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# FOOD20006

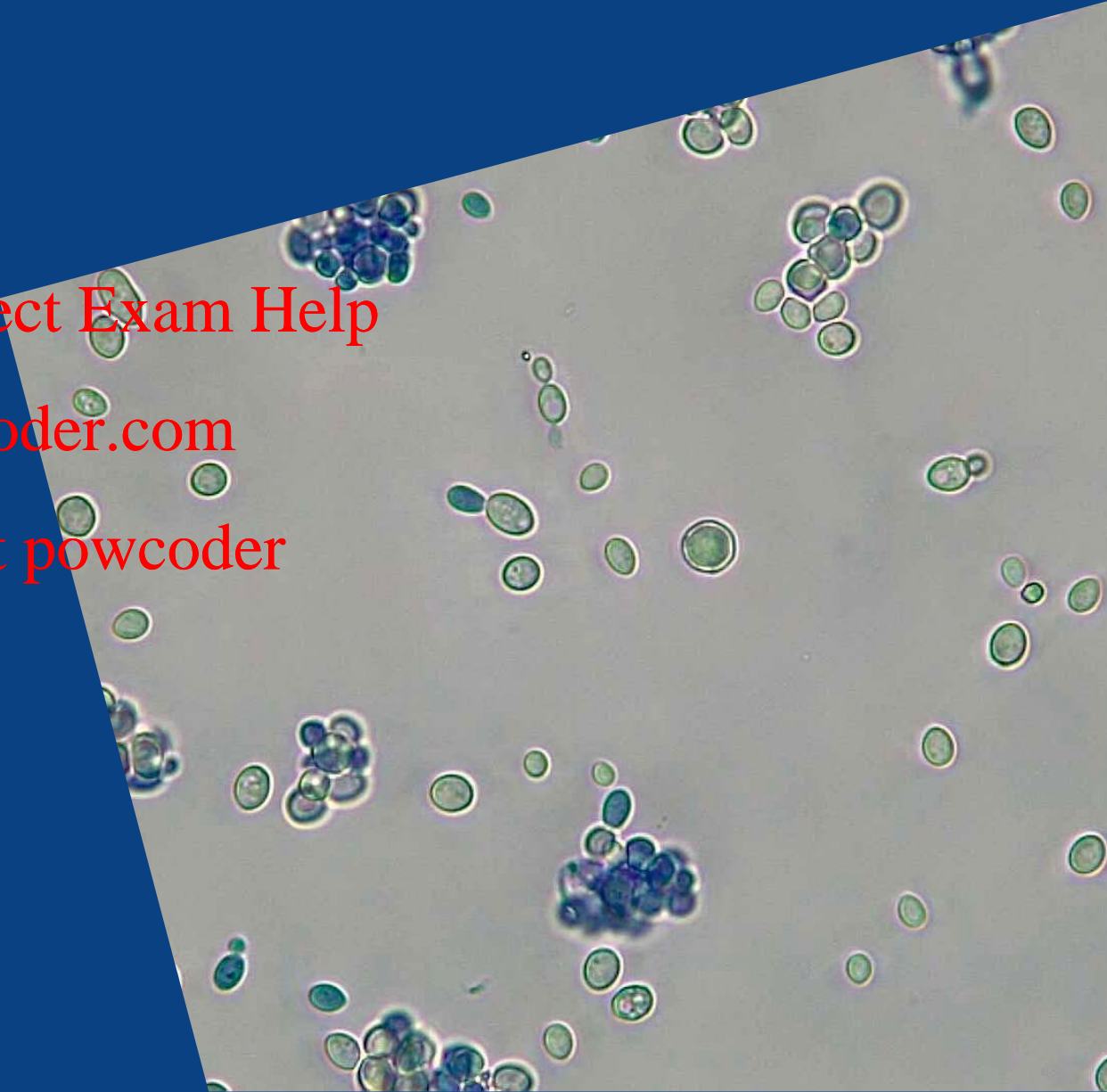
## Food Microbiology & Safety

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Helen Billman-Jacobe





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# Introduction to microorganisms in food

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Ray and Bhunia Ch 2



# Intended learning outcomes

Explain how living organisms are classified

Describe the naming system used for microorganisms

Use the correct format for writing the names of microorganisms

Use the terms which describe the morphology and structures of yeasts and moulds

Give examples of genera of yeast and moulds that are important in food microbiology

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# Introduction

Bacteria, yeasts, moulds and viruses are important in food for their ability to cause foodborne disease and food spoilage and to produce food and food ingredients.

Food spoilage: many bacteria, moulds and yeasts are able to grow in foods and can potentially cause food spoilage.

Viruses cannot grow in food and therefore do not cause spoilage but are important because they can cause foodborne disease.

Protozoa, parasitic worms and some algae are important in foods as they may pose a health hazard. They generally are not able to grow in food.

Bacteria are the largest group of organisms that affect food quality and safety.

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# Classification

Living cellular organisms are classified on the basis of phylogenetic and evolutionary relationships

They are placed in three kingdoms

- Bacteria
- Archaea
- Eukarya

Viruses are not included in this classification because they are not cellular, self replicating organisms

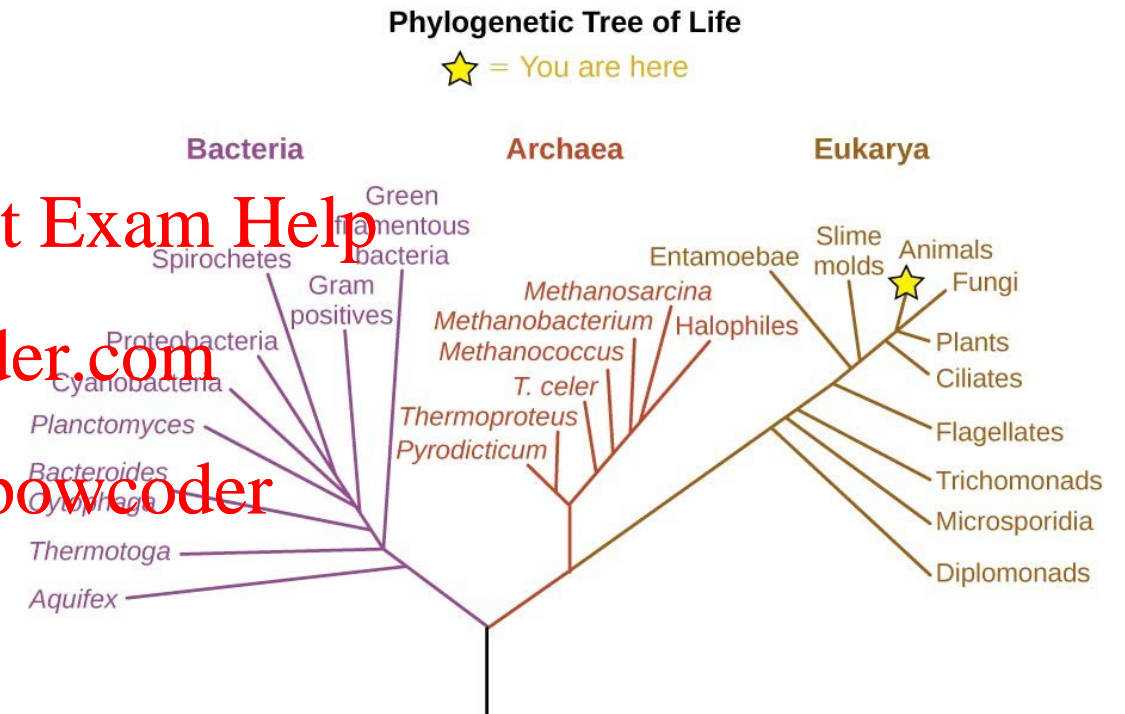
The Archaea include most organisms that live in extreme environments such as thermal pools. They are not important to food microbiology

A **phylogenetic tree** is a way of showing how different organisms are thought to be related to one another from an evolutionary standpoint.

