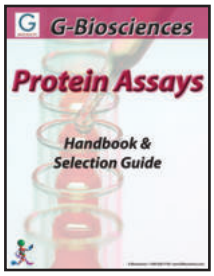
G-Biosciences

Life Science Educational Program

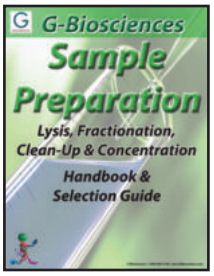
BioScience Excellence™

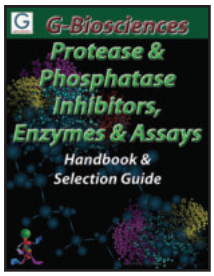
Scientific Teaching Resources



- Protein Estimation Assays
- Apoptosis Assays
- Cytotoxicity Assays
- SAM Methyltransferase Assays
- Protease Assays
- Phosphatase Assays
- Peroxide Assay

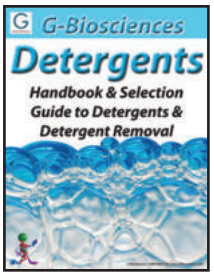
- Lysis Buffers & Systems
- Protein Fractionation Kits
- Dialysis (Micro) System
- Electrophoresis Clean-Up
- Concentration Systems
- Contamination Removal

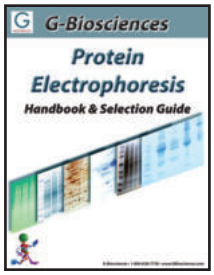




- Protease Inhibitor Cocktails
- Individual Protease Inhibitors
- Protease Assays
- Proteases for Mass Spec.
- Sequencing Grade Proteases

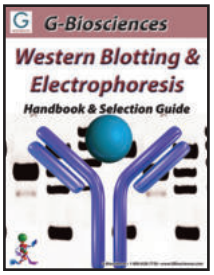
- Proteomic Grade Detergents
- Research Grade Detergents
- Non-Ionic, Ionic & Zwitterionic
- Detergent Estimations
- Detergent Removal Systems

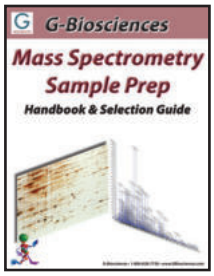




- Gel Preparation Chemicals
- Protein Marker Ladders
- Electrophoresis Buffers
- Reducing & Alkylating Reagents
- Protein Gel Stains

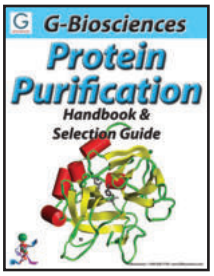
- 1-Hour Western System
- Transfer Buffers & Membranes
- Membrane Stains
- Blocking Buffers
- Secondary Antibodies
- Detection Reagents
- Reprobing Reagents

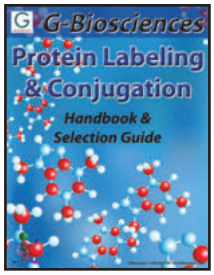




- Protein Sample Preparation
- Protein Clean-Up Systems
- Electrophoresis Reagents
- Mass Spec Grade Protease
- InGel Digestion Kits
- Peptide Generation Reagents

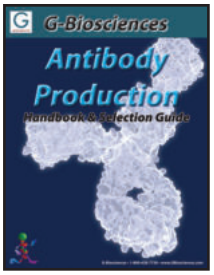
- Affinity Resins
- 6X His Protein Purification Kits
- GST Protein Purification Kits
- Antibody Purification
- Activated Resins
- Buffers & Reagents

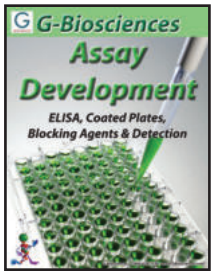




- Biotin Labeling
- Cell Surface Protein Labeling
- Agarose Coupling Kits
- Fluorescent Dye Labeling Kits
- Enzyme Labeling Systems

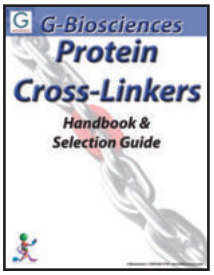
- Carrier Proteins
- Peptide Coupling Systems
- Antibody Purification Resins
- Antibody Fragmentation Kits

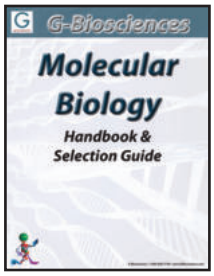




- Coated Plates
- Blocking Buffers
- Wash Buffers
- Secondary Antibodies
- Detection Reagents
- Antibody Labeling Systems

- Homobifunctional
- Heterobifunctional
- Optimizer Systems
- Cross-Linking Systems





- DNA Isolation
- Transformation & Screening
- Polymerase Chain Reaction
- Agarose Electrophoresis
- RNA Isolation
- Yeast Transformation

- Apoptosis Assays
- Cytotoxicity Assays
- SAM Methyltransferase Assays
- Protease Assays
- Phosphatase Assays
- Peroxide Assay
- ELISA

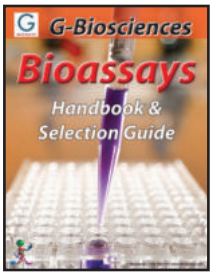


Table Of Contents

CURIOSITY BASED LIFE SCIENCES EDUCATIONAL PROGRAMS

Biotechnology has been described by various commentators as one of the most important technologies of the 21st century. Biotechnology promises to have the potential to solve a wide variety of challenges faced by modern society, including the supply of quality food materials, pharmaceuticals, healthcare, forensic science, environmental concerns and security needs.

The emergence of biotechnology has created a world demand for trained scientists, technicians, and a variety of allied professionals. Hence, teaching topics in biotechnology are now standard in educational programs worldwide.

Recognizing the significance and challenges of life sciences education, G-Biosciences has initiated the BioScience Excellence™ program. The program features hands-on teaching kits based on inquiry and curiosity that explore the fundamentals of life sciences and relate the techniques to the real world around us. The BioScience Excellence™ teaching tools will capture the imagination of young minds and deepen their understanding of various principles and techniques in biotechnology and improve their understanding of various social and ethical issues.

International Standard for Biotechnology Education

The BioScience Excellence™ program has been developed to meet the demands of teaching life sciences. Scientists, professionals, and teachers from the USA, Europe, and Asia have developed the BioScience Excellence™ program. The aim of this BioScience Excellence™ program is to provide a training program of international standard that will prepare students to compete in a global economy driven by biotechnology. The curricula, teaching tools, and kits have been designed to meet the expectations of the most rigorous school and college training worldwide.

The BioScience Excellence™ program offers hands-on and curiosity based laboratory activities to deepen understanding on selected subjects, such as genes, proteins and their interaction within cells. The program enables the learning of biotechnology by posing questions, exploring and utilizing the real world, hands-on exploration that stimulates the interest of students and makes the process of learning interesting.

Biotechnology Careers

A major aim of the BioScience Excellence™ program is to prepare students to the vast career possibilities in the life science fields, such as pharmaceutical development, agriculture, genetic engineering, environmental sciences, forensics, ecology, evolution, and education. A comprehensive training based on the BioScience Excellence™ program will deepen understanding of both the genomic and proteomic. More importantly they build students confidence for their next career challenges, be that further education or seeking employment in the ever growing biotechnology industry. The BioScience Excellence™ hands-on training programs will prepare students to succeed in a global biotechnology profession.

Learning by Hands-on Activity and Curious Exploration

The key strategy of the BioScience Excellence™ program is to pose questions and to challenge students to think, explore, and understand how various processes in life sciences work and their application to the real world, as well as their social implications. Our objective has been to design and develop kits for active participation and problem solving.

Given the rapid growth of information and techniques, the kits are designed to give the most up to date foundation in current technical concepts and scientific methods. Each kit consists of three main components; materials for hands-on activities, “Teacher’s Guide”, and a “Student’s Guide”. The “Teacher’s Guide” provides detailed principles behind the techniques to be introduced, and where feasible, a real world scenario to increase interest in the techniques and step-by-step instructions on conducting each laboratory activity. The “Student’s Guide” details a step-by-step procedure for the laboratory activity, lab activity record sheets, and teaches how to analyze results and draw conclusions.

The kits will challenge students to think, participate in hands-on activities, collect data, analyze and interpret findings, and draw conclusions based on the findings and observations. And finally students learn how to relate and employ what is learnt in the classroom to the real world of science – a skill that is a hallmark of quality education in industrialized nations.

BioScience Excellence™ Kits for All Levels of Learning

Depending on the concept and depth of information needed to be taught, the BioScience Excellence™ program offers kits that can be easily adapted. The range of kits offered under the BioScience Excellence™ program is suitable for training students from school through university levels.

The BioScience Excellence™ program can also be adapted for professional development programs for teachers, technicians, and other professionals with little or no formal science training.

The BioScience Excellence™ program also offers training and workshops for hands-on training in laboratory techniques and professional development in biotechnology.

Support and Services

G-Biosciences is committed to educational excellence and our aim is to help provide support and services beyond teaching kits. G-Biosciences has extensive experience in cutting edge research in life sciences and offers a wide variety of fine biochemicals, research tools, kits, and devices. G-Biosciences will help you acquire tools, resources, and supplies that will enable you to conduct modern educational and instructional programs. G-Biosciences also offers help to teachers and institutions in the development of curriculum and setting up modern laboratories.

BioScience Excellence™ Contents

The BioScience Excellence™ program contents have been divided into six distinct sections. Each section consists of several teaching modules with information provided as to how these modules are connected, and their appropriate order for training purposes. These sections collectively cover the length and breadth of modern life science topics and are adequate for achieving the highest standard for biotechnology education of the most rigorous school, college, and university training worldwide.

The General Biotechnology topic deals with the very basic components of life sciences and gives an overview of the scope of biotechnology. This section is suitable for conveying an understanding of genes, proteins, and their interactions.

The Microbial Studies covers handling of microorganisms, an important tool in biotechnology.

The Molecular Biology and Genomic topics cover the multitudes of molecular cloning and recombination techniques.

