

WJEC Biology A-level

Topic 3.4: Microbiology

Notes



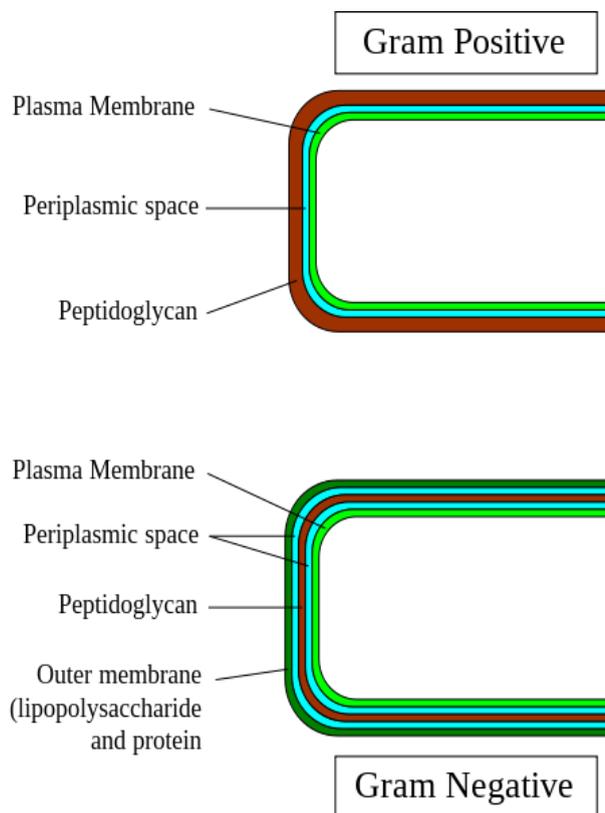


Figure Wikipedia - Gram-negative bacteria

Bacteria can be classified according to their **shape** and their reaction to **Gram stain**.

There are two types of bacteria, **Gram positive** and **Gram negative**. The two types differ by their cell wall structure.

Gram staining occurs as following: firstly, **crystal violet** is used to stain over a fixed culture. After a minute, the stain is poured off and the slide is rinsed with water. Subsequently, **iodine solution** is added and removed after a minute. The slide is then **decolorised with alcohol** and washed off after 5 seconds. The final step of the procedure is **counterstaining with safranin** for another minute. The sample is then dried and examined. Gram positive bacteria is **violet/purple** under the microscope whereas Gram negative bacteria appears **red**.

Microorganisms can be grown in two types of culture, a **pure culture** which initially only contains a single microorganism, whereas a **mixed culture** is a mix of different species.

The growth curve of a microorganism in a closed culture has various distinct features:

- The first phase of microorganism growth is the **lag phase** where microorganisms are **adjusting to the environment** before starting to reproduce, thus meaning during the lag phase the population **remains constant**.
- The next part of the growth curve is the **log phase** where the population size grows **exponentially** meaning that **every round of division doubles the population size**, so long as the dividing organism has a **sufficient amount of nutrients**.
- The stationary phase is where the population size reaches its **maximum due to decreasing nutrient levels** and build up of **toxic substances**.
- The stationary phase is followed by **decline phase** where lack of nutrients and increase in toxic products causes **death of organisms**.



Culturing microorganisms

In **batch culture**, the **fermentation** is carried out in a **closed fermenter**. The microorganisms and nutrients are added and then left to grow for a particular period of time. No further nutrients are added, and products are removed at the end of the period. Whereas continuous culture takes place in an open fermenter, where nutrients are **continuously added and products are removed at a steady rate**. Even though the batch culture is easier to set up and maintain than the continuous culture, the growth rate isn't as fast.

However, in the case of **contamination of batch culture**, only a single batch is lost whereas in the case of continuous culture, it can lead to huge amount of product lost.

To **maximise the yield of product**, the **temperature needs to be maintained at the optimum** with a **sufficient nutrient supply** and the **aerobic conditions** to prevent the formation of undesired products through anaerobic respiration. The **pH needs to be kept constant** to ensure that the **enzyme activity is not altered**.

It's important for the microorganisms to be manipulated under **aseptic conditions**, where **unwanted organisms are absent**. In the case where unwanted organisms are present, the medium is said to be contaminated. This is undesired as **contaminants compete with the culture for nutrients and space**, thus reducing the **product yield**. Some contaminants might produce **toxic chemicals**, thus **destroying the culture microorganisms and the products**.

