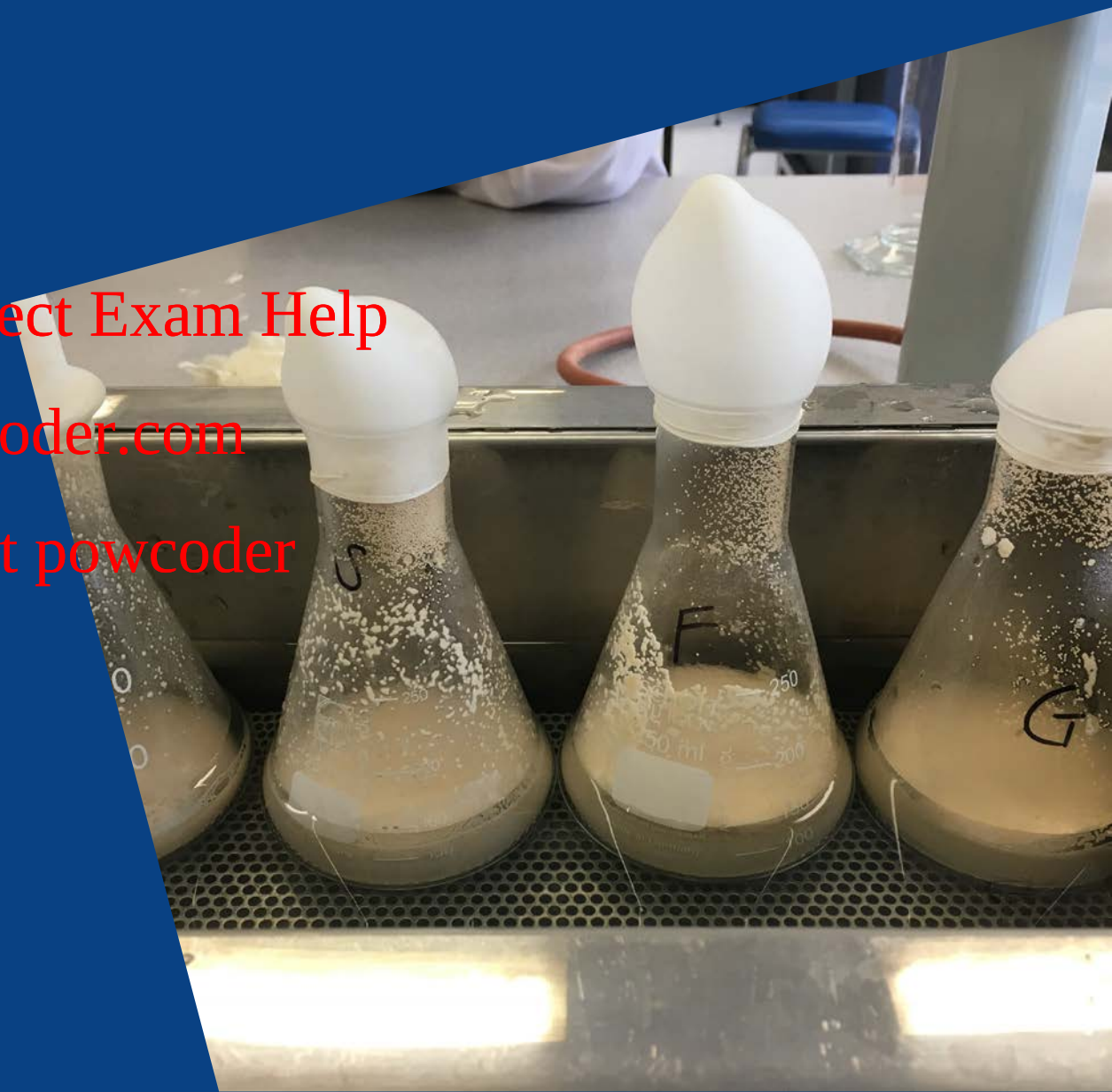
THE UNIVERSITY OF MELBOURNE

FOOD20006 Food Microbiology & Safety

Helen Billman-Jacobe



Microbial metabolism

Ray and Bhunia Ed 5 Ch 8

Todar http://textbookofbacteriology.net/structure_8.html

Intended learning outcomes

Give examples of substrates that microorganisms can use for generating energy and cellular components