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# Classification

The basic taxonomic group for the classification of yeasts, moulds and bacteria is the species

Phyla fall into the three kingdoms, Bacteria, Archaea and Eucarya

Several classes make a phylum

Several orders make a class

Several families make an order

Several genera make a family

Species with similar characteristics form a genus

Strains are variations within a species

Ranks above species genus and family are rarely used in food microbiology

Kingdom	Bacteria
Phylum	Proteobacteria
Class	Gammaproteobacteria
Order	Enterobacterales
Family	<b>Enterobacteriaceae</b>
Genus	<b><i>Escherichia</i></b>
Species	<b><i>coli</i></b>
Strain	<b>O157:H7</b>

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# Binomial nomenclature

Each species of bacteria, yeasts and moulds are given a two-part (binomial) name

The first part is the genus name and the second is the species name

The names are generally based on Latin words.

Both genus and species are written in italics or are underlined

The first letter of the genus is written with a capital letter

The species is written all with lowercase letters

Bacterial species can be divided into subspecies if they show consistent differences

Each strain of a species is identified with a strain number

*Lactococcus lactis subsp. lactis*

*Lactococcus lactis subsp. cremoris*

*Lactococcus lactis subsp. cremoris* HB61

*Lactococcus lactis subsp. cremoris* HP

*Lactococcus lactis subsp. cremoris* IBB477

*Lactococcus lactis subsp. cremoris* KW2

*Lactococcus lactis subsp. cremoris* MG1363

*Lactococcus lactis subsp. cremoris* NBRC 100676

*Lactococcus lactis subsp. cremoris* NZ9000

*Lactococcus lactis subsp. cremoris* SK11

*Lactococcus lactis subsp. cremoris* TIFN1

*Lactococcus lactis subsp. cremoris* TIFN3

*Lactococcus lactis subsp. cremoris* TIFN5

**Binomial nomenclature** assigns organisms Latinized scientific names with a genus and species designation.





# Nomenclature

The scientific names of bacteria are decided by the International Committee on Systematic Bacteriology of the International Union of Microbiological Association

When writing the name of a bacterial species in an article authors usually write both the genus and species names in full the first time and then abbreviate the genus name to its first letter

For example.

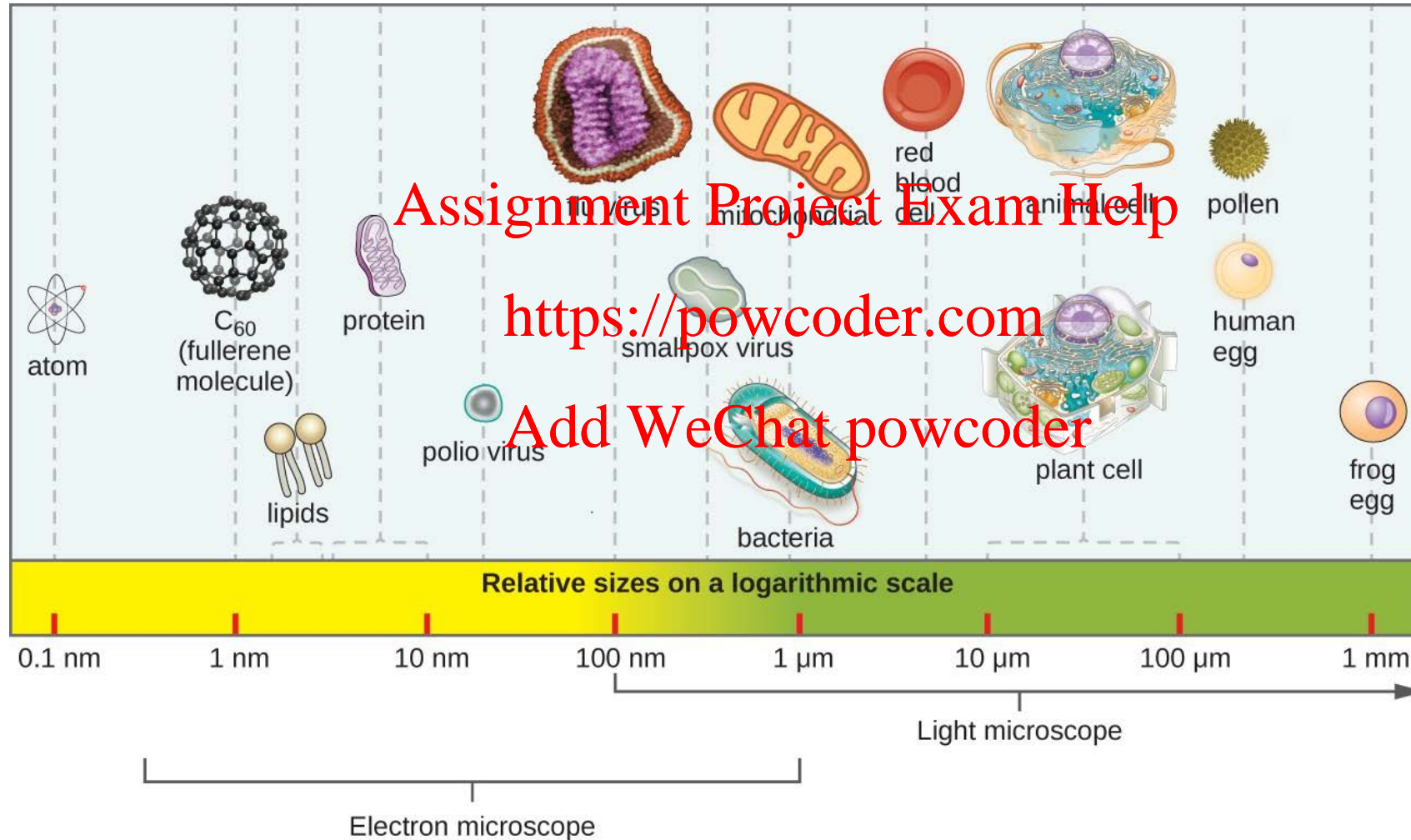
“Large numbers of *Escherichia coli* were found in the undercooked hamburger. Analysis of the *E. coli* isolates revealed they were the pathogenic strain O157:H7.”

