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MICRORGANISMS & BIOTECHNOLOGY

Microorganisms & Biotechnology.

→ e.g/ virus, bacteria and fungi

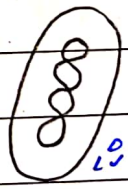
VIRUSES

→ smallest living organism, can only be seen using a micro-scope (electron)
→ considered both living and non-living, borderline of living & non-living things

living
* contain nucleic acid
* reproduce

non-living:
* don't show any life activity outside the host cell
* can crystallize in unsuitable conditions & life for years until conditions suitable resurface

→ general structure:
* outer protein coat — units of repetitive protein : Capsomere (plural: capsid)
* genetic molecule — inclosed by capsid
  - DNA — double stranded — DNA virus e.g/ Bacteriophage
  - RNA — single stranded with an enzyme 'reverse transcripture' — RNA virus. e.g/ HIV
* exist in various shapes e.g/ rod shaped, polyhedral, spherical, tad pole like
* 10 – 100 times smaller than bacteria



→ for existence & reproduction it is dependant on host which is any other living organism
→ virus benefits and host is harmed
  - b/c of which it is strictly parasite
→ viruses are host-specific organisms

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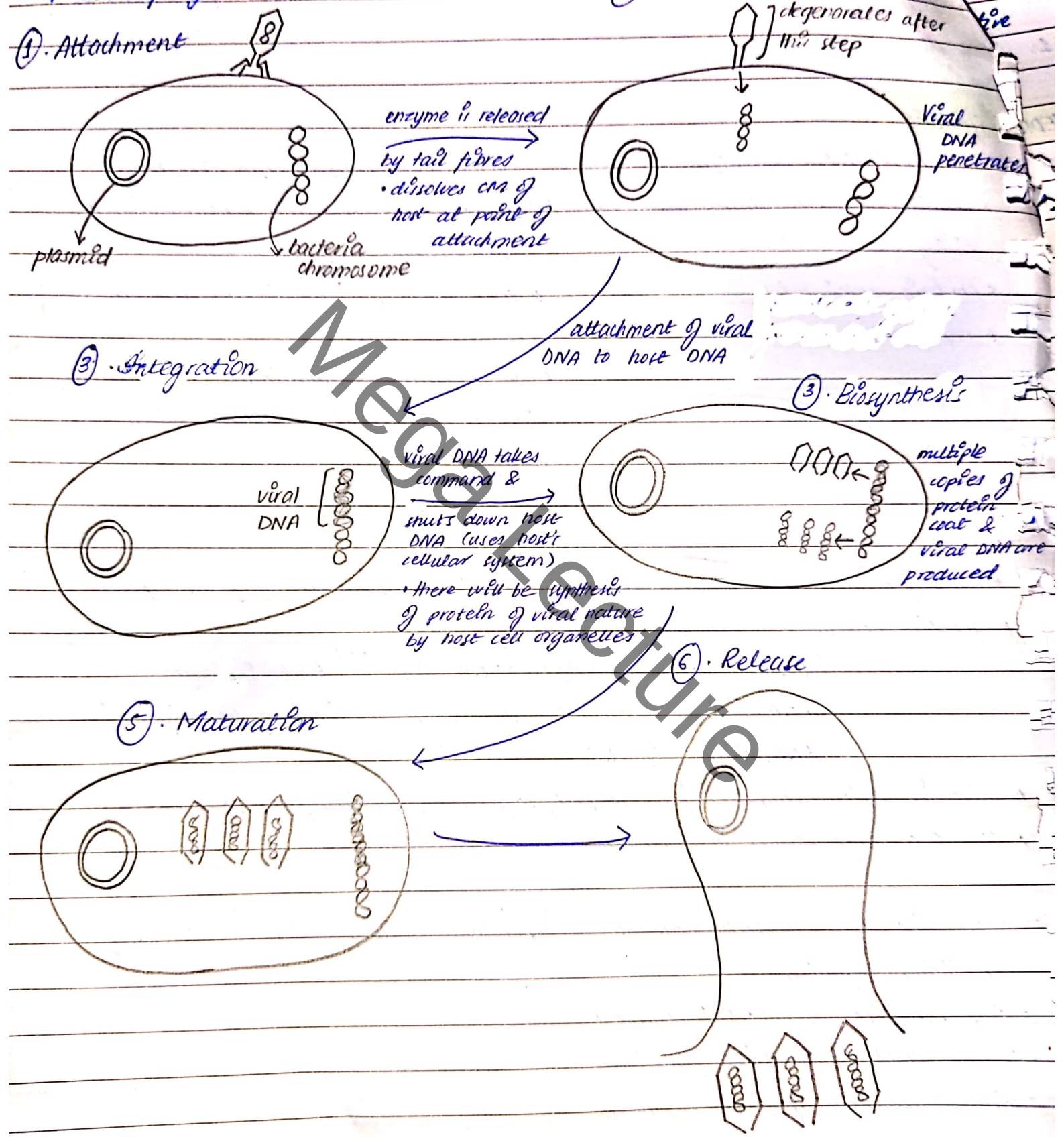
→ the life cycle of a virus:
e.g/ bacteriophage