Explain why some metabolites are desirable and others are not desirable in food

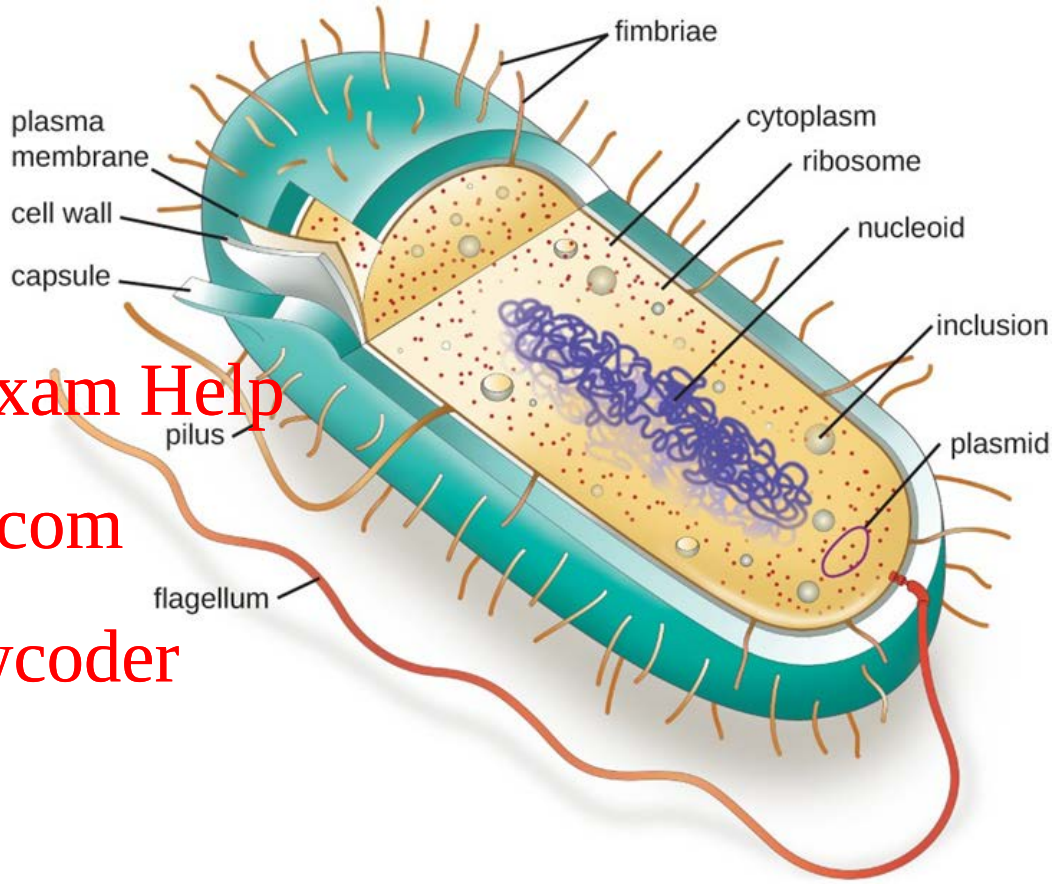
Identify the cellular compartment where monosaccharides are degraded

Name the three types of carbohydrate metabolism (fermentation, anaerobic respiration and aerobic respiration)

Microbial metabolism

Bacterial growth in food occurs though the metabolism of food components or nutrients

- occurs in the cytoplasm and cytoplasmic membrane
- involves the transport of nutrients from the environment through the cell wall and cell membrane and into the cytoplasm
- the breakdown of nutrients generate energy and provide building blocks for growth
- the release of unusable end products into the environment