It can be confusing when writing about several species with the same first letter in the genus name. In this case a three letter system may be used

For example “*Lactobacillus lactis* and *Lactococcus lactis* are both lactic acid producers. We recommend the use of *Lac. lactis* as a starter culture for cheese *Lab. lactis* for other dairy fermentations .”



# The microbial world



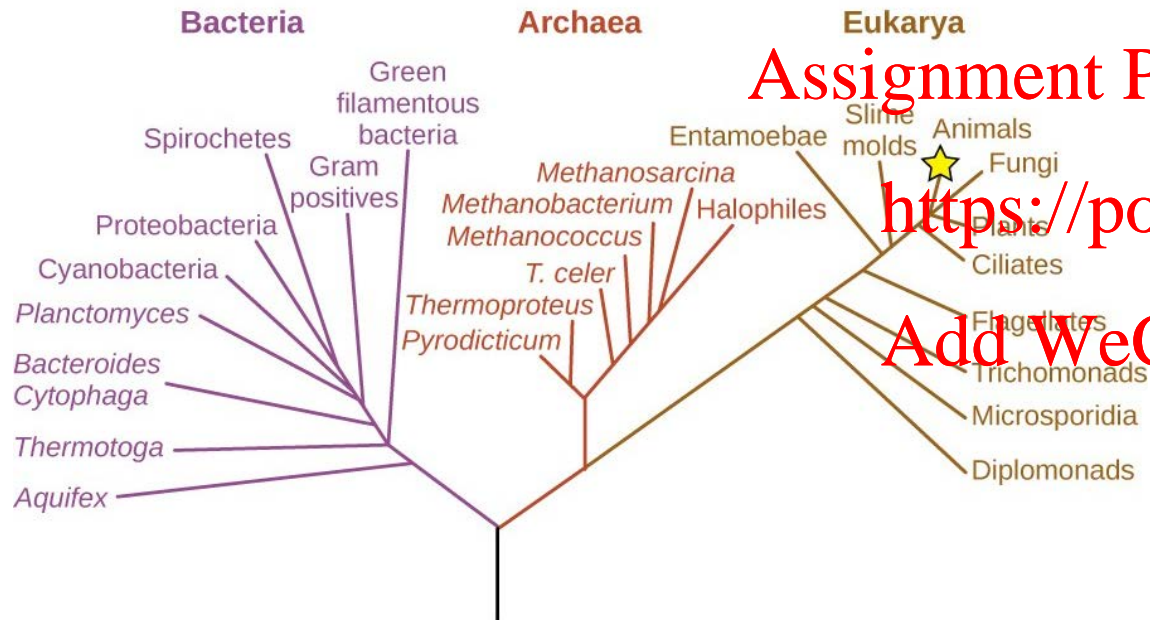
# The microbial world

Microorganisms are found in each of the three domains of life: Archaea, Bacteria, and Eukarya.

Microbes within the domains Bacteria and Archaea are all prokaryotes (their cells lack a nucleus)

Microbes in the domain Eukarya are eukaryotes (their cells have a nucleus).

Some microorganisms, such as viruses, do not fall within any of the three domains of life.



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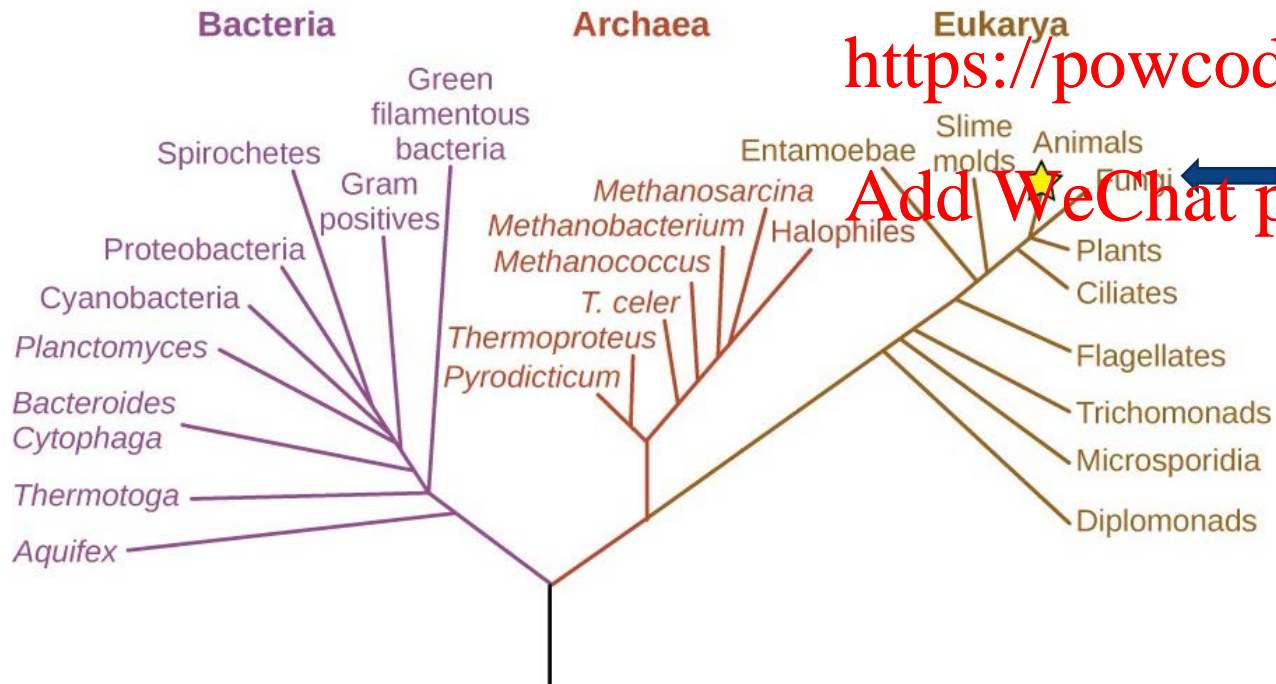
# Morphology and structure: yeasts and moulds

Yeasts and moulds are eukaryotic organisms and belong in the taxonomic group Fungi.

