

BIOTECHNOLOGY

E X P L O R E R



BIO-RAD

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BAY AREA
BIOTECHNOLOGY
EDUCATION
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Consortium of Independent Schools
for Biotechnology Education (CISBE)

East Bay Biotechnology Education
Partnership (EBBEP)

Gene Connection - San Mateo County
Biotechnology Education Partnership
(G≡C)

Program for Biotechnology
Education in Marin County (PROBE)

San Francisco - Biotechnology
Alliance for Science Education
(SF-Base)

San Francisco State University -
Biotechnology Resource Laboratory
(SF-BRL)

Santa Clara County - Biotechnology
Education Partnership (SCCBEP)

Stanford University - Human Genome
Education Program (HGEP)



Eichhornia crassipes

Use the internet to contact researchers, scientists, and other teachers to compare notes. Visit Bio-Rad's website at www.bio-rad.com. Be sure to submit class results and stories for possible inclusion in next year's catalog!

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WELCOME! BIOTECHNOLOGY EXPLORER.

Bio-Rad's innovative Life Science Education Program presents a new generation of inquiry-based biotechnology curriculum supported by classroom kits, laboratory equipment, and supplies. These exciting new teaching tools complement existing biology and integrated science curricula at high school, junior college, and college levels.

Since 1957, Bio-Rad has been a multinational manufacturer and distributor of cutting-edge life science research products, clinical diagnostics, and analytical instruments. Now, Bio-Rad and the San Francisco Bay Area Biotechnology Education Consortium (BABEC), in collaboration with Rutgers University, Maxygen Inc. and The Human Genome Center at Stanford University, introduce Biotechnology Explorer.

Developed over 3 years, our Biotechnology Explorer kits, equipment, and supplies have been extensively teacher-tested in actual classroom settings. We followed recommendations established by the National Science Education Standards while creating comprehensive investigations designed to replace existing "cookbook" labs. The result – real life, problem-centered, and hands-on scenarios. These scenarios will help your students learn the basics in molecular biology and stay current with today's unprecedented rate of advances in biological science and technology.

Bio-Rad strongly supports efforts by scientists and educators to build bridges and partnerships between their respective communities, and we encourage your questions and comments. Please contact us at 1-800-4BIORAD (1-800-424-6723).

BIO-RAD

BIOTECHNOLOGY CURRICULUM THAT LIGHTS UP THE CLASSROOM: THE NEW pGLO SYSTEM

One of the biggest challenges for those studying molecular biology or "biotechnology" for the first time is that many of the events and processes they study are invisible. The Biotechnology Explorer offers a unique solution: the cornerstone of our products is a bioluminescent jellyfish gene and its Green Fluorescent Protein (GFP). GFP fluoresces a brilliant green color when viewed using an inexpensive hand-held UV lamp (long wavelength pocket geology light).

The gene for the fluorescent protein, isolated from the bioluminescent jellyfish, *Aequorea victoria*, has recently been cloned into Bio-Rad's exclusive 'pGLO plasmid' for use in biotechnology education.

Using the pGLO system, students become genetic engineers. They can transform a bacteria and produce and purify a recombinant fluorescent protein. Using the pGLO system, students directly observe the results of gene transfer, gene regulation, gene expression, and the process of protein purification as they are occurring. Bio-Rad's pGLO system is totally unique, and has generated an unprecedented level of excitement and creative teaching applications among science educators.



**Bioluminescent
jellyfish,
*Aequorea victoria***

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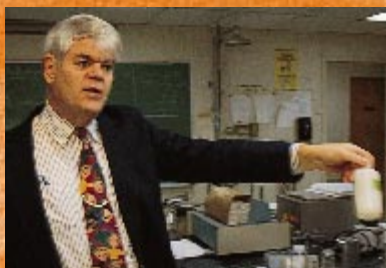
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“With Bio-Rad’s new Green Fluorescent Protein (GFP), students can actually see what they are dealing with when expressing a gene or purifying a protein. We used to purify GFP from the source – bioluminescent jellyfish we’d catch ourselves. Now that the GFP gene’s been cloned, when I go fishing it’s strictly recreational!”



Professor William Ward, Ph.D.
Rutgers University
Department of Biochemistry and Microbiology
WWW3@rci.rutgers.edu

Bacterial Transformation The pGLO System



- General Biology
- Advanced Placement Biology
- Integrated Science
- BioTechnology Tech-Prep

HOW CAN JELLYFISH SHED LIGHT ON THE SUBJECT?

By Cloning and Expressing a Recombinant Fluorescent Protein



Transformation occurs when a cell takes up (takes inside) and expresses a new piece of genetic material, DNA. This new genetic material often provides the organism with a new trait identifiable after transformation. Transformation allows the cloning of genes, and the selection and expression of a gene and its protein. Positive selection for cells transformed with plasmid DNA containing an antibiotic-resistant gene is accomplished by growth on antibiotic plates.

This unique transformation activity is based on the pGLO plasmid which carries a gene encoded for Green Fluorescent Protein (GFP). The pGLO system incorporates an arabinose promoter which precisely controls expression of the GFP gene in transformed cells. Expression of the GFP gene can be turned on simply by including arabinose,

a sugar, in the growth medium. Resistance to ampicillin (Amp), an antibiotic, is used as the selection mechanism for transformation. Cells transformed with pGLO will appear white on Amp plates not containing arabinose, and fluorescent green when arabinose is included in the agar. The unique construction of pGLO allows educators and students, for the very first time, to easily explore mechanisms of gene regulation and genetic selection. The entire process is observable with an inexpensive hand-held UV lamp (i.e. a geology UV lamp). The pGLO system also allows an additional experiment involving purification of the recombinant protein, GFP. See Bio-Rad Kit 2.

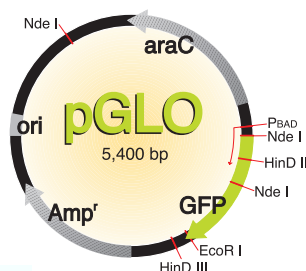
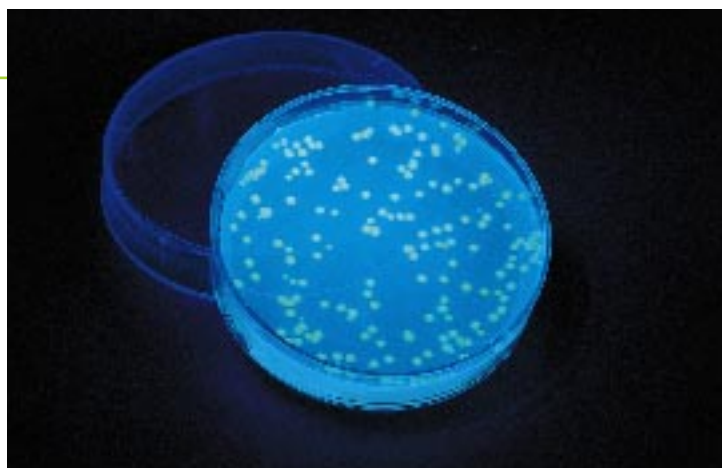


One student workstation – there are eight per kit.

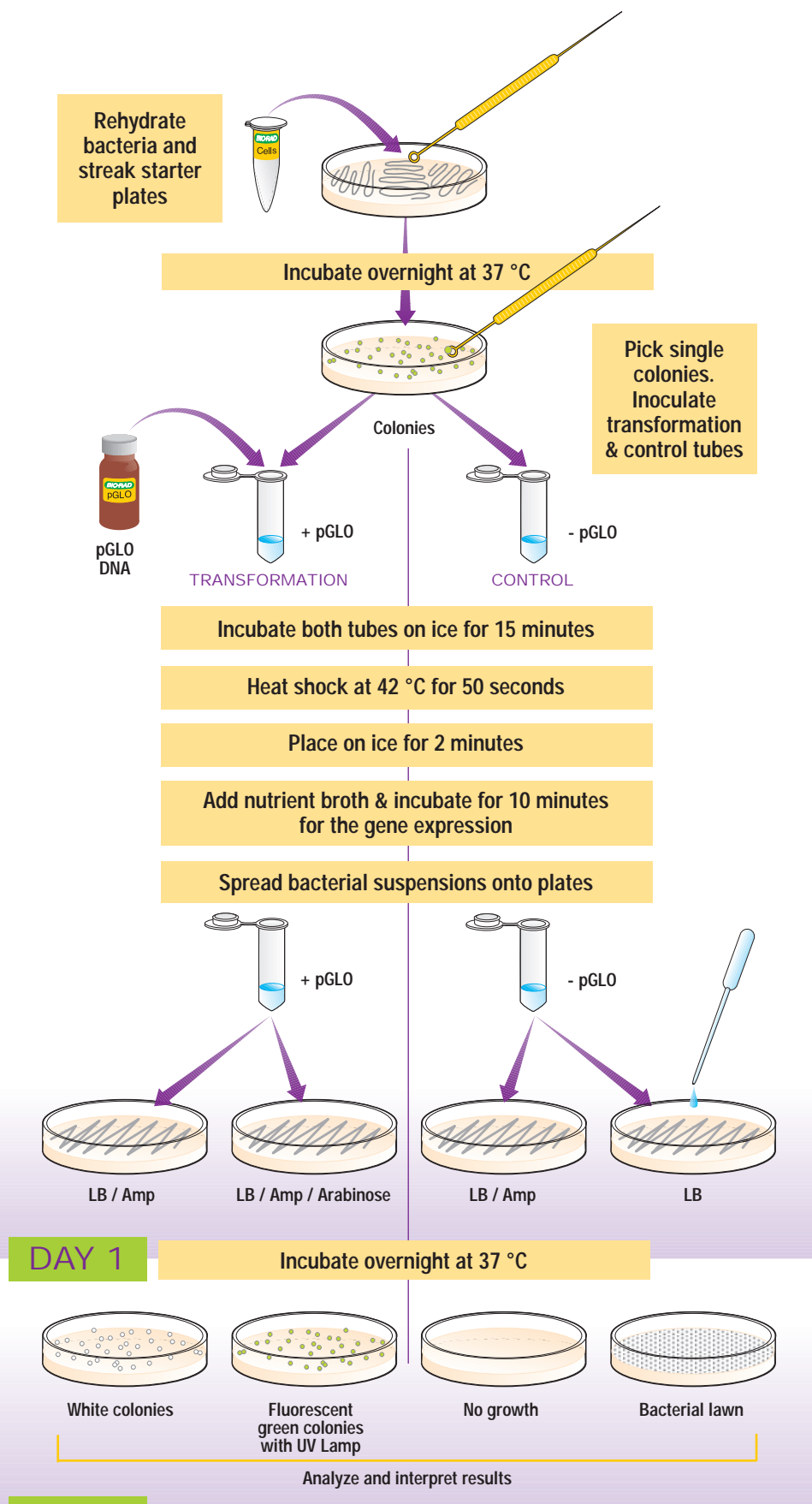


STUDENT OBJECTIVES:

- Learn, apply, and master an understanding of the scientific inquiry process
- Define transformation and its role in genetic engineering and biotechnology
- Transform a bacterium using sterile technique
- Analyze and interpret experimental results using comparisons with controls
- Calculate transformation efficiency
- Apply knowledge gained to design an experiment using biological transformation



Gene expression in all organisms is carefully regulated to allow adaptation to differing conditions and to prevent wasteful overproduction of unneeded proteins. The genes involved in the transport and catabolism of food are good examples of highly regulated genes. For example, the simple sugar arabinose is both a source of energy and carbon. The bacterial genes needed to break down (digest) arabinose for food are not expressed in the absence of arabinose, but are in its presence. In other words, when arabinose is around in the environment, these genes are turned on. When arabinose runs out, these genes are turned back off. In the genetically engineered pGLO plasmid system, some of the genes involved in the breakdown of arabinose have been replaced with the Jellyfish gene for GFP. When bacteria transformed with pGLO are grown in the presence of arabinose, the GFP gene is turned on and the bacteria fluoresce a brilliant green color.



DAY 1

DAY 2

Extension: purify & analyze GFP using Bio-Rad Kit #2

SUGGESTED STUDENT BACKGROUND:

This new activity complements existing biology and integrated science curricula, and is a perfect replacement for plasmid transformation using only antibiotic selection or blue colony selection. It reinforces student understanding of biology's central molecular framework (DNA>RNA>PROTEIN>TRAIT). The pGLO system also allows an additional experiment involving purification of the recombinant fluorescent protein in Kit 2.

KEY FEATURES OF KIT:

- No refrigerator needed
- No micropipet needed
- Autoclave-free bacterial transformation (no more pressure cooker)
- Green Fluorescent Protein is outrageously bright
- Green Fluorescent Protein gene exhibits strong on/off regulation with simple sugar (arabinose)
- Real-life interdisciplinary biotechnology investigation
- High safety standards
- Low cost

MATERIALS PROVIDED IN THIS KIT ARE FOR 8 COMPLETE STUDENT WORKSTATIONS:

- Sterile Transformation Buffer
- Petri dishes - 40
- Inoculation loops - Sterile - 80
- Plasmid (pGLO) - lyophilized
- E. coli* strain - lyophilized
- LB-Broth - sterile
- Ampicillin - lyophilized
- Arabinose - lyophilized
- Microtubes -2.0 mL Sterile color coded - 60
- Floating microtube racks - 8
- Sterile plastic pipets - 40
- LB-Agar (Lennox) Powder Packet
- Manual curriculum & Graphic Quick Guide

REQUIRED ACCESSORIES NOT INCLUDED IN KIT:

- UV Lamp, (p. 53)
- Microwave oven, (p. 54)
- 1-liter flask
- Distilled water, 500 mL
- 37 °C incubator oven (p. 54), optional

KIT #1: CAT. NO. 166-0003-EDU
BACTERIAL TRANSFORMATION pGLO
 Includes 8 workstations \$49.50



Andreas Calmeri, Ph.D.
Maxygen Inc.
Santa Clara, California
<http://www.maxygen.com>

“In the biotechnology industry, it’s important to see where certain genes are expressed. So, we cloned the gene for GFP to be used as a sensitive reporter for gene action. We’re really excited about its use as an educational tool!”

Protein Purification Green Fluorescent Protein



IS FINDING A NEEDLE IN A HAYSTACK EASIER WHEN IT GLOWS?

Isolating and Purifying a Recombinant Green Fluorescent Protein



This laboratory investigation is designed to follow Bio-Rad Kit 1, "Bacterial Transformation Kit – pGLO". Students start with transformed bacteria which produce the green fluorescent protein (GFP) on an agar plate. Green colonies are removed from the agar plate and grown in liquid nutrient media overnight. Then bacterial cells are broken open (lysed) to release the GFP. The green fluorescent protein is subsequently purified from the bacterial lysate using the disposable chromatography columns included in this kit. The unique fluorescent properties of GFP allow the entire process to be observed using an inexpensive, hand-held UV lamp (*i.e.* a geology UV lamp).

Chromatography is a powerful method for separating and purifying biological macro-molecules like proteins. In the biotechnology industry, genetic engineering techniques are used to mass produce



proteins which are used, for example, as medicines to treat human disease, or as powerful enzymes to produce a better laundry detergent. Medicinal proteins from naturally-occurring sources, like Taxol® from the bark of a hardwood tree, are also purified in large quantities. Chromatography is used to separate a protein of interest from other proteins in a cell. A common problem in purifying genetically engineered proteins is the contamination by endogenous bacterial cell proteins. One way to overcome this problem is to develop a chromatography procedure which will purify the cloned protein from the bacterial contaminants. Separating proteins utilizes knowledge of their molecular chemistry, including the protein weight, and molecular charge, shape, and solubility.



One student workstation – there are eight per kit.

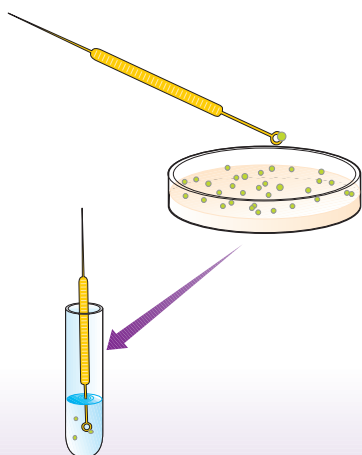
STUDENT OBJECTIVES:

- Learn, apply, and demonstrate a mastery of the scientific inquiry process
- Understand the process of protein purification and its role in biotechnology
- Purify a recombinant protein from its bacterial culture
- Analyze and interpret results
- Use knowledge gained to design a creative experiment using biological transformation and purification



- General Biology
- Advanced Placement Biology
- Integrated Science
- BioTechnology Tech-Prep

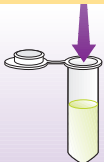
Start with bacterial plate transformed with pGLO DNA from Kit 1



Remove a single fluorescent green colony from the agar plate using a sterile inoculation loop

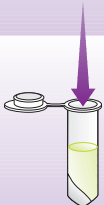
Inoculate liquid culture with a single fluorescent green colony

DAY 1 Grow overnight at 32 °C or 2 days at room temperature



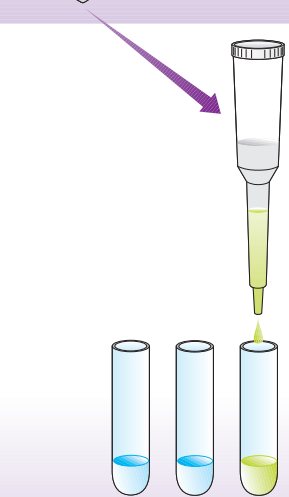
Freeze/thaw to rupture cells and release proteins

DAY 2



Spin to separate bacteria debris from GFP

DAY 3



Collect three 0.75 ml fractions

Purify GFP from bacterial proteins using column chromatography

Identify purified GFP

DAY 4

Extensions: qualitative & quantitative analysis of biochemical profile of fractions for bacterial protein and GFP

SUGGESTED STUDENTS BACKGROUND:

For best results, students should have a background in bacterial transformation and biology's central framework (DNA>RNA>PROTEIN>TRAIT).

