ASSIGNMENT - 3

INNOVATIVE TECHNOLOGY AND BIO-SCIENCE

Submitted By : **YASH VINAYVANSHI**
B.TECH 2nd SEM
SECTION C ; SR : 72 ; ROLL NO. : 19BCS081
JAMIA MILLIA ISLAMIA
E-Mail : yash.vinayvanshi@gmail.com

Submitted To : PROF KEHKASHAN PARVEEN
DEPT. OF APPLIED SCIENCES
JMI FET

Q1. What is the difference between adaptive and innate immunity?

	INNATE IMMUNITY	ADAPTIVE IMMUNITY
Specificity	General protection (not antigen specific)	Highly specific for particular pathogen (antigen specific)
Inducers	Triggered by any molecule or stressful event (eg. Molecules shared by groups of related microbes or produced by damaged host cells, metabolic compounds, pollutants etc.), upon the very first exposure.	For specific antigen, upon a second exposure to the same.
Response time	Immediate maximal response (primary response). Early phase of host response.	Delayed between exposure and maximal response . Later phase of antigen specific lymphocytes to antigens.
Response intensity	Either enhanced (trained memory) to reduced (tolerance)	Much more potent and enhanced
Memory	Does not alter on repeated memory (short lasting immunological memory)	Improves with each successive expose (long lasting immunological memory)
Memory mechanism	Epigenetic changes (eg. DNA methylation, histone acetylation).	Clonal expansion and differenciation
Recognition receptors	Complement - R, inflammosomes, Mannose-R etc.	B and T cell recptors, high affinity immunoglobulins etc
Receptor clonality	Non clonal	Clonal

Receptors agonists/ mediators	Molecular patterns Macrophage derived cytokines (eg alpha, beta interferons) etc.	Antigenic epitopes Lymphocyte derived cytokines (eg gamma interfron) etc.
Receptor Genes	Single gene no rearrange ment required	Encoded in Gene segments rearrangemt required (somatic recombination of gene segments)
Effector Mechanisms	Phagocytosis Leukocyte recruitment Inflammation Healing responses etc.	Clonal expansion of antigen specific B and T cells, antigen specific immunoglobulins.
Cells	Monocytes, Macrophages, Natural killer(NK) cells and other innate immune cells	B and T lymphocytes

Fig 1 : Cells involved in immune response

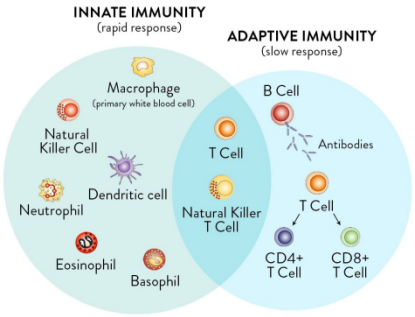
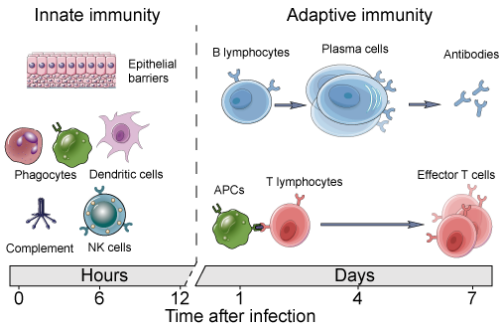


Fig 2 : Timeline after infection



Q2. Explain industrial microbiology?

Industrial microbiology is a branch of **biotechnology** that applies microbial sciences to create industrial products in mass quantities. There are multiple ways to **manipulate** a microorganism in order to increase maximum product yields :

1. Gene amplification achieved by the use of plasmids, and vectors. The plasmids and/or vectors are used to incorporate multiple copies of a specific gene that would allow more enzymes to be produced that eventually cause more product yield.

2. Introduction of mutations into an organism may be accomplished by introducing them to mutagens.

The manipulation of organisms in order to yield a specific product has many applications to the real world like the production of some antibiotics, vitamins, enzymes, amino acids, solvents, alcohol and daily products. Microorganisms play a big role in the industry, with multiple ways to be used.

1. MEDICAL APPLICATIONS

1.1 Production of Antibiotics

Many antibiotics are derived from microorganisms which have greatly improved our capability to treat deadly diseases like plague, whooping cough, diphtheria etc. Some of clinically important antibiotics are :

Penicillin antibiotics derived from *Penicillium* moulds are effective against many bacterial infections caused by *Stephylococci* and *Streptococci*.

Erythromycin isolated from bacterium *Saccharopolyspora erythrea* is used for treatment of many bacterial infections including respiratory tract inf., skin inf., pelvic inflammatory disease, syphilis etc.

Amphotericin B *by Streptomyces nodosus* is anti fungal
Tetracyclin *by Streptomyces rimosus* is broad spectrum antibiotic
Rifamycin *by Streptomyces mediterranei treat tuberculosis*

1.2 Production of Bio-active molecules

Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infraction leading to heart attack.

cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*

Statins produced by the yeast *Monascus purpureus* have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

Insulin hormone, which was earlier extracted from animals is produced by genetically engineered Escherichia Coli

2. FOOD AND CHEMICAL APPLICATIONS

Microbes are also used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes.

Aspergillus niger (a fungus) of **citric acid**,

Acetobacter aceti (a bacterium) of **acetic acid**;

Clostridium butylicum (a bacterium) of **butyric acid**

Propionibacterium sharmanii of **propinoic acid** (swiss cheese)

Lactobacillus (a bacterium) of **lactic acid** (milk to curd)

Yeast (*Saccharomyces cerevisiae)* is used for commercial production of **ethanol**.

Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry.

Bottled fruit juices bought from the market are clearer as compared to those made at home. This is because the bottled juices are clarified by the use of **pectinases and proteases.**

Furthermore, microorganisms are used on a large scale for

3.SEWAGE WATHER TREATMENT

4.BIOGAS PRODUCTION

5.AGRICULTURAL PURPOSES

i. such as fertiliser production - composting etc

Q3. What is concept of gene?

A gene is the basic physical and functional unit of heredity. Genes are made up of DNA. Some genes act as instructions to make molecules called proteins. However, many genes do not code for proteins. In humans, genes vary in size from a few hundred DNA bases to more than 2 million bases. The Human Genome Project estimated that humans have between 20,000 and 25,000 genes.

Every person has two copies of each gene, one inherited from each parent. Most genes are the same in all people, but a small number of genes (less than 1 percent of the total) are slightly different between people. Alleles are forms of the same gene with small differences in their sequence of DNA bases. **These small differences contribute to each person's unique physical features.**

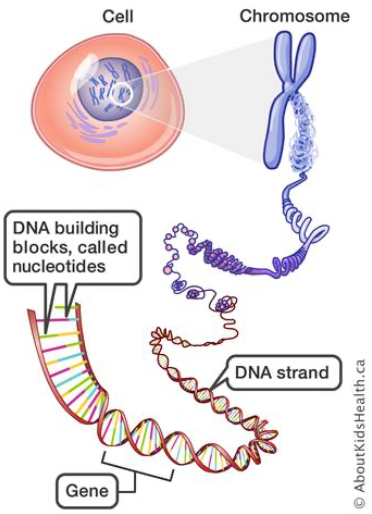


Fig 3 : Gene as DNA sequence

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