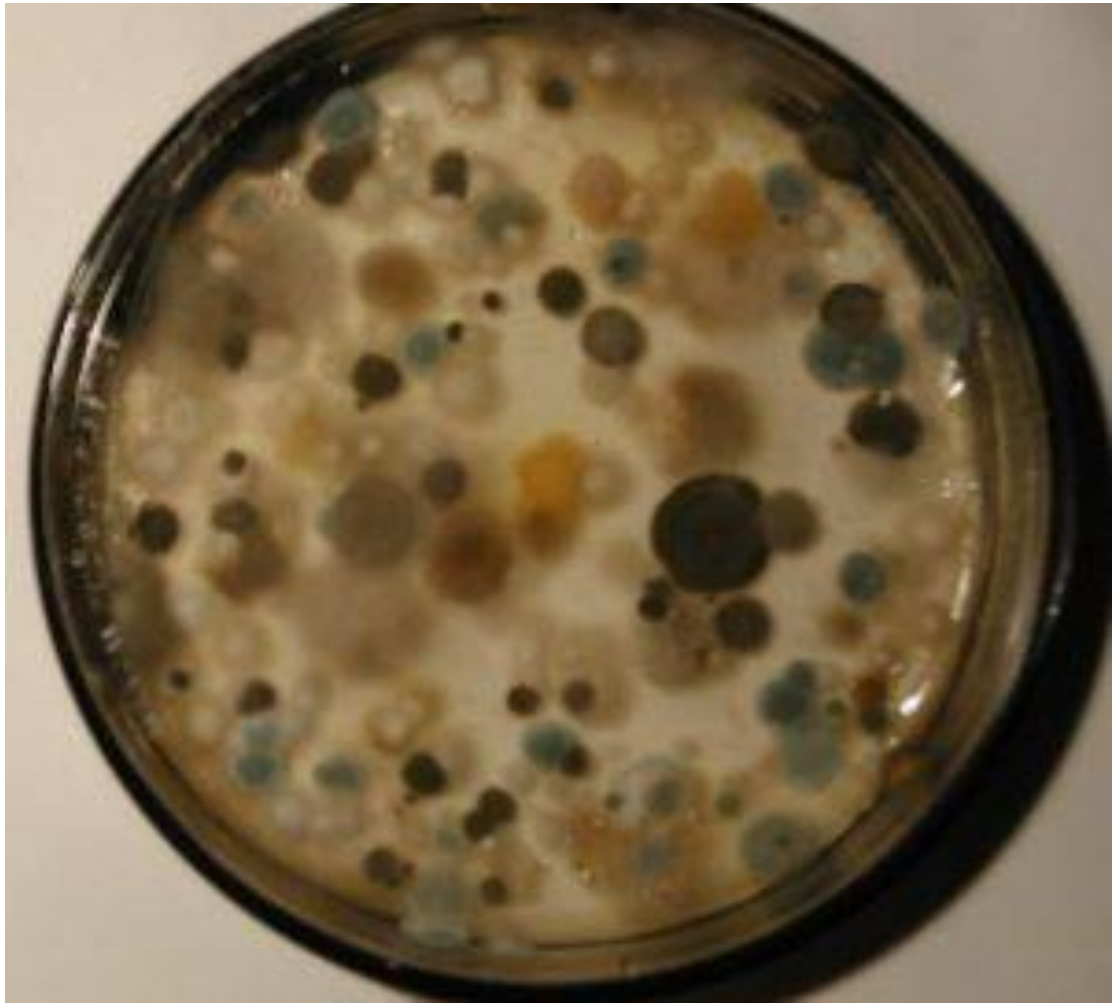
Lactose fermenting colonies

PINK

Non-lactose fermenting colonies

COLORLESS

Yeasts – The colony of yeast, which is a type of fungi, is somewhat similar to that of the colony of bacteria. They can grow as a white patch with a glossy surface.



A petri dish containing mold growth

Factors affecting the colony morphology of bacteria

- **Type of media –** The cultural characteristics of bacteria can be affected by the type of media and the nutrient it contains. Keep in mind that some types of media are more nutritive than others. The more nutritive the media is the more it encourages hearty growth. On the other hand, some types of media can restrict growth.
- **Temperature –** Some bacteria grow more rapidly at body temperature while others are weak at room temperature. More so, some bacteria form pigment under favorable temperature.
- **Length of time –** The incubation time/period may affect the colonial characteristics and colonial size of bacteria.
- **Presence of other organisms –** The growth of bacteria can be affected by the presence of other organisms.

Interpretation

•Colonial morphology serves as the first step in the identification of microbial species from clinical samples. Based on the visual appearance of the colonies, microbiologists can narrow down the list of possible organisms, allowing them to select appropriate tests to provide a definitive diagnosis. For example, if a microbiologist observes colonies that resemble a ***Staphylococcus* species**, they may perform a catalase test to confirm that it belongs to the genus ***Staphylococcus*,** and a coagulase test to determine whether it is a coagulase-negative staphylococcus or a more pathogenic species, such as ***S. aureus*.**

•Observation of **hemolysis** is useful in the identification of bacteria, especially ***streptococci***, which are classified on the basis of their hemolytic reactions. For example, *Streptococcus pyogenes*, which causes strep throat and scarlet fever, displays beta-hemolysis, while *Streptococcus pneumoniae*, which can cause pneumonia and meningitis, displays alpha-hemolysis. The highly pathogenic ***S. aureus*** classically displays beta-hemolysis, while *Staphylococcus epidermidis*, part of the normal skin flora and an occasional opportunistic pathogen, does so weakly or not at all.

•Although automated techniques like MALDI-TOF (Matrix-assisted laser desorption/ionization time-of-flight (**MALDI-TOF**) are increasingly used to identify microorganisms in clinical laboratories, **colonial morphology remains useful to distinguish potential pathogens**, which must be identified, **from normal flora**, for which definitive identification is unnecessary, and to confirm identification when automated techniques give inconclusive results.