KEY FEATURES OF KIT:

- No micropipet required
- Autoclave-free bacterial transformation (no more pressure cooker)
- Green Fluorescent Protein is outrageously bright and easily purified
- Real-life interdisciplinary biotechnology investigation
- High safety standards

MATERIALS PROVIDED IN THIS KIT ARE FOR 8 COMPLETE STUDENT WORKSTATIONS:

- Ampicillin- lyophilized
- Arabinose- lyophilized
- LB-broth tablet
- Inoculation loops- packs of 10 loops - 2
- Pipettes- sterile - 40
- Microtubes- 2.0 ml, clear - 30
- Culture tubes- 15 ml, sterile (pack of 25)
- Collection tubes- 5 ml - 25
- General purpose TE buffer
- Lysozyme- lyophilized
- Binding Buffer
- Column equilibration buffer
- Column wash buffer
- Foam microtube racks - 8
- Teacher guide, student manual & graphics quick guide (1 each)

REQUIRED EQUIPMENT NOT INCLUDED IN KIT:

- UV lamp, (p. 53)
- Microwave oven
- 1-liter flask, 250 ml flask, Bleach
- Distilled water (1 gallon) 300 ml
- Rocking table, (p. 55), optional
- Incubator oven, (p. 54), optional
- Mini centrifuge, (p. 54)

KIT #2: CAT. NO. 166-0005-EDU
 PROTEIN PURIFICATION - GFP
 Includes 8 workstations \$59.50

“Headlines that make news outside the classroom are hot topics inside! These biotechnology labs really help my students understand the applications of biology in the real world. They’ve revolutionized my teaching effectiveness while inspiring greater interest in science among students.”



Stan Hitomi
Monte Vista High School, Danville, California
Hitman55@aol.com

Kirk Brown
Tracy High School, Tracy, California

Restriction Analysis of DNA



- General Biology
- Advanced Placement Biology
- Integrated Science
- BioTechnology Tech-Prep

HOW CAN PIECES SOLVE THE PUZZLE?

Separating and Analyzing DNA Restriction Fragments



Agarose gel electrophoresis is a powerful analytical tool for separating biological molecules. This experiment demonstrates the basic procedures and principles of agarose gel electrophoresis, including gel casting, sample application, separation based on size, DNA staining, and analysis. It introduces the principles of DNA fragment size determination by comparison to known DNA size standards. Electrophoretic techniques for the estimation of DNA fragment sizes are essential in the mapping of the Human Genome. The separation of DNA sam-



ples by agarose gel electrophoresis is a fundamental technique used in genetic engineering and gene cloning. This Restriction Kit includes DNA size standards and two samples containing DNA fragments of unknown size. A unique feature of the curriculum provided in this kit is that it guides students through the procedure of constructing a standard curve using the data they obtain from their own electrophoresis gels. They can then use their standard curve to estimate the molecular size of the unknown DNA fragments.



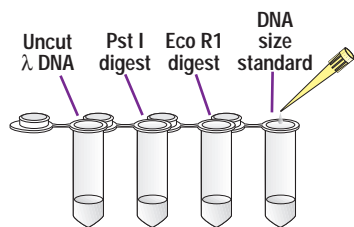
One student workstation – there are eight per kit.

STUDENT OBJECTIVES:

- Learn, apply, and demonstrate mastery of the scientific inquiry process
- Become familiar with agarose gel electrophoresis techniques
- Generate a standard curve from a DNA size standard
- Estimate DNA fragment sizes of unknown DNA samples on agarose gels
- Apply knowledge gained to design an experiment for mapping genes

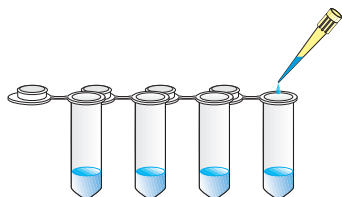


DNA samples electrophoresed in the Mini-Sub cell GT. Following a 30 minute run, 120 V, gels were stained with our unique Bio-Safe DNA staining solution. See the Electrophoresis Supplies Section for details on this new non-toxic DNA stain. Lane 1: uncut lambda (λ). Lane 2: Pst I λ digest. Lane 3: Eco R1 λ digest. Lane 4: DNA standard (Hind III λ digest).

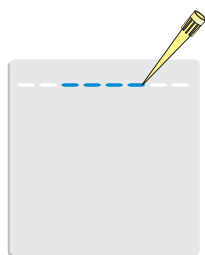


Pipet
Lambda DNA
& standards
into micro
tubes

Add loading
dye to samples



Load samples
into agarose gel



Electrophorese
120 V /
40 minutes



Monitor
migration of
tracking dyes

DAY 1

Stain gel with
Bio-Safe DNA
staining
solution or
ethidium
bromide



Destain gels
& analyze
results

Determine size of DNA restriction fragments

Verify restriction enzyme used in each case

Compare to student's predicted outcome

DAY 2

Extensions: Bio-Rad Kits 4 & 5.

SUGGESTED STUDENT BACKGROUND:

Students should be familiar with:

- Micropipeting
- Graph analysis
- General lab skills and safety
- Biology's central framework (DNA>RNA>PROTEIN>TRAIT).

KEY FEATURES OF KIT:

- Mutagen-free DNA staining, at the sensitivity of Ethidium Bromide
- Real-life interdisciplinary biotechnology investigations
- High safety standards
- Low cost

MATERIALS PROVIDED IN THIS KIT ARE FOR

8 COMPLETE STUDENT WORKSTATIONS:

DNA Standard; Hind III lambda digest
Pst I lambda digest
Eco RI lambda digest
Lambda DNA uncut
Sample Loading Buffer
DNA staining solution - Bio-Safe
Empty 1.5 mL Micro Tubes w/caps
color coded - 60
Floating microtube racks - 8
Teacher guide, student manual & graphic
quick guide

REQUIRED ACCESSORIES NOT INCLUDED IN KIT:

Micropipet (2-20 μ L), (p. 53)
Pipet tips - 1 box of 96, (p. 50)
DNA electrophoresis chamber, (p. 30)
Power supply, (p. 37)
Electrophoresis buffer - 10 x TBE, (p. 41)
Agarose powder, (p. 42)

KIT #3: CAT. NO. 166-0001-EDU
RESTRICTION ANALYSIS KIT

Includes 8 workstations \$49.50



Lane Conn
Stanford Human Genome Center
Director, Education Program
<http://www-SHGC.stanford.edu/bio-ed/>
e-mail: lconn@shgc.stanford.edu

“Biotechnology Explorer Products offer stimulating hands-on curriculum designed and tested by scientists and teachers working in partnership. Our efforts at the Human Genome Center have been to foster science education collaborations. The Bio-Rad program is the outcome of such a fruitful collaboration.”

Restriction Digestion and Analysis of DNA



- General Biology
- Advanced Placement Biology
- Integrated Science
- BioTechnology Tech-Prep

HOW'S THIS FOR A SLICE OF LIFE?

Restriction Digestion and Electrophoretic Analysis of Lambda DNA



Restriction enzymes are endonucleases that recognize and cut double stranded DNA at defined base sequences. They are essential tools for molecular cloning and the mapping of genes. In this experiment, three restriction enzymes are used to digest a sample of Lambda DNA. The resulting DNA fragments are analyzed using agarose gel electrophoresis. The electrophoresis patterns of Lambda DNA are visualized by specific DNA staining within the gel.

Electrophoretic techniques for the estimation of DNA fragment sizes are essential in forensics and the mapping of restriction sites within genes. This experiment demonstrates the basic procedures of agarose gel electrophoresis. It also demonstrates principles of DNA fragment size determination by comparison to known DNA size standards.



The unique curriculum provided in this kit guides students through the procedure of constructing a standard curve using the data they obtain from their own electrophoresis gels. They can then use their standard curves to estimate the molecular weights of the unknown DNA fragments generated using restriction enzymes.



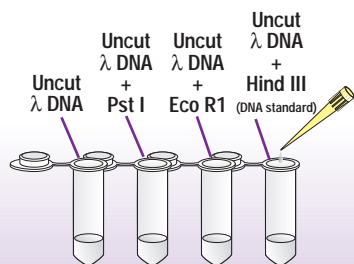
One student workstation – there are eight per kit.

STUDENT OBJECTIVES:

- Learn, apply, and master understanding of the scientific method
- Define restriction enzymes and their role in genetic engineering
- Define the principles and applications of agarose gel electrophoresis
- Become proficient in the techniques of agarose gel electrophoresis
- Construct standard curves and use experimental data to determine the sizes of unknown DNA samples
- Apply knowledge gained to design an experiment for mapping a gene



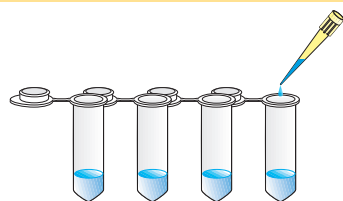
DNA samples electrophoresed in the Mini-Sub cell GT. Following a 30 minute run, 120 V, gels were stained with our unique Bio-Safe DNA staining solution. See the Electrophoresis Supplies Section for details on this new non-toxic DNA stain. Lane 1: uncut lambda (λ). Lane 2: Pst I λ digest. Lane 3: Eco R1 λ digest. Lane 4: DNA standard (Hind III λ digest).



Add Lambda (λ) DNA and restriction endonuclease to microtubes

DAY 1

Digest DNA at 37 °C for 30 minutes or overnight at room temperature



Add loading dye to each sample

Load samples into agarose gel

DAY 2

Electrophorese 120 V / 30 minutes

Monitor migration of tracking dyes

Stain gel with Bio-Safe DNA staining solution or ethidium bromide



Determine size of DNA restriction fragments

Verify restriction enzyme used in each case

DAY 3

SUGGESTED STUDENT BACKGROUND:

Students should be familiar with:

- Micropipeting
- Graph analysis
- General lab skills and safety
- Biology's central framework (DNA>RNA>PROTEIN>TRAIT).

KEY FEATURES OF KIT:

- Mutagen-free DNA staining, at the sensitivity of Ethidium Bromide
- Real-life interdisciplinary biotechnology investigations
- High safety standards
- Low cost

MATERIALS PROVIDED IN THIS KIT ARE FOR 8 COMPLETE STUDENT WORKSTATIONS:

- DNA Standard; Hind III Digest
- Pst I Restriction Enzyme
- Eco RI Restriction Enzyme
- Restriction Buffer
- Lambda DNA uncut
- Sample Loading Buffer
- DNA staining solution
- Empty 1.5 ml Micro Tubes w/caps color coded - 60
- Foam (floating) test tube racks - 8
- Teacher guide, student manual & graphic quick guide (1 each)

REQUIRED EQUIPMENT NOT INCLUDED IN KIT:

- Micropipet (2-20 µl), (p. 53)
- Pipet tips, (p. 49-50)
- DNA electrophoresis chamber, (p. 31)
- Power supply - PowerPac 300, (p. 37-38)
- 10x-TBE electrophoresis buffer, (p. 41)
- Agarose powder, (p. 41)
- Water bath (37 °C), (p. 55), optional

KIT #4: CAT. NO. 166-0002-EDU
RESTRICTION DIGEST & ANALYSIS KIT

Includes 8 workstations \$59.50

“It’s all about achieving a greater understanding. These investigations have students experiencing the scientific-inquiry process first hand. What could be more educational?”



Russ Janigian
Mission High School, San Francisco, California
SFBase web site:
http://www.nisus,sfusd.k12.ca.us/programs/sf_base/welcome.html

DNA Fingerprinting



HOW CAN DNA PATTERNS HELP SOLVE HUMAN PROBLEMS?

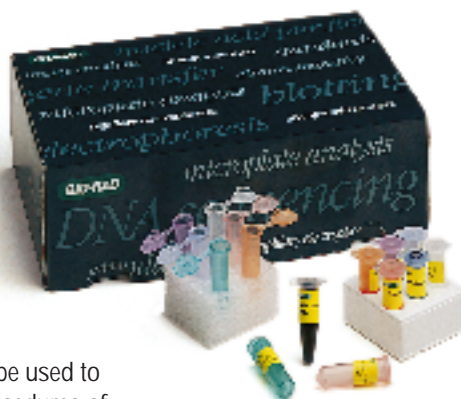
DNA Fingerprinting - Forensic DNA Testing Simulation



This experiment introduces the basic concepts of DNA fingerprinting (DNA Profiling), a method used in various medical and forensic procedures, as well as in paternity determinations. DNA fingerprinting is a powerful analytical tool used to examine similarities and differences in organisms at the genetic-molecular level. This activity allows students to simulate the technique most commonly used in human forensics. That is, taking DNA from any body cell, digesting its DNA with restriction enzymes, and analyzing the resulting DNA fragments using agarose gel electrophoresis. The lab results of this activity provide DNA patterns in a gel which reveal the differences and similarities in an individual's genetic make up. This activity also provides a starting point for rich and diverse discussions on the societal, ethical, and legal implications of DNA analysis.

scene" and four samples are obtained from possible "suspects." The resulting restriction fragments are separated by agarose gel electrophoresis and visualized using Bio-Rad's Bio-Safe DNA staining solution. Based on the restriction fragment patterns, students analyze their results, then match the hypothetical suspect with the correct crime scene sample. (This activity is designed to simulate forensic testing and does not contain human DNA.)

This experiment can also be used to demonstrate the basic procedures of agarose gel electrophoresis, including gel casting, sample application, separation, and DNA staining. Principles of DNA fragment size determinations may also be demonstrated.



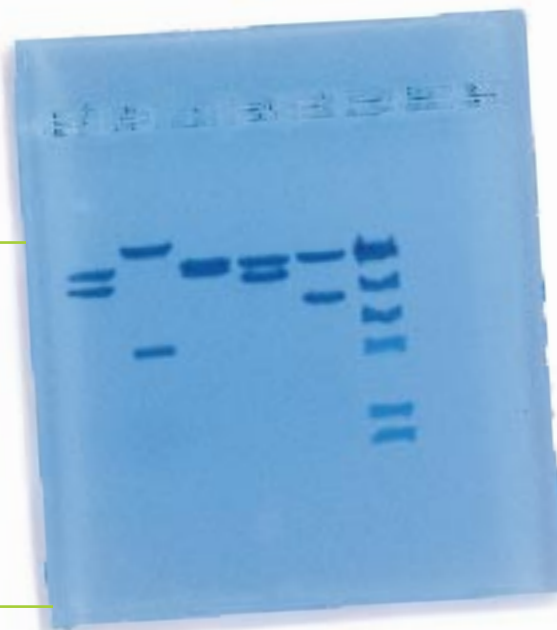
One student workstation – there are eight per kit.

In this experiment, students use restriction enzymes to digest five hypothetical samples of human DNA. In this activity, one sample of DNA is collected from the "crime



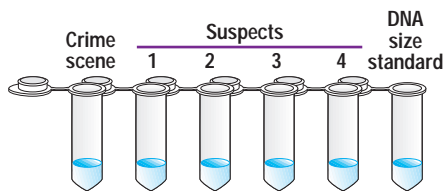
STUDENT OBJECTIVES:

- Learn, apply, and demonstrate mastery of the scientific method
- Become familiar with agarose gel electrophoresis techniques
- Become familiar with the applications of restriction enzymes in forensic biotechnology
- Estimate and compare DNA fragment sizes on agarose gels

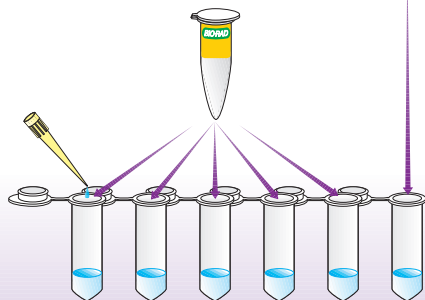


DNA samples from this DNA Fingerprinting Kit electrophoresed in the Mini-Sub cell GT. Following a 30 minute run, 120 V, gels were stained with our unique Bio-Safe DNA staining solution. See the Electrophoresis Supplies Section for details on this new non-toxic DNA stain, p.43.