The Protein and Proteomic section covers various aspects of protein molecules, including composition, structure, function, and various analytical and related techniques.

The Immunotechnology Studies deals with sophisticate immunotechnology detection techniques.

The Miscellaneous Biotechniques section includes various widely used laboratory techniques in protein and nucleic acid research.

Simple, self contained school level kits that introduce students to some of the simple concepts of modern biotechnology. Students learn about DNA, genes, proteins, enzymes and bacteria.

My Genes: The Blueprint of Life

The key biotechnology molecule that has probably had the most media coverage is DNA (also referred to as genes and genomes) that supplies the blueprint for each individual. To grip your students imagination and introduce them to DNA have them see their very own genome. This exercise allows students to comprehend previously mysterious DNA and its function as the blueprint of life.

The kit is designed to give each student experience on how DNA is isolated by scientists from tiny amounts of samples, such as cheek cells. Students collect their own cheek cells, which are first broken open in a solution to release proteins and cellular components. Proteins and cellular materials are then removed by the action of a protease, which essentially “eats” the proteins and releases the genetic material (DNA). The DNA is precipitated with alcohol and visualized as a suspension of long, white strands.

The kit is suitable for junior school grade levels to college and university levels and even those adults and professionals seeking an understanding of molecular basis of life and genomic DNA.

FEATURES AND APPLICATIONS

- Curiosity driven lesson in genomics
- Introductory lesson to DNA and genes
- Safe to perform lab activity in any classroom environment

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer

Cat. No.	Description /Size
BE-101	My Genes: The Blueprint of Life/ 6 groups of 4-5 students

Biotechnology in Your Mouth

The subjects of life sciences and biotechnology allow students to learn about the fundamental building blocks of life, including their proteins. In addition, biotechnology teaches us how scientists manipulate proteins in industrial applications.

This kit allows students to study their own proteins, enzymes and bacteria from their mouths. The building blocks of life, the proteins, are identified with a clear, colorful assay. A simple colorimetric assay demonstrates the high activity of protein enzymes present in saliva. Finally, bacterial colonies can be grown on solid agar plates to show the vast numbers of bacteria present in the mouth

FEATURES AND APPLICATIONS

- Introduction to the basic elements of biotechnology
- Uses colorimetric assays for the identification of proteins and enzymes
- Grow bacteria and other microorganisms on solid agar growth plates

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer
- Incubator (Optional)

Cat. No.	Description /Size
BE-102	Biotechnology in Your Mouth/ 6 groups of 4-5 students

Unlocking the Mysteries of Genetic Material

Molecular biology and genetic engineering are important skills used in the scientific world that allow for the modification and manipulation of DNA to generate proteins that have been used as drugs or novel food sources. The techniques of molecular biology and genetic engineering are crucial tools used in many of today's biotechnology fields, including forensic science and scientific research.

This kit unlocks the mysteries of genetic materials by introducing students to the concepts of genes, transferable DNA (plasmids) and bacteria as living factories for the production of important proteins. Students will understand the relationship between genes and proteins, by transforming a gene, encoding a light emitting protein, into bacteria to produce glowing green bacteria. In addition to expressing the light emitting protein, the trait for drug resistance is also conferred on the bacteria, allowing students to learn about antibiotic selection.

FEATURES AND APPLICATIONS

- Understand simple molecular biology and genetic manipulation techniques
- Transformation of bacteria with a gene or DNA
- Role of bacteria as a production factory
- Understand transformation in biotechnology

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer
- Shaking Incubator (Optional)
- UV lamp or UV light box
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description /Size
BE-103	Unlocking the Mysteries of Genetic Material/ 6 groups of 4-5

DNA Fingerprinting

Today's media routinely covers forensic stories of criminals captured and innocents released using the powerful DNA fingerprinting technique. This kit allows students to carry out their own criminal investigation by comparing DNA samples collected from suspects to DNA collected at a pseudo-crime scene.

Students will use specialized molecules to cut the DNA into fragments, which can then be visualized by a process known as electrophoresis. The resulting pattern, or fingerprint, can be compared and the guilty suspect identified.

FEATURES AND APPLICATIONS

- Introduces DNA fingerprinting technique
- Teaches DNA fragmentation by specific enzymes
- Introduction to agarose electrophoresis

ADDITIONAL HARDWARE REQUIRED:

- Agarose electrophoresis equipment

Cat. No.	Description /Size
BE-104	DNA Fingerprinting/ 6 groups of 4-5 students

DNA Strands Revealed

One of the most important molecules in an organism is its genomic DNA. Genomic DNA is found in every cell of an organism and carries all the necessary information required to make that organism. This kit provides all the reagents required to visualize genomic DNA strands by a process known as spooling. Students release the long strands of genomic DNA from bacteria and spool, or wind, them onto a rod. This allows students to clearly visualize DNA.

FEATURES AND APPLICATIONS

- Introduces genomic DNA and DNA structure
- Isolate and visualize genomic DNA
- Introduction to DNA isolation

Cat. No.	Description /Size
BE-105	DNA Strands Revealed/ 6 groups of 4-5 students

Microorganisms In Our Environment

Microorganisms, such as bacteria and fungi, are all around us. This kit allows students to collect samples from the world around them and grow the microorganisms so that students can visualize the microorganisms. This teaches students how to plate and grow microorganisms.

FEATURES AND APPLICATIONS

- Introduction to microorganisms
- Plate and grow microorganisms
- Introduction to sterile techniques

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer
- Incubator (Optional)

Cat. No.	Description /Size
BE-106	Microorganisms In Our Environment/ 6 groups of 4-5 students

How Clean Is Our Water

Water pollution is a major problem throughout the world, raising severe concerns about health and sanitization issues. A common problem in polluted water is the presence of bacteria, particularly coliform bacteria from fecal matter, which can directly result in disease, as well as act as a marker for the presence of fecal and sewer contamination in water supplies.

Students can use this kit to test different water sources for the presence of bacteria.

FEATURES AND APPLICATIONS

- Introduction to microorganisms
- Learn about water pollution
- Simple and easily visualized colorimetric test

ADDITIONAL HARDWARE REQUIRED:

- Incubator (Optional)
- UV lamp or UV light box (Optional)

Cat. No.	Description /Size
BE-107	How Clean Is Our Water?/ 6 groups of 4-5 students

Self contained, advanced kits that introduce students to microbes, with a particular focus on bacteria. Students learn about growing, characterizing and isolating bacteria. Students also acquire an understanding of antibiotic sensitivity and screening.

Bacterial Culture & Growth Study

This kit teaches aseptic handling techniques and cultivation of bacteria in liquid culture media and on solid phase agar plates. This kit is designed to educate students about the various stages of the bacterial growth cycle, i.e., lag, log or exponential, stationary and decline or death phases. The kit also teaches the importance of growing bacteria on solid phase agar plates to isolate single colonies of bacteria. This lab activity involves preparation of culture medium and solid agar plates.

FEATURES AND APPLICATIONS

- Aseptic techniques and bacteria culture
- Study growth curve of bacteria in liquid medium
- Growth of single bacterial colonies on a solid phase.
- Hands-on experimentation with microorganism
- Understand the importance of bacterial culture techniques in industrial biotechnology

ADDITIONAL HARDWARE REQUIRED:

- 250-300ml Erlenmeyer flasks
- Spectrophotometer and cuvettes
- Autoclave (or 6 premade LB Broth (L021-C) and 2 premade LB agar (L011))
- Shaking Incubator
- Incubator
- 10ml sterile culture tubes

Cat. No.	Description /Size
BE-201	Bacterial Culture & Growth Study/ 6 groups of 4-5 students

Bacterial Gram Staining

The Gram staining method was first described in 1844 by the Danish bacteriologist Hans Christian Gram, after whom the test was named. The Gram staining test for bacteria is one of the most important tests in microbiology and is often one of the first tests performed in the identification of bacteria. The Gram staining method utilizes the properties of bacterial cell walls and the stain crystal violet. Gram-positive microorganisms have a higher peptidoglycan and lower lipid content than Gram-negative bacteria in their cell walls and this makes them capable of retaining the Gram stain. This kit is supplied with two strains of bacteria and all the necessary components to carry out the Gram staining.

FEATURES AND APPLICATIONS

- Stain two strains of bacteria with Gram stain
- Understand the principle of Gram staining
- Role of Gram stain in clinical diagnostics

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator
- Bunsen Burner
- Microscope

Cat. No.	Description /Size
BE-202	Bacterial Gram Staining/ 6 groups of 4-5 students

Antibiotic Sensitivity & Bacteria Screening

Antibiotics play a crucial role in the manipulation, screening and killing of bacteria in a range of biotechnology processes. This kit specifically teaches the basic principles of antibiotics, bacterial resistance and susceptibility. Students learn and understand the use of antibiotic resistance in screening for infectious diseases. Utilizing a bacterial strain, students learn the effects of different antibiotics and visualize bacterial sensitivity and resistance to the supplied antibiotics. This method involves the use of filter paper discs impregnated with a specified concentration of antibiotics on the surface of an agar plate containing microbial cells. This kit will enable students to analyze the inhibitory effects of different antibiotics on selected bacterial cells and then determine which antibiotic is the most suitable to treat a bacterial infection.

FEATURES AND APPLICATIONS

- Teaches antibiotic selection, bacteria sensitivity, and resistance
- Hands-on experimentation, including bacteria growth
- Learn use and significance of screening for antibiotic resistance
- Use of antibiotic screening in recombinant techniques
- Understand the importance of aseptic techniques

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator
- Incubator
- Autoclave (or 2 premade LB agar (L011))

Cat. No.	Description /Size
BE-203	Antibiotic Sensitivity & Bacteria Screening/ 6 groups of 4-5

Isolation & Characterization of Bacteria

An interesting hands-on lab activity that teaches students the skills required for the isolation of bacteria from test samples. This kit teaches aseptic handling techniques and cultivation of bacteria. Using bacterial culture techniques, students discover and isolate the bacteria present in the soil around us. Following isolation of bacteria students characterize the bacteria with household products and antibiotics. In addition, students can characterize bacteria with the included Gram Staining Kit. Students learn and understand the significance of bacterial isolation in applied biotechnology.