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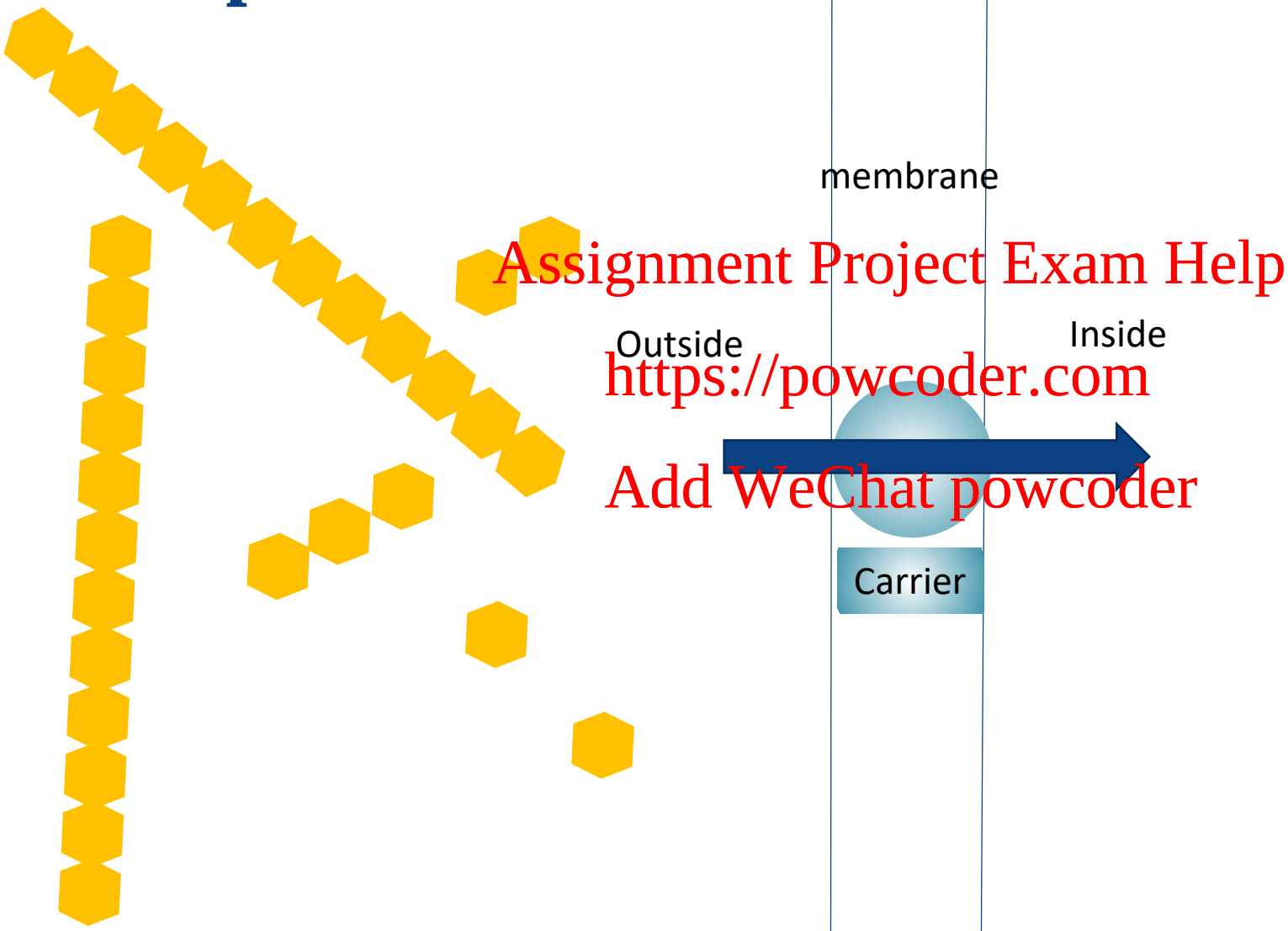