Obtain samples of DNA from crime scene and 4 suspects, and DNA size standard



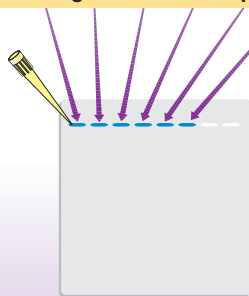
Digest 5 DNA samples with restriction enzyme mix



DAY 1

Incubate at 37 °C for 50 minutes or overnight at room temperature

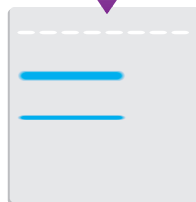
Load samples into agarose gel



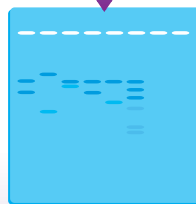
DAY 2

Electrophorese 120 V / 30 minutes

Monitor migration of tracking dyes



Stain gel with Bio-Safe DNA staining solution or ethidium bromide



Match crime scene DNA to suspect's DNA

DAY 3

Extensions: molecular puzzles included in kit manual

SUGGESTED STUDENT BACKGROUND:

Students should be familiar with:

- Micropipeting
- Graph analysis
- General lab skills and safety
- Biology's central framework (DNA>RNA>PROTEIN>TRAIT).

KEY FEATURES OF KIT:

- Mutagen-free DNA staining, at the sensitivity of Ethidium Bromide
- Real-life interdisciplinary biotechnology investigation
- High safety standards
- Low cost

MATERIALS PROVIDED IN THIS KIT ARE FOR 8 COMPLETE STUDENT WORKSTATIONS:

DNA size standard
 Crime scene DNA
 Suspect 1 DNA
 Suspect 2 DNA
 Suspect 3 DNA
 Suspect 4 DNA
 Restriction Enzyme Buffer
 Bam H1/Hind III Enzyme Mix
 Sample Loading Dye
 DNA Staining Solution - Bio-Safe
 Microtubes, 1.5 ml, color coded - 80
 Foam test tube racks - 8
 Gel staining trays - 10
 Teacher Guide, student manual & graphic quick guide (1 each)

REQUIRED ACCESSORIES NOT INCLUDED IN KIT:

Micropipet (1-10 µl or 2-20 µl), (p. 53)
 Pipet tips - 1 box of 96, (p. 50)
 DNA Electrophoresis chamber, (p. 31)
 Power supply, PowerPac 300, (p. 37-38)
 10xTBE electrophoresis buffer, (p. 41)
 Agarose powder, (p. 41)
 Microwave oven
 37 °C water bath, (p. 55), optional
 Microcentrifuge, (p. 54), optional

KIT #5: CAT. NO. 166-0007-EDU
 DNA FINGERPRINTING KIT

Includes 8 workstations \$69.50



Desmond Marcarenhas
Celtrix Pharmaceuticals Inc., Santa Clara, California
<http://www.biodisk.com>

Louise Handly
Overfelt High School, San Jose, California

Mark Okuda
Silver Creek High School, San Jose, California

“Biotechnology is about applying biology in the real world. How does a protein become a commercial product? That’s one of the lessons of ‘Secrets of the Rain Forest’. Developed through a partnership of scientists and teachers, it tackles scientific, ethical, and legal issues.”

Secrets of the Rain Forest



- General Biology
- Advanced Placement Biology
- Integrated Science
- BioTechnology Tech-Prep

WHAT SECRETS DOES THE RAIN FOREST HOLD?

Applying Biotechnology to Help Solve a Human Problem



“Secrets of the Rain Forest” is a 2-week biotechnology curriculum. During the first week, students purify a medicinal, fluorescent protein from bacteria in which the gene for this protein has been cloned. The real-life source of this green protein gene is the jellyfish *Aequoria victoria*. In this simulation, we suggest that this gene comes from ‘mysterious leaves’ which can cure cancer. In both cases the principle would be exactly the same, *i.e.* the gene codes for a green fluorescent protein. The curriculum takes students on a journey to a South American Rain Forest, to a biotechnology laboratory, and to the Federal Drug Administration.

In the second week, students simulate the real world process of taking this protein to market - as a treatment for stomach cancer. They will examine the needs and viewpoints of advocacy groups, the biotechnology industry, and the Federal Drug

Administration (FDA). Given real life scenarios, students will develop possible strategies with what they feel are the best outcomes.

This portion of the simulation is true biotechnology in action!



Week one:

- LESSON 1: Introduction
- LESSON 2: Cloning
- LESSON 3: Cloning, Step 2
- LESSON 4: Protein Purification
- LESSON 5: Protein Purification, Step 2

Week two:

- LESSON 6: Testing

LESSON 7: Marketing

LESSON 8: Biotechnology Dilemmas

Lessons 6 through 8 are the most important of all because they create real-life scenarios which may be encountered when bringing a medicinal protein to market. This is the real biotechnology aspect of the module: The preceding laboratory segments, including the cloning and purification of the Green Fluorescent Protein, merely set the stage for what students are about to explore.

In order for your students to gain the most from this simulation, they need to know what a gene is and understand the relationship between genes and proteins. Knowing about the process of moving genes from one organism to the next with the aid of plasmid will help explain how the plant's fluorescent protein gene was moved into the bacteria in the first place. However, it is not necessary for students to understand the details of

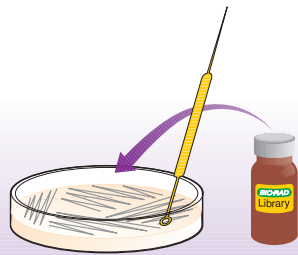


One student workstation – there are eight per kit.

STUDENT OBJECTIVES:

- Learn, apply, and demonstrate mastery of the scientific method
- Become familiar with the “Big Picture” of the biotechnology industry
- Isolate and propagate genetically engineered bacteria
- Purify a cloned green fluorescent protein using column chromatography
- Apply knowledge gained to design an experiment for mapping genes

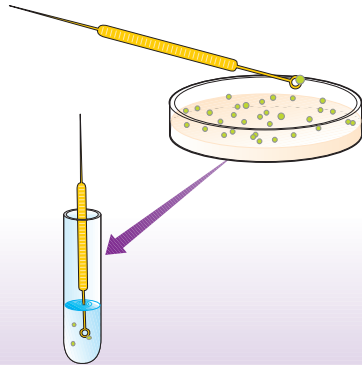




Streak bacterial library to produce single colonies

DAY 1

Grow overnight at 37 °C

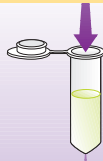


Inoculate liquid culture with a single green colony

Remove a single fluorescent green colony from the agar plate

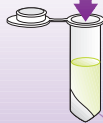
DAY 2

Incubate overnight at 32 °C or at room temperature for 48 hours



Freeze/thaw to rupture cells and release proteins

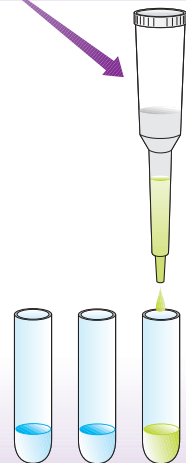
DAY 3



Spin to separate bacterial debris from GFP

DAY 4

Separate and purify GFP from bacterial proteins using column chromatography



Collect fractions

DAY 5

Identify purified product

Week Two: take the protein to market

SUGGESTED STUDENT BACKGROUND:

The laboratory portion of this curriculum integrates well into existing biology and integrated science curricula. It reinforces student understanding of the central dogma of biology (DNA>RNA>PROTEIN>TRAIT).

KEY FEATURES OF KIT:

- No micropipet needed
- Autoclave-free
- GFP is outrageously bright and easily purified
- Real-life interdisciplinary biotechnology scenario

MATERIALS PROVIDED IN THIS KIT ARE FOR 8 COMPLETE STUDENT WORKSTATIONS:

Module 1- Library plating
Bacterial library- lyophilized
LB-agar tablets - 5
Petri Dishes - 60 mm, sterile, - 20
Inoculation loops- packs of 10 loops - 2
Pipets- sterile - 10

Module 2- Purification
Ampicillin- lyophilized
Lysozyme- lyophilized
Arabinose- lyophilized
LB-broth tablet
Inoculation loops- packs of 10 loops - 2
Pipets- sterile - 40
(Microtubes- 2.0 ml, clear - 30
Culture tubes- 15 ml, sterile - 25
Collection tubes- 5 ml, polystyrene - 25
General purpose TE buffer
Binding Buffer
Column equilibration buffer
Column wash buffer
Prepacked chromatography columns - 8
Foam microtube racks - 8
Teacher guide, student manual & quick guide

REQUIRED ACCESSORIES NOT INCLUDED IN KIT:

Incubation oven, (p. 54)
UV lamp, (p. 53)
Microwave oven
Rocking table, (p. 55), optional
1-liter flask, 250-ml flask
Distilled water (1 gallon), 300 ml
Mini-centrifuge, (p. 54)
Bleach

KIT #6: CAT. NO. 166-0006-EDU
SECRETS OF THE RAIN FOREST KIT

Includes 8 workstations \$89.50

“Matching our educator partners’ curriculum with accurate and compelling state-of-the-art laboratory science was our number one goal. I know we succeeded.”



Dr. Laurie Usinger
Bio-Rad Research & Development
Biotechnology Explorer Division
www.bio-rad.com
e-mail: Laurie_Usinger@bio-rad.com



Size Exclusion Chromatography

- **General Biology**
- **Advanced Placement Biology**
- **Integrated Science**
- **BioTechnology Tech-Prep**

HOW CAN YOU SIZE UP THE SITUATION?

Size Separation of Biomolecules



Size exclusion chromatography (SEC) is a powerful technique for separating solubilized molecules by their size. Complex mixtures of molecules can be applied to a solid support of porous beads which act as "sieves" to filter smaller molecules away from larger components. Size exclusion chromatography is an important technique used in biotechnology to separate a desired protein from larger or smaller contaminating proteins.



This kit teaches basic principles of size exclusion chromatography. When a mixture of molecules in solution is applied to a small cylinder (column) that contains microscopic, porous beads, large molecules pass quickly around the beads, whereas smaller molecules enter the beads causing them to pass through the column more slowly. This kit utilizes the colored molecules hemoglobin (reddish-brown) and vitamin B12 (pink). The contrasting colors are highly visible as both molecules pass through the column at different rates and into collection tubes.

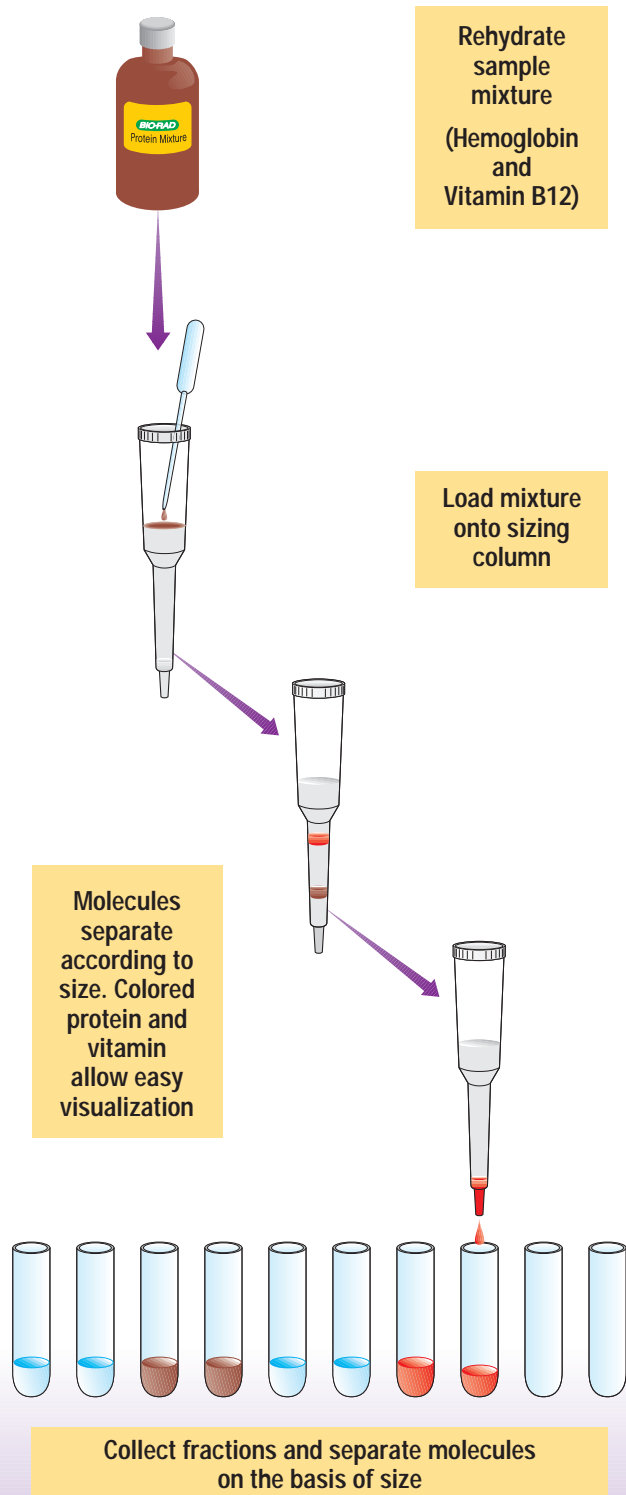


One student workstation – there are eight per kit.

STUDENT OBJECTIVES:

- Learn, apply, and demonstrate a mastery of the scientific inquiry process
- Understand the process of protein purification and its role in biotechnology
- Analyze and interpret results
- Use knowledge gained to design a creative experiment using protein chromatography





SUGGESTED STUDENT BACKGROUND:

This laboratory activity integrates well into both basic and advanced biology curricula. Hemoglobin and vitamin B12 are both compounds essential to functions in the human body; thus this laboratory activity can be linked to basic lessons in biology, human physiology, and biochemistry.

KEY FEATURES OF KIT:

- Real-life interdisciplinary biotechnology investigations
- High safety standards
- Low cost

MATERIALS PROVIDED IN THIS KIT ARE FOR 8 COMPLETE STUDENT WORKSTATIONS:

- Protein Mix
- Hemoglobin
- Vitamin B12
- Prefilled chromatography sizing columns - 8
- Column buffer, 50 ml
- Pipettes (1 ml) - 10
- Collection tubes - 100

REQUIRED EQUIPMENT NOT INCLUDED IN KIT:

- Test tube rack for holding 10 tubes
- Black marking pen (per group)

KIT #7: CAT. NO. 166-0008-EDU
SIZE EXCLUSION CHROMATOGRAPHY KIT

Includes 8 workstations \$39.50

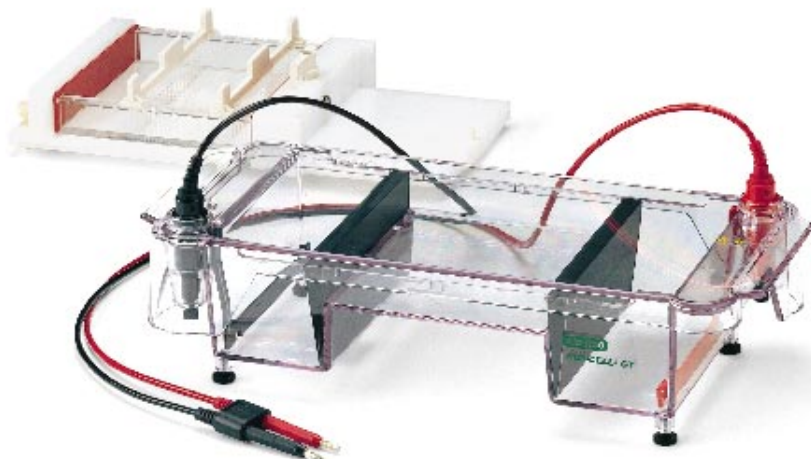


ELECTROPHORESIS EQUIPMENT: DNA

Horizontal DNA Electrophoresis Systems

Submerged horizontal agarose gels have become a primary tool for the classroom molecular biologist, since they're more economical and easier to use than vertical systems. And our Sub-Cell GT systems are designed for many classroom applications, including

- Restriction digest analysis
- Northern and Southern blotting
- PCR fragment analysis
- RFLP analysis
- DNA fingerprinting
- Protein fingerprinting



DNA samples from our DNA fingerprinting kit electrophoresed in the Mini-Sub cell GT. Following a 30 minute run, 120 V, gels were stained with our unique non-toxic Bio-Safe DNA staining solution. See the Electrophoresis Supplies Section for details on this new non-toxic DNA stain.

Sub-Cell GT Cells

You Taught Us a Few Things. Now, Here's a New Line Geared to Help You Teach Others You know our Sub-Cell electrophoresis cells are sturdy and reliable. Building upon this reputation, we've taken the best ideas teachers and other users had to offer, and created the GT line. Your suggestions helped us create remarkably user-friendly, advanced, and versatile electrophoresis cells. For more technical information, request Bulletin 2049.

New Combs.

Save time and reduce loading errors with large-well, fixed-height combs that drop into place for ease in casting gels.

Tape-Free Gel Casting. No tape. No Mess!