FEATURES AND APPLICATIONS

- Aseptic handling techniques
- Cultivation of bacteria
- Bacteria isolation from test samples
- Characterize bacteria with Gram staining
- Applications of bacterial isolation

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator
- Incubator
- Autoclave (or 3 premade LB agar (L011))
- Bunsen Burner

Cat. No.	Description /Size
BE-204	Isolation & Characterization of Bacteria/ 6 groups of 4-5

The Molecular Biology & Genomics kits introduce students to popular molecular cloning techniques, including restriction digestion, ligation, bacterial transformation and protein expression. Other techniques covered in this section include the polymerase chain reaction, bacterial conjugation and viral transduction. A selection of the Molecular Biology kits can be grouped together to form a complete cloning project.

Bacterial Conjugation

Bacterial conjugation is a naturally occurring process that allows the transfer of DNA from one bacterium to another, which allows the transfer of genetic traits, particularly drug resistance. The Bacterial Conjugation kit contains two bacteria with different drug resistance genes and all the tools for students to study bacterial conjugation. This kit teaches the difference between bacterial genomic DNA and the transferable plasmid DNA and the mechanisms of bacterial conjugation. Students will also learn important basic microbiological techniques, including bacterial growth in liquid broth and on solid agar plates, antibiotic selection of bacteria and important aseptic techniques.

FEATURES AND APPLICATIONS

- Understand the bacterial conjugation
- Learn the difference between bacterial genomic & plasmid DNA
- The importance of antibiotic selection in molecular biology
- Application of gene transfer in recombination techniques
- Understand the importance of aseptic techniques

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator, incubator
- Autoclave (or 2 premade LB agar (L011))

Cat. No.	Description /Size
BE-301	Bacterial Conjugation/ 6 groups of 4 student

Viral Transduction

Viral transduction is an important tool in the generation of recombinant bacteria, which offers high efficiency. Phages, or bacterial viruses, are used to deliver genetic material into bacteria. Basically, scientists utilize the normal life cycle of the phage to introduce the researcher's DNA of interest into bacteria.

The Viral Transduction kit teaches students about the life cycle of bacterial viruses (phages) and how to manipulate them to introduce genomic information into the bacteria. Students will learn what a plaque is and how to differentiate between them and bacterial colonies, learning about the lytic and lysogenic phases of transduction. In addition to identifying plaques, students will titrate plaques to calculate the transduction efficiency.

FEATURES AND APPLICATIONS

- Teaches viral transduction
- Understand the life cycle of bacterial viruses (phages)
- Carry out Viral Plaque Titration
- Hands on experimentation with bacteria and bacteriophages

ADDITIONAL HARDWARE REQUIRED:

- Shaking incubator
- Autoclave. (or 2 premade LB agar (L011))
- Low speed centrifuge for 1.5-2ml tubes
- Incubator

Cat. No.	Description /Size
BE-302	Viral Transduction/ 6 groups of 4 students

Isolate Your Own Genomic DNA

Genomic DNA isolation is a crucial technique in molecular biology, genetic manipulation and biotechnology. To carry out these exciting and innovative sciences, researchers require an original source of DNA, which is easy to acquire as it is found in every living organism. Genomic DNA is the blueprint of life and this kit teaches students how to isolate their very own genomic DNA.

Our Genomic DNA isolation kit utilizes detergent lysis of tissues, followed by precipitation of interfering agents, including proteins and recovery of genomic DNA with isopropanol precipitation. The kit is supplied with variations of the main protocol to educate students on the different conditions required for purification from different tissues, such as blood, bacteria and plants. Importantly, this kit does not utilize toxic agents, such as phenol or chloroform for genomic DNA extraction.

The Agarose Electrophoresis kit can be employed to visualize the purified DNA.

FEATURES AND APPLICATIONS

- Handling of biological samples for genomic analysis
- Teaches genomic DNA isolation and manipulation
- Students can isolate their own genomes

ADDITIONAL HARDWARE REQUIRED:

- Waterbaths or beakers & thermometer
- Low speed centrifuge for 1.5-2ml tubes
- Pure or distilled water
- 15ml Sterile tubes
- Agarose Electrophoresis Equipment (optional)

Cat. No.	Description /Size
BE-303	Isolate Your Own Genomic DNA/ 6 groups of 4 students

Introduction to Agarose Electrophoresis

Agarose gel electrophoresis is a routinely used tool for separating nucleic acids. Nucleic acids are negatively charged molecules, which when loaded onto the solid agarose matrix, migrate in the presence of an electric field, separating the nucleic acids by size.

This kit provides all the reagents and supplies necessary for casting and loading agarose gels, the migration of nucleic acids and the subsequent calculation of the DNA molecular weight using a reference DNA ladder.

FEATURES AND APPLICATIONS

- Learn to compare different size DNA molecules
- Calculate DNA size with a DNA ladder
- Hands-on experimentation

ADDITIONAL HARDWARE REQUIRED:

- Agarose Electrophoresis Equipment
- Waterbath or beaker & thermometer
- Shaker (optional)
- Washing Trays 12cm X 12cm

Cat. No.	Description /Size
BE-304	Introduction to Agarose Electrophoresis/ 6 groups of 4 students

Polymerase Chain Reaction (PCR)

A major factor in the advancement of the genomic field and subsequent sequencing of the human genome was the ability to amplify the amount of genes, giving researchers an unlimited supply of DNA. This technique, which has also been a major contributor to the advancement of molecular biology, is the polymerase chain reaction (PCR). PCR utilizes the unique characteristics of enzymes found in the thermophile Thermus aquaticus, an organism that lives at high temperatures (>60°C). The basic principle of the PCR reaction is to heat the DNA to be copied to >90ºC to denature it, rapidly cool the DNA to allow specific primers to bind and then heating to 72°C to activate the polymerase, an enzyme for copying DNA. The presence of a polymerase from a thermophile ensures that the high temperatures are not detrimental to the enzyme. The Polymerase Chain Reaction kit teaches students how to perform PCR and many of the various applications of this technique in research, biotechnology and other applications. In addition, the kit can be used to insert additional genetic information, such as tags, on to the gene of interest.

FEATURES AND APPLICATIONS

- Teaches the principle of polymerase chain reaction (PCR)
- Hands on PCR
- Contains everything necessary for amplification of a gene of interest

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer
- PCR Machine (Thermocycler)
- Agarose Electrophoresis Equipment

Cat. No.	Description /Size
BE-305	Polymerase Chain Reaction/ 6 groups of 4 students

Purification of a Gene

Agarose electrophoresis is an important tool for isolating DNA by its molecular weight; following separation of DNA molecules, the DNA needs to be purified from the agarose for further applications. The Purification of a Gene kit teaches the recovery and purification of DNA fragments following agarose electrophoresis. This technique is commonly used in molecular biology and is important for purifying fragments for subsequent cloning.

FEATURES AND APPLICATIONS

- Teaches agarose electrophoresis
- Teaches elution of DNA from agarose

ADDITIONAL HARDWARE REQUIRED:

- Agarose Electrophoresis Equipment
- Waterbath or beaker & thermometer
- Balance (Optional)
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description /Size
BE-306	Purification of a Gene/ 6 groups of 4 students

DNA Restriction Digestion Analysis

Restriction enzymes are DNA-cutting enzymes found in bacteria and as they cut within the molecule, are often called restriction endonucleases. A restriction enzyme recognizes and cuts DNA only at a particular unique sequence of nucleotides, allowing for restriction sites to be mapped.

The DNA Restriction Digestion Analysis kit demonstrates the specificity of restriction enzymes and their need for specific buffers. An extension of this allows students to understand the crucial role restriction enzymes play in molecular cloning and the analysis of genomic and recombinant DNA.

FEATURES AND APPLICATIONS

- Supplied with multiple restriction enzymes
- Learn about restriction enzyme specificity
- Teaches the role or restriction enzymes in molecular cloning

ADDITIONAL HARDWARE REQUIRED:

- Agarose Electrophoresis Equipment
- Waterbath or beaker & thermometer

Cat. No.	Description /Size
BE-307	DNA Restriction Digestion Analysis/ 6 groups of 4 students

DNA Ligation

Following restriction enzyme digestion of DNA molecules, researchers need to rejoin the ends of the DNA to generate recombinant DNA, a process known as ligation. Ligation of DNA is achieved with the bacterial enzyme T4 DNA ligase, which catalyzes the formation of phosphodiester bonds.

The DNA Ligation kit teaches students about ligation as they ligate several DNA fragments together to make larger pieces of DNA that are easily identified by agarose electrophoresis. This kit is also designed to be used with the DNA fragments produced with the "DNA Restriction Digestion" kit and purified with the "Purification of a Gene". This will result in the generation of a viable plasmid that can be transformed into bacteria with the "Bacterial Transformation" kit.

FEATURES AND APPLICATIONS

- Teaches joining of DNA ends by a process known as ligation
- Contains all the reagents necessary for ligation

ADDITIONAL HARDWARE REQUIRED:

- Agarose Electrophoresis Equipment

Cat. No.	Description /Size
BE-308	DNA Ligation/ 6 groups of 4 students

Bacterial Transformation

Bacterial transformation allows researchers to insert their recombinant DNA into bacteria, which then multiply making more copies of the transformed bacteria. The transformed plasmid can also be used by the bacteria as a template to make recombinant protein.

Students will explore the principles of bacterial transformation and will learn how to make bacteria susceptible, or competent, for transformation. They will also transform bacteria with DNA that confers antibiotic resistance and encodes for a light emitting protein. The results of the transformation can be easily visualized under UV light as glowing bacteria.

FEATURES AND APPLICATIONS

- Bacterial transformation
- Preparation of Competent cells
- Antibiotic selection of transformed bacteria

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer
- Shaking Incubator
- Low speed centrifuge for 1.5-2ml tubes
- Autoclave (or 2 premade LB agar (L011))
- UV lamp or UV light box

Cat. No.	Description /Size
BE-309	Bacterial Transformation/ 6 groups of 4 students

Plasmid Isolation (Alkaline Lysis)

Bacterial plasmids, the non-genomic transferable DNA, can easily be purified from bacteria using numerous techniques. The purification of DNA is important for genetic research as it provides a source of transferable DNA and allows researchers to isolate large amounts of recombinant DNA.

