GOVERNMENT OF TAMIL NADU

HIGHER SECONDARY FIRST YEAR

MICROBIOLOGY

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Department of School Education

Untouchability is Inhuman and a Crime

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Assessment

HOW TO USE THE BOOK ?

Chapter Outline	Presents a complete overview of the chapter
Learning Objectives:	Goals to transform the classroom processes into learner centric with a list of bench marks
	Amazing facts, Rhetorical questions to lead students to biological inquiry
Activity	Directions are provided to students to conduct activities in order to explore, enrich the concept.
Infographics	Visual representation of the lesson to enrich learning .
	To motivate the students to further explore the content digitally and take them to virtual world
ICT	To enhance digital Science skills among students
Glossary	Explanation of scientific terms
Evaluation	Assess students to pause, think and check their understanding
Career corner	List of professions particular to that chapter
References	List of related books for further details of the topic
Web links	List of digital resources

Career Opportunities for Microbiologists

Microbiologists are biological scientists who study about organisms that are generally so small and can only be seen with a microscope. These microorganisms include bacteria, algae, yeasts, fungi, protozoa, viruses, and other microscopic forms of life. Some microbiologists specialize in one type of microorganism. For example, bacteriologists concentrate on bacteria and virologists study viruses. Microbiologists isolate and make cultures of microorganisms, identify their characteristics, and observe their reactions to chemicals and other kinds of stimuli. They also study how microorganisms develop and reproduce as well as their distribution in nature.

The Scope of Microbiology (Course Benefit / Advantages)

The whole ecosystem depends on bacterial activities. The modern microbiology is a large discipline with different specialities. Microbiology has a great impact on fields such as medicine, agriculture, food sciences, ecology, genetics, biochemistry and molecular biology. There are many possible avenues of advancement for microbiologists.

Medical Microbiology – Medical microbiologists are involved in identifying the microorganisms causing the infectious diseases. They work on identifying the pathogens and assist the medical practitioners for prescribing the apt antibiotics in right dosages. They also study the ways in which the micro organisms cause the infection. Medical microbiologists study the relationship between microorganisms and disease establishment.

Immunology – Those who work on immune system related work are called immunologists. Immunologist study the body's defensive responses to microorganisms. They learn how our immune system protects our body during the infection. They suggest possible ways to increase our immunity. It is one of the fastest growing areas in science.

Microbial Ecology - The microbial interactions with living and non-living matters of the environmental habitats is referred to as microbial ecology. Microbial ecologists study the contributions of microorganisms to the cycling of various nutrients or elements. The ecologists are employed in reducing the pollution of the environment which is the burning issue in all metro cities. They work on employing microorganisms in bioremediation to reduce pollution effects.

Food and Dairy Microbiology – Some of our foods are actually the by-products of microbial growth. Example: Cheese is produced by the growth of microorganisms such as *Leuconostoc citrovorum* and *Streptococcus lactis*. Yoghurt results from the growth of bacteria such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus* in milk. The leavening of bread is accomplished by *Saccharomyces cerevisiae* (Baker's yeast). Main work of the food and dairy microbiologists in the food industry is to prevent contamination during processing and the transmission

of food borne diseases. Microbiologists are currently employed in all food and dairy processing industries. They are also employed in Mineral water companies to check the quality of water.

Agricultural Microbiology – It is concerned with the impact of microorganisms on agriculture. Most bacteria and fungi live saprophytically on dead and organic matter of the soil. They decompose the complex organic matter into simpler form making it available for the soil microorganisms. Thus they form an important constituent of soil called humus. Certain microbes increase the fertility of the soil by converting the atmospheric nitrogen into ammonia, nitrites and nitrates. This is brought about by the microbes such as *Nitrosomonas*, *Nitrobacter* and *Rhizobium* sp. Agricultural microbiologists try to combat plant diseases that attack commercial food crops and they also work on methods to increase soil fertility and crop yields.

Industrial Microbiology – Microorganisms are used to make products such as antibiotics, vaccines, steroids, alcohols, vitamins, amino acids and enzymes. Some important drugs are synthesized by microorganisms such as streptomycin, penicillin, chloramphenicol, tetracycline. Industrial microbiologists work on improving the strains that produce the industrially important products and thereby increase the yield. The Research and Development (R&D) units in the industries provide various job opportunities to microbiologists.