Our Sub-Cell line is the first to let you cast gels by using the tape-free caster or by casting in the electrophoresis chamber using gates with or without the gel tray. Of course, tape can still be used.

Stackable Casting Tray with Fluorescent Ruler.

No more searching high and low for that ruler; we designed one right into the tray! And made it fluorescent for good measure. Plus, the ruler provides you with an automatic record of migration distance after gel documentation.

IEC 1010-1 Safety Certification.

As the first submerged gel electrophoresis line to be IEC 1010-1 certified, you know our Sub-Cell systems are among the safest you can buy!

Drop-In Replaceable Electrode.

Our unique electrode cassettes, complete with banana plugs, make electrode replacement a snap – literally!

Damage Proof Tank and Lid.

Our unique injection molded polycarbonate electrophoresis chambers are guaranteed to withstand the most rigorous classroom applications.

ELECTROPHORESIS EQUIPMENT: DNA



Mini-Sub Cell GT:

A Compact Classic for the Classroom

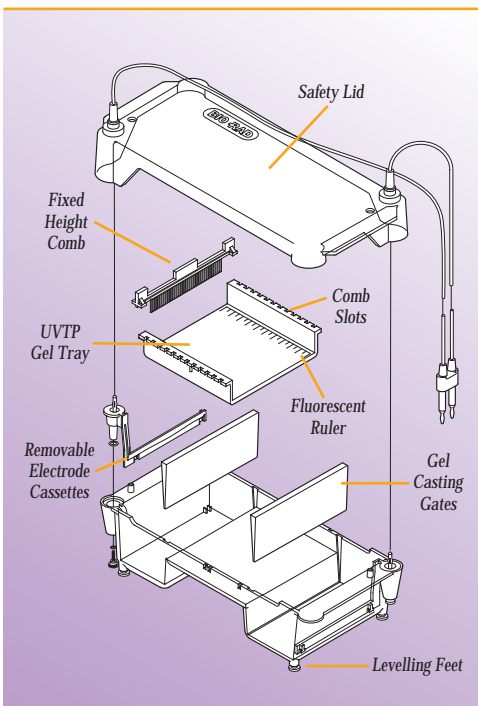
The speed of DNA separations like restriction digest analysis and DNA fingerprinting can be increased using miniature submersible gel electrophoresis. For example, Eco RI or Hind III digests of Lambda phage DNA can be easily resolved in 30 minutes at 120 V using the Mini-Sub cell GT. Separations of small DNA fragments are performed in as little as 15 minutes at 150 V. The economical Mini-Sub cell GT is about 1/4 the size of the Sub-Cell GT DNA cell, and can resolve from 8 to 15 samples per comb. Its short narrow format allows 7 and 10 cm runs. PowerPac 300 recommended, p.37.



Wide Mini-Sub Cell GT

Electrophoresis Cell

Ideal when you need a wide platform that can separate 15 to 30 samples per comb – two to three times more than the Mini-Sub cell! PowerPac 300 recommended, p.37.



Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
Sub-Cell GT Systems			
170-4400-EDU	Mini-Sub Cell GT System, with 7 x 7 cm tray	\$235.00	\$185.00
170-4466-EDU	Mini-Sub Cell GT System, with 7 x 10 cm tray	235.00	185.00
170-4405-EDU	Wide Mini-Sub Cell GT System, with 15 x 7 cm tray	320.00	255.00
170-4406-EDU	Wide Mini-Sub Cell GT System, with 15 x 10 cm tray	320.00	255.00
166-0900-EDU	Four Mini-Sub Cell GT Systems, with 7 x 7 cm tray and one PowerPac 300	1,335.00	995.00
System includes Sub-Cell unit, UV transparent tray, casting gates, and two 1.5 mm thick fixed height combs (15- and 20-well for the Wide Mini Sub-Cell, 8- and 15-well for the Mini-Sub cell).			
Sub-Cell GT Accessories			
170-4422-EDU	Mini-Gel Caster - fits all mini gel trays	55.00	44.00
170-4436-EDU	GT UV Transparent Mini-Gel Tray, 7 x 7 cm	45.00	36.00
170-4437-EDU	GT UV Transparent Mini-Gel Tray, 7 x 10 cm	55.00	44.00
170-4416-EDU	GT UV Transparent Wide Mini GT Gel Tray, 15 x 10 cm	55.00	44.00
170-4417-EDU	GT UV Transparent Wide Mini GT Gel Tray, 15 x 7 cm	55.00	44.00
170-4434-EDU	Mini-Sub Cell GT Casting Gates (for 7 x 10 cm trays only), 2	45.00	36.00
170-4425-EDU	Wide Mini-Sub Cell GT Casting Gates (for 7 x 15 cm trays only), 2	45.00	36.00
170-4432-EDU	Mini-Sub Cell GT Electrode (anode) Red	35.00	28.00
170-4433-EDU	Mini-Sub Cell GT Electrode (cathode) Black	35.00	28.00
170-4423-EDU	Wide Mini-Sub Cell GT Electrode (anode) Red	35.00	28.00
170-4424-EDU	Wide Mini-Sub Cell GT Electrode (anode) Red	35.00	28.00
170-4462-EDU	Mini-Sub Cell GT Fixed Height Comb - 8 well, 0.75 mm thick	37.00	30.00
170-4463-EDU	Mini-Sub Cell GT Fixed Height Comb - 8 well, 1.5 mm thick	37.00	30.00
170-4462-EDU	Wide Mini-Sub Cell GT Fixed Height Comb - 15 well, 0.75 mm thick	37.00	30.00



ELECTROPHORESIS EQUIPMENT: DNA



Vertical DNA Electrophoresis Sequencing Cell*

Did you ever consider having your students sequence a gene? Now you can! The patented Sequi-Gen GT nucleic acid sequencing cell insures smile-free DNA patterns, and has IEC 1010 safety certification. In addition, the Sequi-Gen GT cell introduces an easy horizontal casting method that dramatically simplifies gel casting.

Sequi-Gen GT Laboratory Applications

Not Just for Sequencing Anymore

The long, thin, polyacrylamide gel format of the Sequi-Gen GT cell provides excellent separation of DNA and RNA fragments that differ by only a single nucleotide. In addition, it's ideal for:

- DNA fingerprinting
- DNA footprinting
- Oligonucleotide analysis

When the sequencing cell is used in these applications in conjunction with the PowerPac 3000 Power Supply with Temperature Probe, constant power, voltage, or current, electrophoresis is possible. The PowerPac 3000 Power Supply also offers ultimate user safety with arc, ground leak, and no-load detection features. For more technical information, request Bulletin 2006. PowerPac 300 recommended, p. 37-38.

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE		
Sequi-Gen GT Sequencing Systems					
165-3860-EDU	Sequi-Gen GT System, 21 x 40 cm*	\$850.00	\$680.00		
165-3861-EDU	Sequi-Gen GT System, 21 x 50 cm*	890.00	715.00		
165-3862-EDU	Sequi-Gen GT System, 38 x 30 cm*	925.00	740.00		
165-3863-EDU	Sequi-Gen GT System, 38 x 50 cm*	970.00	775.00		
Machined Vinyl Sharktooth Combs**					
CATALOG NO.	DESCRIPTION	WELL NO.	SIZE	LIST PRICE	EDU PRICE
165-3836-EDU	0.4 mm	24	15 cm	35.00	28.00
165-3837-EDU	0.4 mm	36	15 cm	40.00	32.00
165-3838-EDU	0.4 mm	48	15 cm	45.00	36.00
165-3839-EDU	0.4 mm	49	30 cm	50.00	40.00
165-3840-EDU	0.4 mm	73	30 cm	60.00	48.00
165-3841-EDU	0.4 mm	97	30 cm	70.00	52.00
Machined Vinyl Spacers**					
165-3812-EDU	30 cm		0.4 mm	35.00	28.00
165-3814-EDU	40 cm		0.4 mm	35.00	28.00
165-3816-EDU	50 cm		0.4 mm	35.00	28.00

* Sequi-Gen GT systems include GT IPC assembly (IPC and bonded inner glass plate, outer glass plate, and clamp set), GT universal base, GT safety covers with cables, stabilizer bar, precision caster assembly (precision caster base, gasket, tubing, luer tapers, tubing, and syringe), 0.40 mm vinyl sharktooth comb and spacers, gel temperature indicator, leveling bubble, drain port connector, and instruction manual. **Machined vinyl spacers are color-coded and include 2 spacers per package. 0.25 mm thick combs are blue, 0.4 mm combs are red, and 0.75 mm combs are gray.



Simple Horizontal Gel Casting Method

Assembling and casting with the Sequi-Gen GT cell is convenient and reliable.

- (1) The lever clamps slide over the gel sandwich.
- (2) Each clamp exerts an even pressure over the entire length of the glass plate sandwich, resulting in a positive seal. This prevents damage to the plates or leakage which can result from uneven pressure. Tape, screws, and binder clamps are unnecessary.
- (3) With the new casting method, a precision caster is attached to the bottom of the Sequi-Gen GT cell. This assembly is placed flat on the lab bench, and the gel is injected with a syringe through an injection port in the precision caster. Simple as that!



Vertical Acrylamide Gel Electrophoresis

Handcast or Precast?

Why spend valuable class time casting gels when you could be working on the actual application? Hand casting gels can occupy up to 2 hours of class time; even more if you have to prepare chemicals. By contrast, it takes seconds to remove a precast gel from its individually sealed protective bag. Since they're ready to run, students save hours of preparation and polymerization time. And the entire process is safer – since they're handling precast gels, there's no exposure to acrylamide, a hazardous neurotoxin.

Bio-Rad's Ready Gels - More Applications, Less Cost!

Ready Gels are precast polyacrylamide gels for use with Bio-Rad's Ready Gel Cell. Bio-Rad's Ready Gels are among the most affordable precast gels you can buy anywhere! And you can count on the highest quality, since they're from Bio-Rad, the leader in purified acrylamide products.

10-Well Combs

Hold 30 μ l (maximum load 34 μ l) per well – ideal for conventional samples. Available in all three buffer types (Tris-HCL, Tris-Tricine, and TBE), and all gel percentages (single percentages and gradients).

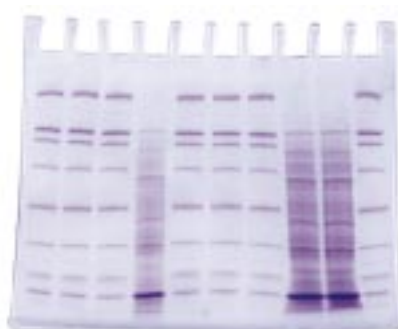
15-Well Combs

Allow 15 μ l (maximum load 20 μ l) of multiple samples to be loaded, increasing throughput by 50%! Available in all three buffer types and all gel percentages.

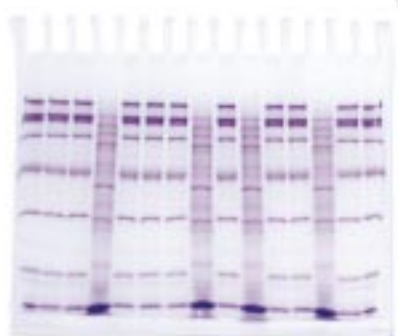
50 μ l Combs - Easy Target!

Ten lanes hold 50 μ l (maximum 60 μ l) each, making them ideal for dilute samples. Available in all three buffer types (Tris-HCL, Tris-Tricine, and TBE), and all gel percentages (single percentages and gradients).

For more information on Ready Gels, request Bulletin 2062.



10-well Comb



15-well Comb



10-well 50 μ l Comb



Ordering Information

DESCRIPTION	10-WELL CATALOG NO.	15-WELL CATALOG NO.	2-D/PREP WELL CATALOG NO.	50- μ l COMB CATALOG NO.	LIST PRICE	EDU PRICE
Tris-Glycine for SDS-PAGE and native PAGE (10 gels each)						
7.5% resolving gel, 4% stacking gel	161-0900-EDU	161-0930-EDU	161-0950-EDU	161-0960-EDU	\$82.00	\$65.00
10% resolving gel, 4% stacking gel	161-0907-EDU	161-0937-EDU	161-0957-EDU	161-0967-EDU	82.00	65.00
12% resolving gel, 4% stacking gel	161-0901-EDU	161-0931-EDU	161-0951-EDU	161-0961-EDU	82.00	65.00
15% resolving gel, 4% stacking gel	161-0908-EDU	161-0938-EDU	161-0958-EDU	161-0968-EDU	82.00	65.00
4-15% linear gradient	161-0902-EDU	161-0932-EDU	161-0952-EDU	161-0962-EDU	82.00	65.00
4-20% linear gradient	161-0903-EDU	161-0933-EDU	161-0953-EDU	161-0963-EDU	82.00	65.00
10-20% linear gradient, 4% stacking gel	161-0906-EDU	161-0936-EDU	161-0956-EDU	161-0966-EDU	82.00	65.00
Tris-Borate-EDTA (TBE) for DNA electrophoresis (10 gels each)						
5% uniform TBE gel	161-0904-EDU	161-0934-EDU	N/A	161-0964-EDU	82.00	65.00
10% uniform TBE gel	161-0905-EDU	161-0935-EDU	N/A	161-0965-EDU	82.00	65.00
Tris-Tricine for peptide and small protein electrophoresis (10 gels each)						
16.5% resolving gel, 4% stacking gel	161-0922-EDU	161-0925-EDU	161-0942-EDU	161-0944-EDU	82.00	65.00
10-20% linear gradient, 4% stacking gel	161-0923-EDU	161-0926-EDU	161-0943-EDU	161-0945-EDU	82.00	65.00



ELECTROPHORESIS EQUIPMENT: PROTEIN/DNA

Modular Protein Electrophoresis Systems for All Teaching Labs

Mini vertical cell systems provide a quick and efficient way to achieve analytical protein electrophoresis results. You gain high resolution in applications ranging from purity assessments to the analysis of complex protein mixtures.

Bio-Rad's mini vertical electrophoresis systems are versatile instruments which allow vertical slab electrophoresis using handcast or precast gels, and electrophoretic blotting, to be performed in the same cell. Interchangeable modules allow you to easily convert from one application to another. Each module uses the same mini buffer tank and lid to form a complete cell. The mini system minimizes reagent consumption, while preserving high quality results. The cells and modules include

- *Ready Gel Cell dedicated to running precast acrylamide gels*
- *Mini-PROTEAN II cell for running hand-cast or precast PAGE and SDS-PAGE gels*
- *Mini Trans-Blot cell for western blotting*

Ready Gel Electrophoresis Cell

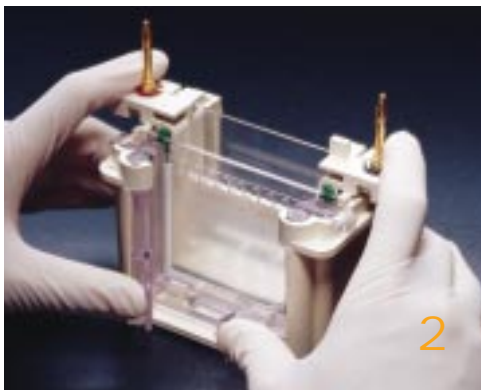
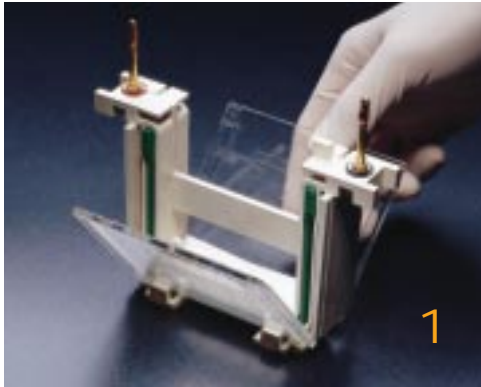
The Ready Gel Cell incorporates innovative, user-friendly features that make it easier than ever to run precast protein or DNA gels in your classroom laboratory.

Exclusive sample loading guides prevent overlooking or doubling-up on a lane. The buffer dam is also an industry first – a single molded piece for fast, simple setup when running only one gel. The new Ready Gel Cell features

- *Unique sample loading guides to help students locate and load sample wells*
- *Indestructible molded polycarbonate construction*
- *Compatible with all Ready Gels, including native PAGE, SDS-PAGE, Tricine, and TBE buffer systems*

For more information on the Ready Gel Cell, request bulletin 2061.





Ready Gel Cell Application: Evolution Lab: Protein Fingerprinting

A Classroom Application Demonstration

Precast mini gels can be used in your classroom lab to demonstrate evolutionarily conserved phenotypic traits between different fish species.

Students separate proteins from different types of fish on polyacrylamide mini gels. By comparing the patterns obtained, students hypothesize about the degrees of relatedness by comparing their results to an evolutionary tree.

Different fish species reveal variable banding patterns - "protein fingerprints". Many of the bands are composed of several polypeptides linked together to form functional proteins. Since these larger proteins involve the interaction of several genes to form a functional unit, they tend to resist evolutionary change more than smaller functional proteins consisting of a single polypeptide. Notice the variations in banding patterns in the low molecular weight region of the gel, above right.



