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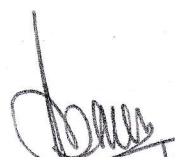


UNIVERSITY OF CALCUTTA

NOTICE

Program Outcome (PO)/ Program Specific Outcome (PSO)/ Course Outcome (CO) for the following Subjects, offered by the University of Calcutta pertaining to the U.G. (4-Year Honours & Honours with Research/ 3-Year MDC) Courses of Studies under CCF , as laid down in the accompanying pamphlets:-

- ✓ 1. Bio-Chemistry
2. French
3. Human Development
4. Political Science
5. Economics
6. Mathematics
7. Philosophy
8. Women's Studies


20/06/2025
Secretary
U.G. Councils

Biochemistry Learning Outcomes

3 YEAR B.Sc Biochemistry (MDC)

Programme Learning Outcomes (PO)

The curriculum is designed to achieve the following outcomes:

- PO1: Ability to understand the basic concepts of biochemistry encompassing the fundamental biochemical principles and related applications with a scientific and methodical approach.
- PO2: Develop awareness on the current developments in the emerging fields of biochemistry and related subjects.
- PO3: Students will gain the ability to critically evaluate a problem and develop analytical skills to solve it.
- PO4: Students will gain knowledge in basic laboratory techniques and learn the concept of experimentation, data interpretation and logical conclusions. They will learn to work in a team.
- PO5: Through the laboratory experiments students will learn to work safely in the laboratory. They will gain the concepts of ethical and good laboratory practices, health and biohazard regulations, and responsible conduct of research.
- PO6: Students will learn to present their work in seminars and effectively communicate scientific reasoning and data analysis in both written and oral forms.
- PO7: The programme will allow students to have knowledge of research and higher academic achievements in the field of biochemistry and related subjects.
- PO8: A minor degree in biochemistry is designed to prepare students for higher studies in the field of biochemistry and related subjects. It also opens career choices in basic biochemistry, clinical chemistry, pathology, toxicology, pharmacology, food science, neurobiology and forensic science.

Biochemistry Learning Outcomes

4 YEAR B.Sc. Biochemistry Major

Programme Learning Outcomes (PO)

The curriculum is designed to achieve the following outcomes:

- Students would gain knowledge & skills which will help them to cope up with latest research work in the field of Modern Biology going on in the national & international levels.
- They would be able to build careers in academics and research and developments in pharmaceutical, agricultural Science, Bioinformatics, Biotechnology, Microbiology, Biophysics, Genetics, Biostatistics, Forensic Science, Environmental Science, Marine Science and Food Industry.

Semester-wise program outcomes are:

- PO1: Ability to understand the basic concepts of biochemistry encompassing the fundamental biochemical principles and related applications with a scientific and methodical approach.
- PO2: Develop awareness on the current developments in the emerging fields of biochemistry and related subjects.
- PO3: Students will gain knowledge in basic laboratory techniques and learn the concept of experimentation, data interpretation and logical conclusions. They will learn lab safety, concepts of ethical and good laboratory practices, health and biohazard regulations, and responsible conduct of research.
- PO4: Students will be able to carry out research/ investigation and development work to solve practical problems. They will gain the ability to think critically and apply appropriate logic, analysis, judgment to solve the problem.
- PO5: Students will learn to apply advanced knowledge and skills appropriate to the discipline, which they will use to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments
- PO6: Students will learn to demonstrate collaborative and multidisciplinary work and mastery over the area of their specialization.
- PO7: Students will learn to write and present a substantial technical report/document.
- PO8: A major degree in Biochemistry opens up careers in higher education and research and development such as Project assistant, Research fellow, Pathologist, Lab technician, Enzymologist, Forensic expert, Bioinformatics expert.
- PO9: It opens up arenas in research fields of health, medicine and drug discovery.