Directors of Research Units and Universities – Many microbiologists work for universities, where they teach and do research. Microbiologists can become directors of research in medical centres, private firms, or government agencies. Those who hold a teaching and research position in a university can advance to the rank of full professor. They can also make significant discoveries in their research and gain the recognition of other microbiologists. Many scientists consider this to be the highest form of advancement.

Microbial Genetics and Molecular Biology – The use of micro organisms has been very helpful in understanding the functions of the genes. Microbial geneticists play an important role in applied microbiology by producing new microbial strains that are more efficient in synthesizing useful products. Genetic techniques are used to test substances for their ability to cause cancer. Microbiologists are in greater demand in genetic engineering companies and research units.

Biomining – Microbes are used in extracting valuable metals like uranium from rocks. *Thiobacillus ferrooxidans* unlocks energy from inorganic compounds like iron sulphide. During this process, it produces sulphuric acid and iron sulphate. The use of micro organisms in mining has considerably reduced the cost of mining to 75%. Microbiologists involved in Biomining research are highly paid in the Government sector.

Medical coding – Medical coding is the transformation of healthcare diagnosis, procedures, medical services and equipment into universal medical alphanumeric codes. The diagnoses and procedure codes are taken from

medical record documentation, such as transcription of physician's notes, laboratory and radiologic results. Medical coding jobs are assigned to Life Science, Paramedical and Medical Graduates and Post Graduates.

Editor in Scientific Journals – Editing, proof reading in scientific journals, handle manuscripts on topics ranging from Zoology, Biology, Plants and Animal sciences are few assignments that could be accomplished by microbiologists. Microbiologists review the research articles that are to be published in reputed National and International Journals. They are employed as Editors and Associate Editors of Scientific Publishing Companies.

Pharma companies – A microbiologist in a pharmaceutical company is a member of quality department. The role of the microbiologist is to ensure the quality of raw materials before they are processed in the production area, monitor the microbiological quality of environment and water and validate the test methods used in testing the finished products from microbiological perspective.

Eligibility Criteria for Undergraduate level courses in Microbiology

In order to apply for under graduate level courses in Microbiology, candidates should complete 12th class. It is important to opt Physics, Chemistry and Biology subjects in 12th class to join for Microbiology courses. Candidates need to score good percentage of marks in 12th class as the selection process for undergraduate level courses in this stream will be based on the marks scored. There are certain top universities which conduct selection through entrance examination. Candidates can choose any of the specialization streams in order to choose courses related to Microbiology

- Agricultural Microbiology
- Food microbiology
- Medical Microbiology
- Pharmaceutical Microbiology
- Microbial Genetics
- Environmental Microbiology
- Aero Microbiology
- Microbial Physiology

Different Courses in Microbiology

- Bachelor of Science in Microbiology
- Bachelor of Science in Microbiology and Microbial Technology
- Bachelor of Science in Clinical Microbiology
- Bachelor of Science in Medical Microbiology
- Bachelor of Science in Industrial Microbiology
- Bachelor of Arts in Microbiology
- Diploma Courses in Microbiology
- Post Graduate Diploma in Marine Microbiology
- M.Sc in Microbiology
- M.Sc in Applied Microbiology
- M.Sc in Microbial Genetics and Bioinformatics

Universities offering Courses in Microbiology

- Indian Institute of Technology
- Banaras Hindu University

- Aligarh Muslim University
- University of Mumbai
- Vinayaka Mission University
- Mahatma Gandhi University
- Indian Institute of Science
- Amity University
- Kurukshetra University

Para Medical Courses and certificate courses in Tamilnadu Government Medical Colleges

1 Year Certificate Courses

Courses	Educational Qualification	Age limit
Cardio Sonography Technician	Pass in H.Sc. with physics, Chemistry, Botany & Zoology (or) Biology and Microbiology	Should complete 17 yrs Should not exceed 32 yrs
ECG/ Tread Mill Technician		
Pump Technician		
Cardiac Catheterisation Lab Technician		
Emergency Care Technician		
Dialysis Technician		
Anaesthesia Technician		
Theatre Technician		
Orthopaedic Technician		
Audiometry Technician		
Hearing Language and Speech Technician		
Clinical, Therapeutic, Nutrition & Food Service Management Technician		
E.C.G/E.M.G Course Technician		
Multipurpose Hospital Worker Course	Pass in SSLC	