One common technique for plasmid purification is the alkaline lysis method, which breaks open bacteria with an alkaline solution, proteins are removed by precipitation and the plasmid DNA is recovered with alcohol precipitation.

Students purify bacterial plasmids from a liquid culture using this alkaline lysis method.

FEATURES AND APPLICATIONS

- Teaches alkaline lysis plasmid purification
- Teaches ethanol precipitation

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator
- Agarose Electrophoresis Equipment
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description /Size
BE-310	Plasmid Isolation (Alkaline Lysis)/ 6 groups of 4 students

Plasmid Isolation (Solid Particle)

Bacterial plasmids, the non-genomic transferable DNA, can easily be purified from bacteria using numerous techniques. The purification of DNA is important for genetic research as it provides a source of transferable DNA and allows researchers to isolate large amounts of recombinant DNA.

A second commonly used technique for plasmid isolation, following lysis of bacteria, is when the DNA is immobilized on a glass particle support, where it can be washed free of contaminants and then the purified DNA is eluted.

Students learn an alternative technique for plasmid purification, utilizing a DNA binding solid support to purify the DNA from a bacterial lysis.

FEATURES AND APPLICATIONS

- Teaches bacterial lysis
- Teaches solid phase DNA purification

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator
- Waterbath or beaker and thermometer
- Agarose Electrophoresis Equipment
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description /Size
BE-311	Plasmid Isolation (Solid Particle)/ 6 groups of 4 students

Expression of a Recombinant Protein

The final goal in molecular biology is often the expression of a recombinant protein. The transformed plasmids can be used as templates by the bacteria to produce protein.

Students learn about essential promoters and other elements necessary for successful protein expression in bacteria, including the differences between inducible and constitutive (unregulated) expression.

The Expression of a Recombinant Protein kit allows students to express a protein either constitutively or under the control of an inducible promoter, which is activated with IPTG (isopropyl-beta-D-thiogalactopyranoside).

FEATURES AND APPLICATIONS

- Teaches recombinant protein expression
- Students learn about bacterial growth phases and inducible vectors

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator
- Low speed centrifuge for 1.5-2ml tubes
- Protein electrophoresis equipment
- Waterbath or beaker & thermometer

Cat. No.	Description /Size
BE-312	Expression of a Recombinant Protein/ 6 groups of 4 students

Genetic Defect Correction with Bacterial Transformation

A major goal of genetic engineering is to have the ability to correct genetic defects to treat genetic diseases, such as cystic fibrosis, sickle cell anemia and Huntington's disease. One technique to correct genetic defects in bacteria is to introduce the corrected gene back into bacteria utilizing plasmids, a technique known as a-complementation. An additional advantage of a-complementation is that it can be used to screen for recombinant plasmids.

Many cloning vectors in current use encode for the regulatory sequences and N-terminal of b-galactosidase and within this coding region is a cloning site for the insertion of recombinant DNA. These vectors are transformed into bacteria that encode the carboxy terminus of b-galactosidase. Neither the plasmid nor the bacteria can encode an active enzyme, the two together complement each other, producing active b-galactosidase. If colonies are grown on plates containing the enzyme substrate

5-bromo-4-chloro-3-indolyl-b-D-galactoside (X-gal) blue colonies are produced. If the plasmids have recombinant DNA cloned into them then they fail to produce the amino terminus, resulting in the production of white colonies. This blue/white screening allows researchers to rapidly identify colonies with their recombinant DNA.

This kit is designed to teach students how a genetic defect in bacteria can be corrected by transferring in the correct DNA sequence, a method commonly referred to as complementation.

FEATURES AND APPLICATIONS

- Teaches bacterial complementation
- Students utilizes blue/white bacterial screening
- Involves bacteria transformation and antibiotic selection

ADDITIONAL HARDWARE REQUIRED:

- 37 °C Waterbath or beaker & thermometer
- Shaking Incubator
- Autoclave (or 2 premade LB agar (L011))
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description /Size
BE-313	Genetic Defect Correction with Bacterial Transformation/ 6 groups of 4 students

Mutation Detection & Analysis

A PCR Based Laboratory Research Experiment. A major challenge for molecular biologists and genetic engineers is to easily detect and analyze genetic mutations that occur naturally, causing diseases, or during genetic engineering or cloning, whether deliberate or accidental.

Students learn about different types of genetic mutations, including substitutions, deletions and point mutations and about various techniques used to detect genetic mutations.

The kit contains all the reagents to screen simulated clinical samples for a mutant gene, using both the polymerase chain reaction (PCR) and restriction digestion mapping.

Students conduct a simple clinical diagnostic experiment in order to identify a diseased patient.

FEATURES AND APPLICATIONS

- Understand detection and analysis of genetic mutations
- Carry out a polymerase chain reaction (PCR) to amplify DNA source
- Screen amplified DNA using restriction mapping with restriction enzymes

ADDITIONAL HARDWARE REQUIRED:

- PCR Machine (Thermocycler)
- Agarose Electrophoresis Equipment
- Waterbath or beaker & thermometer

Cat. No.	Description /Size
BE-314	Mutation Detection & Analysis/ 6 groups of 4 students

Southern Blot Analysis

Southern blot analysis, named after its inventor Edwin M. Southern, is a common research technique for enhancing the results of agarose electrophoresis. DNA is resolved on an agarose gel and is subsequently transferred to a nylon membrane. The resulting membrane can be probed for specific DNA sequences using a single stranded probe that anneals or hybridizes with a specific sequence. The hybridization probes are often labeled, which can be detected later.

The Southern Blot Analysis kit is a class demonstration kit that allows students to visualize the Southern blot technique and visualize the blotted DNA with a safe blue stain.

Supplied with all reagents needed for a class demonstration, including a detailed Teacher's Guide.

FEATURES AND APPLICATIONS

- Class demonstration of Southern blot technique
- Demonstrate agarose electrophoresis
- Introduce principle of probes and hybridization

ADDITIONAL HARDWARE REQUIRED:

- Agarose Electrophoresis Equipment

Cat. No.	Description /Size
BE-315	Southern Blot Analysis/ 1 class demonstration

Onion or Bacterial Genomic DNA Isolation

Isolation of genomic DNA is an essential technique in modern research science, particularly molecular biology and biotechnology. Genomic DNA is purified from a multitude of sources including mammalian tissue, such as cheek cells (BE-303), plant cells or bacterial cells.

These kits use detergent lysis and precipitation to purify genomic DNA from onion or bacteria. Other plants or fruits can be used, such as strawberries. These kits do not utilize toxic agents, such as phenol or chloroform for genomic DNA extraction.

Agarose electrophoresis can be used to visualize the genomic DNA on an agarose gel.

FEATURES AND APPLICATIONS

- Understand principle of genomic isolation
- Purify genomic DNA from plants or bacteria
- Adaptable for a variety of plant tissues

ADDITIONAL HARDWARE REQUIRED

- Waterbaths or beakers & thermometer
- Low speed centrifuge for 1.5-2ml tubes
- Agarose Electrophoresis Equipment (optional)

Cat. No.	Description /Size
BE-316	Onion Genomic DNA Isolation/ 6 groups of 4 students
BE-317	Bacterial Genomic DNA Isolation/ 6 groups of 4 students

Nucleic Acid Quantification

The kit utilizes the principle of diffusion of nucleic acids on a nylon membrane to determine their concentration. No spectrophotometers required.

Nucleic acid concentration can be measured by measuring the diameter of diff used nucleic acid spots or comparing the color density of the spots with a set of known standards.

Accurate and fast DNA and RNA concentrations can be determined with as little as 1µl of DNA sample.

FEATURES

- No expensive equipment required
- Rapidly quantitate DNA and RNA samples
- Enough reagents for over 50 assays

EQUIPMENT REQUIRED:

- DNA samples

Cat. No.	Description	Size
BE-318	Nucleic Acid Quantitation	50 Assays

The Protein and Proteomic kits provide a thorough and in depth overview of proteins, with a particular focus on studying protein properties, including physical properties and structural features. Many techniques related to protein analysis are featured, including protein electrophoresis techniques, such as zymograms. An important skill in research is purification of proteins and several kits cover a multitude of techniques for purification, including fractionation and chromatography.

Physical Properties of Proteins

Proteins are the building blocks of life and there are estimated to be almost 1 million different proteins in a normal animal cell. Each protein has very different and unique physical properties. The Physical Properties of Proteins kit is a lab activity that enables students to investigate the physical properties of several different proteins.

Students will learn about protein solubility and how it is affected by various parameters; including temperature, pH, salt and dielectric constant. They will understand about protein precipitation due to pH, high salt and in the presence of organic solvents and about protein denaturation as a result of high temperature. In addition, the kit will demonstrate how non-protein agents, such as detergents drastically alter the physical properties of protein molecules and as a result, understand the importance of detergents in protein solubilization.

This lab activity involves analysis of three different types of pure proteins and then students alter some of those properties with a detergent and re-examine physical properties of those proteins. Students are challenged to consider how physical properties of protein molecules can be exploited for purification and characterization of proteins and apply their findings on a test sample of complex tissue extract.

FEATURES AND APPLICATIONS

- Physical properties of proteins molecules in aqueous solution
- Effect of temperature on protein solubility and denaturation
- Effects of pH on protein solubility and protein isoelectric point
- Role of salt on protein solubility and protein salting-out or precipitation
- Interaction between protein and water molecules and hydrogen bonds
- Effects of organic solvent on dielectric constant and protein precipitation
- The effects of detergents in altering the physical properties of proteins

ADDITIONAL HARDWARE REQUIRED:

- Waterbath or beaker & thermometer
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description
BE-401	Physical Properties of Proteins/ 6 groups of 4 students

Assays for Protein Quantification

Determination of protein concentration is an essential technique in all aspects of protein studies and proteomics.

The Assays for Protein Quantification kit includes three of the most widely used protein assays and allows for a direct comparison of the three assays that teaches students the benefits and limitations of each assay. Each assay is available individually to allow teaching of a specific assay, without the option of comparing and contrasting with other assays.