BIOCHEMISTRY BCMM
4-YEAR B.Sc. (HONOURS WITH OR WITHOUT RESEARCH)
UNDER CCF (NEP)

COURSE OUTCOME

SEMESTER	PAPER/COURSE NAME DESCRIPTION	OUTCOME
I	DSCC1- INTRODUCTION TO BIOCHEMISTRY AND BIOMOLECULES	<p>➤ STUDENTS SHALL LEARN:</p> <ol style="list-style-type: none"> 1. The history of Biochemistry and key contributions of scientists. 2. Study the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids and their importance in biological systems. 3. Illustrates the functions of different biologically important proteins. 4. understand the methods of determination of amino acid and nucleotide sequence of proteins. <p>Practical: Qualitative- quantitative estimation of biomolecules and their Identification.</p>
	SEC-1- TOOLS AND TECHNIQUES IN BIOCHEMISTRY	<p>➤ STUDENTS SHALL LEARN;</p> <ol style="list-style-type: none"> 1. Elaborates on the preparation of solutions and their properties and teaches the use and principles of different basic laboratory instruments. 2. Elaborates the principle and application of different techniques used in biological laboratories. <p>Practical: Gives practical demonstration on use of pipettes and teaches the preparation of solutions of different strengths, developing ideas of pH and other properties of solutions.</p>

II	DSCC2- GENERAL AND ORGANIC CHEMISTRY	<p>➤ STUDENTSSHALLLEARN;</p> <ol style="list-style-type: none"> 1. Illustrates the structures of atoms of matter and their energy states. 2. Develops knowledge on different chemical bonding between atoms, their characteristics and theories describing the nature of bonding. 3. Illustrates on different isomeric forms of elements. stereochemistry of carbon compounds 4. Emphasizes on the properties and configuration of radioactive elements, their measurements and their application in cancer. 5. Describes the structural configuration of organic compounds. 6. Illustrates the different reactions, the defining rules of compounds involved in organic chemistry. <p>Practical: The physical characterization of organic compounds and detection of functional groups present in them.</p>
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	SEC– 2 PROTEIN PURIFICATION TECHNIQUES	<p>➤ STUDENTS SHALL LEARN;</p> <ol style="list-style-type: none"> 1. Develops ideas about the different methods of isolation and purification of proteins and studies the advantages and disadvantages of the methods used. <p>Practical: The hands-on experience of determination of molecular weight of proteins and activity of alkaline phosphatase enzyme.</p>
III	DSCC3 ENZYMOLGY	<ol style="list-style-type: none"> 1. The nature and importance of enzymes in living systems, their thermodynamics and molecular basis of catalysis and the specificity. 2. knowledge of enzymes, their properties and classification, Michaelis-Menten initial rate equation, methods for the determination of K_m and V_{max}. 3. The enzyme kinetics, effect of enzyme concentration, pH and temperature on kinetics of enzyme reactions, enzyme inhibition and activation, and Multisubstrate enzyme kinetics. <p>Practical- Hands-on training of estimation of enzyme activity, determination of pH optimum, K_m and V_{max} of enzymes and analysis of enzyme kinetics.</p>
	DSCC4 METABOLISM OF CARBOHYDRATES AND BIOENERGETICS	<ol style="list-style-type: none"> 1. Concept of Metabolism, Characteristics of metabolic pathway, catabolic and anabolic pathway. 2. role of high energy compounds in the cell. They will acquire knowledge related to regulation of various metabolic pathways. 3. Concepts of the catabolic and anabolic process of carbohydrate and its reciprocal regulation. 4. concepts of Bioenergetics, mechanisms of ETC, oxidative phosphorylation and photophosphorylation, mechanism of ATP synthesis in mitochondria. <p>Practical Practical training on estimation of plasma glucose, serum creatinine, HbA1C, serum amylase activity and interpret their clinical significance.</p>

	SEC-3 CLINICAL BIOCHEMISTRY	<p>➤ STUDENTS SHALL LEARN</p> <ol style="list-style-type: none"> 1. The concepts of assessing human physiology using biological fluid, 2. about the normal constituents of urine, blood and their significance in maintaining good health. 3. The mechanisms of causation of diseases of liver, kidney, heart will be explained and will become aware of the variations in the levels of important clinical parameters and their relationship with various diseases. 4. Students will get acquainted with the role of enzymes in diagnosis of various diseases. <p>Practical- Qualitative and quantitative analysis of constituents of biological fluids such as urine, blood and their estimation using standard spectrophotometric methods.</p>
IV	DSCC5 PHYSICAL CHEMISTRY	<p>➤ STUDENTS SHALL LEARN</p> <ol style="list-style-type: none"> 1.The Thermodynamic terms and thermodynamic functions and parameters, laws of thermodynamics, Concept of heat and work. 2.Knowledge about homogeneous and heterogeneous equilibria and principle involved. 3.Laws in electrochemistry and electrical properties like solubility product and common ion effect and conductances etc. and apply them in experiments, types of electrodes and to determine their EMF. <p>Practical- Perform Acid base titrations using a conductometer , formol titration, specific rotation determination of an optically active compound.</p>