2 Years Diploma Courses

Courses	Educational Qualification	Age limit
Dental Mechanic(Male)	Pass in H.Sc. with physics, Chemistry, Botany & Zoology (or) Biology and Microbiology	Should complete 17 yrs Should not exceed 32 yrs
Dental Hygienist (Female)		
Diploma in Medical Lan Rechnology (Dmlt)		
Diploma in Radio Diagnosis Technology (Drdt)		
Diploma in Radio Therapy Technology (Drtt)		
Diploma in Optometry		

Medical Record Science

Courses	Educational Qualification	Age limit
Diploma in Medical Record Technician (Six Months)	Pass in H.Sc. with physics, Chemistry, Botany & Zoology (or) Biology and Microbiology	Should complete 17 yrs Should not exceed 32 yrs

Job Prospects

Candidates who have studied courses related to Microbiology have good scope for jobs in different sectors. Candidates can take up jobs in private sectors mainly in pharmaceutical companies, research firms. Candidates can get in to roles like Medical Microbiologists, Agricultural Microbiologists, and Marine Microbiologists. Candidates can join for teaching jobs as well. Jobs are also available in public sector after doing under graduate or post graduate level courses in Microbiology. Job opportunities occur in government controlled development laboratories, chemical industries, hospitals, food industry, pharmaceutical companies. Apart from this, candidates can also try for jobs abroad. Candidates who attain good experience in this field will get higher salary packages in jobs.

Career Prospects after completion of B.Sc Microbiology course

Candidates, who have completed their B.Sc Microbiology, can become microbiologists and there is wide range of employment opportunities available for microbiologists. They can find job placement in research laboratories and research organizations in public sector and private sector. They can also find job placement in pharmaceutical firms, chemical firms. Since there is many similarities between microbiology and biotechnology, the career options available for professionals in the field of biotechnology are applicable to the professionals in the field of microbiology as well.

Central Government jobs after M.Sc Microbiology

Post Graduates of Microbiology can find plenty of job opportunities in the Central Government sector. Several vacancies are available for them in the research institutes run by Central Government. These graduates can apply for Scientist, Research Assistant, Technical Assistant, Field Assistant or Project Assistant posts in these institutes whenever vacancies are available. Institute of Liver and Biliary Sciences, New Delhi offers Microbiologist job for these graduates. They can apply for this post when the notification gets published in the newspaper or website. Staff Selection Commission conducts Combined Graduate Level Exam for recruiting graduates to various departments in the Government. Those who have completed M.Sc Microbiology can apply for this exam, if they are interested to work in the Government sector. There are many laboratories working under the supervision of Council of Scientific and Industrial Research (CSIR). M.Sc

Microbiology graduates can apply for various posts available for them in these laboratories. There are also vacancies available for these graduates in Government hospitals.

Teaching Profession in Government Sector after M.Sc Microbiology

Candidates who want to work in the teaching field after M.Sc Microbiology can apply to various colleges or universities. An M. Phil / Ph.D degree is required for these graduates to apply for these posts. They also need to clear NET exam so as to be eligible for teaching posts available in various universities.

Microbiology in India

There are number of Institutes engaged in microbiological research in our country. The Indian Institute of Petroleum, Dehradun; Tata Energy Research Institute, Delhi and National Chemical Laboratory, Pune have worked on microbial dewaxing of heavier petroleum fractions. The Institutes has also played a vital role on the area of microbial enhanced oil recovery and production of biosurfactants. National Institute of Nutrition, Hyderabad and National Institute of Occupational Health, Ahmedabad have already completed a long time plan on monitoring and surveillance of food contaminants hazards in India while genome analysis and synthetic gene design for modulation of genome expression *invivo* was carried out by the scientists of Indian Institute of Science, Bangalore.

The Future of Microbiology

Microbiology has a clearer mission than other scientific disciplines. It is confident of its value because of its practical significance. The following brief list will give us some idea of what the future may hold:

- Everyday microbes are changing its nature (mutation) and new diseases are emerging. Microbiologists will have to respond to these threats.
- Microbiologists must find ways to stop the spread of established infectious diseases.
- Microbial diversity is another area requiring considerable research.
- Much work needs to be done on microorganisms living in extreme environmental conditions. The discovery of new microorganisms may lead to further advances in industrial processes and enhanced environmental control.
- The genomes of many micro organisms already have been sequenced, and many more will be determined in the coming years.
- Microorganisms are essential partners with higher organisms in symbiotic relationships. Greater knowledge of symbiotic relationships can help improve our appreciation of the living world. It also will lead to improvements in the health of plants, livestock and humans.