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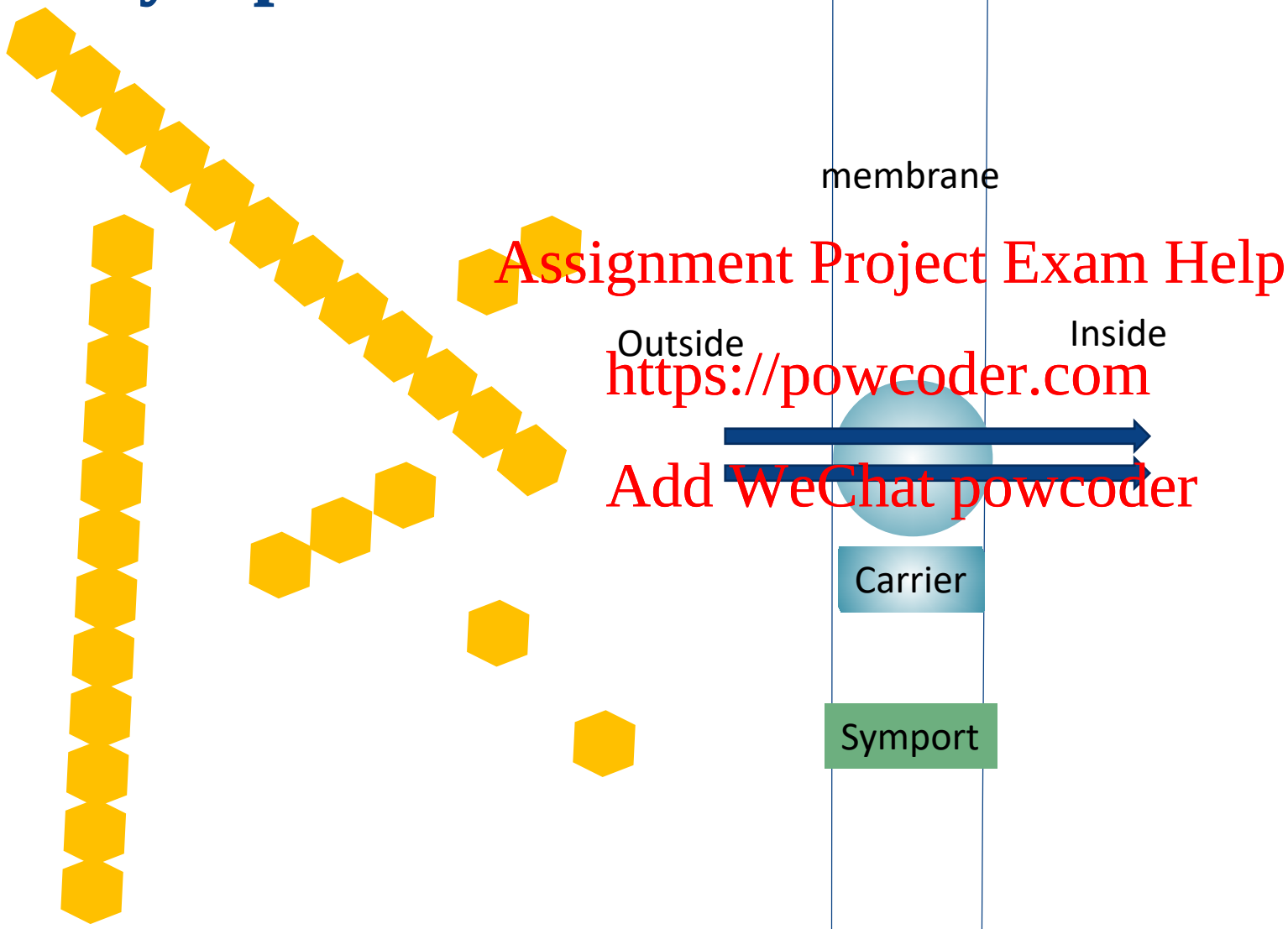

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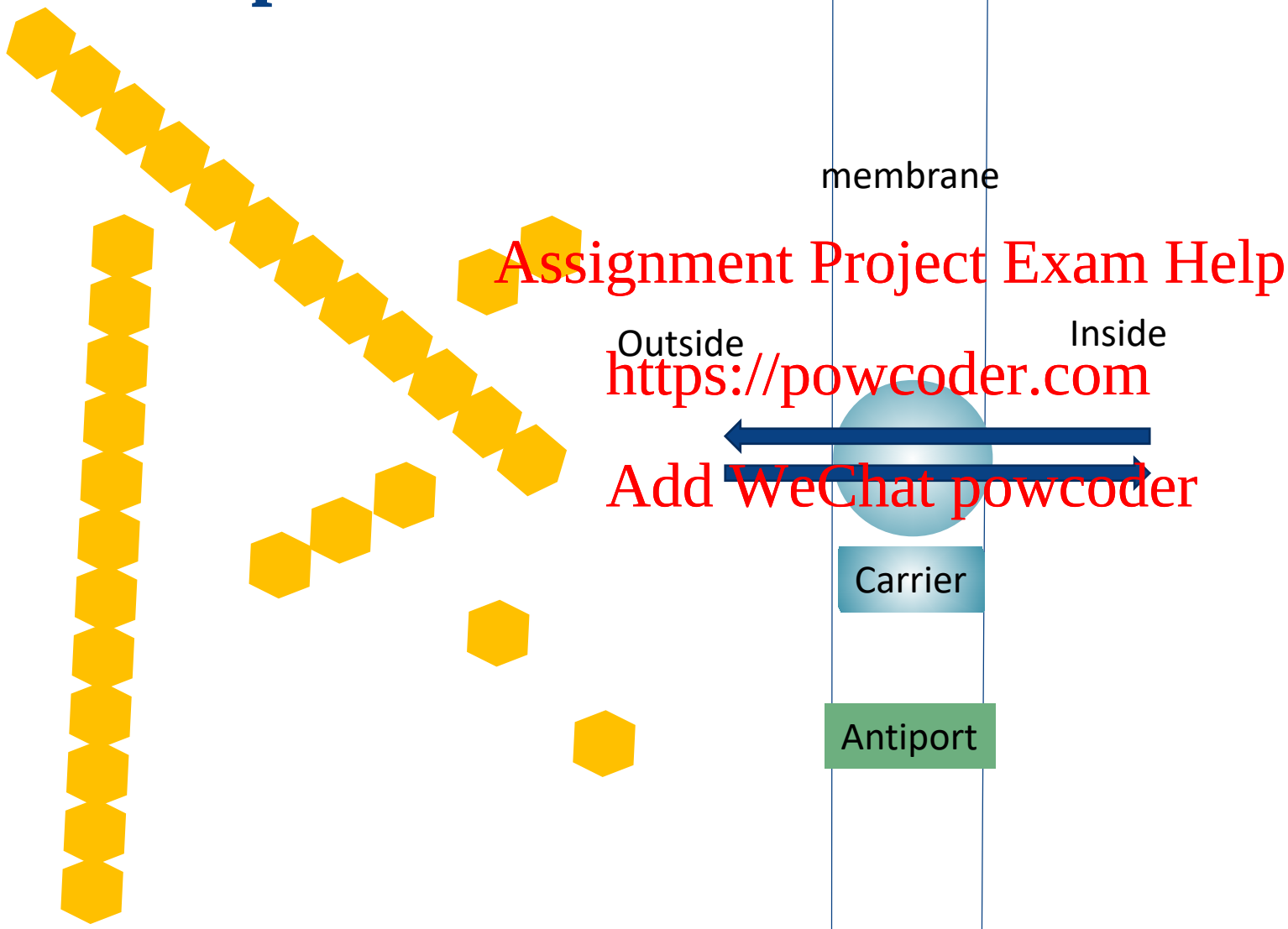