	DSCC6 CELL BIOLOGY AND CELL SIGNALING	<ol style="list-style-type: none"> 1. Concepts of the structure of cell and function of various subcellular organelles, about cell theory, basic cell structure, cell fractionation and cell visualization techniques. 2. The composition of cytoskeleton and extracellular matrix. 3. Knowledge of cell cycle and cell division. 4. Fundamental theme of a generalized cell signalling pathway. <p>Practical:</p> <ol style="list-style-type: none"> 1. The handling of microscope and visualization of animal (Squamous epithelium) and plant (Onion) cells. 2. Microscopic study of mitosis and meiosis from permanent slides.
	DSCC7 LIPID METABOLISM AND MEMBRANE BIOLOGY	<ol style="list-style-type: none"> 1. The concepts of oxidation and synthesis of fatty acids, biosynthesis and physiological importance of triacylglycerol. 2. Knowledge about the lipid storage diseases 3. Composition of biological membranes and its components, transport mechanisms across biological membranes. 4. Primary idea about membrane dynamics and techniques used to study membrane dynamics – FRAP. <p>Practical:</p> <p>Quantitative analysis of Blood glucose, conductometric determination of Critical micelle concentration from any surfactant Functional study in RNA Ghost cell.</p>
	DSCC8 NUTRITIONAL BIOCHEMISTRY	<ol style="list-style-type: none"> 1. The importance of Nutrition in the Overall Health & Wellbeing and the analysis of Bodily Fluids for Diagnostic & Therapeutic Analysis. 2. The basic concept of nutrition for maintaining normal health, role of nutrients for the body, dietary requirements of carbohydrates, proteins, fats, vitamins, minerals, etc. 3. Importance of essential amino acids, essential fatty acids and vitamins for the body <p>Practical:</p> <p>Learn how to estimate Calcium, Vitamin C from food source, total phenolic content from black-Tea.</p>

V	DSCC9 METABOLISM OF AMINO ACIDS AND NUCLEOTIDES	<p>➤ STUDENTS SHALL LEARN;</p> <ol style="list-style-type: none"> 1. Details of metabolism of amino acids, disorders related to amino acid metabolism. 2. Biosynthesis of some amino acids and regulation of the enzyme glutamine synthase. 3. The detailed mechanism of porphyrine metabolism, and disorders related to heme metabolism. 4. Metabolism of nucleic acids, the detailed pathways of reactions, regulation of nucleic acid metabolism and disorders related to purine and pyrimidine metabolism. <p>Practical: Techniques for assay of SGOT, SGPT, total protein and uric acid from serum sample.</p>
	DSCC10 BASIC MICROBIOLOGY	<p>➤ STUDENTS SHALL LEARN;</p> <ol style="list-style-type: none"> 1. Basic concepts of microbiology with a brief history. 2. Morphology and cellular structure of microbes, microbial nutrition, bacterial growth and their regulation. 3. Techniques of culture and long term storage of bacteria. 4. Control of microorganisms by physical or chemical methods and by means of antibiotics. <p>Practical:</p> <ol style="list-style-type: none"> 1. Basic microbiological laboratory practices, biosafety. 2. Details of basic instruments related to microbiological work-their principle and applications, Isolation and cultivation of pure bacterial culture by different methods, their identification by Gram staining methods and study of shapes of different microbes.