The three assays covered are the Biuret Protein Assay, Lowry Protein Assay and the Coomassie Blue Dye Protein Assay.

The Biuret assay is a copper ion based protein assay, protein solutions are mixed with an alkaline solution of copper salt, cupric ions (Cu^{2+}). The protein assay is based on the interaction of cupric ions with protein in an alkaline solution. The interaction of cupric ions (Cu^{2+}) with protein results in a purple color that can be read at 545nm. The amount of color produced is proportional to protein concentration.

Under alkaline conditions cupric ions (Cu^{2+}) chelate with the peptide bonds resulting in reduction of cupric ions (Cu^{2+}) to cuprous ions (Cu^{+}). The Cuprous ions can be detected with Folin Ciocalteu Reagent (phosphomolybdic/phosphotungstic acid); this method is commonly referred to as the Lowry method. Reduction of Folin Ciocalteu Reagent by cuprous ions (Cu^{+}) produces a blue color that can be read at 650-750nm. The amount of color produced is proportional to the amount of peptide bonds.

The Coomassie Blue Dye Protein Assay is based on the binding of protein molecules to Coomassie dye under acidic conditions. The binding of protein to the dye results in a spectral shift, the color of Coomassie solution changes from brown (absorbance maximum 465nm) to blue (absorbance maximum 610nm). The change in color density is read at 595nm and is proportional to the protein concentration.

The Assays for Protein Quantification kit provides all the reagents required to perform both protein assays, including protein standards for accurate quantification, in a single lab activity. An often underestimated factor in quantifying protein is the presence of non-protein interfering agents, such as salts and detergents. This kit teaches students about common laboratory agents that affect the protein assays, the reasoning behind their interferences and how to overcome the interference. Students also learn how to select a protein assay for different applications.

The protein assays are also offered separately for those who prefer to use individual protein assays:

1. Biuret Protein Assay (BE-402B)
2. Lowry Protein Assay (BE-402L)
3. Coomassie Blue Dye Protein Assay (BE-402C)

FEATURES AND APPLICATIONS

- Three protein assays or as individual assays
- Teaches three widely used methods of estimation
- Biuret, Lowry & Coomassie Dye Protein Assays
- Understand effects of common laboratory agents on protein estimation

ADDITIONAL HARDWARE REQUIRED:

- Spectrophotometer and cuvettes or microplate reader and microplate

Cat. No.	Description
BE-402	Assays for Protein Quantification/ 6 groups of 4 students
BE-402B	Biuret Protein Assay/ 6 groups of 4 students
BE-402L	Lowry Protein Assay/ 6 groups of 4 students
BE-402C	Coomassie Blue Dye Protein Assay/ 6 groups of 4 students

Biodiversity Study & Biomass Analysis

Biodiversity lab activity is designed for determination of protein contents and biomass in diverse biological samples to study how biomass is related to biodiversity in nature.

Students collect and catalog plant leaf samples from a diverse group of locally available plants. This lab activity involves determination of natural weight of each plant sample, grinding a predetermined amount of each sample, and the subsequent extraction of proteins from the samples. Students then learn to determine protein contents of each plant sample and attempt to relate the protein content with biomass. Students in this lab activity are challenged to think, analyze, and seek answers as to why protein biomasses vary for a given natural weight for different plants. Finally, they will relate that finding to the biodiversity of nature.

FEATURES AND APPLICATIONS

- Extraction of proteins from biological samples and determination of protein contents
- Method of protein assay and quantification
- Determination of protein mass and biomass
- Relationship of biomass to biodiversity in nature

ADDITIONAL HARDWARE REQUIRED:

- Fresh plant leaves
- Spectrophotometer and cuvettes or microplate reader and plate
- Balance
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description
BE-403	Biodiversity Study & Biomass Analysis/ 6 groups of 4 students

Hydrophobic & Hydrophilic Proteins

Recent proteomic studies have led scientists to estimate that there are almost a million different proteins in a single human cell. The function and properties of these proteins are highly distinct ranging from structural proteins involved in cell integrity, including hydrophobic cell membrane proteins, to soluble signal proteins that are responsible for passing cellular messages from the cell membrane to the nucleus. A major property of proteins that determines their function and location is their solubility within a cell. There are two major classes; the hydrophobic (water-"scared") and hydrophilic (water-"friendly") proteins. This lab activity is designed to demonstrate the different classes of protein molecules and their classification based on solubility. Students learn fractionation of soluble, insoluble membrane proteins, and cytoskeleton proteins from a tissue sample. The insoluble protein fraction is further fractionated into hydrophilic and hydrophobic membrane proteins. Cell membrane structure and the role of hydrophobic membrane proteins are considered. This lab activity also provides an opportunity to understand characteristics of various classes of detergents and the role of detergents in solubilization of hydrophobic membrane proteins.

FEATURES AND APPLICATIONS

- Different classes of proteins based on solubility
- Solubilization of proteins and role of detergents
- Characteristics of detergents in aqueous solution
- Hydrophilic and hydrophobic proteins
- Membrane proteins and structure of membranes

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Incubator
- Spectrophotometer and cuvettes or microplate reader and plate

Cat. No.	Description
BE-404	Hydrophobic & Hydrophilic Proteins/ 6 groups of 4 students

Enzyme Analysis

Enzymic proteins are functional molecular engines of life and as such carry out cellular reactions in cells. Enzymes convert a target molecule (substrate) into a different molecule (product). Enzymes have a number of distinct advantages over conventional chemical catalysts. The most distinctive feature of enzyme-based catalysis is its specificity and requires lock-key matching specificity before the reaction can proceed. This lock-key specificity of enzyme reactions allows the chosen reaction to be catalyzed in complex cellular environments to the exclusion of side-reactions eliminating undesirable by-products. Because of this lock-key matching specificity, agents or conditions that either compete or alter the lock-key match influence the enzyme reaction. In addition to the high specificity, the enzyme reactions require less energy than conventional chemical reactions and follow saturation kinetics. This lab activity involves analysis of an enzyme reaction using a specific enzyme substrate and inhibitor. Students study how the rate of enzyme reaction is dependent on substrate concentration and the influence of agents (inhibitors) and conditions that affects the enzyme reaction.

FEATURES AND APPLICATIONS

- Enzyme kinetic and regulation of enzyme activity
- Role of substrate concentration
- Effects of pH and temperature on the reaction rate
- Inhibition of enzyme reaction

ADDITIONAL HARDWARE REQUIRED:

- Microplate reader or Spectrophotometer and cuvettes

Cat. No.	Description
BE-405	Enzyme Analysis/ 6 groups of 4 students

Protein Structure Analysis

This lab activity has two objectives, on one hand it is designed to deepen the understanding of protein molecules. On the other hand, students also learn the potential of electrophoresis in protein analysis.

Students study the fundamentals of protein structure from their primary structure to the more complex tertiary and quaternary structures, utilizing protein electrophoresis. Complex mixture of protein samples and characterized pure protein samples, in conjunction with electrophoresis, are utilized to study protein structure and the potential of protein electrophoresis. Using non-denaturing and denaturing electrophoresis, students understand the difference between primary, tertiary and quaternary structures, the importance of disulfhydryl bridges in maintaining protein structure and electrophoresis in studying complete proteins and protein subunits.

FEATURES AND APPLICATIONS

- Potential of electrophoresis in protein research
- Use of electrophoresis for protein characterization
- Parameters affecting protein electrophoresis analysis
- Analysis of proteins structure by electrophoresis
- Role of denaturing and reducing agents in protein electrophoresis
- Protein degradation, breakdown, & role of protease

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- Waterbath or beaker & thermometer

Cat. No.	Description
BE-407	Protein Structure Analysis/ 6 groups of 4 students

Protein Electrophoresis

An important and essential tool in protein analysis is electrophoresis. Protein electrophoresis allows researchers to separate complex protein samples by their molecular size and/or net charge on polyacrylamide gels. The proteins can be subsequently visualized with various protein stains or further analyzed by transferring to a solid membrane (Western blotted; see Western Blot Analysis kit (BE-503)). Students will learn the principles of various types of electrophoresis, including denaturing and non-denaturing electrophoresis, and how this powerful technique is used to analyze proteins. The kit will introduce students to the different separation matrices currently in use and will understand their differing separation properties and their role in protein analysis. Students have an option of casting their own electrophoresis gels using polyacrylamide or using pre-cast commercially available gels. This kit is provided with all of the reagents, buffers and supplies needed for casting acrylamide gels, preparing protein samples, running electrophoresis, and staining the gels for visualization of protein bands. Test protein samples and protein standards are also provided with this kit.

FEATURES AND APPLICATIONS

- Principle of protein electrophoresis and its various applications
- Hands-on lab activities to run electrophoresis
- Casting of electrophoresis gels, protein sample preparation, and running electrophoresis with test samples
- Staining electrophoresis gels for visualization of resolved proteins
- Use of protein standard for determination of protein mass

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- Waterbath or beaker & thermometer

Cat. No.	Description
BE-406	Protein Electrophoresis/ 6 groups of 4 students

Protein Fingerprinting

Each tissue of an organism performs a specific function, for example, the heart has a completely different role than that of the brain. The diverse functions of an organism's tissues is due to the protein make-up, or fingerprint, of the tissue. Each organ contains specialized proteins that work together to allow the organ to complete its function.

In this lab activity, students learn to perform simple protein isolation procedures to isolate the protein fingerprint from various fresh tissues. They will compare the protein fingerprints of 4 different tissues to understand that the function of a particular organ is due to the proteins that are localized to the specific organ.

Also included in this kit are four dried protein samples to compare as a control, if fresh tissues can not be obtained. These include mouse liver, brain, heart and lungs.

FEATURES AND APPLICATIONS

- Manipulation of protein samples
- Protein molecules as the building blocks of life
- Protein electrophoresis for problem solving tasks
- Protein diversity across the animal kingdom

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment

Cat. No.	Description
BE-408	Protein Fingerprinting/ 6 groups of 4 students

Conservation of Genetic Information

The protein make-up of an organism is unique to that individual species, however many essential proteins are highly conserved. This level of conservation can be seen when protein fingerprinting is used to compare and contrast different organisms. The Conservation of Genetic Information kit is an advanced protein analysis lab activity designed to teach delicate manipulation of protein samples and the use of a powerful and highly sensitive protein electrophoresis method.