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# Morphology and structure: yeasts

Yeasts are unicellular eukaryotes

Yeast cells are 20-100 $\mu$ m compared to bacteria 1-10 $\mu$ m

The cell wall is composed of carbohydrates and does not have peptidoglycan

The cell membrane lies within the cell wall and contains sterols

The cytoplasm contains organelles (mitochondria and vacuoles) which are membrane bound

The DNA is linear and enclosed in a nuclear membrane

Cell division occurs by mitosis (asexual reproduction)

Sexual reproduction may occur by meiosis

Yeast cells in counting chamber under x40 mag



Bacteria in counting chamber under x40 mag



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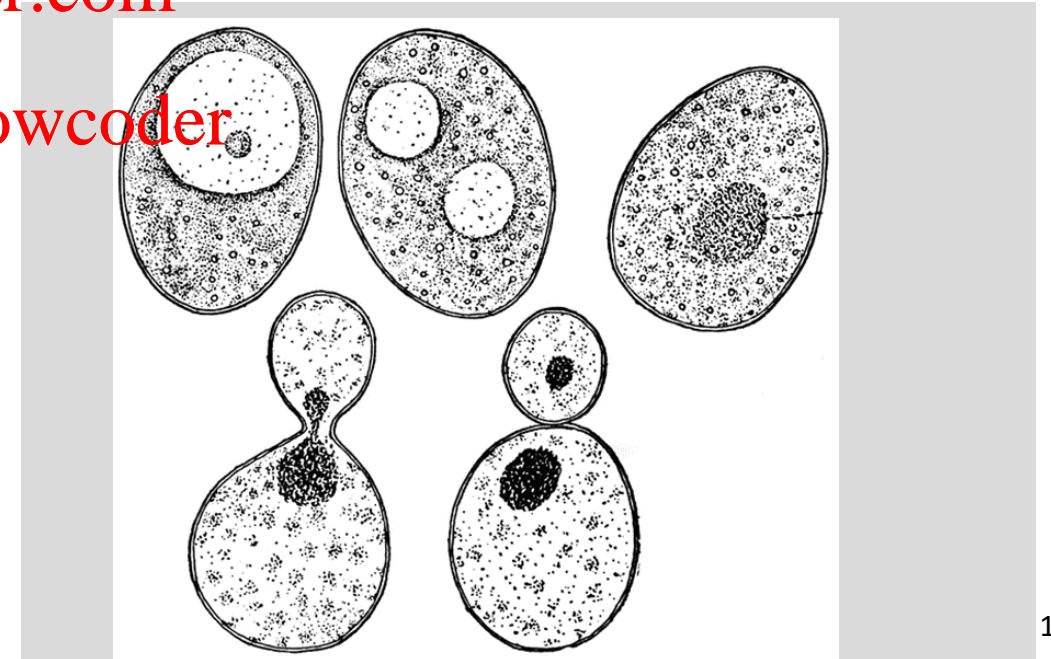
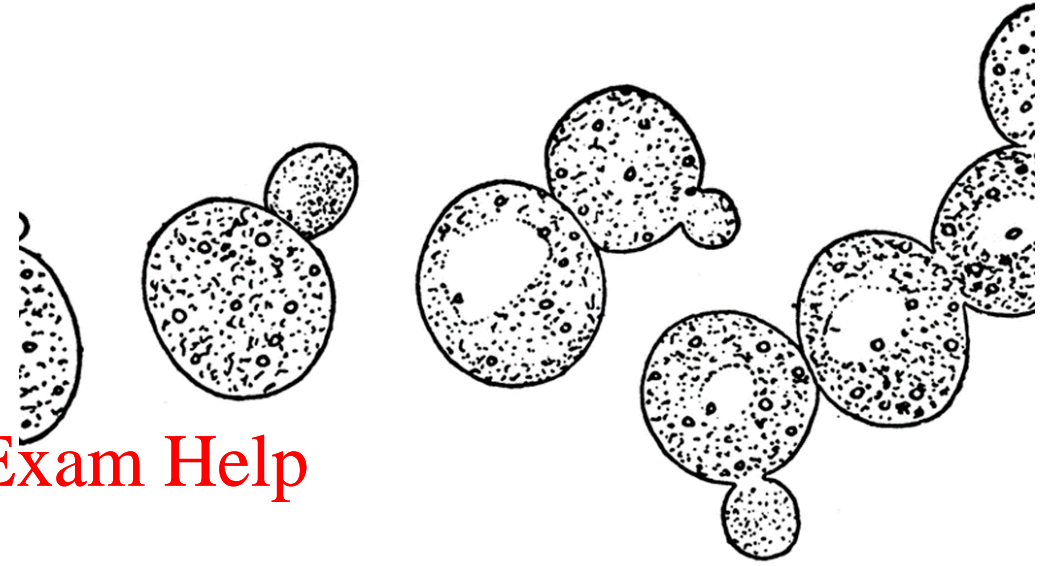
# Morphology and structure: yeasts

Budding yeasts reproduce by mitosis in asymmetric manner

A bud forms on the parent cell and develops into a mature cell and eventually detaches

The cells can have scars where the progeny have detached

Fission yeasts reproduce by binary fission rather than budding. Binary fission occurs in a symmetrical manner



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# Morphology and structure: yeasts

Sometimes the detachment of progeny cells of budding yeast is delayed

Short chains of un-detached cells may be observed

These groups of cells are called pseudo-hyphae

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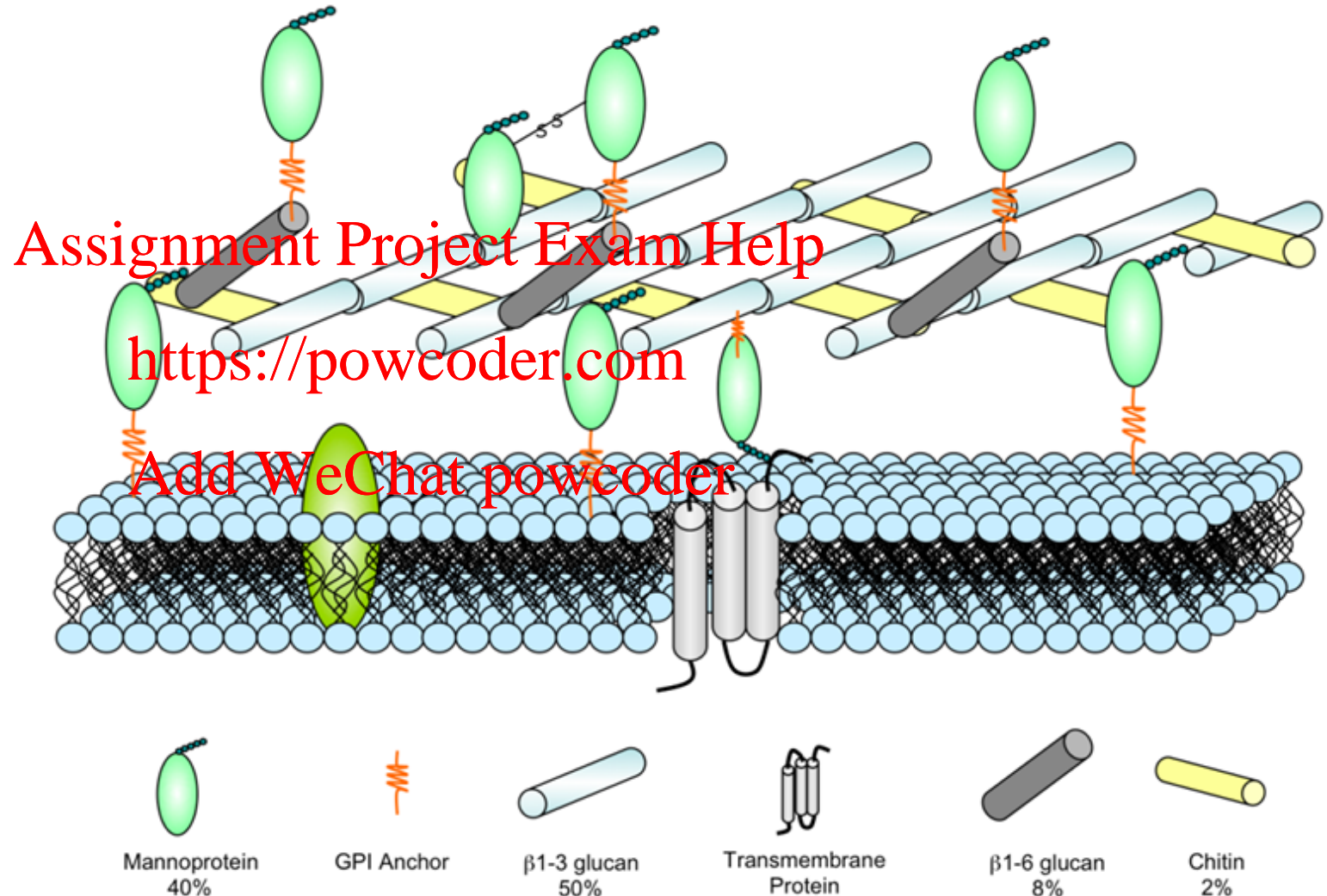