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viruses are also known as 'pathogens'
↳ all disease causing organisms

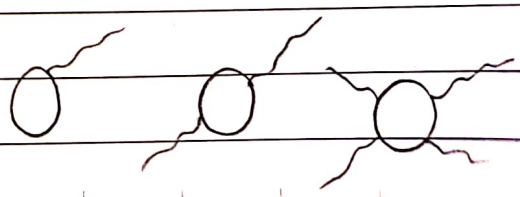
→ they can develop resistance against medicine
↳ can change their genetic makeup
→ fast growth time
↳ a very serious threat as pathogens to living organisms

→ infections:
e.g/ In humans:
* influenza
* measles
* chicken pox
* ~~AIDS~~ AIDS
* herpes

In plants:
* tobacco mosiac (sugar cane)
* leaf curl virus (cotton)

BACTERIA

→ unicellular
→ absence of nuclear membrane (Prokaryotae)
→ DNA is embedded in cytoplasm: nucleoid
→ absence of membraned organelles in cytoplasm e.g/ mitochondria, vacuole [dispersed randomly throughout]
→ single chromosome
→ cell membrane + cell wall
↳ combination of protein + a carbohydrate ⇒ Peptidoglycon
→ presence of plasmids - may contain
↳ circular ring of DNA
↳ contains information to produce a chemical
↓
Antibiotics
→ flagellum / flagella (may or may not have)
↳ helps to locomote within the environment



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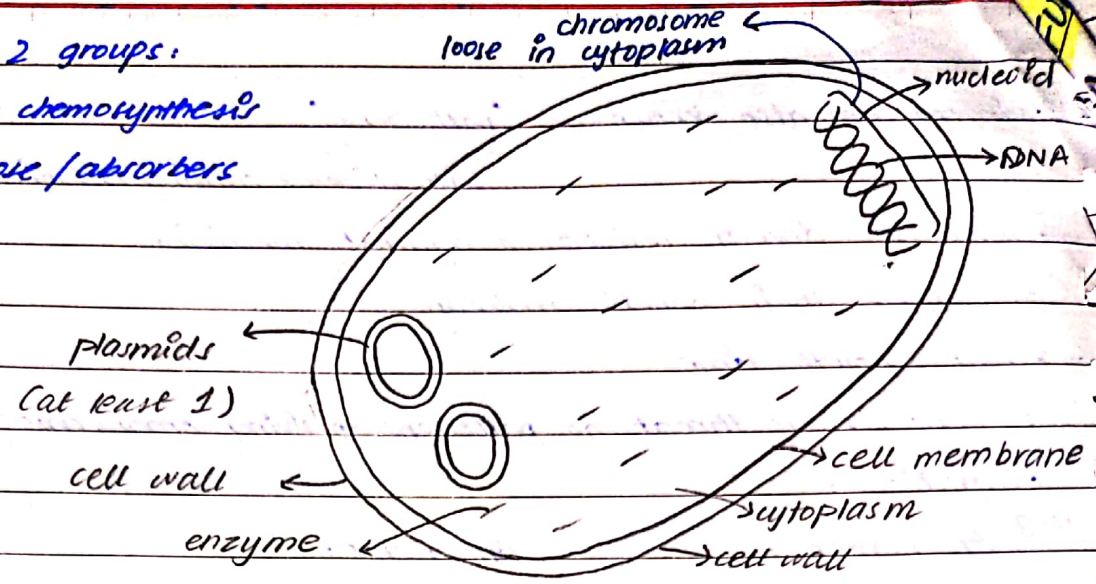
→ can be divided into 2 groups:

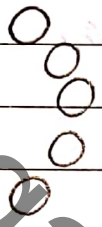
* Autotrophs — perform chemosynthesis
* Saprophytes — decompose / absorbers



→ come in different shapes

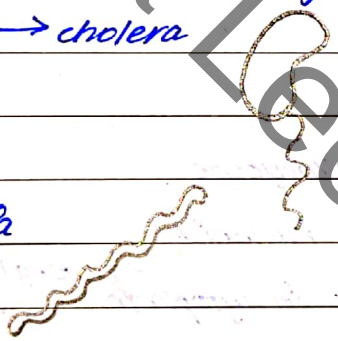
→ presence of ribosomes

e.g/ spherical → coccus → cocci



rod like → bacillus → bacilli → yoghurt making

comma → vibrio → vibrios → cholera



spiral → spirillum → spirilla

→ they respire aerobically an anaerobically

→ sexually reproduce by binary fission

→ importance:

* some are pathogenic — they cause disease
* some are involved in nutrient cycles
* some are exploited by humans in food production & biotechnology

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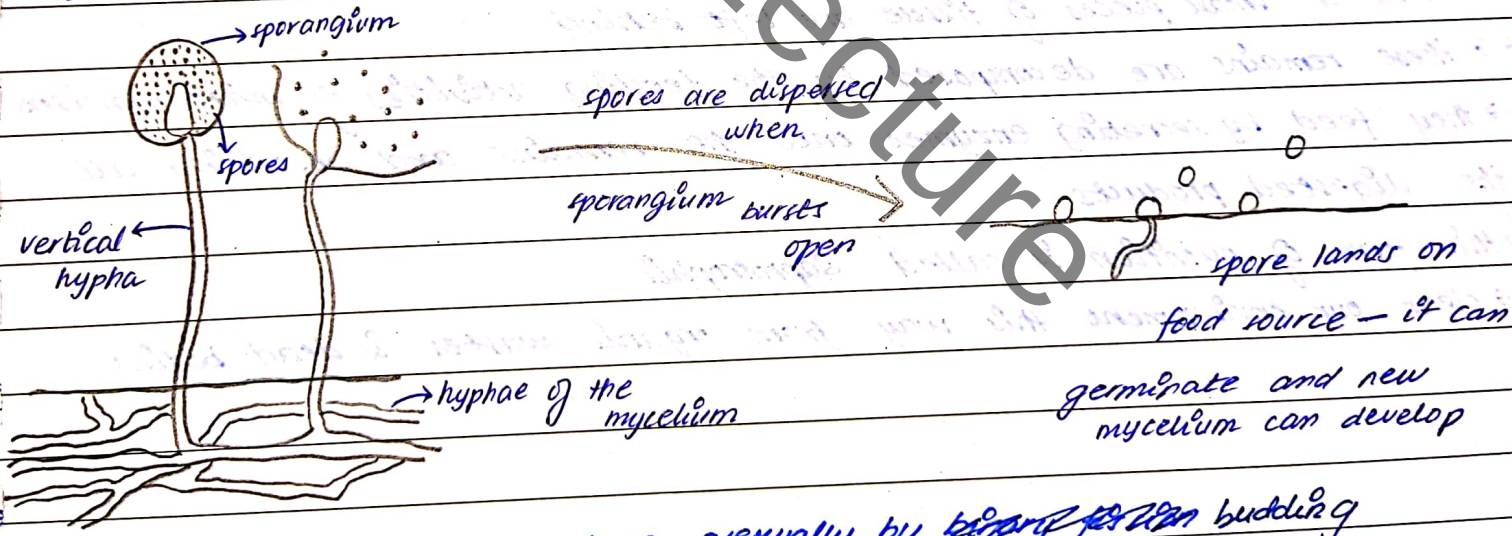
unicellular or can be multi-cellular
↓ yeast ↓ bread mould

→ multicellular forms consist of thread like structures called hyphae
→ are woven together to make the vegetative body of a fungus called mycelium
→ each hypha consists of a cell wall made of chitin
→ one or more nucleus may be present along with other organelles
→ mode of nutrition is heterotrophic
→ do not contain chlorophyll/chloroplast
→ food storage is generally in the form of lipids & glycogen
→ all of them require food & water
→ grow in almost every habitat imagineable as long as there is some type of organic matter present & environment is not too extreme
→ diverse group, numbered species is somewhere b/w 69,000 to 100,000 (estimated 1.5 m in total)



→ single-celled yeasts reproduce asexually by ~~binary fission~~ budding
→ but all others reproduce by the production of spores

→ importance :

* decomposers & play an important role in nutrient cycles
* their decomposing action may destroy animals
* mould fungi consume food which may otherwise be eaten by humans
* may themselves be a source of food e.g/mushrooms
* used in biotechnology

DECOMPOSITION & ROLE OF MICRORGANISMS IN THE PROCESS

→ when an organism dies, the nutrients in its body are returned to the environment to be reused
→ they are recycled by a series of processes
→ first ones to appear are usually scavengers which break up the body into more manageable pieces and eat some of it
→ blood or small pieces of tissue are left behind
→ these remains are decomposed by the feeding activities of microorganisms
→ they feed by secreting enzymes onto the remains and absorbing all the digested products
This form of nutrition is called Saprotrophic
→ clean our environment this way from organic wastes & dead bodies