In this lab activity, students learn to perform carefully controlled experiments to generate protein fragments using a proteolysis enzyme and then analyze the protein fragments by electrophoresis. By analysis of protein fragmentation patterns, i.e. protein fingerprints, students learn about protein sequence, structure, and their conservation. Students resolve a set of 3 functionally identical protein samples selected from throughout the animal kingdom; including human, bovine and sheep. After generating fingerprints by electrophoresis, students examine the protein fingerprint of each sample to determine the degree of conservation.

FEATURES AND APPLICATIONS

- Manipulation of protein samples
- The concept of protein sequence
- Time course dependent experiments
- Use of protein electrophoresis for problem solving tasks

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- Incubator
- Waterbath or beaker & thermometer

Cat. No.	Description
BE-409	Conservation of Genetic Information/ 6 groups of 4 students

Subcellular Fractionation & Protein Distribution

Proteins within a cell are often localized to specific cellular compartments, such as the nucleus, mitochondria, plasma membrane, or vesicles and their specific localization can provide crucial information about the function of the protein. An important technique in identifying novel proteins and understanding their function is subcellular fractionation. This process allows cells to be fractionated into compartment enriched fractions, often utilizing differential centrifugation. In addition to separating compartment specific fractions, subcellular fractionation drastically reduces the complexity of protein samples allowing for easier identification.

The Subcellular Fractionation kit exposes students to how research laboratories handle delicate samples for protein analysis and it serves as an advanced training in protein electrophoresis and protein analysis. This study involves the subcellular fractionation of a tissue sample into fractions enriched with nuclear, mitochondria or cytoplasm proteins. Students also learn about centrifugation techniques and differential centrifugation of samples for fractionation of cellular subcompartments. Students then use electrophoresis to analyze the fractionated cellular compartments and study how protein distribution or protein fingerprints differ between the subcellular compartments. Finally, students will develop an understanding of cell organelles and cellular organization.

FEATURES AND APPLICATIONS

- How to handle delicate biological samples
- Use of differential centrifugation technique
- Study subcellular fractionation of tissue samples
- Use of protein electrophoresis
- Study protein diversity at cellular level

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- Waterbath or beaker & thermometer
- Low speed centrifuge for 1.5-2ml tubes
- Balance

Cat. No.	Description
BE-410	Subcellular Fractionation & Protein Distribution/ 6 groups of 4 students

Protein Folding Study

A proteins life cycle begins once its gene is turned on and its mRNA is transcribed and translated to produce the polypeptide strand. The correct folding of a protein is the first crucial stage of the life cycle of a protein. Correct folding is essential for a protein to be functional, whereas incorrect folding can have severe detrimental effects. For example, several misfolded protein diseases include bovine spongiform encephalopathy (BSE) and its human equivalent Creutzfeld-Jakob disease (CJD), Alzheimer's disease, Parkinson's disease, type II (non-insulin dependent) diabetes and some types of cancer. The symptoms of Mad Cow Diseases (BSE) and Alzheimer's are a result of misfolded proteins aggregating and forming insoluble protein deposits in the brain. Protein unfolding and folding, a reversible process, is analyzed using a light emitting protein specifically prepared for this study and a protein electrophoresis technique. The kit allows students to see when a light emitting protein is denatured (unfolded) as it loses its property to emit light. After electrophoresis the protein in the gel is subjected to a renaturation and folding treatment, which returns the protein to its natural configuration resulting in a return of the light emitting properties.

FEATURES AND APPLICATIONS

- The principles of protein denaturation and refolding
- The importance of correct folding for protein activity

ADDITIONAL HARDWARE REQUIRED:

- UV Light Box
- Waterbath or beaker & thermometer
- Protein electrophoresis equipment

Cat. No.	Description
BE-411	Protein Folding Study/ 6 groups of 4 students

Protein Fractionation

The aim of proteomics is to identify and characterize all the proteins in an organism. The major restrictions in protein identification are the large number of proteins and the huge differences in abundance. These restrictions mean low abundance, critical proteins are often masked and are therefore hard to identify and purify. One key tool in resolving this issue is to utilize protein fractionation techniques.

The Protein Fractionation kit teaches common protein fractionation techniques used during protein purification, including acid and salt fractionation. The individual or combined use of acid and salt fractionations allows for the concentration and enrichment of proteins into defined fractions dependent on their precipitation at differing salt concentrations and/or pH. Students understand the importance of enrichment of target proteins in the scheme of purification of protein molecules. This lab activity involves preparation of a crude protein extract and fractionation of proteins by incremental changes in pH and salt concentration.

FEATURES AND APPLICATIONS

- Strategies in protein purification
- Principles of protein fractionation
- Protein fractionations by changing pH
- Protein fractionation by increasing salt concentration

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Spectrophotometer and cuvettes or microplate reader and microplate

Cat. No.	Description
BE-413	Protein Fractionation/ 6 groups of 4 students

Protein Degradation Study

The cellular environment is a constant dynamic with the continued synthesis, degradation and recycling of protein molecules. This dynamic allows for close regulation of cellular processes by switching off cellular pathways by degrading key proteins. The degradation of proteins is controlled and regulated by specialized proteins, known as proteases. This Protein Degradation kit is designed to demonstrate the dynamic nature of protein molecules in living cells, by incorporating hands-on training in protein analysis and electrophoresis. This lab activity exposes students to time course dependent reactions and orderly manipulation of step-by-step lab activity in research laboratories. It teaches students analytical and organizational skills needed for conducting serious laboratory tasks. Students explore protein biosynthesis and the role of proteolytic degradation and recycling of protein building blocks in the cellular environment. Students perform proteolytic degradation of protein molecules and learn to understand the role and significance of proteases in normal cells and disease processes. Students will understand the concept of proteases in protein analysis, protein purification, and industrial applications.

FEATURES AND APPLICATIONS

- Dynamic nature of protein molecules in living cells
- Time course dependent reactions
- Orderly and timely manipulation of multi-step procedures
- Significance of protease activity in living cells

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- UV lamp or UV light box

Cat. No.	Description
BE-412	Protein Degradation Study/ 6 groups of 4 students

Zymogram: Study of an Active Enzyme with Electrophoresis

Zymography is an electrophoretic technique that includes a substrate copolymerised with the polyacrylamide gel for the detection of enzymes and their activity. Samples are prepared without denaturing the active enzymes present in the samples. Following electrophoresis, the gel is placed in an enzyme activation buffer which allows the enzymes present in the sample to become active and digest the substrates copolymerised in the gel. The zymogram is subsequently stained and the areas of enzyme activy and digestion become visible.

Gelatin is the most commonly used substrate, and is useful for demonstrating the activity of gelatin-degrading proteases, but zymography has been applied to a variety of enzymes, including xylanases, proteases, lipases, etc. Suitable for drug discovery and screening of low abundunt enzymes and their isomers in complex mixtures.

FEATURES AND APPLICATIONS

- A modified protein electrophoresis technique
- Use of electrophoresis to study enzyme activity
- Introduction to zymograms

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment

Cat. No.	Description
BE-420	Zymogram:Study of an Active Enzyme with Electrophoresis/ 6 groups of 4 students

Size Exclusion Chromatography

Size exclusion chromatography (SEC), also called gel filtration chromatography or gel-permeation chromatography (GPC), uses porous particles to separate molecules of different sizes. It is generally used to separate biological molecules and to determine molecular weights and molecular weight distributions of polymers. Molecules that are smaller than the pore size can enter the particles and therefore have a longer path and longer transit time than larger molecules that cannot enter the particles.

The Size Exclusion Chromatography kit teaches gel filtration or size exclusion chromatography and the use of this method in purification of biological samples. This method is based on separation of protein molecules based on their molecular size. This lab activity involves running size exclusion chromatography for separation of molecules based on their molecular sizes.

FEATURES AND APPLICATIONS

- Principles of gel filtration or size exclusion chromatography
- Factors affecting gel filtration chromatography
- Hands-on chromatography lab activity
- Role of gel filtration and strategies in protein purification

ADDITIONAL HARDWARE REQUIRED:

- Clamp and stand

Cat. No.	Description
BE-414	Size Exclusion Chromatography/ 6 groups of 4 students

Ion Exchange Chromatography

Ion exchange chromatography is used to separate charged molecules from complex biological samples. The charged molecules bind to a solid support carrying an opposite charge to the molecule. Proteins contain regions of charged groups on the surface which interact with the ion exchange groups immobilized on the solid support (resin column). Immobilized proteins are eluted by changing either pH or the salt gradient or a combination of both. This lab activity involves preparation of a crude protein extract and running ion exchange chromatography for isolation of proteins.

FEATURES AND APPLICATIONS

- The principle ion exchange chromatography
- Immobilization of protein on ionic charged columns
- Factors influencing binding and elution of proteins in ion exchange chromatography
- Hands-on ion exchange chromatography lab activity

ADDITIONAL HARDWARE REQUIRED:

- Spectrophotometer and cuvettes or microplate reader and microplate (optional)
- Low speed centrifuge for 1.5-2ml tubes

Cat. No.	Description
BE-415	Ion Exchange Chromatography/ 6 groups of 4 students

Hydrophobic Chromatography

Hydrophobic chromatography is based on the fact that protein molecules can have extensive hydrophobic regions. These hydrophobic regions, in media favoring hydrophobic interactions, such as an aqueous solution with high salt concentration, can bind to hydrophobic ligands coupled to an uncharged column matrix. Elution is brought about by decreasing the salt concentration and in some cases decreasing the solvent polarity with PEG, non-ionic detergents, denaturants, urea or chaotropic ions.

The Hydrophobic Chromatography kit is designed to teach students the basic principle of hydrophobic chromatography utilizing a hydrophobic enzyme. The use of the enzyme allows purification followed by a simple enzyme assay to detect the fractions that contain the enzyme. This lab activity involves preparation of a crude protein extract and running hydrophobic chromatography to isolate the enzyme.