# Morphology and structure: yeasts

Yeast cell walls have a plasma membrane consisting of a phospholipid bilayer

The lipids in a yeast membrane contain ergosterol.

This sterol does not occur in plant, animal or bacterial cells  
The rigidity of the yeast cell wall is due to the glucan / chitin outer layer





# Important genera of yeasts

*Saccharomyces* species

*S. cerevisiae* :

- Used in beer and bread making
- “top-fermenting yeast” in beer making.
- First eucaryote to be sequenced.

*S. pastorianus*:

“bottom fermenting” yeast

*Schizosaccharomyces pombe*

is a brewing yeast originally isolated from African millet beer.

Fission yeast forms a rod-shaped cell  
grows by elongation and divides by fission.  
doubling time of 2-4 hours

Used as a model organism for cell biology and genetics

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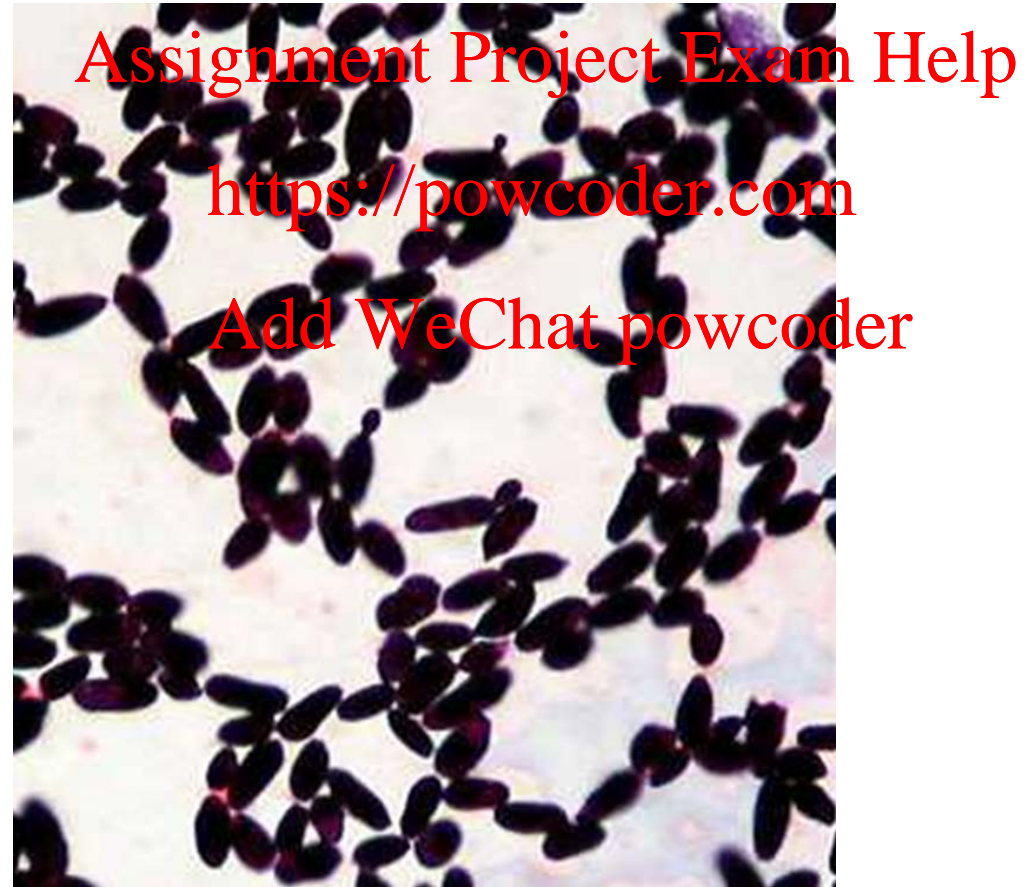
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# Morphology and structure: yeasts and moulds

These cells have been stained with simple stain using crystal violet. The staining aids in the visualisation of cells under a microscope.