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FOOD BIOTECHNOLOGY

Bread-making

→ involves 3 steps: 1. Kneading 2. Fermentation 3. Baking

1 → food, water, salt, sugar and yeast are mixed up thoroughly, it makes dough

2 → dough is placed in molds and left at warm temperature for 2-3 hours

2 → during this process anaerobic respiration of yeast produces CO_2 and alcohol

3 → the dough is treated at high temperatures

3 → the high temperature causes CO_2 to expand and escape from the dough causing the dough to rise and soften

3 → high temperature also kills the yeast & hardens the outer crust which maintains shape of bread

Beer making / Alcohol:

→ soak seeds in water and allow them to germinate for 2-3 days

→ roast the germinated seeds and grind them

→ add hot water to the ground grains, it makes 'wort'

→ add yeast in it which converts sugar into alcohol

sugar
↓
yeast cell — fermentation → ethanol (alcohol) + CO_2
↓
energy (ATP)

$$C_6H_{12}O_6 \xrightarrow{\text{yeast}} C_2H_5OH + CO_2$$

→ as the yeast respires, it produces CO_2
→ it escapes from the medium and produces foam at the top of the 'wort'
→ it creates anaerobic conditions

Yoghurt production

→ yoghurt is milk that has been soured by fermentation of lactose and thickened by denaturation of proteins
→ milk is pasteurized at 60°C for 30 minutes
↳ it is now free from dangerous bacteria ~~and therefore does not contain proteins~~
→ add starter culture into it which is made up of streptococcus and lacto bacillus ~~bacteria~~
→ streptococcus is an aerobic bacterium which absorbs oxygen from the milk and produces anaerobic conditions
→ lacto bacillus converts milk sugar into lactic acid – it drops pH of milk which causes milk protein to solidify → preservation → gives texture
→ the curdled milk is called yoghurt

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Cheese production:

→ in pasteurized milk, lactobacillus is added *
→ milk solids are pressed to remove water
→ other bacteria & fungi give flavour to cheese
* conversion of milk sugar (lactose) to lactic acid causes pH to fall
this makes milk protein denature coagulate, and the milk separates into curds (solid) and whey (liquid)
↳ help preservation
↳ denaturation of proteins
the process is aided by rennin and chymosin

Penicillin:

→ nutrient medium and starter culture are added into a fermenter
→ favorable conditions of pH, temperature are maintained
→ oxygen is supplied to allow aerobic respiration {sterile air is provided to avoid contamination of contents of the fermenter in case of entry of unwanted microorganisms}
→ the fungus grows maximum in aerobic conditions
→ after maximum growth is acheived, conditions are made unfavorable for growth (oxygen is stopped)
→ under unfavorable conditions, fungus released antibiotics
→ the contents are removed and purified anti-biotic is extracted

Biogas production : Bacteria : Biogas :
Cheese : Bacteria : Cheese :
Yoghurt : Bacteria : Yoghurt :
Baking : Yeast : Bread :
Brewing : Yeast : Beer :
Winemaking : Yeast : Wine :

INDUSTRIAL BIOTECHNOLOGY

fermenter: a vat or container made up of non-corrosive material used for fermentation

* grow bacteria & fungi in large amounts

→ parts of a fermenter & their uses:

01. **Cooling jacket**

* during fermentation heat is released which increases temperature of culture medium
* ↑ temperature can effect the enzyme action and hence the growth of micro-organisms
* it is used to lower down temperature of culture medium

02. **Impellers**

* are connected to the motor/turbine which rotates them and mixes the contents of the fermenter thoroughly

03. **Air sparger**

* allows air to be thoroughly passed through the contents mixing with them evenly * O_2 sufficient supply as well

04. **Inlet**

* used for adding nutrient medium and starter culture

05. **Outlet**

* harvest is collected through the opening

06. **Biosensors**

* used to monitor changes in pH, temperature & pressure. etc.

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continuous process: nutrients are added continuously through the inlet without stopping the process
harvest is collected periodically at the end

batch process: culture medium (nutrients) and starter culture are added once and after the product is made, the process is stopped & product removed
+ fermenter can be used for many products
+ if contamination occurs, only single batch is destroyed
+ maintainence of condition is easier
- it wastes time } the need to wash fermenter after every
- expensive } use

*sterile air is essential for the microorganisms in the fermenter & to provide oxygen

e.g/ vinegar made by converting ethanol into ethanoic acid using microbes
ethanol, microbes and oxygen are mixed
e.g/ insulin, penicillin
e.g/ household farm/waste can be put into the fermenter, anaerobic bacteria produce methane as the waste is broken down

*antibiotics can be used to treat only bacterial infections