FEATURES AND APPLICATIONS

- The principle of hydrophobic chromatography
- Immobilization of protein on hydrophobic columns
- Factors influencing binding and elution of proteins on hydrophobic columns
- Hands-on hydrophobic chromatography lab activity

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Waterbath or beaker & thermometer

Cat. No.	Description
BE-416	Hydrophobic Chromatography/ 6 groups of 4 students

Affinity Chromatography

Affinity chromatography is a powerful tool for the purification of specific biomolecules, including proteins. The basic principle is that a biospecific ligand is immobilized to a solid support or resin to which a solution containing the protein of interest is passed over. Ligands are often based on biological functional pairs, such as enzymes and substrate or antigens and antibodies. The specific ligand binds the protein of interest and all non-specific molecules are washed away. The protein is eluted in a specific buffer, either by pH and/or ionic strength shift or by competitively displacement elution.

The Affinity Chromatography kit teaches the basic principle of affinity chromatography utilizing highly specific affinity columns. This lab activity involves preparation of a crude protein extract and running affinity exchange chromatography for isolation of a protein.

FEATURES AND APPLICATIONS

- The principle of affinity chromatography
- Immobilization of protein on affinity columns
- Binding and elution of proteins on affinity columns
- Factors influencing affinity chromatography
- Hands-on affinity chromatography lab activity

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Spectrophotometer and cuvettes or microplate reader and microplate (optional)

Cat. No.	Description
BE-417	Affinity Chromatography/ 6 groups of 4 students

Protein Purification from Tissue

Proteomics often involves the purification and identification of novel proteins from tissues. The strategy often employed is one using multiple and different protein purification techniques to fractionate proteins into specific fractions. This allows for easier identification and characterization of novel proteins.

The Purification of Proteins from Tissue kit is a comprehensive kit designed to teach students the principle of utilizing numerous purification techniques to identify novel proteins. Students will purify proteins from a mammalian tissue (mouse liver) and will use various fractionation and chromatography techniques to purify three target proteins from the mouse liver extract. The purification procedure will be closely monitored and easily visualized with gel electrophoresis. Students will then be able to assign specific characteristics to the isolated proteins, based on the purification techniques. This kit teaches protein fractionation, gel filtration and hydrophobic chromatography.

FEATURES AND APPLICATIONS

- Step-by-step approach to protein purification
- Protein purification strategies
- Perform salt fractionation, gel filtration and Hydrophobic chromatography

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Waterbath or beaker & thermometer

Cat. No.	Description
BE-418	Protein Purification from Tissue / 6 groups of 4 students

Recombinant Protein Purification

Molecular cloning is a commonly used technique for the generation of recombinant proteins. The gene for a protein of interest is cloned into a vector, or plasmid, in frame with the gene for a protein tag. These tags are used to purify expressed protein by established methodologies. The most common tags in use consist of the six histidine motif (6XHis), purified on a nickel metal chelating column; the glutathione S-transferase (GST) tag, purified with a glutathione resin; and the calmodulin binding peptide (CBP) tag, isolated with calmodulin resin.

The Recombinant Protein Purification kit teaches students the basic principles of purifying recombinant proteins and has a hands-on lab activity that teaches students the purification of a tagged protein. The recombinant protein supplied is a light emitting protein that allows for easy detection of the purified protein, using UV light. Students will learn about protein tags and affinity chromatography.

FEATURES AND APPLICATIONS

- Strategies used in the purification of recombinant proteins
- Purification of a recombinant protein
- Purification of recombinant tagged protein

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- UV light box

Cat. No.	Description
BE-419	Recombinant Protein Purification/ 6 groups of 4 students

The Immunotechnology kits provide an introduction to immunology, especially antibodies, and their role in research science. The self contained kits examine antigen and antibody interactions and techniques based on this interaction, including Dot and Western blot analysis, ELISA, immunoprecipitation and immunoaffinity techniques.

Antigen-Antibody Interactions

This lab activity is designed to study highly specific lock-key matching properties of antigen-antibody and how this highly specific interaction can be exploited as a tool for research and analysis. This study involves the use of an immunodiffusion technique in which antigen and antibody are allowed to diffuse in a solid agarose medium. When antigen and antibody meet, antigen-antibody complex is formed, which leads to precipitation. Antigen-antibody precipitate is formed in the zone where the concentration of the two matching pair reaches an optimal known as the zone of equivalence, which results in formation of a visible opaque precipitate region in agarose medium. Those regions of precipitation can determine the concentration or titer of both antigen and antibody.

This kit is a hands-on study of both Ouchterlony Double Diffusion and Radial Immunodiffusion techniques. This kit also provides additional guidance materials for teaching other types of antigen-antibody interactions concepts such as immunoelectrophoresis and immunoprecipitation.

FEATURES AND APPLICATIONS

- Specific properties of antigen & antibody
- Antigen-antibody diffusion, interaction, & complex formation
- Teaches Ouchterlony Double Diffusion & Radial Immunodiffusion
- Application of antigen-antibody interaction in research

ADDITIONAL HARDWARE REQUIRED:

- Waterbaths or beakers & thermometer

Cat. No.	Description /Size
BE-501	BE-501 Antigen-Antibody Interactions/ 6 groups of 4 student

Dot Blot Analysis

properties of antigen-antibody for detection of antigenic or antibody proteins in complex samples. One such immunodetection method is widely known as Dot Blot. The method involves applying small volumes of antigens or test samples on protein binding membrane; the membrane captures and immobilizes proteins. The proteins immobilized on the membrane are probed with a specific antibody and a matching specific detection reagent.

In this lab activity students screen test samples from a population and identify those who are carriers of a disease. Students learn Dot Blot technique and learn how this method is applied in the real world, for example in clinical testing.

FEATURES AND APPLICATIONS

- Teaches immunodetection technique
- Hands-on Dot Blot Analysis technique
- Learn Dot Blot screening of unknown test samples, technique used by testing laboratories
- Supplied with simulated test samples

ADDITIONAL HARDWARE REQUIRED:

- Shaking Incubator

Cat. No.	Description /Size
BE-502	Dot Blot Analysis/ 6 groups of 4 students

Western Blot Analysis

Lab activity that teaches use of specific lock-key matching properties of antigen-antibody for detection and characterization of antibody or antigenic proteins in complex samples. One such widely used method is known as Western Blot analysis. Western Blot analysis involves electrophoresis separation of test protein samples on polyacrylamide gels, then the separated protein samples are electroblotted on a protein binding membrane – where protein is captured and immobilized. The membrane containing transferred proteins is probed with a specific antibody and a matching detection probe.

In this lab activity, students carry out Western Blot procedure and screen test samples from a population of infected individuals and group them according to the precise nature of their disease. Students learn how this technique is applied in the real world, such as detection and characterization of specific marker proteins in clinical testing laboratories.

FEATURES AND APPLICATIONS

- Teaches Western Blot analysis technique
- Learn to perform Western Blot analysis and screen unknown sample, technique used by many research and testing laboratories
- Supplied with necessary reagents and supplies for a complete analysis
- Supplied with simulated test samples

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- Blotting Unit for Western Transfer
- Shaking Incubator
- Methanol

Cat. No.	Description /Size
BE-503	Western Blot Analysis/ 6 groups of 4 students

Immunoquantification Technique (ELISA)

Lab activity that teaches the use of lock-key matching properties of antigen-antibody for detection as well as quantification of antibody or antigenic proteins in complex samples. This method is widely known as Enzyme Linked Immunosorbent Assay, or ELISA.

In this lab activity, students screen test samples from a population and identify infected individuals and the severity of their disease, i.e. the levels of infection. Students learn how the ELISA technique is used in clinical and crime laboratories for the detection of disease or specific markers or criminals at crime scenes. This is a widely used technique in research laboratories.

FEATURES AND APPLICATIONS

- Teaches ELISA technique
- Learn to perform ELISA assay and screen unknown samples
- Simulates a real world ELISA test
- Supplied with simulated test samples

ADDITIONAL HARDWARE REQUIRED:

- Shaker
- Microplate Reader (optional)

Cat. No.	Description /Size
BE-504	Immunoquantification (ELISA)/ 6 groups of 4 students

Quantitative Precipitin Assay (QPA)

The Quantitative Precipitin Technique is a simple technique that is routinely used in the analysis of antibody and antigen interactions and for the estimation of the antibody or antigen content in a sample. The technique is based on the interaction of antibody and antigen to form a large protein complex that in certain solutions (buffer) will result in precipitation. Students undertake a simple experiment to determine the zone of equivalence of an antigen and antibody interaction. The kit is provided with a fluorescent labeled protein to make visualization of the results clearer and easier to compare.

FEATURES AND APPLICATIONS

- Teaches immunoprecipitation technique
- Hands-on activity of immunoprecipitation and isolate specific antigen and antibody
- Supplied with needed reagents and supplies

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- UV light box
- Fluorescence Reader (optional)

Cat. No.	Description /Size
BE-505	Quantitative Precipitin Assay (QPA)/ 6 groups of 4 student

Immunoprecipitation Technique

Immunoprecipitation is a routinely used technique that removes a protein or peptide, which specifically reacts with an antibody, from a solution. The name of the technique is a misnomer as the interaction of the peptide or protein with the antibody does not cause precipitation. The “precipitation” is caused by an immunoglobulin binding protein, such as protein A or protein G, immobilized to a solid support or bead. The protein A or G binds the antibody-antigen complex and the complex is precipitated and removed from the solution by spinning down the beads.

This kit contains all the reagents necessary to immunoprecipitate a specific protein from a complex sample.

FEATURES AND APPLICATIONS

- Hands-on activity of immunoprecipitation and isolate specific antigen and antibody
- Teaches immunoprecipitation technique
- Supplied with needed reagents and supplies

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Rotator to hold 1.5ml tubes or a Shaking Incubator
- UV light box

Cat. No.	Description /Size
BE-506	Immunoprecipitation Technique/ 6 groups of 4 students

Immunoaffinity Chromatography

A hands on lab activity to study immunoaffinity chromatography and use a specific antibody to purify antigenic proteins from complex samples. This technique involves performing a chromatography procedure using antigen or antibody immobilized on a chromatographic resin. The solution containing antigen or antibody is passed through the column, which specifically and efficiently captures antibodies (antigen). The captured molecules are eluted from the column as a pure fraction.