# Morphology and structure: moulds

Moulds are multicellular fungi

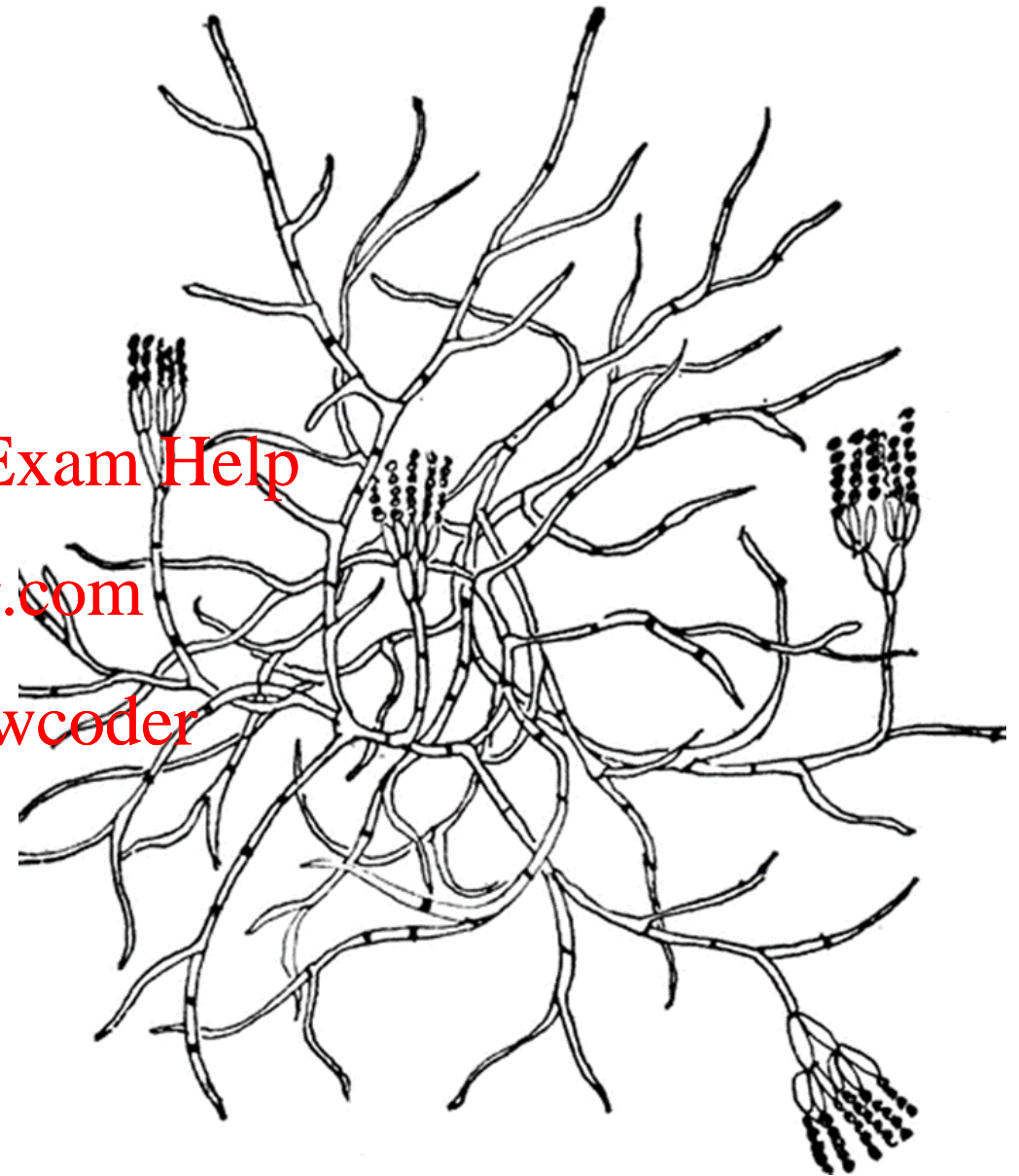
Moulds are non-motile, filamentous and branched

The cell wall is composed of chitin (rigid)

The body of the mould is called the thallus

A thallus is made up of filaments called hyphae

A mass of hyphae is called a mycelium







# Morphology and structure: moulds

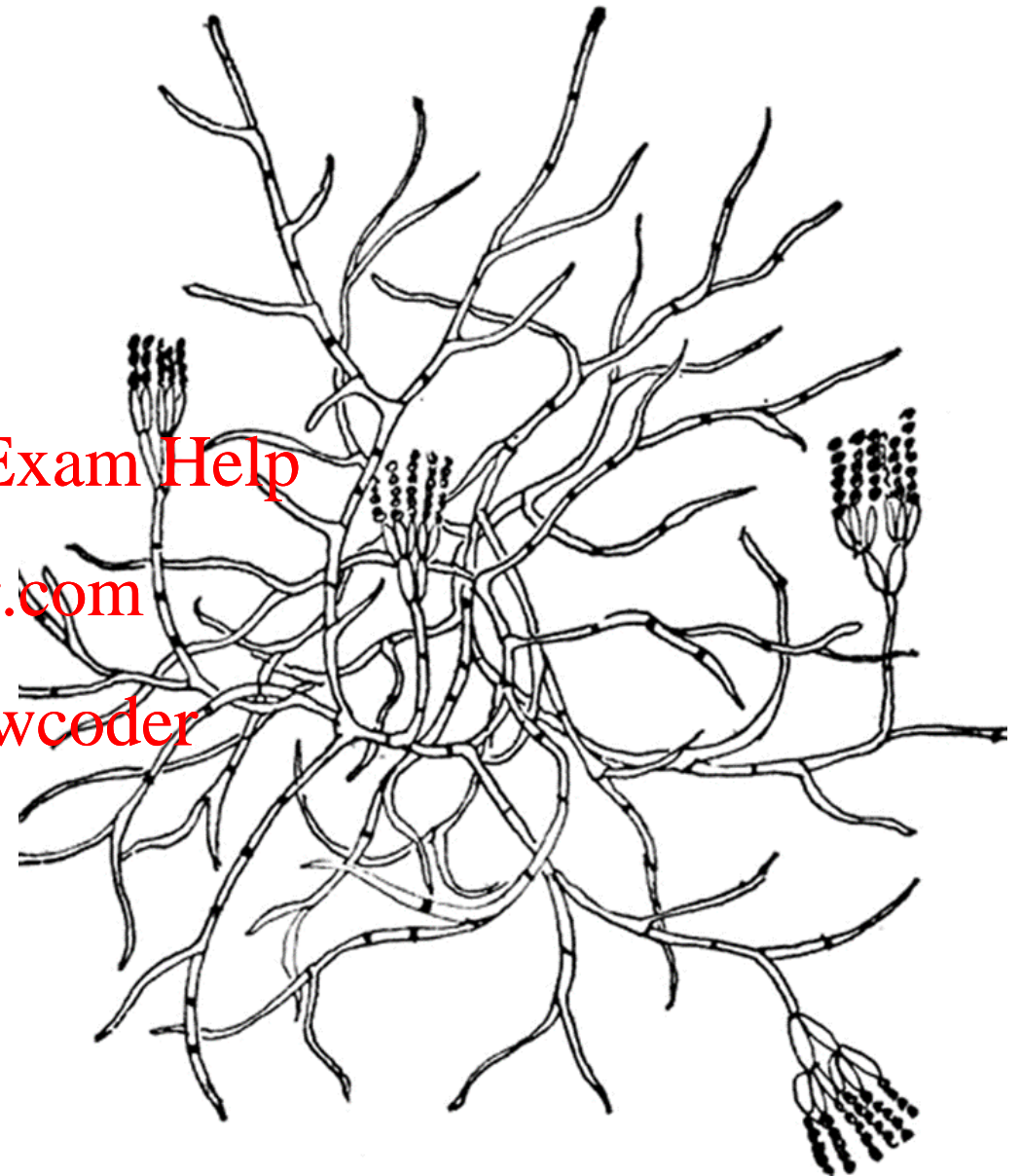
Hyphae are long filaments of cells

Hyphae grow by elongating at the tips

Septate hyphae: Cells are divided by cross walls (septa)

Coenocytic (Aseptate) hyphae: Long, continuous cells that

are not divided by septa.





