

Key Facts about Tissue Culture for UPSC Exam

Tissue culture is an important tool for the study of the biology of cells from multicellular organisms. This article deals with the Tissue Culture in detail as the topic would be of importance in the IAS exam for both Prelims and Mains.

What is Tissue Culture?

It is the growth of tissues or cells in an artificial medium separate from the organism. This is typically facilitated via use of a liquid, semi-solid, or solid growth media, such as broth or agar. Tissue culture commonly refers to the culture of animal cells and tissues, with the more specific term plant tissue culture being used for plants.

Tissue culture means growing cells in vitro, from tissues taken from a multicellular organism. The term tissue culture is often substituted with the word cell culture. After the cells are extracted from a donor organism, they are bathed in the culture medium, which helps in the revival of the cells, as they contain energy sources and important nutrients.

What is Growth Medium or Culture Medium or Nutrient Broth and What does it contain?

A growth medium or culture medium or nutrient broth is a solution which is freed of all microorganisms through sterilization. Sterilization is achieved by applying heat under pressure for a specific time period. However, the solution contains all the microorganisms required for growth, such as algae, fungi, bacteria and protozoans.

When the Agar is added to the medium it solidifies. Some media are made up of inorganic salts and one or more inorganic compounds. This is a chemical or synthetic defined media. Different types of living cells or tissue cultures can also be used as part of the media. There are types of media which are made up of an assortment of ingredients like plant or animal tissue extracts. Some of the examples are peptone, meat extract, yeast extract.

There are special-purpose media like enriched media and selective media. Enriched media consists of nutrients that help in growth and selective media consists of substances that help in the growth of selective organisms and prevent the growth of other organisms.

How are cells grown?

Cells can be grown in three ways.

1. Chemically defined synthetic medium using tissue extract.

2. The culture medium of biological origin like blood serum.
3. A mixture of the culture medium of biological origin and chemically defined synthetic medium.

Some of the important prerequisites in a medium are it must have the essential nutrients for the cells in the right proportions and it must be suitably acid or alkaline.

How are cultures grown?

1. Usually grown as a single layer
2. Usually grown either on glass or a plastic surface or as a suspension in a liquid or a semi-solid medium.

How to start a culture?

A small sample of the tissue is spread out on the medium or in the medium. Later the tube or plate or flask containing the culture is incubated. The temperature maintained should be approximately that of the tissue environment. Usually, at the start of the culture, single cells are used, this results in the growth of clones, which are a set of uniform biological populations.

Chronology of Developments in Tissue Culture

Year	Event
1885	The 1st attempt was by Wilhelm Roux, he was a German Zoologist, he cultivated tissue from chick embryo. The medium used was warm water.
1907	Growth of frog nerve cell process by Ross G Harrison in 1907. He was an American Zoologist. The medium used was clotted lymph
1910-11	French surgeons Alexis Carrel and Montrose Burrows published many papers on the subject they coined the term tissue culture and gave definition to the concept
Post-1910-11	Later on, there were lots of success in cultivating animal cells. The culture medium used was different biological fluids like plasma, lymph, blood serum.

Main Types of Cultures

1. Primary (Mortal) Cultures
2. Established Cultures (Immortal)

What are Primary Cultures?

Primary culture usually involves collecting normal cells, tissues, or organs which are collected through biopsy from a living organism. In this type of culture, the cells, tissues and organs under study are functioning as per its natural condition. There will be more mutations, change in chromosome structure and cell functions when the samples are maintained in culture for a longer duration.

What is the Hayflick limit?

This discovery is named after American Biologist Leonard Hayflick. It is the point at which cells will stop growing in primary culture.

How to process the cultured cells and tissues?

There are different ways of examining the live cultures.

1. Directly through microscope
2. Photographs and motion pictures were taken through the microscope.
3. As per objectives of the experiment, cells, tissues and organs could either be preserved, killed or stained for any additional examination.
4. Samples can also be embedded on materials like resin which can be cut into thin sections which will help in discerning further details under light or electron microscope.
5. Scientists try to understand the changes in the cells in the tissue culture when they are subjected to numerous experiments by adding viruses, and any type of disease-causing organisms. Even drugs, vitamins and hormones are added to understand how cells will react.

What are the discoveries in biological sciences due to research in Tissue culture?

1. Information on cells regarding their composition and form.
2. The biochemical and genetic activity of cells.
3. Metabolism, nutrition and specialized function of cells
4. Differences between normal cells and abnormal cells
5. The effects caused on cells by physical, chemical and biological agents.
6. Assisted in identifying infections, enzyme deficiencies, chromosomal activities.
7. Helped in formulating test drugs and vaccines.
8. Tissue culture technique helped in developing vaccines for measles, influenza, mumps, poliomyelitis and other infectious diseases.
9. Tissue culture studies have clarified the genetic causes of certain hereditary diseases.