The central four lanes shown below contain muscle extracts from (left to right) salmon, shark, catfish, and sea bass, run on a 15% precast acrylamide mini gel.

Procedure:

1. Solubilize fish samples separately in SDS-PAGE sample buffer
2. Paper filter to remove all particles
3. Run samples on 15% acrylamide mini gel – 30 minutes/200volts
4. Stain gels with Coomassie Blue
5. Observe and discuss results

The operation requires three simple steps:

1. Place the Ready Gels into the slots at the bottom of each side of the electrode assembly.
2. Place the electrode assembly and gels into the clamping frame, and seal the inner chamber by pressing down on the electrode assembly and gently closing the two soft touch cam levers on the clamping frame.
3. Place the sample loading guide on the electrode assembly, and you're ready to load the gel and run your separation.

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
Ready Gel Cells			
165-3125-EDU	Ready Gel Cell, includes electrode assembly, clamping frame, mini buffer tank, lid with power cables, mini cell buffer dam, one 10-well and one 15-well sample loading guide, and instructions	\$350.00	\$280.00
165-3126-EDU	Ready Gel Cell Module, includes electrode assembly, clamping frame, one 10-well and one 15-well sample loading guide, mini cell buffer dam, and instructions	235.00	185.00
Ready Gel Cell Accessories			
165-3130-EDU	Mini Cell Buffer Dam, 2, molded one-piece buffer dam for use with the Ready Gel Cell and the Mini-PROTEAN II cell	15.00	12.00
165-3120-EDU	Ready Gel Sample Loading Guides, includes one each, 10-well and 15-well guide; for use with 10-well and 15-well Ready Gels and Ready Gel Cell	10.00	8.00
165-3149-EDU	Ready Gel Cell Replacement Gaskets, electrode assembly, 2	25.00	20.00
161-3990-EDU	Ready Gel Cassettes, empty, 10		



ELECTROPHORESIS EQUIPMENT: PROTEIN/DNA



Mini-PROTEAN II Electrophoresis Cell

If most of your lessons are done with handcast gels, the Mini-PROTEAN II cell is ideal. It's the core of our modular Mini-PROTEAN II electrophoresis system, a versatile line of instruments for miniature electrophoresis applications. With the Mini-PROTEAN II cell, your students can perform vertical slab electrophoresis using handcast or precast gels, as well as electrophoretic blotting. Fast separations are combined with easy set-up and the ultimate flexibility in gel selection. For more technical information, request Bulletin 1845.

- Damage resistant molded polycarbonate construction
- Compatible with all Ready Gels, including native PAGE, SDS-PAGE, Tricine, and TBE buffer systems
- Innovative casting stand quickly aligns gel sandwiches for leak free casting without grease or agarose plugs
- Separations in less than 45 minutes

Ordering Information

CATALOG NO. DESCRIPTION LIST PRICE EDU PRICE

Mini Trans-Blot Electrophoretic Transfer Cell

170-3930-EDU	Mini Trans-Blot Electrophoretic Transfer Cell, includes 2 Gel Holder Cassettes, 4 Fiber Pads, modular electrode assembly, Bio-Ice cooling unit, lower buffer chamber, lid with cables, and instructions	\$375.00	\$300.00
170-3935-EDU	Mini Trans-Blot Module, without the lower buffer chamber and lid	295.00	236.00

Mini-PROTEAN II Cell

165-2940-EDU	Mini-PROTEAN II Cell, 10-well combs, 0.75 mm spacers, includes electrode assembly with gaskets, lower buffer chamber, lid with cables, 3 sets* Glass Plates, clamp assemblies, 2, 10-well, 0.75 mm thick combs, 2, 0.75 mm thick spacers, 4, Casting Stand with Gaskets, leveling bubble, and instructions	490.00	392.00
165-2941-EDU	Mini-PROTEAN II Cell, without combs and spacers	410.00	328.00
165-2944-EDU	Mini-PROTEAN II Module, without tank and lid	425.00	340.00

Mini-PROTEAN II Cell Accessories

165-2943-EDU	Casting Stand with Gaskets, to cast 1 or 2 gels	75.00	60.00
165-2904-EDU	Replacement Gray Gaskets, casting stand, 2	20.00	16.00
165-2902-EDU	Replacement Red Foam Gaskets, casting stand, 2	15.00	12.00
165-2946-EDU	Clamp Assembly, to cast 1 gel	50.00	40.00
165-2905-EDU	Replacement Gaskets, electrode assembly, 2	25.00	20.00
165-2912-EDU	Glass Plates, 10 sets*	40.00	32.00
165-2907-EDU	Inner Glass Plates, 7.3 x 10.2 cm, 10	25.00	20.00
165-2908-EDU	Outer Glass Plates, 8.3 x 10.2 cm, 10	25.00	20.00
165-2975-EDU	Buffer Tank and Lid, for Mini-PROTEAN II cell	115.00	92.00
165-2942-EDU	Mini-PROTEAN II Electrode Assembly with Gaskets	180.00	144.00
165-2948-EDU	Replacement Power Cables	35.00	28.00
165-2957-EDU	Mini-PROTEAN II Alignment Card	10.00	8.00
165-2949-EDU	Cell Lid, with power cables	75.00	60.00

Mini-PROTEAN II Spacers (set of 4)

	0.5 MM	0.75 MM	1.0 MM	1.5 MM		
	165-2930-EDU	165-2931-EDU	165-2932-EDU	165-2933-EDU	25.00	20.00

Mini-PROTEAN II Combs**

	5-WELL	9-WELL	10-WELL	15-WELL	2-D/PREPARATIVE (1 REFERENCE WELL)	LIST PRICE	EDU PRICE
0.5 mm	165-2915-EDU	165-2936-EDU	165-2919-EDU	165-2923-EDU	—	20.00	16.00
0.75 mm	165-2916-EDU	165-2937-EDU	165-2920-EDU	165-2924-EDU	165-2927-EDU	20.00	16.00
1.0 mm	165-2917-EDU	165-2938-EDU	165-2921-EDU	165-2925-EDU	165-2928-EDU	20.00	16.00
1.5 mm	165-2918-EDU	165-2939-EDU	165-2922-EDU	165-2926-EDU	165-2929-EDU	20.00	16.00

*One set = 1 inner plate and 1 outer plate (enough to cast one gel).

**The overall length of each comb is 8 cm. The depth of each sample well is 13 mm.

Mini Trans-Blot Electrophoretic Transfer Cell

The Mini Trans-Blot module uses the same buffer tank as the Ready Gel Cell and the Mini-PROTEAN II cell.

- Two blots can be run in the unique, molded module
- The fragile platinum wire is protected by the carefully designed, recessed electrode assembly
- The anode and cathode are 4 cm apart, providing a high field strength for rapid 1-hour transfers
- The Bio-Ice cooling unit dissipates heat generated during transfer, preventing buffer ion depletion, and reducing the amount of transfer buffer in the tank
- Can run overnight at low voltages

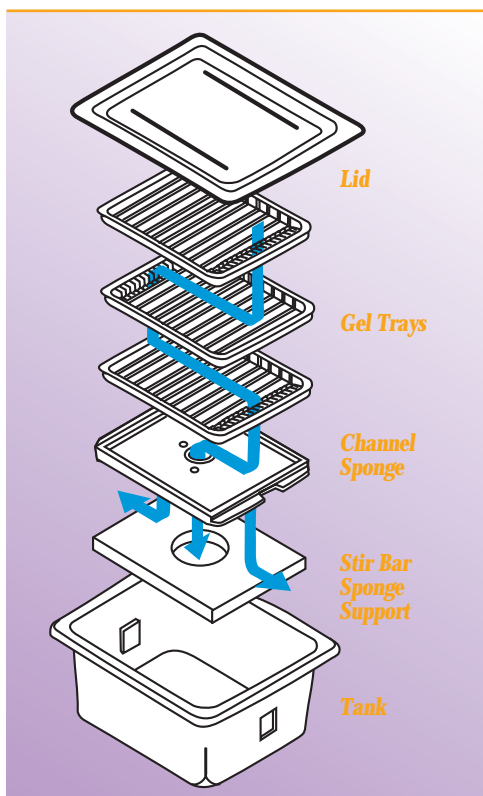
With its modular design, minimal buffer consumption, and self-contained cooling system, the Mini Trans-Blot cell is an efficient apparatus for obtaining quality blotting results. For more technical information about blotting, request Bulletin 1721.

Model 556 Gel Destainer

The Model 556 Gel Destainer can destain up to 24 mini acrylamide or agarose slab gels in an hour! Solution flows in one direction through each tray, insuring even destaining of every gel. A stir bar controls the flow rate, so there are no complex adjustments to make. After passing through the trays, the solution filters through an activated Charcoal Sponge removing all dye. Because the sponge constantly removes the dye, destaining time is reduced, and there's no need to change the destaining solution. Each Charcoal Sponge will absorb dye for at least 3 months of daily use.

Trays Stack Easily Without Slipping

Up to 4 trays of gels can be stacked for destaining at once, and slab and tube gel trays can be used simultaneously. Each tray has a built-in interlock for perfect alignment, insuring proper solution flow. And the clear trays let you and your students view the entire destaining process.



Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
Gel Destainer			
165-2010-EDU	Model 556 Gel Destainer, includes outer chamber and lid, 3 Slab Gel Trays, stir bar/sponge support, Charcoal Sponge, and instructions	\$375.00	\$300.00
165-2011-EDU	Slab Gel Tray	50.00	40.00
165-2013-EDU	Charcoal Sponge, 2	55.00	44.00

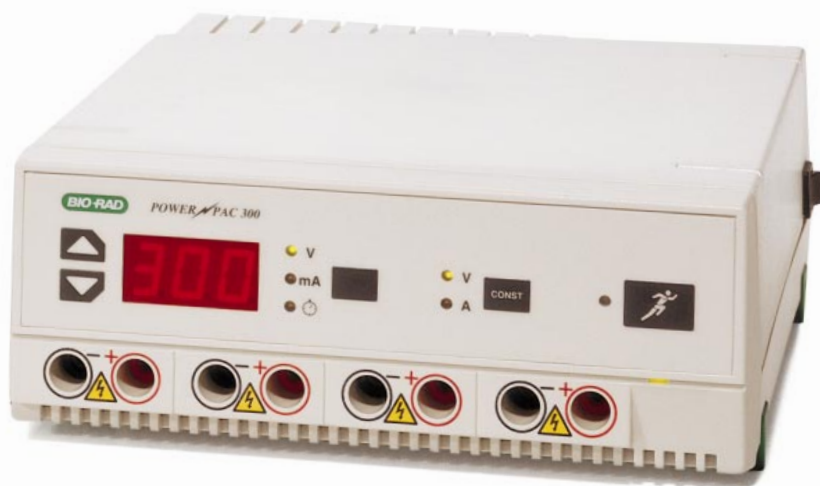


ELECTROPHORESIS EQUIPMENT: ACCESSORIES

Boost Classroom Performance with Bio-Rad's Electrophoresis Power Supplies

There's positively no family of power supplies that offers you more value and better performance than our PowerPac series. We've utilized two decades of experience and research in electrophoresis to develop these four power supplies. By carefully matching output ranges and features to applications, our PowerPac series offers you all the versatility required for your classroom laboratory. Since power supplies are essential to every electrophoretic application, all PowerPac Power Supplies are designed with continuous, rigorous use in mind.

In addition, each PowerPac Power Supply is IEC 1010-1 certified, making ours among the safest electrophoresis power supplies available.



PowerPac 300 Power Supply

- *Runs 4 cells simultaneously*
- *Timer controlled*
- *Fully programmable*
- *Very affordable*

PowerPac 300

The PowerPac 300 Power Supply is perfect for submarine and mini-vertical gel electrophoresis. The PowerPac 300 can run four mini-vertical electrophoresis cells or four horizontal DNA electrophoresis cells at once.

PowerPac 200

With a 2 ampere capability, the PowerPac 200 Power Supply is a powerhouse of potential for performing demanding electrophoretic blotting techniques. High field intensity tank blotting, semi-dry blotting, and high current nucleic acid transfers from acrylamide gels are just a few applications the PowerPac 200 can perform. In addition to being the ideal blotting power supply, the PowerPac 200 is also useful for mini-vertical and submarine electrophoresis.

PowerPac 1000

The PowerPac 1000 Power Supply is versatile and supports many applications. The current/voltage capabilities and step programmability can run SDS-PAGE and native PAGE, making the PowerPac 1000 Power Supply ideal for 2-D electrophoresis. The PowerPac 1000 (like the PowerPac 3000) features a keypad for easier method set-up, and a bright graphics LCD for single-glance assessment of power settings.

PowerPac 3000

The perfect workhorse for busy teaching labs performing high voltage applications, the PowerPac 3000 Power Supply offers enough power to run up to four DNA sequencing cells at once. The optional Temperature Probe allows automatic and precise control of temperature between 0 and 90 °C during electrophoresis. The PowerPac 3000 uses a proprietary algorithm and circuitry to sense the gel temperature, and adjusts the power to remain within 2 °C of the desired temperature. This function is particularly useful for DNA sequencing analysis, where constant temperature is very important for superior band resolution and reproducibility.

For more technical information about Power Supplies and Accessories request Bulletin 1924.

ELECTROPHORESIS EQUIPMENT: ACCESSORIES



PowerPac 3000 Specifications

Output range (programmable)	25-3,000 V in 1 volt steps 1-400 mA in 1 mA steps 1-400 W in 1 watt steps
Type of output	Constant voltage, current, or power w/ auto. crossover
Programmability	
Memory storage	9 programs
Steps per program	9 steps
Timer control	99 hours, 59 minutes maximum
Volt-hour control	99,999 volt-hours maximum
Display	Backlit graphics LCD
Dimensions (L x W x H)	29 x 28 x 11 cm
Weight	3.7 kg
Temperature control (optional)	
Operating range	0-90 °C ± 2 °C



PowerPac 300 Specifications

Output range (programmable)	10-300 V in 1 volt steps 4-400 mA in 1 mA steps 75 W maximum
Type of output	Constant voltage or current with automatic crossover
Timer control	0-999 minutes
Display	3 digit LED
Dimensions (L x W x H)	29 x 21 x 8 cm
Weight	1.8 kg



PowerPac 1000 Specifications

Output range (programmable)	5-1,000 V in 1 volt steps 1-500 mA in 1 mA steps 1-250 W in 1 watt steps
Type of output	Constant voltage, current, or power with automatic crossover
Programmability	
Memory storage	9 programs
Steps per program	9 steps
Timer control	99 hours, 59 minutes maximum
Volt-hour control	99,999 volt-hours maximum
Display	Backlit graphics LCD
Dimensions (L x W x H)	29 x 28 x 11 cm
Weight	3.1 kg



PowerPac 200 Specifications

Output range (programmable)	5-200 V in 1 volt steps 0.01-2.0 A in 0.01 A steps 200 W maximum
Type of output	Constant voltage or current with automatic crossover
Timer control	0-999 minutes
Display	3 digit LED
Dimensions (L x W x H)	29 x 21 x 8 cm
Weight	2.4 kg

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
PowerPac 3000 Power Supply			
165-5056-EDU	PowerPac 3000 Power Supply, * 100/120 V	\$1,995.00	\$1,596.00
165-5057-EDU	PowerPac 3000 Power Supply, * 220/240 V	Inquire	Inquire
165-5059-EDU	PowerPac 3000 Power Supply with Temperature Probe, † 100/120 V	2,100.00	1,680.00
165-5060-EDU	PowerPac 3000 Power Supply with Temperature Probe, † 220/240 V	Inquire	Inquire
PowerPac 1000 Power Supply			
165-5054-EDU	PowerPac 1000 Power Supply, * 100/120 V	1,150.00	920.00
165-5055-EDU	PowerPac 1000 Power Supply, * 220/240 V	Inquire	Inquire
PowerPac 200 Power Supply			
165-5052-EDU	PowerPac 200 Power Supply, † 100/120 V	775.00	620.00
165-5053-EDU	PowerPac 200 Power Supply, † 220/240 V	Inquire	Inquire
PowerPac 300 Power Supply			
165-5050-EDU	PowerPac 300 Power Supply, † 100/120 V	395.00	295.00
165-5051-EDU	PowerPac 300 Power Supply, † 220/240 V	Inquire	Inquire
165-5061-EDU	PowerPac Adaptor*	15.00	12.00

*Note: The PowerPac Adaptor is required to connect non-IEC certified electrophoresis cells with banana plug handles ≤ 40 mm in length (excluding the metal portion) to the PowerPac 1000 or 3000 Power Supply.

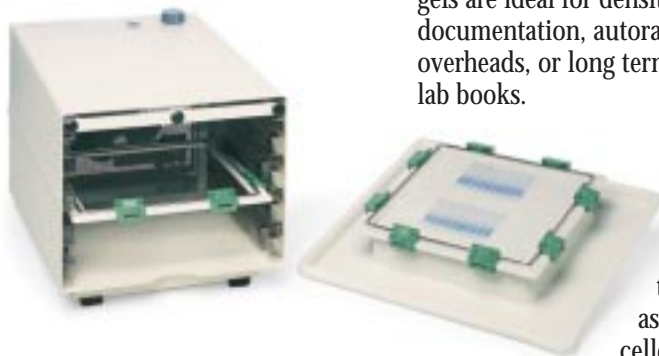
†Note: The PowerPac Adaptor is required to connect non-IEC certified electrophoresis cells with banana plug handles ≤ 26 mm in length (excluding the metal portion) to the PowerPac 200 or 300 Power Supply.