# Morphology and structure: moulds

There are different types of hyphae

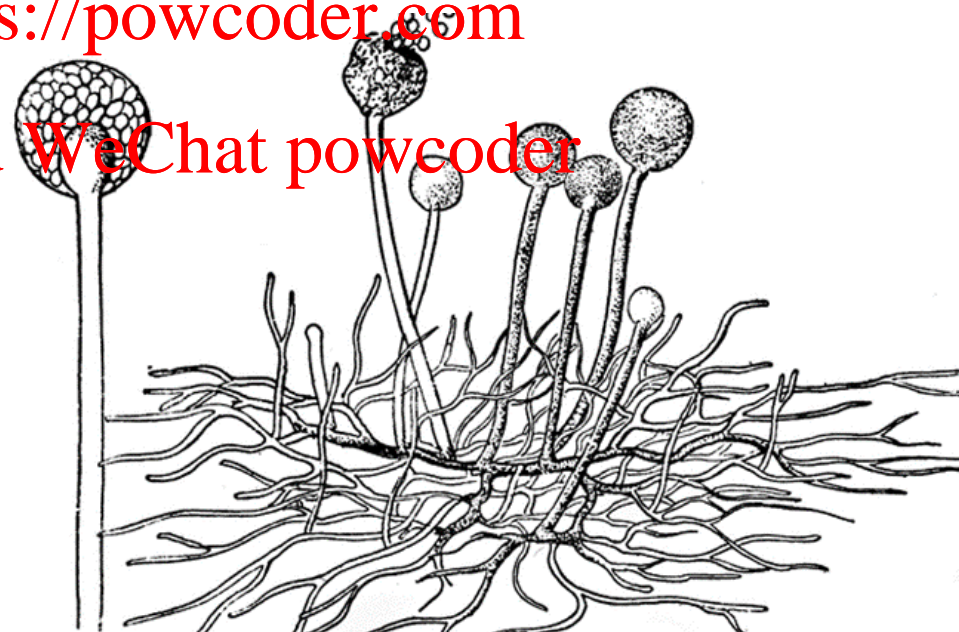
Vegetative hyphae: Portion that obtains nutrients.

Reproductive or Aerial Hyphae: Portion connected with reproduction.



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# Morphology and structure: moulds

Some fungi can reproduce asexually by fragmentation or production of asexual spores

Two types of mould spores can be produced asexually

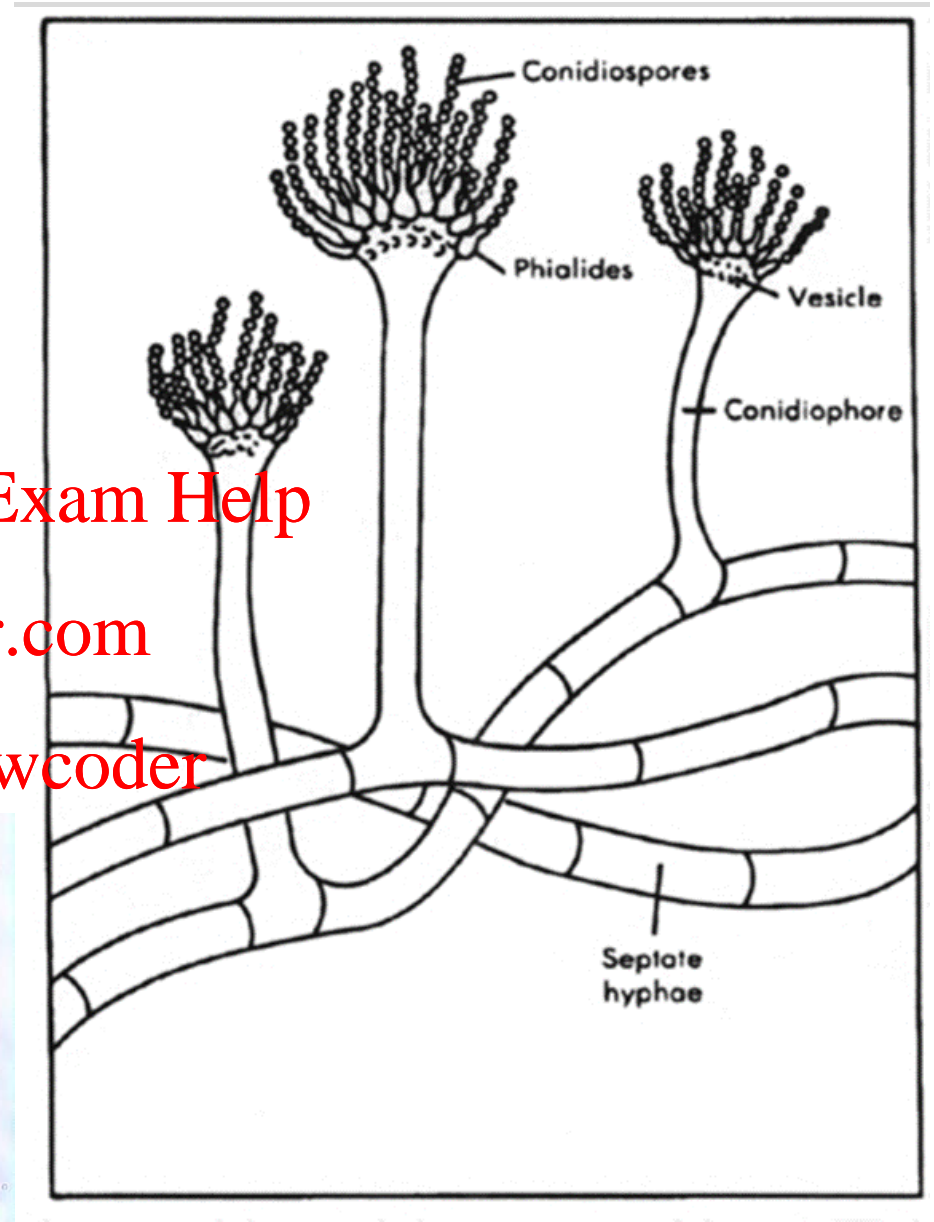
–Conidiospores (conidia)-a unicellular or multicellular

spore that is not enclosed in a sac

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# Morphology and structure: moulds

Some fungi can reproduce asexually by fragmentation or production of asexual spores

Two types of mould spores can be produced asexually

—**Sporangiospores**—formed within a sporangium (sac).

