

Difference Between Inoculation and Incubation

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Key Difference - Inoculation vs Incubation

Microorganisms are cultured in laboratories and industries for various purposes such as characterization, differentiation, identification, development of antibiotics, development of [vaccines](#), production of transgenic plants and animals, and extraction of [organic acids](#). They are grown in artificially synthesized growing media or in natural substrates. Hence different types of sterile fresh media should be prepared, and the desired microorganisms are cultured in pure or mixed cultures. Media are supplemented with all nutrients necessary for the growth of the microorganism. The action of introducing the microorganism into fresh medium or substrate is known as inoculation. However, the optimum growing conditions should be provided to achieve a sufficient growth of the microorganism. The process of providing the required growth conditions such as temperature, moisture, and pH and allowing microorganisms to grow on media are known as incubation. Thus, the key difference between inoculation and incubation is that **inoculation is the introduction of microorganisms to growing media or substrates while incubation is allowing microorganisms to grow under supplied growth conditions.**

What is Inoculation?

Inoculation is the process of introducing microorganisms into a growing medium which is suitable for their growth. In other words, inoculation can be defined as the process which introduces a pathogenic or antigenic microorganism into a living organism in order to stimulate the production of [antibodies](#). When the inoculation is complete, microorganisms start to grow and multiply in the medium by forming visible colonies.

There are different types of inoculation tools and techniques used in [microbiology](#). Inoculating loop, inoculating needle, cotton swabs, forceps, glass preaders, dispenser pipettes are the commonly used inoculation tools in laboratories. All these materials should be free from contaminants. Therefore, prior to inoculation, it is necessary to sterilize them using a suitable sterilization technique to avoid [contaminations](#) or the growth of unwanted microorganisms in the culture media. Streak plate method, spread plate method, pour plate method, point

inoculation, stab culture, slant culture are several inoculating techniques used in microbial laboratories to grow [bacteria and fungi](#).

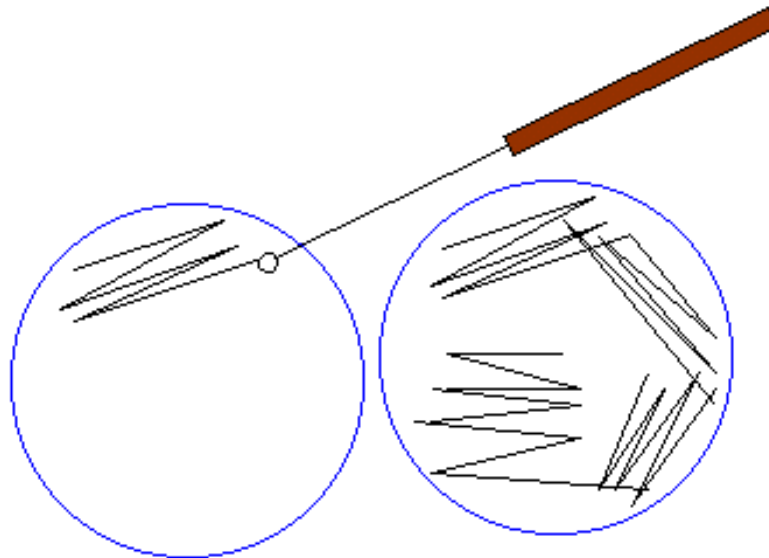


Figure 01: Inoculation of bacterium using streak plate technique

What is Incubation?

Microorganisms have different growing requirements. They should be provided with required nutrients, water, minerals, growth factors, trace elements and other growth conditions. After inoculating of a microbe into a fresh medium, growing conditions should be maintained to support the growth of the microorganism. The process of allowing microorganisms to grow in a medium by providing necessary growth conditions is known as incubation. Inoculated culture plates can be placed inside a device called incubator for incubation. Incubators are designed in such a way that the operator can control the [temperature, humidity](#), gas concentrations, etc. as per the microbe requirement.

What are the Phases in Microbial Growth?

When optimal conditions are provided, microorganisms tend to grow, reproduce and multiply by utilizing the available nutrients in the medium. Microbial growth has four distinct phases in a culture medium. After the inoculation, they initiate the **lag phase**. During the lag phase, microbes do not show a rapid growth or multiplication. They start adjusting to the new environment and stabilize there. Once they are adjusted, the second phase, which shows an exponential growth of

the microorganism, initiates. The second phase is known as **log** or **exponential phase**. During the log phase, microbes show optimal growth rate and multiplication. The third phase starts after log phase when the nutrients and other requirements are limited in the medium. During the **stationary phase**, growth and dying rates become equal, and growth curve is in a straight line parallel to the x-axis. The fourth phase is the **death phase** where death rate exceeds the growth rate. After several days, microbial growth ceases, leaving behind a dead culture.



Figure 02: Microbial plate incubator

What is the difference between Inoculation and Incubation?

Inoculation vs Incubation

Inoculation is the process of introducing microorganisms or suspension of microorganisms into a culture medium.

Incubation is the process of allowing inoculated microorganisms to grow under required growing conditions.

Tools Used	
Inoculation can be done using inoculating needles, inoculating loops, cotton swaps, pipettes, etc.	Incubation can be done in a culture room, incubator, culture racks, etc.
Time	
Inoculation is performed within a short time.	Incubation takes several hours to days.
Conditions Maintained	
Inoculation is done under aseptic conditions inside a laminar air cabinet.	Incubation is done by providing suitable growth conditions such as temperature, humidity, oxygen concentration, light, etc.

Summary - Inoculation vs Incubation

Inoculation and incubation are two major steps involved in culturing microorganisms in laboratories. Inoculation is the action of introducing microorganism to a suitable culture medium or substrate. Inoculated media are provided with suitable growing conditions to grow and multiply. This process is known as incubation. This is the main difference between inoculation and incubation. There are special tools and equipment in microbial laboratories for incubation purposes. The incubator is a device which allows microorganisms to grow under controlled temperature, aeration, humidity, etc. Inoculation and incubation should be performed following proper aseptic conditions to prevent contaminations and waste of time.

References:

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2. "Microbiological plates incubator-02" By real name: Matylda Sękpl.wiki: Cygaretkacommons: Cygaretkka - Own work ([CC BY-SA 3.0](#)) via [Commons Wikimedia](#)

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