ELECTROPHORESIS EQUIPMENT: ACCESSORIES

GelAir Drying System

The GelAir Drying System is perfect for drying polyacrylamide and agarose gels up to 20 x 20 cm. Gels dried between two sheets of cellophane are crystal clear with a glossy finish. The GelAir system is easy to use, maintenance-free, and fast. The dried gels are ideal for densitometry, photo-documentation, autoradiography, overheads, or long term storage in students' lab books.



The complete GelAir Drying System includes the GelAir Dryer, two drying frames, assembly table, cellophane, new Gel

Drying Solution, and a manual with optimized drying protocols. Since the GelAir Drying System does not require a vacuum source, there is no pump or trap maintenance.

Optimized Drying Protocols

Protocols optimized for the GelAir Drying System include:

- Drying gels between two sheets of cellophane
- Drying gels for autoradiography
- Drying gels for fluorography
- Drying agarose gels
- Drying gels on filter paper

For more technical information about Gel Drying request Bulletin 1965.

Specifications

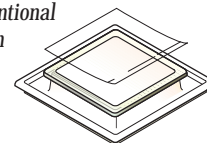
GelAir Dryer	
Timer control	0 to 3 hour, fully adjustable
Function modes	Fan only, fan plus heat, and off
Dryer capacity	4 shelves, each accommodating 1 drying frame
Dimensions	27 x 43 x 30 cm (H x D x W)
Weight	8 kg

GelAir Drying Frames

Inner dimensions	20 x 20 cm
Drying frame	Molded polycarbonate bottom frame, stainless steel top frame
Clamps	Molded polysulfone, 8 clamps per drying frame
Gel capacity	1 large (20 x 20 cm) or 4 small (7 x 8 cm) gels

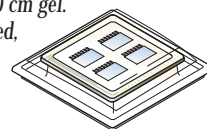
GelAir Dryer

The GelAir Dryer is a heated drying chamber that works like a convection oven to dry mini-gels in about 45 minutes, or 20 x 20 gels in 60 minutes, rivaling the speed of a conventional gel dryer requiring a vacuum pump. The GelAir Dryer holds up to four drying frames simultaneously.



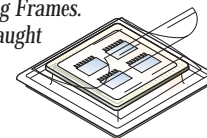
GelAir Drying Frames

The GelAir Drying System includes two complete drying frames, which are made of a durable, molded plastic base with a stainless steel top frame. The GelAir Drying Frames may be added to or removed from the GelAir Dryer at any time while it is running. Each frame holds four mini-gels or one 20 x 20 cm gel. When the dryer is fully loaded, four large gels or sixteen mini gels can be dried at once.



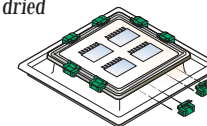
GelAir Assembly Table

The GelAir Assembly Table is a custom workspace for assembling the GelAir Drying Frames. Any excess liquid is neatly caught by the GelAir Assembly Table, saving clean up time.



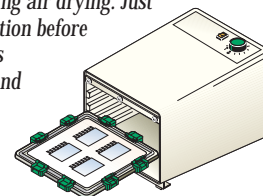
GelAir Cellophane Support

The GelAir Cellophane Support is precut to fit the GelAir Drying Frames. Gels dried between two sheets of cellophane are uniformly clear with a glossy finish.



New Gel Drying Solution

A pretreatment for polyacrylamide gels to help prevent gels from cracking during air drying. Just 10 minutes of equilibration before drying the gels prevents excessive gel swelling and resultant cracking.



Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
GelAir Dryers			
165-1771-EDU	GelAir Drying System, 115 V, 60 Hz, includes dryer, 2 drying frames, 16 clamps, assembly table, 50 precut sheets of cellophane support, and Gel Drying Solution	\$695.00	\$556.00
165-1772-EDU	GelAir Drying System, 230 V, 50 Hz	Inquire	Inquire
165-1777-EDU	GelAir Dryer, 115 V, 60 Hz	545.00	436.00
165-1778-EDU	GelAir Dryer, 230 V, 50 Hz	Inquire	Inquire
Accessories			
165-1775-EDU	GelAir Drying Frames, includes 2 frames and 16 clamps	95.00	76.00
165-1776-EDU	GelAir Assembly Table	65.00	52.00
165-1779-EDU	GelAir Cellophane Support, 50 precut sheets	35.00	28.00
165-1780-EDU	GelAir Drying Frame Clamps, 8	30.00	24.00
161-0752-EDU	Gel Drying Solution, 1 L	22.00	18.00



Polaroid Gel Documentation System

Bio-Rad's Standard Documentation System records results of conventional agarose electrophoresis using a Polaroid camera. The system provides the convenience of the DS-34 fixed, focal length camera with a darkroom hood and Mini-Transilluminator for quick images right at the benchtop. Systems include a filter for use with ethidium bromide stained gels.

For more technical information about Photodocumentation Systems request Bulletin 1924.



Ordering Information

CATALOG NO.	DESCRIPTION	LIST/EDU PRICE
170-3742-EDU	Standard Documentation System, 120 V, includes Mini-Transilluminator, DS-34 camera, Standard Electrophoresis Hood, Deep Yellow, DS-34 camera filter, film, 1 pack	Inquire
170-3746-EDU	Standard Documentation System, 100 V	Inquire
170-3747-EDU	Standard Documentation System, 220/240 V	Inquire
170-3745-EDU	Mini-Transilluminator, 100 V	Inquire
170-3737-EDU	Mini-Transilluminator, 120 V	Inquire
170-3738-EDU	Mini-Transilluminator, 220/240 V	Inquire
170-3739-EDU	Standard Electrophoresis Hood, 5" x 7" (12.7 x 17.8 cm)	Inquire
170-3741-EDU	DS-34 Polaroid Camera	Inquire
170-3744-EDU	Deep Yellow DS-34 Camera Filter	Inquire
170-3751-EDU	Mini-Transilluminator Fluorescent Lamp, 302 nm	Inquire
170-3759-EDU	Fluorescent Ruler	Inquire
170-7555-EDU	White Light Mini-Transilluminator, 120 V	Inquire
170-7556-EDU	White Light Mini-Transilluminator, 240 V	Inquire
170-7554-EDU	White Light Mini-Transilluminator, 100 V	Inquire



ELECTROPHORESIS SUPPLIES: BUFFERS & GEL MEDIA

Obtaining optimal electrophoresis results requires the careful selection and use of both equipment and reagents. Bio-Rad pioneered the production of reagents specifically for use in electrophoresis. This section describes electrophoresis buffers, convenient premixed electrophoresis gel forming reagents, buffer components, and stains.

Premixed Buffers for Electrophoresis

Save Preparation Time and Insure Results

Premixed liquid concentrate buffers for protein and nucleic acid electrophoresis let you standardize your runs and save preparation time. Our complete line is made with Bio-Rad's electrophoresis purity reagents, and quality controlled to insure reproducible results. Available in four buffer formulas, they're the perfect companion to agarose gel electrophoresis and vertical acrylamide gel applications in the classroom laboratory.



Premixed Sample Buffers

Simplify and standardize your sample loading while saving preparation time! Bio-Rad's concentrated formulas allow Premixed Sample Buffers to be used with both liquid and lyophilized samples. Made with our electrophoresis purity reagents, Premixed Sample Buffers are tested to insure quality and consistency. Buffers are available in three formulas for agarose gel electrophoresis and vertical acrylamide gel applications.

Ultra Pure DNA Grade Agarose

Bio-Rad offers ultra pure DNA grade agarose ideal for classroom molecular biology applications. Each agarose fills a molecular biology niche, and is tested for specific molecular biology requirements.

High Strength Analytical Grade Agarose for the Classroom

High Strength Analytical Grade Agarose offers the high gel strength required for preparation of lower percentage agarose gels used in DNA fingerprinting and restriction digest analysis. This allows separation of larger restriction fragments in gels which are easy to handle. The agarose also demonstrates minimal UV quenching. As a result, ethidium bromide stained gels exhibit high clarity when transilluminated at 300 nm, allowing more sensitive detection of DNA fragments. Each batch is tested for gel strength and clarity, and the agarose is specifically selected to provide the sharpest resolution in DNA electrophoresis. These properties make High Strength Analytical Grade Agarose ideal for analytical restriction fragment separations.



AmpliSize Agarose

AmpliSize agarose is specifically for high resolution separation of small DNA molecules ranging from 25 to 1,000 base pairs. AmpliSize agarose exhibits high gel strength and low melting point properties. It is ideal for separating PCR products, particularly when used in conjunction with the AmpliSize DNA size standards (50–2,000 bp).

Acrylamide for Handcast Gels

Polyacrylamide is a commonly used vertical slab gel electrophoresis matrix formed by free radical polymerization of acrylamide and the co-monomer crosslinker, bis. Reliable electrophoresis results depend on the reproducibility of this reaction, making highly purified starting reagents an important factor in gel quality. The polymerization reaction is initiated by the addition of Ammonium Persulfate (APS) and catalyzed by TEMED. For a discussion of the factors affecting acrylamide polymerization, request bulletin 1156.

Acrylamide/Bis Solutions

Bio-Rad's ready-to-use Acrylamide/Bis Solutions are made from 99.9% pure acrylamide and bis-acrylamide, and are available in two different crosslinker ratios: 19:1 and 37.5:1. High purity reagents and carefully controlled manufacturing conditions allow Acrylamide/Bis Solutions to be stable for 1 year at 4 °C.

Acrylamide/Crosslinker Ratios

RATIO	% C	COMMON APPLICATIONS
19:1	5%	DNA sequencing
37.5:1	2.6%	Protein separations

Crosslinkers and Catalysts

	FORMAL NAME	USE
Bis	N,N'-methylene-bis-acrylamide	Crosslinks linear Acrylamide molecules to form polyacrylamide matrix
APS	Ammonium Persulfate	Initiates reaction between Bis and Acrylamide
TEMED	(N,N,N',N'-tetra-methyl-ethylenediamine)	Catalyses reaction between Bis and Acrylamide

Ordering Information

CATALOG NO.	DESCRIPTION	APPLICATIONS	LIST PRICE	EDU PRICE
Premixed Electrophoresis Buffer				
161-0732-EDU	10x Tris/Glycine/SDS	SDS-PAGE- denatured proteins	\$20.00	\$16.00
161-0734-EDU	10x Tris/Glycine	Native PAGE -non-denatured proteins	20.00	16.00
161-0733-EDU	10x Tris/Boric Acid/EDTA (TBE)	Horizontal and vertical DNA electrophoresis	24.00	20.00
161-0743-EDU	50x Tris/Acetic Acid/EDTA (TAE)	Horizontal and vertical DNA electrophoresis	24.00	20.00

CATALOG NO	DESCRIPTION	TRACKING DYES	LIST PRICE	EDU PRICE
Premixed Sample Buffer				
161-0737-EDU	SDS-PAGE Sample Buffer	Bromophenol Blue	\$12.00	\$10.00
161-0738-EDU	Native PAGE Sample Buffer	Bromophenol Blue	12.00	10.00
161-0401-EDU	DNA Electrophoresis Sample Loading Dye	Xylene Cyanol and Bromophenol Blue	10.00	5.95

CATALOG NO.	PRODUCT DESCRIPTION	QUANTITY PER PACKAGE	LIST PRICE	EDU PRICE
Ultra Pure DNA Grade Agarose				
162-0125-EDU	High Strength Analytical Grade Agarose	100 g	\$99.00	\$80.00
162-0144-EDU	AmpliSize Agarose	50 g	175.00	140.00
Catalysts				
161-0800-EDU	TEMED	5 ml	12.00	10.00
161-0700-EDU	Ammonium Persulfate	10 g	10.00	8.00
Acrylamide Solutions				
161-0148-EDU	40% Acrylamide/Bis Solution, 37.5:1	500 ml	48.00	39.00
161-0149-EDU	40% Acrylamide/Bis Solution, 19:1	2 x 500 ml	89.00	72.00
161-0144-EDU	40% Acrylamide	500 ml	37.00	30.00
161-0145-EDU	40% Acrylamide	2 x 500 ml	69.00	55.00

- Hazardous shipping charges may apply.
- Store at 4 °C.

All other reagents should be stored at room temperature, dry, and away from direct sunlight. Bulk and custom packaging is available for all reagents. Call 1-800-4BIORAD (1-800-424-6723) for information.

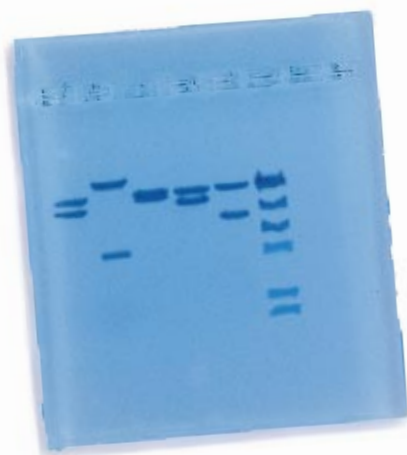


ELECTROPHORESIS SUPPLIES: DNA & PROTEIN STAINS

DNA Stains

Bio-Safe Non-Toxic DNA Staining Solution

Bio-Rad's unique Bio-Safe DNA staining solution is an ultrasensitive nucleic acid stain for agarose and acrylamide gels. It is non-toxic and comparable in sensitivity to ethidium bromide. This revolutionary DNA stain leaves bands a deep blue and eliminates the need for costly photo-documentation systems. Agarose and acrylamide gels stained with Bio-Safe stain provide vivid results. And because the stain won't fade, gels can simply be dried and kept as a permanent record of the electrophoresis run.



- No exposure to carcinogenic chemicals
- Eliminates the need for expensive photography equipment and film
- Available only from Bio-Rad

Ethidium Bromide Tablets

An alternative to weighing out hazardous chemicals. Simply dissolve the tablet in 11 ml of water for a 1 mg/ml solution.

Ethidium Bromide Solution

Eliminate preparation and minimize exposure to hazardous ethidium bromide. A convenient dropper built into the lid of the bottle prevents contamination of pipets and reduces hazardous waste of contaminated pipet tips.



Protein Stains

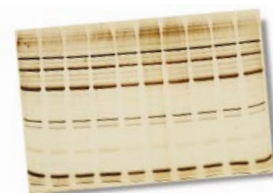
Coomassie Brilliant Blue R-250 Stain and Destain

Bio-Rad's Coomassie Brilliant Blue R-250 Staining Solution is the fastest, most efficient way for students to Coomassie stain their Ready Gels or other protein acrylamide gels. CBB R-250 Destaining Solution comes ready-to-use in convenient 1 liter bottles. Sensitivity > 100 ng/band.



Silver Stain Plus Kit

Silver Stain Plus is our most sensitive and easiest to use silver stain. The Silver Stain Plus Kit is ideal for both proteins and nucleic acids in polyacrylamide and agarose matrices. Sensitivity < 100 ng/band.



The Silver Stain Plus Kit

- Detects nanogram quantities of protein and DNA
- Eliminates gel background by preventing silver precipitation in the gel matrix
- Involves only three steps: fixing, washing, and staining
- Detects bands in 1 hour
- Stains 40 mini gels

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
166-0400-EDU	Bio-Safe DNA Staining Solution, 500x, 1 ml	\$10.00	\$5.95
161-0433-EDU	Ethidium Bromide Solution, 10 ml, 10 mg/ml	27.00	22.00
161-0430-EDU	Ethidium Bromide Tablets, 10 x 11 mg	41.00	33.00
161-0435-EDU	Coomassie Brilliant Blue R-250 Staining Solutions Kit, includes 1 L CBB R-250 Staining Solution, 2 x 1 L CBB R-250 Destaining Solution	90.00	72.00
161-0436-EDU	Coomassie Brilliant Blue R-250 Staining Solution, 1 L	40.00	32.00
161-0438-EDU	Coomassie Brilliant Blue R-250 Destaining Solution, 1 L	30.00	24.00
161-0449-EDU	Silver Stain Plus Kit, includes fixative enhancer concentrate, silver complex solution, reduction moderator solution, image development reagent, development accelerator reagent, and instructions.	128.00	103.00
161-0461-EDU	Fixative Enhancer Concentrate,* 1,000 ml	42.00	34.00
161-0462-EDU	Silver Complex Solution,* 100 ml	22.00	18.00
161-0463-EDU	Reduction Moderator Solution,* 100 ml	33.00	27.00
161-0464-EDU	Image Development Reagent,* 100 ml	43.00	35.00
Tracking Dyes			
161-0404-EDU	Bromophenol Blue, 10 g	29.00	24.00
161-0423-EDU	Xylene Cyanole FF, 25 g	54.00	44.00

All dyes and stains should be stored at room temperature, dry, and away from direct sunlight. Bulk and custom packaging is available for ampholytes. Contact your local office for information. *Hazardous shipping charges may apply.