	DSCC11 HUMAN PHYSIOLOGY	<p>➤ STUDENTS SHALL LEARN;</p> <ol style="list-style-type: none"> 1. Basic concepts of circulatory system and cardiovascular system and diseases related to those. 2. Basis structure and details of respiratory system and disorders related to respiratory system. 3. Basic details of digestive system, excretory system and nervous system. Study related to some neurodegenerative diseases. 4. Introduction to endocrinology, biochemical synthesis and physiological functions of hormones, regulation of endocrine secretion and endocrine disorder. <p>Practical: Hands-on training on methods of estimation of haemoglobin, serum proteins, serum phosphorus and calcium, estimation of normal and abnormal constituents of urine.</p>
	DSCC12 GENE AND GENE EXPRESSION	<ol style="list-style-type: none"> 1. The molecular aspects of biology and basic concepts of DNA structure and genome organisation. 2. Replication and transposition of DNA. 3. Molecular basis of mutation and various modes of DNA repair. 4. Biosynthesis of RNA and proteins. 5. Mendel's principal and chromosomal basis of heredity and extension of Mendelian genetics. <p>Practical: Hands-on training of Isolation and quantification of genomic DNA from bacterial cells, assessment of purity of isolated DNA and agarose gel electrophoresis. Estimation of unknown DNA concentration by preparing standard curve</p>

VI	DSCC13 RECOMBINANT DNA TECHNOLOGY AND GENETIC ENGINEERING	<p>➤ STUDENTS SHALL LEARN;</p> <ol style="list-style-type: none"> 1. Basic knowledge of recombinant DNA technology, DNA manipulation in prokaryotes and eukaryotes, engineering of DNA molecules using restriction and modifying enzymes. 2. The use of cloning and expression vectors, construction of genomic and cDNA libraries and their applications. 3. Fundamentals of Polymerase Chain Reaction, DNA sequencing and how recombinant DNA technology is used to produce proteins and how these proteins are used in industrial systems. <p>Practical: Hands on training on basic Recombinant DNA Technology like Plasmid DNA isolation and digestion with Restriction Enzymes, competent cell preparation and transformation, primer designing.</p>
	DSCC14 IMMUNOLOGY	<ol style="list-style-type: none"> 1. Overview of the immune system including cells, organs and receptors, 2. Comprehend the structure and roles of several immunoglobulin classes, the genetic foundation of antibody diversity, and the significance of humoral, cell-mediated, and innate immune responses in the fight against infections. 3. The significance of traditional vs recombinant vaccinations, as well as the mechanisms underlying various forms of hypersensitivity. 4. The significance of antigen-antibody interaction in disease diagnosis will be explained to them. 5. The concepts of tolerance, autoimmunity, and the function of immunity in defense against infections. <p>Practical:</p> <ol style="list-style-type: none"> 1. Perform various immunoassays such as Ouchterlony double immunodiffusion (DID), RID, immunoelectrophoresis and enzyme linked immunosorbent assay (ELISA) 2. The principles of agglutination reaction and precipitation reaction (blood typing).

	DSCC15 MOLECULAR DIAGNOSTICS	<ol style="list-style-type: none"> 1. Basic introduction to biochemical diagnostics, inborn error of metabolism and diagnostic enzymes and their clinical significance. 2. Details of immunodiagnostics and molecular diagnostics methods. 3. Disease identification and genetic tests for some disorders. <p>Practical:</p> <ol style="list-style-type: none"> 1. Perspective of basic diagnostic techniques like estimation of surface antigen of Hepatitis B and Hepatitis C virus, estimation of serum Alkaline phosphatase and Acid phosphatase, Lipid profile. 2. Diagnosis by studying slides of pathogens and histology/cytology slides for different types of cancer.
VII	DSCC- 16 MOLECULAR BASIS OF INFECTIOUS DISEASE	<p>➤ STUDENTS SHALL LEARN</p> <ol style="list-style-type: none"> 1. The biology of diseases, how they spread, treatment concepts, medication resistance for different antimicrobial drugs, and different groups of microbial infectious agents. 2. The knowledge of the molecular underpinnings of disease detection and treatment, as well as methods for creating vaccinations to prevent certain illnesses. 3. Important infectious diseases that are quite common in tropical nations, like AIDS, malaria, filariasis, and tuberculosis. 4. The importance of cleanliness, hygiene, and immunization in preventing infectious diseases. <p>Practical- Hands on experience on bacterial contamination (CFU) from water, soil, Antibiotic assay(MIC) by different methods, acquire knowledge by demonstration about PCR based diagnosis, Dot Blot and ELISA assay.</p>