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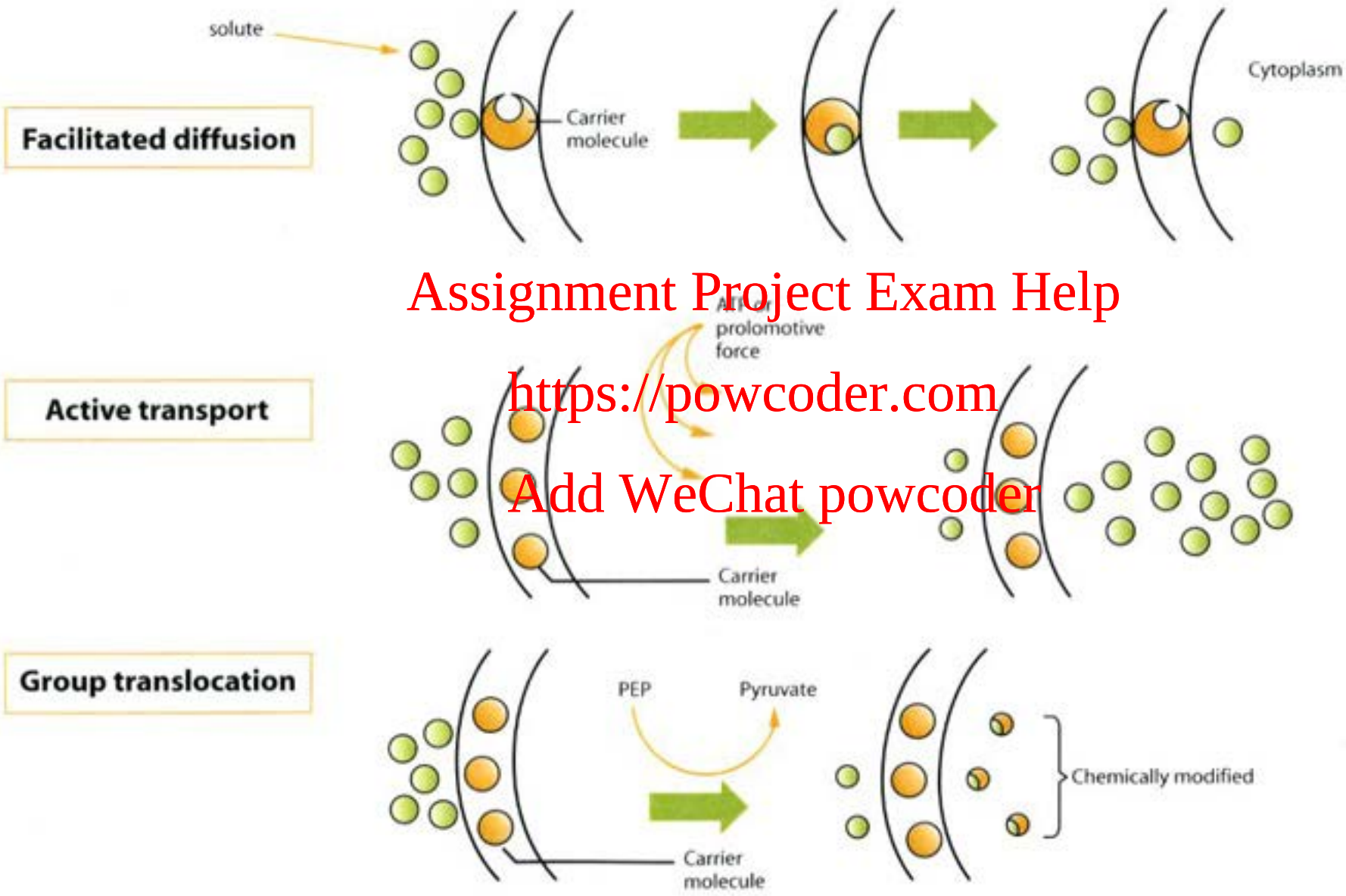