In this lab activity, students perform immunoaffinity chromatography and learn how this method is utilized in research laboratories.

FEATURES AND APPLICATIONS

- Teaches antibody:antigen precipitation
- Hands-on activity to precipitate antigen and antibody complex
- Quantitative assessment of antibody concentration

ADDITIONAL HARDWARE REQUIRED:

- Low speed centrifuge for 1.5-2ml tubes
- Rotator to hold 1.5ml tubes or a Shaking Incubator
- UV light box

Cat. No.	Description /Size
BE-507	Immunoaffinity Chromatography/ 6 groups of 4 students

Accessories

The following replacemnt parts are available. For additional reagents see the main catalog sections.

BE Antibody 4 (HRP Secondary)

A goat anti-rabbit IgG secondary antibody labeled with the horseradish peroxidase (HRP) enzyme.

Protein Binding Membrane Strips

Precut nitrocellulose strips (6.5 x 0.8cm). Ideal for Dot blots.

Assay Strips and Holders

8-well strips of 200ml flat bottomed wells. Ideal for ELISA assays. Cost effective as individual strips can be used as opposed to a whole 96-well plate. Each holder holds 12 strips.

Cat. No.	Reagent	Size
A101-B	Antibody: BE Antibody 4 (HRP Secondary)	10U
P451	Protein Binding Membrane Strips	20 pack
A121-B	Assay Strip/ 8 wells/ strip	12
A131	Assay Strip Holder	1

The Miscellaneous Biotechniques section includes a selection of self contained kits that cover a selection of widely used techniques commonly employed in today's research laboratories that are not restricted to a single field, such as proteins.

These techniques include an introduction to fatty acids, lipids and membranes, electroelution of DNA, RNA or protein, microdialysis, protein labeling and cross-linking, and RNA isolation.

Fatty Acids, Lipids & Membranes

Membranes play a crucial role in cells by enclosing specific compartments and regulating the entry and exit of metabolites and other crucial components in and out of a cell. They also play a key role in signaling from plasma membrane receptors to the cell nucleus.

The key constituents of cellular membranes are lipids and fatty acids. This kit involves the extraction of fatty acids and lipids as liposomes from a biological sample and their resolution by thin layer chromatography (TLC).

Students will also understand the role of liposomes and their potential use of drug entrapment and delivery by viewing liposomes under a microscope.

FEATURES AND APPLICATIONS

- Role of membranes, lipids and fatty acids
- Isolate membranes from biological sample
- Visualize membrane components using TLC

ADDITIONAL HARDWARE REQUIRED:

- Thin Layer Chromatography (TLC) Apparatus

Cat. No.	Description
BE-601	Fatty Acids, Lipids and Membranes/ 6 groups of 4 students

Electroelution

Nucleic acids (DNA and RNA) and proteins are routinely resolved by electrophoresis, which separates molecules based on size and/or charge. Following electrophoresis, the molecules need to be extracted from the electrophoresis medium for use in downstream applications and experiments. Electroelution is routinely used to extract both nucleic acids and proteins from electrophoretic media.

This kit teaches the principles of electroelution and allows students hands-on experience of electroelution.

FEATURES AND APPLICATIONS

- Understand principles and alternatives to electroelution
- Purification of DNA fragment using electroelution

ADDITIONAL HARDWARE REQUIRED:

- Agarose Electrophoresis Equipment

Cat. No.	Description
BE-602	Electroelution/ 6 groups of 4 students

Dialysis

Dialysis is a routinely used technique in research laboratories to "change" the solution a biomolecule is dissolved in. Often the buffers used to isolate biomolecules, such as proteins, are not compatible with downstream applications due to high concentrations of reagents, such as salts.

A sample is placed in a bag with a semi-permeable membrane and then placed in the new solution or water. Small molecules, such as salt, can pass through the membrane, moving from an area of high concentration to low concentration. The larger molecules, such as proteins, are retained in the bag.

Microdialysis is a modification of dialysis to overcome the problem of dialyzing small volumes of precious samples. Microdialysis uses small devices designed for small volumes. This kit allows students to study dialysis using patented microdialysis devices.

FEATURES AND APPLICATIONS

- Introduction to dialysis
- Hands-on experience with microdialysis devices
- Simple, easily visualized dialysis experiment

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment

Cat. No.	Description
BE-603	Dialysis/ 6 groups of 4 students

Protein Labeling

Protein labeling is an important technique that allows researchers to study a protein's location, movement and interactions within a living cell. The most common labels used are fluorescent labels that allow researchers to study proteins with fluorescent microscopy techniques.

Fluorescent labels are used to label proteins directly or, more commonly, to label antibodies or antigens and then follow the antigen:antibody complex in living cells.

This kit allows students to label a protein with green (FITC) and red (Rhodamine) fluorescent labels, which allows students to understand the principle of colocalization, the production of a different color when two different fluorescent labels localize to the same area.

This kit uses protein electrophoresis and a UV lamp or light box to visualize the result, so no expensive fluorescent microscopes are required.

FEATURES AND APPLICATIONS

- Understand importance of protein labeling
- Fluorescence labeling of antibody:antigen complex
- Label proteins with fluorescent red and green labels
- Teaches principle of colocalization

ADDITIONAL HARDWARE REQUIRED:

- Protein electrophoresis equipment
- UV lamp or UV light box

Cat. No.	Description
BE-604	Protein Labeling/ 6 groups of 4 students

Protein Cross-linking

A single protein molecule rarely carries out its role in the body on its own. Many proteins and cofactors are often involved and act as regulators, activators or inhibitors of the protein's function. Researchers are constantly on the hunt for biomolecules that interact with their protein of interest and routinely use specialized molecules known as cross-linkers.

Cross-linkers are small chemical bridges that interact with specific regions of a protein and as a result are able to covalently link proteins that are interacting due to their close proximity to each other.

This kit allows students to use a protein cross-linker to chemically link proteins together and subsequently visualize the linked proteins. This kit uses a reversible cross linker, so students can visualize coupling and release of cross linked proteins.

FEATURES AND APPLICATIONS

- Introduction to protein cross-linking
- Simple, easily visualized cross-linking experiment

ADDITIONAL HARDWARE REQUIRED:

- Protein Electrophoresis Equipment and Waterbath

Cat. No.	Description
BE-605	Protein Cross-linking/ 6 groups of 4 student

RNA Isolation

RNA isolation is an important tool in understanding gene and protein expression regulation. The RNA Isolation kit is a safe RNA isolation kit as it does not utilize toxic phenol or chloroform. Each kit is provided with an extraction buffer for the lysis of biological samples and inhibition of RNase, an enzyme that destroys RNA. The released RNA is captured with a RNA binding resin binding resin and finally the pure RNA is eluted from the resin.

FEATURES AND APPLICATIONS

- Introduction to RNA isolation
- Safe isolation as no phenol or chloroform required
- Simple visualization on agarose gels

ADDITIONAL HARDWARE REQUIRED:

- Agarose electrophoresis equipment
- RNase free plasticware
- Molecular grade ethanol and waterbath

Cat. No.	Description
BE-607	RNA Isolation/ 6 groups of 4 students

G-Biosciences Research Product Line Overview

Protein Research	Estimation	7 Assays	CB-X Non Interfering SPN RED 660 dotMETRIC BCA CB	
	Isolation	Extraction & Lysis	Sample Grinding Lysis Buffers	Mild Denaturing Strong Chaotropic Specialized
		Fractionation & Enrichment	12 Fractionation Kits Dialysis (Micro) Concentration	
		Sample Preparation	Contamination Removal	Desalting Detergent Removal General Cocktails Species Specific Individual Inhibitors
		Reagents	Protease Inhibitors Detergents Chaotropes	
	Detection	Electrophoresis	1D & 2D Reagents	2D Specific Kits Buffers & Reagents
			Gel Stains	Coomassie Silver Reversible
		Western Blotting	1 Hour System Blocking Agents	Non-Animal Animal Non-Protein
			Secondary Antibodies Chemiluminescence Detection	
		Mass Spectrometry	Trypsin, Mass Spec Grade InGel Kits	
		Assays (ELISA)	Coated Plates Blocking Agents	Non-Animal Animal Non-Protein
			Secondary Antibodies Detection Reagents	
	Purification	Affinity Resins	6X His Tag	Nickel resin Cobalt resin Copper resin Zinc Resin Glutathione Resin Streptavidin Resin Calmodulin Resin
			GST Tag Biotin Tag CBP Tag	
		Activated Resins	Sulfhydryl reactive Amine reactive Carboxyl reactive	
		Antibody Purification	Drug/ Steroid reactive Protein A or G Pearl Resin	
	Modification	Labeling	Biotin Fluorescent Dye Enzyme (HRP/AP)	
		Crosslinkers Reducing Agents Alkylating Agents Protein Cleavage Iodination Amino Acid Side Chain Modifiers		
	Antibody	Production	Carrier Proteins	BSA KLH HyperCarrier
		Purification	Peptide Coupling Protein A or G Resin Activated Resins Pearl Resin Thiophilic Resin	
		Fragmentation	Ficin Pepsin Papain	
BioAssays	SAM Methyltransferase	Continuous, Enzymatic Assays Lactate Dehydrogenase (LDH)		
	Cell Toxicity & Proliferation	SRB WST-1		
	Apoptosis	Caspase	Assays Substrates Inhibitors	
	Protease	Inducers Assays Inhibitors		
	Phosphatase Peroxide			
	B-Galactosidase	CPRG Fluorescent (MUG)		
Molecular Biology	Genomic DNA	Isolation	Tissue Blood Plant Yeast Bacteria Fungi Mouse Tail	
	Plasmid DNA	Isolation Colony Screening Transformation		
	Electrophoresis	Apparatus Loading Dyes DNA Ladders Gel Extraction		
	PCR	Taq dNTPs		
	RNA	Extraction RNase Decontamination		
	Yeast	Transformation Plasmid Isolation		

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