	DSCC- 17 MICROBIAL GENETICS AND BIOSTATISTICS	<ol style="list-style-type: none"> 1. The genetic code, gene control, and mutation. 2. To analyze processes involved in gene mutation and transfer in microorganisms. 3. Identify and distinguish genetic regulatory mechanisms at different levels. 4. The knowledge of gene mapping and strain construction. 5. How to design sample analysis and perform chi square and multivariate analysis. 6. A good understanding of measures of correlations. <p>Practical Hands-on knowledge on preparation of Master and Replica Plates, chemical and physical mutagen effects, demonstration of conjugation, transformation, transduction and AMES test.</p>
	DSCC- 18 ADVANCED CELL BIOLOGY	<ol style="list-style-type: none"> 1. The principle and application of some of the classical and advanced cell biology techniques. 2. The Molecular mechanisms of signal transduction and hormone signalling pathways. 3. About the factors regulating cell cycles, ideas of apoptosis and necrosis, comprehend the role and therapeutic value of stem cells. 4. Comprehensive knowledge of the genetic basis of cancer, molecular diagnosis and treatment of cancer. <p>Practical: Morphological study of cancer cells using microscope, use of hemocytometer, cell cycle study, cell viability/death assay by trypan blue, demonstration of biopsy study, apoptotic study (DNA fragmentation assay).</p>

	DSCC-19 ADVANCED BIOCHEMISTRY	<ol style="list-style-type: none"> 1. In depth study of Protein Structure and Protein Folding, Biophysical study of protein folding, defects in protein folding and diseases. 2. About the different types of biomolecular interaction study like spectroscopic study , SPR, ITC, Thermal melting, DNA footprinting, CHIP assay, Co-IP, pull down assay etc. 3. Modern method and principles of drug discovery and development, basics of clinical trials: phase I, phase II, phase III and phase IV trials. <p>Practical Hands-on experience on Spectrophotometric analysis of DNA-ligand interactions, in-silico analysis of protein drug interaction, Molecular docking (Pymol Software).</p>
	Additional Core Paper 1- VIROLOGY	<p>➤ STUDENTS SHALL LEARN</p> <ol style="list-style-type: none"> 1. To understand the architecture of viruses, their classification and the methods used in their study. 2. Know the replication strategies of representative viruses and comprehend the significant interactions between viruses and host cells. 3. Comprehensive role of viruses in oncogenesis, and ways of preventing/ treating viral infections. 4. Use of viruses as tools to study biological processes, as cloning vectors and for gene transfer. <p>Practical- The hands-on experience on viral growth curve and determining the titre value, Phage typing , Induction of Lambda phage, Lambda phage DNA isolation and transduction study.</p>

VIII	DSCC20 MOLECULAR BASIS OF NON-INFECTIOUS DISEASE	<p>➤ STUDENTS SHALL LEARN</p> <ol style="list-style-type: none"> 1. The different classifications of non-infectious diseases and their risk factors. Causes of genetic and lifestyle disorders, management/ treatment of some important diseases related with these disorders. 2. The Important aspects of biochemical and genetic features of cancerous cells, use of tumor biomarkers for treatment and detection. 3. Concepts on some important age related diseases (osteoarthritis, COPD, Alzheimer disease, dementia etc.). <p>Practical- Acquire experience on microscopic observation on different types of cancer, Estimation of important Clinical parameters related with diseases using semi auto analyzer instruments.</p>
	DSCC21 REGULATION OF GENE EXPRESSION	<ol style="list-style-type: none"> 1. Acquire knowledge about the process of transcription and translational regulation in prokaryotes and eukaryotes. 2. Genetic regulation of Bacteriophages, Lytic and lysogenic cycles 3. Develop understanding the molecular basis of RNA processing and RNA splicing 4. About the various ways of regulation and its significance. 5. Concepts on RNAi pathways and Chromatin Remodelling in Eukaryotic Gene Expression <p>Practical- Acquiring the Practical knowledge about Northern and Southern Blotting by demonstration, Hands in experience on bacterial growth curve analysis and effect of temperature on Bacterial growth.</p>