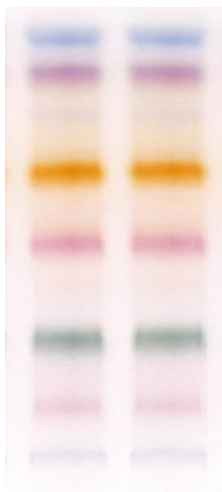
ELECTROPHORESIS SUPPLIES: PROTEIN STANDARDS



Bio-Rad's protein standards provide an excellent way for your students to monitor the progress of electrophoresis runs and make valid gel-to-gel comparisons. DNA and protein standards calibrate molecular weight or base pair size on agarose and polyacrylamide gels. Standards are available for DNA and protein electrophoresis and western blotting. This section describes the components and specific applications for each standard.

Kaleidoscope Prestained Standards

Kaleidoscope Prestained Standards contain seven individually colored proteins, allowing instant band recognition on western blots or SDS-PAGE gels. The molecular weights of each lot are individually calibrated and included with every vial.



Calibrated Molecular Weights of Kaleidoscope Standards*

PROTEIN CONTROL NUMBER	COLOR	POLYPEPTIDE STANDARD #75442	PRESTAINED STANDARD #74815
Myosin	Blue	—	202,000
b-galactosidase	Magenta	—	133,000
BSA	Green	—	71,000
Carbonic anhydrase	Violet	38,600	41,800
Soybean trypsin inhibitor	Orange	25,000	30,600
Lysozyme	Red	16,300	17,800
Aprotinin	Blue	7,800	6,900
Insulin	Blue	3,400	—

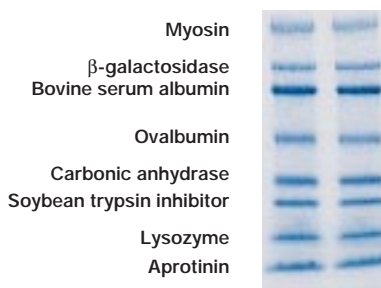
*Molecular weights are of representative lots; actual weights may vary. The lot-specific molecular weights are included with each vial.

Original Blue Prestained Standards

Prestained standards are used in SDS-PAGE and western blotting applications. They provide a quick and easy way to assess blotting efficiency, and allow continuous monitoring of protein separations during electrophoresis.

Prestained standards are provided pre-blended in a stable sample buffer. No reconstitution or further dilution is necessary before use.

Prestained SDS-PAGE Standards



Bio-Rad's original blue Prestained SDS-PAGE Standards are available in high, low, and broad ranges, so you can select the range best for your application. The molecular weights of each lot are individually calibrated and included with every vial.*

Calibrated Molecular Weights of Prestained SDS-PAGE Standards*

PROTEIN	HIGH RANGE	LOW RANGE	BROAD RANGE
Control #	#71605	#74177	#72807A
Myosin	205,000	—	208,000
β-galactosidase	118,000	—	115,000
Phosphorylase B	—	107,000	—
BSA	85,000	76,000	79,500
Ovalbumin	47,000	52,000	49,500
Carbonic anhydrase	—	36,800	34,800
Soybean trypsin inhibitor	—	27,200	28,300
Lysozyme	—	19,000	20,400
Aprotinin	—	—	7,200

* Molecular weights are of representative lots; actual weights may vary. The lot-specific molecular weights are included with every vial.



ELECTROPHORESIS SUPPLIES: PROTEIN STANDARDS

Molecular Weight Standards

Bio-Rad's molecular weight standards allow accurate molecular weight determination on SDS polyacrylamide gels. Every batch is tested for proper mobility, providing a reliable control for gel-to-gel variability.

Molecular weight standards are provided pre-blended in a stable buffer for fast, easy preparation and use. The glycerol content of the buffer prevents the proteins from freezing solid at -20 °C, eliminating freeze/thaw degradation and the need to aliquot.

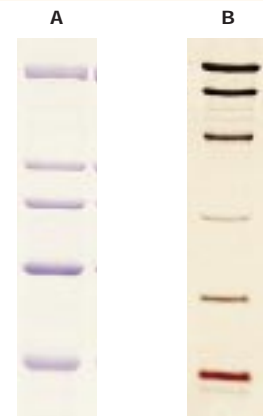
SDS-PAGE Standards

SDS-PAGE Standards are blended to give even band intensities when stained with Coomassie blue R-250 dye. SDS-PAGE standards are available in high, low, and broad molecular weight ranges, allowing calibration of almost any percentage gel.

For more technical information about DNA Standards request Bulletin 1924.

Silver Stain SDS-PAGE Standards

Silver Stain SDS-PAGE Standards are blended to give even band intensities with no extraneous bands when stained with Silver Stain Plus. Available in high and low ranges.



SDS-PAGE Standards provide accurate molecular weight determinations. A. High range SDS-PAGE Standards run on a 7.5% gel and stained with Coomassie blue R-250 dye. B. Low range Silver Stain SDS-PAGE Standards run on a 12% gel and stained with Bio-Rad's Silver Stain Kit.

Composition of SDS-PAGE and Silver Stain Standards

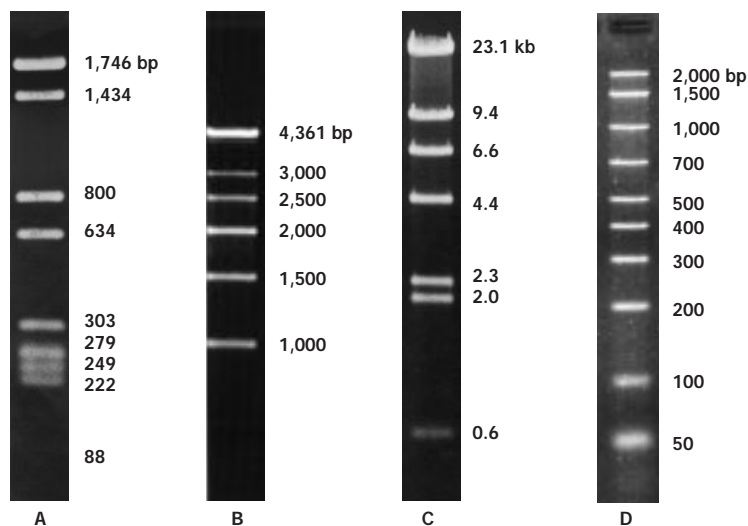
PROTEIN	SOURCE	MW (DALTONS)	POLYPEPTIDE	LOW	HIGH	BROAD
Myosin	Rabbit skeletal muscle	200,000			X	X
β-galactosidase	E. coli	116,250			X	X
Phosphorylase B	Rabbit muscle	97,400		X	X	X
Serum albumin	Bovine	66,200		X	X	X
Ovalbumin	Hen egg white	45,000		X	X	X
Carbonic anhydrase	Bovine	31,000		X		X
Triosephosphate isomerase	Rabbit	26,625	X			
Trypsin inhibitor	Soybean	21,500		X		X
Myoglobin	Equine	16,950	X			
α-Lactalbumin	Bovine	14,437	X			
Lysozyme	Hen egg white	14,400		X		X
Aprotinin	Bovine pancreas	6,500	X			X



DNA Size and Mass Standards

Bio-Rad's DNA standards and markers include traditional digested DNA, tested for proper concentration and mobility to provide a reliable control for gel to gel variability. Choose a size range that is most appropriate for your specific application.

For more information on electrophoresis and blotting standards, request Bulletin 1787.



Electrophoretic Profiles of the DNA Size Standards

A. pBR322 digest on 1.8% analytical grade agarose. B. 1-4.2 kb graded series on 1% analytical grade agarose. C. λ HindIII digest on 0.75% analytical grade agarose. D. AmpliSize DNA Size Standard, 50-2,000 bp ladder on 4.0% AmpliSize agarose.

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
Prestained Standards			
161-0325-EDU	Kaleidoscope Polypeptide Standards, 500 μ l	\$94.00	\$76.00
161-0324-EDU	Kaleidoscope Prestained Standards, 500 μ l	94.00	76.00
161-0305-EDU	Prestained SDS-PAGE Standards, low range, 500 μ l	72.00	58.00
161-0309-EDU	Prestained SDS-PAGE Standards, high range, 500 μ l	77.00	62.00
161-0318-EDU	Prestained SDS-PAGE Standards, broad range, 500 μ l	84.00	68.00
Molecular Weight Standards			
161-0304-EDU	SDS-PAGE Standards, low range, 200 μ l	76.00	61.00
161-0303-EDU	SDS-PAGE Standards, high range, 200 μ l	87.00	70.00
161-0317-EDU	SDS-PAGE Standards, broad range, 200 μ l	88.00	71.00
161-0314-EDU	Silver Stain SDS-PAGE Standards, low range, 200 μ l	77.00	62.00
161-0315-EDU	Silver Stain SDS-PAGE Standards, high range, 200 μ l	94.00	76.00
DNA Size and Mass Standards			
Bio-Rad's full complement of standards and markers includes traditional digested DNA, tested for proper concentration and mobility to provide a reliable control for gel-to-gel variability.			
170-3465-EDU	Low Range DNA Size Standard, AvaII/EcoRI digested pBR322, 50 applications	99.00	80.00
170-8210-EDU	Mid Range DNA Size Standard, 1-4.2 kb ladder, 50 applications	99.00	80.00
170-3470-EDU	High Range DNA Size Standard, Hind III digested λ , 1,600 applications	99.00	80.00
170-8200-EDU	AmpliSize DNA Size Standard, 50-2,000 bp ladder, 50 applications	99.00	80.00



PROTEIN ASSAY: KIT & APPLICATION



Bio-Rad Protein Assay Kit: One Teacher's Classroom Teaching Application.

"The simplicity, sensitivity, and color of Bio-Rad's Protein Assay make it a great vehicle for math, experimental design, and technique. Following are some terrific hands-on experiments I've developed using this assay. For preparation convenience, use microplates (1 per team). These make a wonderful demonstration on the overhead.

Testing for protein concentration:

Students use containers of milk to determine how to calculate the concentration of protein in the container (in grams/container, grams/ml, milligrams/ml, and micrograms/ml). The protein assay detects protein levels in the microgram range. Students prepare dilutions and three separate charts: for the milk dilution, assay of the protein standard provided in the kit, and assay of the diluted milk samples.

After mixing, students compare the colors of their unknown milk dilution samples with the protein standard colors, then assign a protein value to each sample. Students can then calculate the protein content in the container from the protein amount in the assay sample. Students' results, using their eyes only (no spectrophotometer is needed), should closely fit the amount printed on the milk label. It's amazing how accurate this eyeball test is!"

Courtesy of Toby Horn PhD.

Thomas Jefferson High School For Science & Technology, Alexandria, Virginia, Thorn@lan.TJHSST.edu

Bio-Rad Protein Assay As a General Test for Protein:

Mix 1 drop of diluted protein assay reagent with 1 drop of the following samples: distilled water, bovine gamma globulin, 2% milk, beer, simulated urine, bacteria, agar, egg white (1 part fresh egg white and 10 parts distilled water), butter (solid), cheese (solid). All but the distilled water and solid butter will test positive for protein. Try it with your students!

For more technical information about Protein Assay Kits, request Bulletin 1069.

The Standard Protein Assay

The most commonly used commercially available protein assay is the Bio-Rad Protein Assay. The chemistry is based on the color change of Coomassie brilliant blue G-250 dye in response to various concentrations of protein. It is compatible with most common laboratory reagents.

Advantages of Bio-Rad Protein Assay

- Store up to 1 year at a recommended 4 °C.
- Excellent indicator of protein in dilute solutions
- Indicates the presence of protein in a variety of samples
- Replaces biuret reagent
- Excellent microchemistry procedure in keeping with the direction of science and technology

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
For determinations by method of Bradford:			
500-0002-EDU	Protein Assay Kit II, includes dye concentrate and BSA standard	\$79.00	\$64.00
500-0006-EDU	Dye Reagent Concentrate, includes reagent without a standard	68.00	55.00
500-0007-EDU	Protein Standard II (BSA)	42.00	31.00
224-0096-EDU	Costar 96 well microplates (200)	220.00	176.00



New Thermal Cycler for Nucleic Acid Amplification

The Gene Cycler thermal cycler meets the needs of teachers and students without access to a large laboratory thermocycler or the budget to acquire one. Lightweight with a small footprint, it can easily be moved and used anywhere, including the user's desk.

The Gene Cycler thermal cycler is an advanced, solid state, thermocycler featuring oil-free operation. It offers fast ramping times thanks to the electrical resistors for heating and cooling the fan. It displays interior tube temperatures, since the cycler uses software algorithms that compensate for temperature differences between the heating block and the sample. Temperature uniformity in all samples is insured by even distribution of the electrical resistors throughout the heating block, and sample evaporation is avoided by keeping the block lid at a higher temperature than the samples. The cycler can link up to 6 programs, and still provide enough memory to store up to 100 programs.

Gene Cycler Specifications

Physical Specifications

Footprint	27 cm x 19 cm x 16.5 cm (L x W x H)
Weight	5 kg
Sample capacity	24
Sample size	0.2 ml micro test tubes

Operating Specifications

Method of heating (resistors)	Electrical resistance
Method of cooling	Air cooled (fan)
Overall temperature range	Room temperature to 97 °C
Temperature control range	0.5 °C increments between 40-97 °C
Temperature accuracy	+/- 1.2 °C between 40-97 °C
Temperature over/under shoot	+/- 1.2 °C between 40-97 °C

Software Specifications

No. of programs	100 (comprising cycles and steps within the cycles)
No. of cycles/program	5 different types of cycles/program
No. of steps/cycle	5 different temperatures/ cycle
No. of repeated cycles	300
No. of link programs (LP)	50
No. of programs linked per LP	10

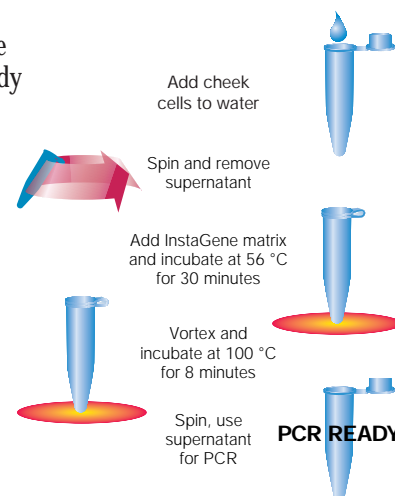
Temperature input range	37-97 °C in 0.5 °C increments
Maximum time input range	99 minutes, 59 seconds
Sample volume input range	10-150 µl
Program features	New/Edit/Insert/Delete programs; Pause/Stop/Clear Program or Run capability
Temperature ramping	Automatic increment/decrement ramping capabilities



InstaGene Matrix

The InstaGene matrix, composed of a specially formulated Chelex resin, makes DNA sample preparation fast, easy, and cost-effective, providing PCR-quality template DNA in less than an hour. The Chelex matrix binds to PCR inhibitors rather than DNA, thus preventing DNA losses due to irreversible DNA binding. Simply place the cells in a microcentrifuge tube, add the InstaGene matrix, boil, and spin. PCR-ready DNA is removed from the supernatant directly to PCR reactions. The matrix adsorbs cell lysis products that interfere with the PCR amplification process.

- *Easy-to-use, small particle size slurry won't clog pipet tips*
- *Appropriate matrix concentration upon suspension*
- *Simple resuspension using the provided magnetic stir bar*
- *Enough for 100 samples in each low-cost bottle*



Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
Gene Cycler Thermal Cycler			
170-6700-EDU	Gene Cycler Thermal Cycler, 100/220 V	\$2,500.00	\$1,995.00
170-6701-EDU	Gene Cycler Thermal Cycler, 200/240 V	Inquire	Inquire
InstaGene Matrix			
732-6030-EDU	InstaGene Matrix, 20 ml, enough for 100 samples	35.00	28.00



LIQUID HANDLING: PIPET TIPS



Pipet Tip Quality and Selection

Bio-Rad's pipet tips are made from virgin polypropylene, accurately molded for an airtight fit, and have a smooth interior surface – essential for precision pipetting.

Wide Selection

Available in over 4 styles in bulk or fully enclosed racks. Special purpose tips include gel loading and aerosol barrier. Standard tips are also available.

Autoclavable

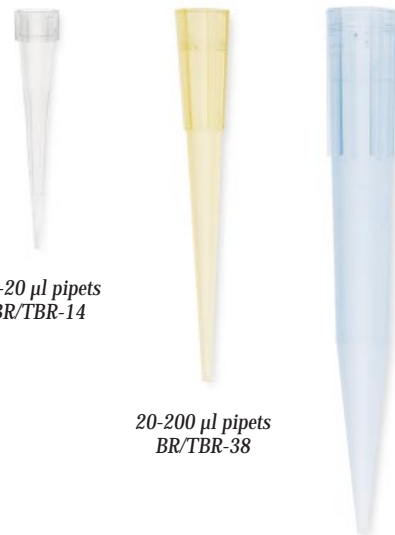
Pipet tips and racks are autoclavable at a recommended temperature of 120 °C at 15 pounds of pressure for 15 minutes.