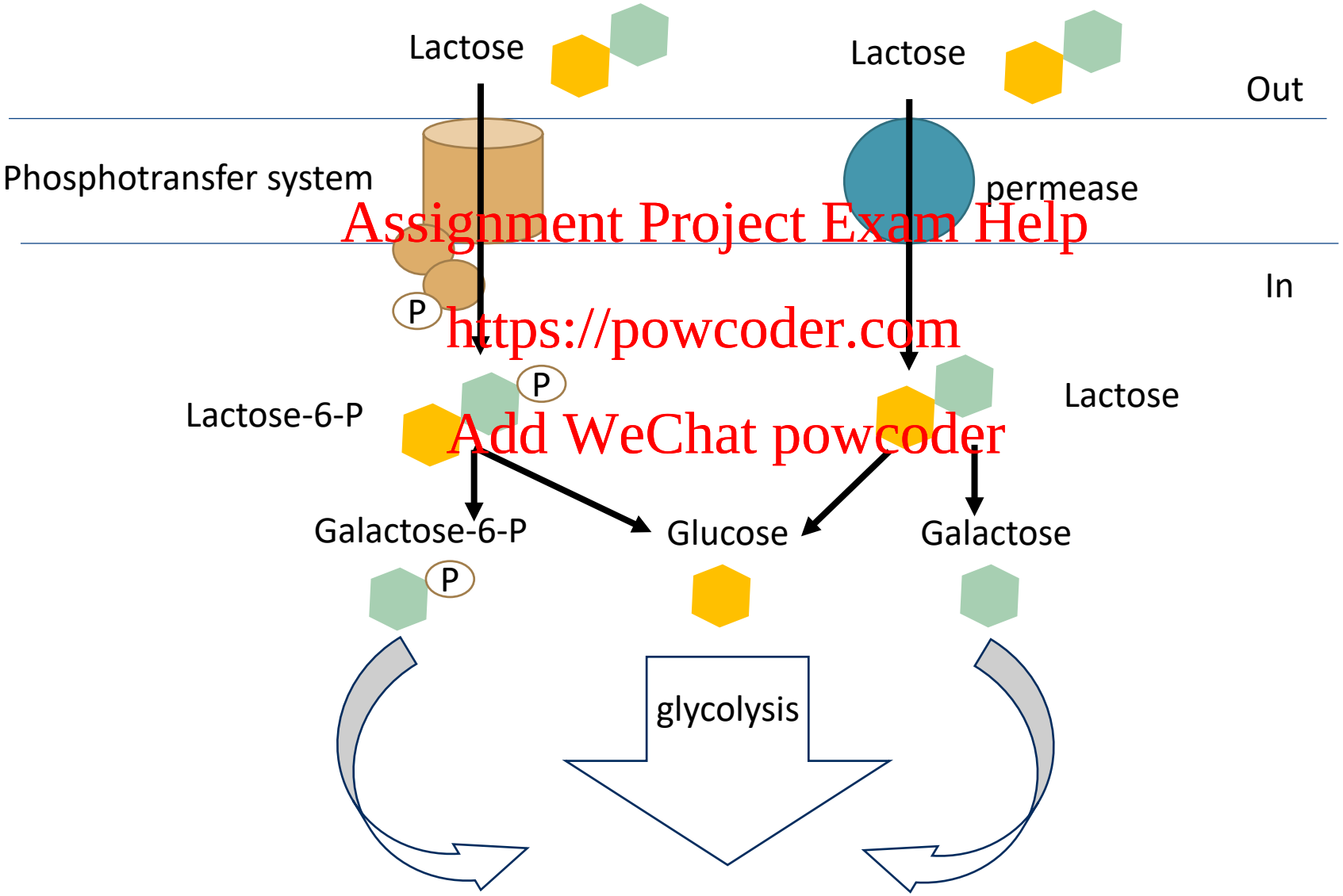

Generating energy

Microorganisms synthesise energy and cellular materials during growth in food

The energy producing reactions are oxidation reactions

The sequence of reactions are called metabolic pathways

The metabolic pathways generate energy from an organic substrate

Energy liberating oxidation reactions generate electrons

$$H_2 \longrightarrow 2H^+ + 2e^-$$

The electron are accepted by oxidising agents

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Different energy generating reactions have terminal electron acceptors

Aerobic respiration = e^- acceptor is oxygen