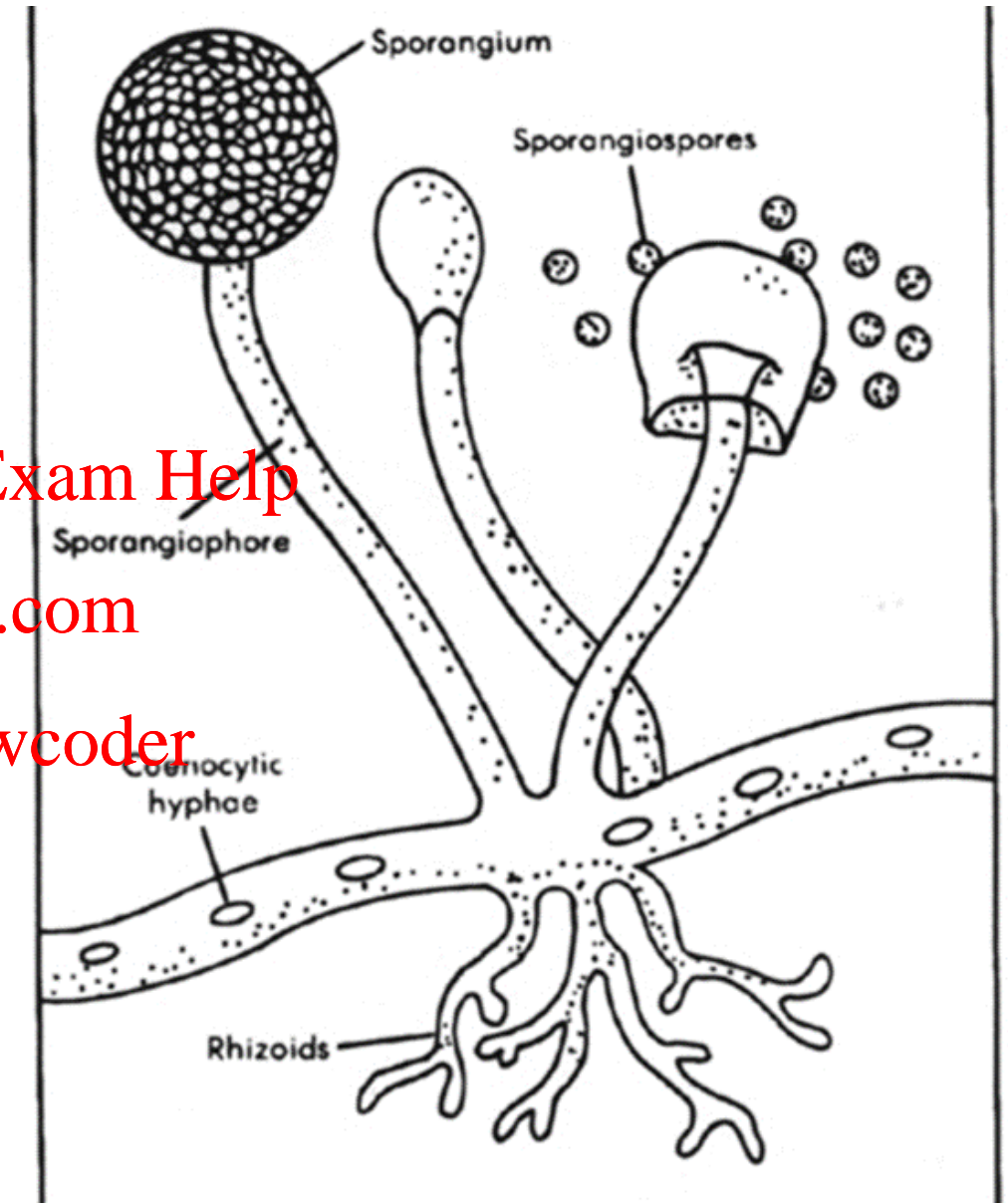


Lactophenol cotton blue stain, x 1000 HBJ

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# Important genera of moulds: *Aspergillus*

*Aspergillus oryzae* is used to make sake and tempe

*Aspergillus niger* is grown to produce a variety of enzymes for food processing

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# Important genera of moulds: *Penicillium*

Examples of *Penicillium* species used to make cheese

*Penicillium roqueforti*

*Penicillium caseicolum*

*Penicillium camemberti*



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# Morphology and structure: yeasts and moulds

Take a moment to examine this microscope image

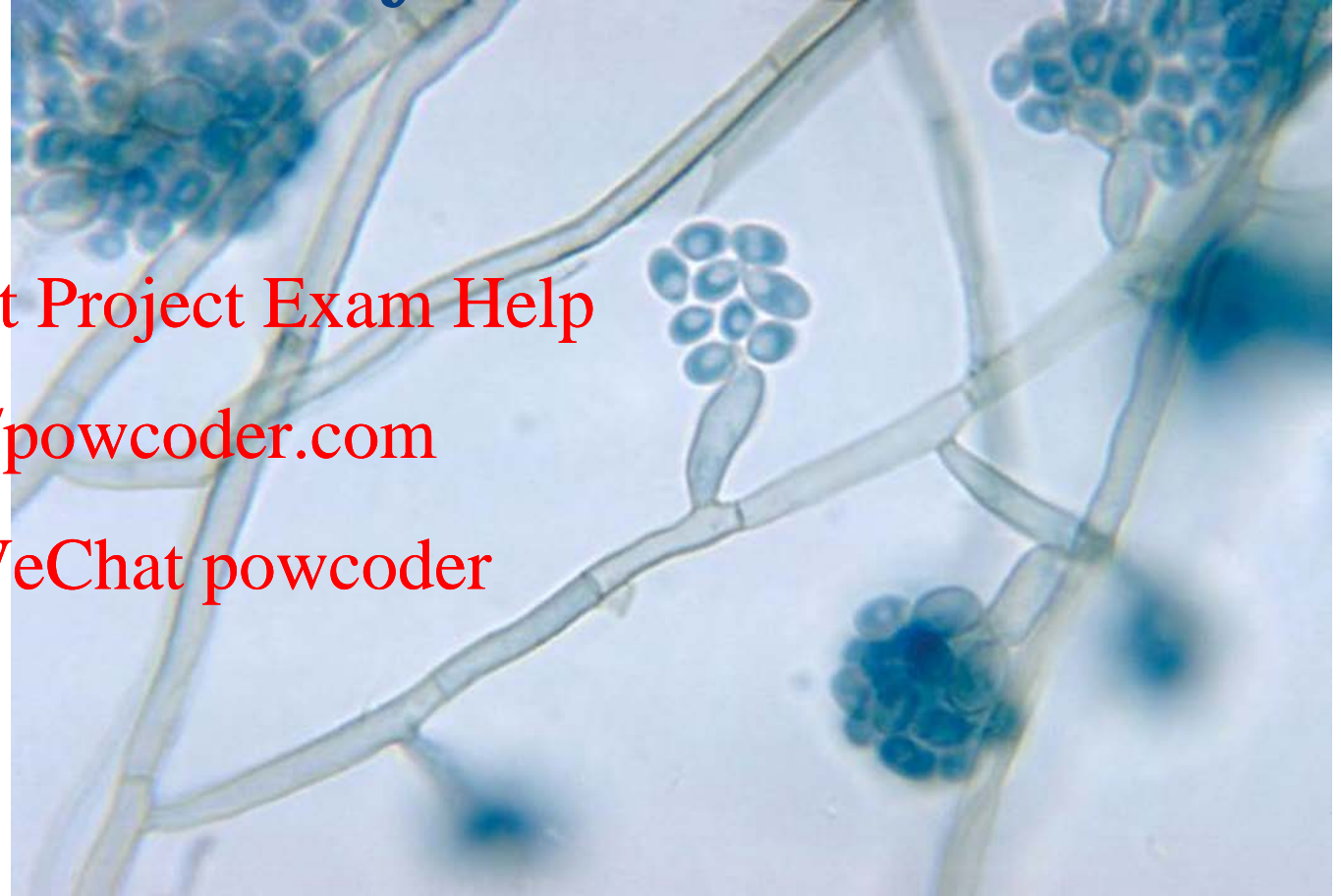
Use appropriate scientific terms to describe the structures

Is this a yeast or a mould?

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