Presterilized

For those who prefer not to autoclave, Bio-Rad offers tips presterilized by gamma-cobalt 60 irradiation.

Free Samples Available!

Request our Pipet Tip Precision Test (Bulletin 1712) and a free tip sample to test reproducibility.



10-20 μ l pipets
BR/TBR-14

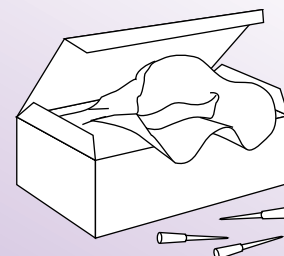
20-200 μ l pipets
BR/TBR-38

1,000 μ l pipets
BR/TBR-40

General Use Pipet Tips

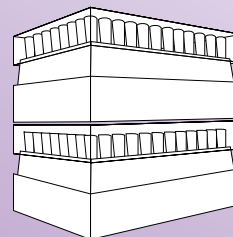
Standard Pipet Tips

Available for all general pipetting applications, and molded to fit 10, 20, 200 and 1,000 μ l pipets.



Bulk tips

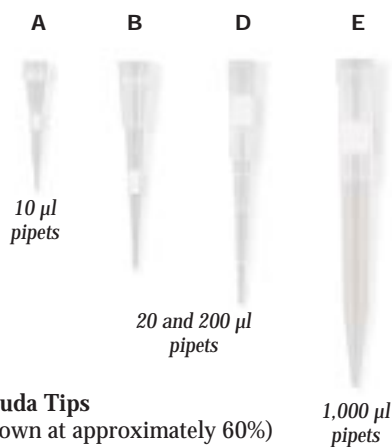
Plastic bag in a dust free box.



Racked Tips

Ideal for autoclaving but also available presterilized, each rack has its own lid and covered bottom for full enclosure.

LIQUID HANDLING: PIPET TIPS



Gel Loading Pipet Tips

Seque/Pro Capillary Pipet Tips

With an average OD of less than 0.3 mm, they're ideal for loading sequencing gels. Use with 10 and 20 µl pipets for maximum performance.

Prot/Elec Pipet Tips

Fit easily between vertical slab gel plates of 0.75 mm while maintaining a large bore for fast sample flow. The 200 µl capacity tips are molded to fit 20 and 100 µl pipets.

Aerosol Barrier Pipet Tips

Xcluda aerosol barrier pipet tips guard against aerosol contamination of samples, a feature particularly important in PCR experiments. The barrier will not seal upon contact – should unintentional over-pipetting occur – protecting samples from accidental loss. Available presterilized in fully enclosed racks, and independently tested and certified to be DNase, RNase, and pyrogen free. Molded to fit 10, 20, 200, and 1,000 µl pipets.



Ordering Information

CATALOG NO.	TIP	DESCRIPTION	BOX QUANTITY	LIST PRICE	EDU PRICE
Standard BR – Bulk Tips					
223-9014-EDU	BR-14	Natural	1,000	\$22.50	\$18.00
223-9038-EDU	BR-38	Yellow, Graduated, Beveled	1,000	22.50	18.00
223-9040-EDU	BR-40	Blue	500	11.70	10.00
Standard TBR – Racked, each rack has a cover					
223-9354-EDU	TBR-14	Natural	960	33.30	27.00
223-9338-EDU	TBR-38	Yellow, Graduated, Beveled	1,000	33.30	27.00
223-9350-EDU	TBR-40	Blue	1,000	36.90	30.00
Standard TBR-S -Racked, presterilized; each rack has a cover¹					
223-9384-EDU	TBR-14-S	Natural	960	43.20	35.00
223-9364-EDU	TBR-38-S	Yellow, Graduated, Beveled	1,000	39.60	32.00
223-9370-EDU	TBR-40-S	Blue	1,000	43.20	35.00
Xcluda Aerosol Barrier Pipet Tips, Pesterilized					
211-2001-EDU	Xcluda Style A		960	93.60	75.00
211-2006-EDU	Xcluda Style B		960	93.60	75.00
211-2016-EDU	Xcluda Style D		960	93.60	75.00
211-2021-EDU	Xcluda Style E		960	93.60	75.00
Tips for Gel Loading					
223-9911-EDU	Seque/Pro Capillary Tips, in enclosed autoclavable rack		200	32.40	26.00
223-9912-EDU	Seque/Pro Capillary Tips, sterilized in enclosed rack		200	34.20	28.00
223-9915-EDU	Prot/Elec Tips, bulk pack, plastic bag in dust free box		1,000	31.50	26.00
223-9917-EDU	Prot/Elec Tips, racked, 200 per rack		1,000	42.30	34.00



LIQUID HANDLING: MICRO TUBES

EZ and Standard Micro Test Tubes

EZ polypropylene micro test tubes feature graduations, a frosted marking area, and a capped top. EZ microtubes are easy to open and close.

- General purpose benchtop and centrifuge use
- Sturdy uniform walls that easily withstand up to 13,000 g
- Autoclavable to 120 °C; freezable to -80 °C
- Available in 2 ml, 1.5 ml, and 500 µl sizes



2 ml EZ



1.5 ml EZ



500 µl EZ

Ordering Information

CATALOG NO.	DESCRIPTION	BOX QUANTITY	LIST PRICE	EDU PRICE
200 µl Thin Wall Tubes				
223-9473-EDU	Natural	1,000	\$67.50	\$54.00
223-9451-EDU	Red	1,000	67.50	54.00
223-9452-EDU	Yellow	1,000	67.50	54.00
223-9468-EDU	Green	1,000	67.50	54.00
223-9453-EDU	Blue	1,000	67.50	54.00
600 µl Thin Wall Tubes				
223-9466-EDU	Natural	1,000	44.10	36.00
223-9448-EDU	Red	1,000	44.10	36.00
223-9449-EDU	Yellow	1,000	44.10	36.00
223-9467-EDU	Green	1,000	44.10	36.00
223-9450-EDU	Blue	1,000	44.10	36.00
1.5 ml EZ Micro Test Tube				
223-9480-EDU	Natural	500	18.90	16.00
223-9505-EDU	Red	500	18.90	16.00
223-9506-EDU	Yellow	500	18.90	16.00
223-9507-EDU	Green	500	18.90	16.00
223-9508-EDU	Blue	500	18.90	16.00
500 µl EZ Micro Test Tube				
223-9503-EDU	Natural	1,000	27.90	23.00
223-9481-EDU	Red	1,000	27.90	23.00
223-9482-EDU	Yellow	1,000	27.90	23.00
223-9483-EDU	Green	1,000	27.90	23.00
223-9484-EDU	Blue	1,000	27.90	23.00
2 ml EZ Micro Test Tube¹				
223-9430-EDU	Natural	500	20.70	17.00

1. To fit centrifuges, 2 ml tubes have thinner walls than standard tubes. They are intended for short runs at no more than 13,000 x g in centrifuges with adequate ventilation or cooling. Heavy samples, high g force, long runs, or centrifuges that develop excess heat may damage this tube and cause loss of its contents. If any such condition exists, test before committing samples, or use two 1.5 ml tubes instead.

Thin Wall Micro Test Tubes for PCR Applications

Bio-Rad's tubes and strips for PCR are specially designed and engineered to maximize DNA amplifications. A unique manufacturing process provides consistent, uniform, thin walls and bubble tops (200 µl sizes), allowing optimal heat transfer every time.



600 µl and 200 µl Thin wall PCR tubes



Disposable Polyethylene Transfer Pipets

DPTPs are useful for transferring samples and reagents when precise measurement is not needed, for temporary storage, to collect samples, to dispense solutions, or to serve as micro reservoirs. Snip them to make a quick tubing connector, a handy micro funnel, a chromatography column, or a spatula. Made of low density polyethylene, DPTPs are inert, non toxic, and meet FDA food additive requirements for non-cooking food contact applications.

- Eliminate safety risks associated with glass pipets
- Unbreakable, freezable, heat-sealable
- Won't scratch cuvettes
- Eliminate cross contamination associated with rubber bulbs
- Convenient for numerous laboratory chores
- Available presterilized



Style M
223-956
63 mm



Style L
223-9562
106 mm



Style C
223-9522
156 mm



Style J
223-9560
300 mm

Specifications

Disposable Plastic Transfer Pipets

STYLE	TOTAL LENGTH	BARREL OD X LENGTH	BULB OD X LENGTH	TIP OD	WORKING CAPACITY	STORAGE CAPACITY	DROPS PER ML H ₂ O		GRADUATIONS (NOMINAL)
							AS IS	DRAWN OUT ¹	
C	156	5 x 110	13 x 46	3.6	3.5	5.7	30-40	40-100+	0.25 ml
J	300	9.5 x 234	20 x 66	3.5	8	13	22-25	25-50+	None
L	106	5 x 80	9.5 x 26	1.8	0.75	1	60-70	n.a.	None
M	63	1.5 x 30	10 x 33	1.9	0.65	1	50-55	n.a.	None

Dimensions in mm, capacities in ml

1. Drop size determined with water; may vary with other solutions. Drop size from drawing out may vary.

Chemical Resistance of Polyethylene

Polyethylene is compatible with water and aqueous solutions of inorganic salts, and most polar organic solvents such as alcohols, aldehydes, acids, esters, and ketones. Aliphatic, aromatic, and chlorinated hydrocarbons will swell polyethylene; strong oxidizing agents such as 30% hydrogen peroxide, concentrated nitric acid, and strong solutions of sodium hypochlorite will render it brittle. Polyethylene is not suitable for autoclaving.

For more technical information about Liquid Handling Products, request Bulletin 1981.

Ordering Information

CATALOG NO.	DESCRIPTION	BOX QUANTITY	LIST PRICE	EDU PRICE
DPTP,¹ non-sterile				
223-9522	DPTP, Style C	500	\$17.10	\$15.00
223-9560	DPTP, Style J	100	18.90	16.00
223-9562	DPTP, Style L	400	19.80	17.00
223-9563	DPTP, Style M	500	24.30	20.00
DPTP, sterilized, individually packaged				
223-9540	DPTP, Style C	500	43.20	35.00

1. Polyethylene DPTPs are not suitable for autoclaving.



Digital Micropipettes

No teaching lab is complete without this new generation of adjustable digital microliter pipettes. Designed and engineered for exceptional comfort, accuracy, and durability, Bio-Rad's digital Pipettes deliver outstanding performance. Every aspect of pipette use in the teaching lab was incorporated into their design. From the digital micrometer and slender contour of the hand grip to the uniquely ergonomic tip ejector, these pipettes function efficiently and comfortably.

Four models are available to cover the range of pipetting applications where transfer and manipulation of small volumes of precious solutions are required.



Range

Model	0.5 - 10 μ l
Model	2 - 20 μ l
Model	20 - 200 μ l
Model	100 - 1,000 μ l



Long Wave Ultra Violet Lamp

This portable mini UV Lamp is the recommended light source for viewing Green Fluorescent Protein. It's the perfect companion to the Biotechnology Explorer Kits 1, 2 & 6 which incorporate the pGLO system. Includes acrylic safety shield.

Hot Plate

This rugged hot plate stirrer heats up to 2 liters of liquid on a corrosion-resistant cast aluminum top plate. Stepless heat adjustment lets you dial temperatures from ambient to 371 °C while the stainless steel housing stays cool to the touch.

The hot plate is ideal for a broad range of classroom laboratory applications, including restriction enzyme digests of DNA, heat shock for bacterial transformation, melting agarose for DNA electrophoresis, and melting agar before pouring agar plates.





Microcentrifuge

This sturdy microcentrifuge provides the features you need for all your teaching lab applications – at an unbeatable price.

Features

- Maximum speed: 14,000 rpm/16,000 x g
- Complete with 18 place rotor for 1.5 and 2.2 ml microtubes
- Quick spin feature
- Safety interlock
- 9 x 10 inch footprint
- Safe for cold room operation
- Exceptionally quiet
- 30 minute timer or pulse/quick spin button



Mini Centrifuge

This low budget alternative to more expensive microcentrifuges is ideal for all Biotechnology Explorer Kit applications. This personal centrifuge weighs only 1 pound. It is designed for all applications that don't require extremely high g-force, including quick spin downs from walls or caps of microtubes, micromixing, and cell pellets.

Features

- 6,000 rpm
- Close lid to start
- Starts and stops in seconds



Mini Incubation Oven

An economical alternative for routine incubations, this bacterial incubator is thermostatically controlled for growth of bacteria at a wide range of temperatures.

Specifications

Temperature range	Ambient + 5 °C to 80 °C
Temperature uniformity	+/- 5 °C
Size	Holds up to 80 - 6.5 cm plates
Exterior W x D x H	11" x 11.5" x 10"
Chamber W x D x H	9" x 9" x 8"



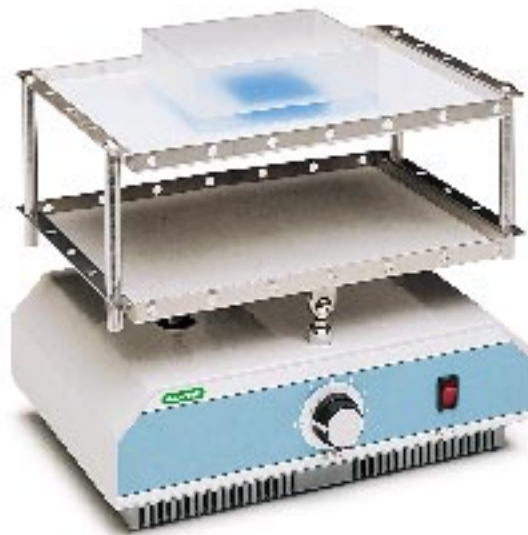


MICROBIOLOGY: ACCESSORY EQUIPMENT

Rocking Table

A workhorse rocker designed for classroom molecular biology applications, this versatile rocking platform is useful in a broad range of mixing applications. Its tilt capacity and variable speed control permit adjustment to the exact agitation desired for:

- Overnight incubations of liquid bacterial cultures
- Staining and destaining agarose and acrylamide gels and blots
- Southern hybridization



Specifications

Speed settings	8 to 40 rpm
Motion	Tilting
Platform dimensions	28 x 20 cm
Distance between platforms	9 cm
Max. load	4.5 kg



Water Bath

This temperature-controlled water bath is known for accuracy, dependability, affordability, and safety.

Features

Easy-to-clean seamless stainless steel tank
 Six liter capacity
 Temperature range; 5 °C to 100 °C
 Stainless steel gable cover
 Electrostatically applied finish resists rust, corrosion, and scratches
 Over-temperature protection
 Thermometer

Ordering Information

CATALOG NO.	DESCRIPTION	LIST PRICE	EDU PRICE
166-0500-EDU	UV Lamp (Requires 4 AA batteries)	\$24.95	\$19.95
166-0501-EDU	Mini Incubation Oven ¹ , 120 V	355.00	295.00
166-0502-EDU	Micro Centrifuge ¹ - 18 place ¹ , 120 V	1,554.00	1,295.00
166-0503-EDU	Mini Centrifuge ¹ - 6 place, 120 V	285.00	229.00
166-0504-EDU	Temperature Controlled Water Bath ¹ - 6 liter, 120 V	595.00	475.00
166-0505-EDU	Micropipetor - Adjustable volume - 0.5-10 µl	215.00	179.00
166-0506-EDU	Micropipetor - Adjustable volume - 2-20 µl	215.00	179.00
166-0507-EDU	Micropipetor - Adjustable volume - 20-200 µl	215.00	179.00
166-0508-EDU	Micropipetor - Adjustable volume - 100-1,000 µl	215.00	179.00
166-0509-EDU	Rocking Table ¹ , 120 V	579.00	529.00
166-0510-EDU	Hot Plate with Magnetic Stirrer ¹ , 120 V	239.00	195.00

1. For voltages not listed above contact your local Bio-Rad representative (back cover).



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Hercules, California 94547

Toll Free Telephone
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When placing orders, please provide the following information:

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Purchase order number
Billing address
Product catalog number
Shipping address
Product description
Credit card number
Quantity

Confirming Orders

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Prices

Prices in this catalog are in U. S. dollars, F. O. B. shipping point, and are subject to change without notice. Prices in effect when your order is received will apply. Freight charges and any special packaging charges will be added to the invoice. Call us for current prices if you require this information prior to placing your order. Payment terms are generally net 30 days.

Perishables and Hazardous Materials

Special Packaging and Dangerous Goods Surcharge

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<i>Blue Ice Packaging</i>	<i>\$ 5.00</i>
<i>Dry Ice Packaging</i>	<i>10.00</i>
<i>Dangerous Goods Surcharge</i>	<i>10.00</i>
<i>Blue Ice Packaging and</i>	
<i>Dangerous Goods Surcharge</i>	<i>15.00</i>
<i>Dry Ice Packaging and</i>	
<i>Dangerous Goods Surcharge</i>	<i>20.00</i>

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Hercules, California. See back cover for points outside the United States.

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- *Replacement parts information*
- *Samples of some products*

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pGLO
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