Fermentation = variety of different organic compounds can act as e^- acceptors

Microbial metabolic products

Metabolites

Energy generating metabolic pathways produce cellular components and compounds that are released into the environment

The type of metabolites produced varies greatly and depends on the substrate and oxygen availability

Consequences of microbial metabolites in food

Undesirable

spoilage (loss of flavour, texture, colour or appearance; organoleptic properties)

toxin production (bacterial toxins, mycotoxins)

Desirable

Enzymes for food processing

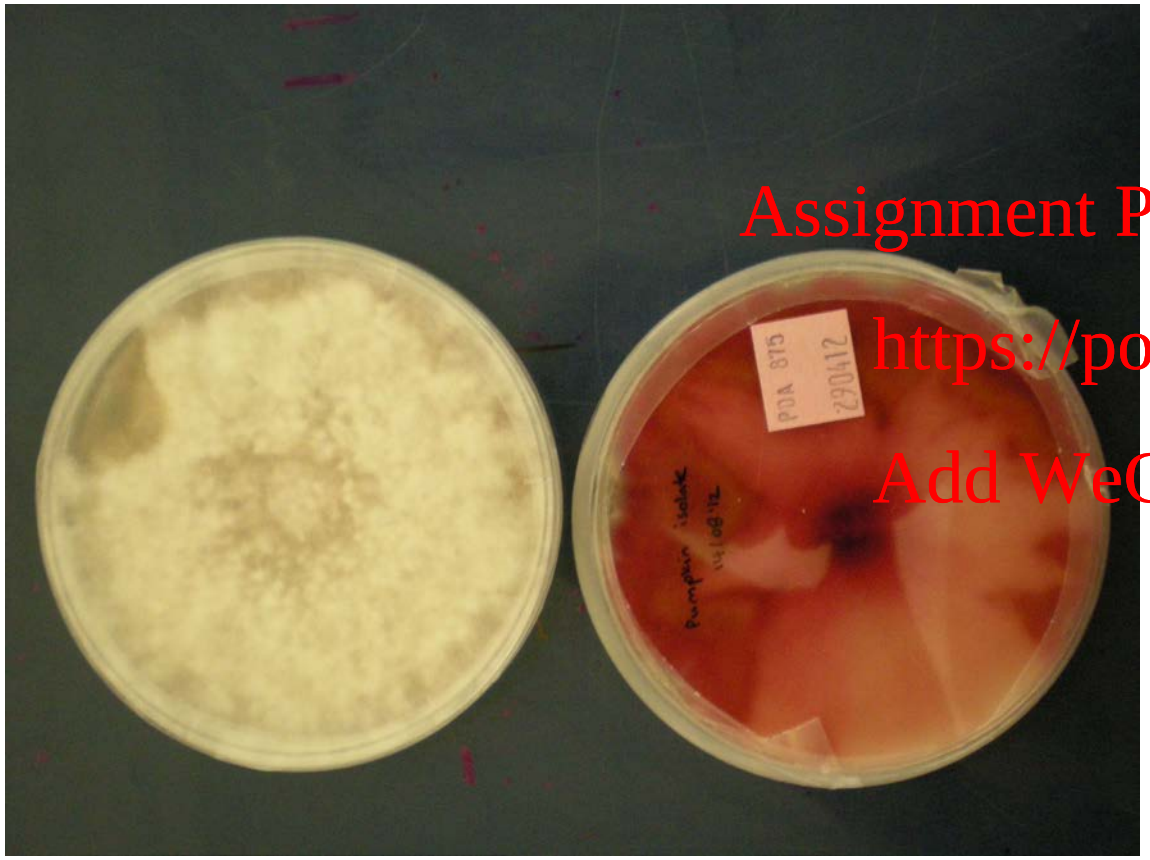
Bio preservatives (bacteriocins and acids)