	DSCC22 PLANT BIOCHEMISTRY	<ol style="list-style-type: none"> 1. Plant physiological processes are compiled in this work at the molecular level. 2. Detailed knowledge of plant-specific metabolic processes, such as nitrate absorption, photosynthesis, respiration, and nitrogen fixation, as well as the function of several metabolic pathways in plant growth and development. 3. The different environmental stressors that impact plant development and productivity as well as the defense mechanisms that plants have in place to withstand stress. 4. Basics concepts on Plant tissue culture <p>Practical- Gain expertise to determine the contents of photosynthetic pigments, carbohydrates in plant samples, understanding the spectral patterns of Chlorophyll, Photosynthetic pigments separation techniques (Thin Layer Chromatography) and gather some knowledge about plant tissue culture.</p>
	Additional Core Paper 2 ADVANCED TECHNIQUES IN MODERN BIOLOGY-1	<p>➤ STUDENTS SHALL LEARN</p> <ol style="list-style-type: none"> 1. Acquiring a sound background of the latest methods used in biochemistry for Spectroscopic study (Fluorescence, IR, ¹H NMR) of Biomolecules and ideas about Mass Spectrometry. 2. The concepts related to applications of advanced microscopy (confocal and immunofluorescence microscopy, SEM, TEM) in biochemistry research. The students will get equipped with the latest techniques used in analysis of biomolecules and this will help them in undertaking further research in the area of biochemistry in any research/industrial institution. <p>Practical Develop laboratory/practical skills to perform various experiments with spectroscopic analysis and microscopic studies by visiting a Research Laboratory.</p>

	<p>Additional Core Paper 3 ADVANCED TECHNIQUES IN MODERN BIOLOGY-2</p>	<ol style="list-style-type: none"> 1. The principle and applications of various electrophoretic techniques such as cellulose acetate, gel, PAGE, etc. and their applications in analyzing proteins and nucleic acids, Histochemical and immunotechniques (FACS, FISH, GISH, IHC and detection of molecules in living cells). 2. The knowledge of Molecular cloning (RDT) in prokaryotic and eukaryotic systems, expression and application of recombinant proteins. 3. The importance of different DNA sequencing methods, genome sequencing (NGS), RNA-sequencing, analyses of gene expression at RNA and protein level (microarray), RFLP, RAPD, AFLP, PCR, q-PCR, semiquantitative PCR. 4. The basics of Bioinformatics/Computational biology and ability to use several web based tools /softwares/Biological databases regarding Biological data mining and analyses (Gene bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignments- BLAST and FASTA) <p>Practical</p> <p>Hands on training on DNA Fingerprinting (Using RFLP Technique), Flow cytometric data analysis, acquire training in working with the NCBI-BLAST, Multiple Sequence Alignment and construction of phylogenetic trees by using different webtool.</p>
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SL. NO.	COURSE
1	CC 1
2	CC 2
3	CC 3
4	CC 4
5	CC 5
6	CC 6
7	CC 7
8	CC 8

THREE YEAR B.Sc BIOCHEMISTRY SYLLABUS (CCF)

COURSE OUTCOME
Biomolecules - Learning about the structure of Bio molecules such as amino acids, proteins, lipids, carbohydrates, nucleic acid, which will help the students to understand metabolism of these.
General & Organic Chemistry - Learning atomic structure, bonding, mechanism of common organic reactions.
Enzymology - Learning basic functions, properties of enzymes, importance of enzymes in living systems, principles enzyme kinetics, study of enzyme inhibition would help the students to know about the discovery of drugs.
Nutritional Biochemistry - Students will learn relationship between diet and various functions of body, role of vitamins, minerals & etc
Intermediary Metabolism - Students learn carbohydrate, fatty acid, amino acid, nucleotide metabolism & integration of metabolism
Gene & Gene expression - learning the fundamental steps of DNA replication, transcription, and translation including the roles of key enzymes.
Cell Biology - students learn to use cell biology knowledge in Biotechnology, medicine etc
Basic Microbiology - Learning about microorganisms, their role in food, and how to control their growth.
PROGRAMME OUTCOME
Students are ready with skill to help in Scientific research lab, Educational laboratories, Commercial & Pathological Laboratories, Biochemical Laboratories, Pharmaceutical Laboratories, Agricultural Laboratories & etc

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