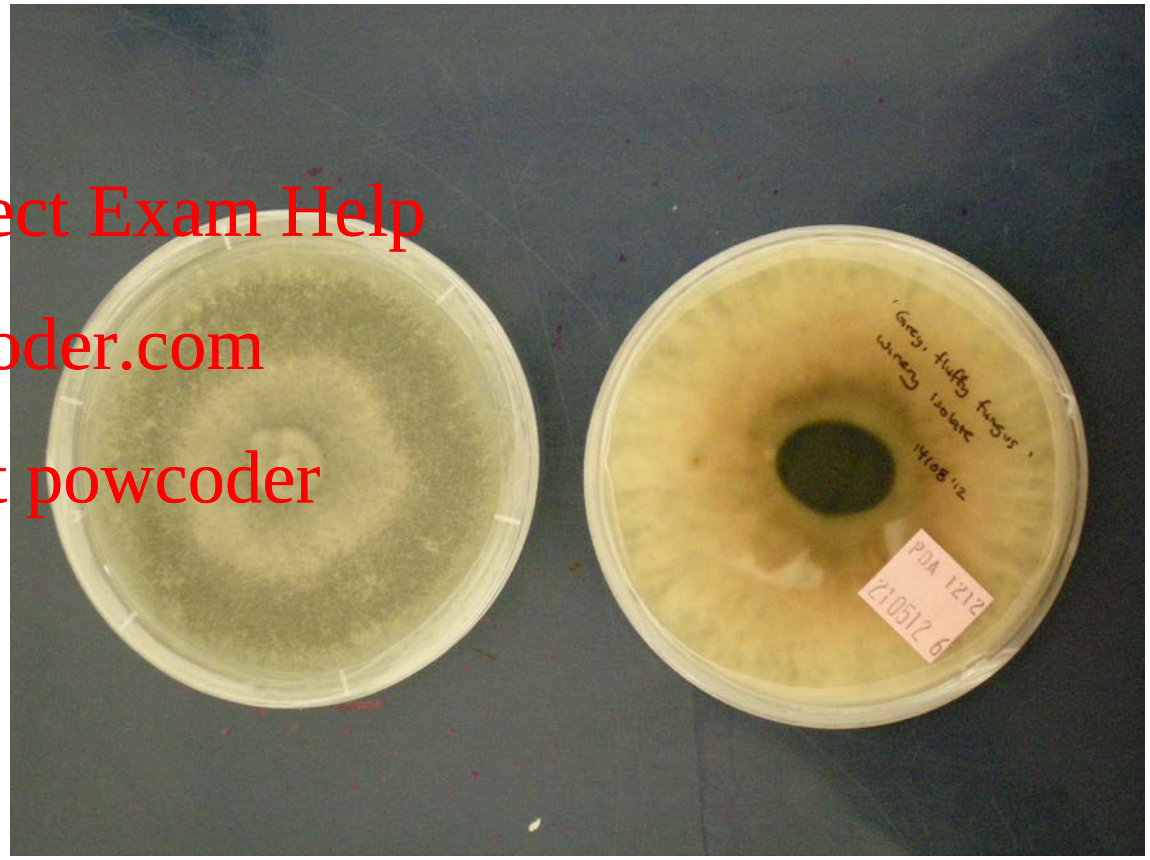
Flavours (diacetyl, acetoin, lactic acid, acetic acid)

Alcohol

Polysaccharides

Microbial metabolic endproducts





Substrates

Microorganisms use the organic carbon sources are growth substrates

Growth substrates available in food

- Carbohydrates
- Proteins
- Lipids

Plants: rich in carbohydrates, some (soy) rich in protein, some rich in oil

Meat and fish: rich in proteins, low in carbohydrates

Molluscs, milk: rich in protein and carbohydrates

Processed food can have all the nutrients in sufficient quantities to support microbial growth

Microbes generally metabolise carbohydrates before proteins or lipids

Metabolism of carbohydrates produces acid

Microbial metabolic endproducts

Carbohydrates

Polysaccharides (starch, glycogen, cellulose, pectin)

- converted into monosaccharides, disaccharides, and trisaccharides outside the cell.
- Mono-, di-, and tri- separates are transported into the cell
- hydrolysed into monosaccharides in the cytoplasm

Monosaccharides are metabolised by aerobic, anaerobic and facultative anaerobic microorganisms are different pathways and produce different metabolic endproducts

All microorganisms can metabolise glucose

Microorganisms differ in their ability to use other sugars

Yeast using different sugars