

Biotechnology **Explorer**TM

CAPTIVATING SCIENCE EDUCATION

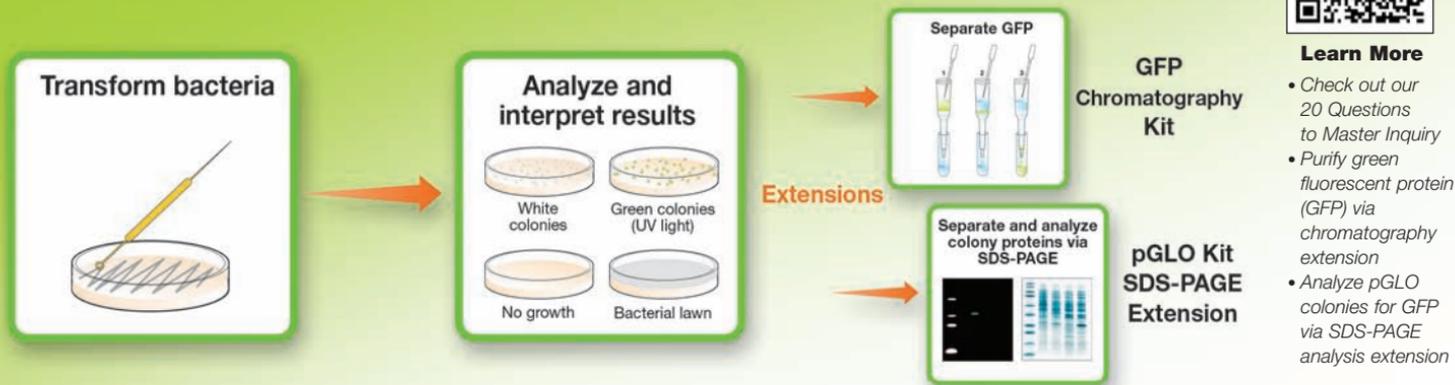


BIO-RAD

As the worms learn, they **tutor** my students for the **AP biology** exam!

Story on page **14**

pGLO™ Bacterial Transformation Kit — AP Biology Big Idea 1, 2, 3, and 4

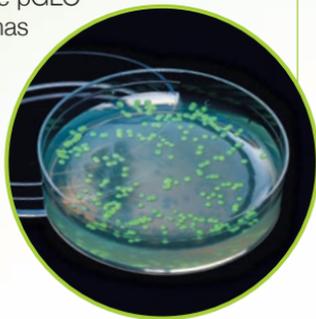


Learn More

- Check out our 20 Questions to Master Inquiry
- Purify green fluorescent protein (GFP) via chromatography extension
- Analyze pGLO colonies for GFP via SDS-PAGE analysis extension

When students genetically engineer bacteria

to glow green on cue, they not only get excited — they start to wonder why. The pGLO Bacterial Transformation Kit has inspired students for more than 17 years — the original and the best! Now, infuse INQUIRY into this classic experiment using our 20 Questions to Master Inquiry and enhance the experience with GFP chromatography and SDS-PAGE extensions.



Ordering Information

		EDU Price
166-0003EDU	pGLO Bacterial Transformation Kit Free online curriculum manual is available.	\$119.20
166-0043EDU	pGLO Bacterial Transformation Kit Includes printed curriculum manual.	128.00
166-0005EDU	Green Fluorescent Protein Chromatography Kit Includes printed curriculum manual.	131.20
166-0013EDU	pGLO Kit SDS-PAGE Extension Includes printed curriculum manual.	120.00

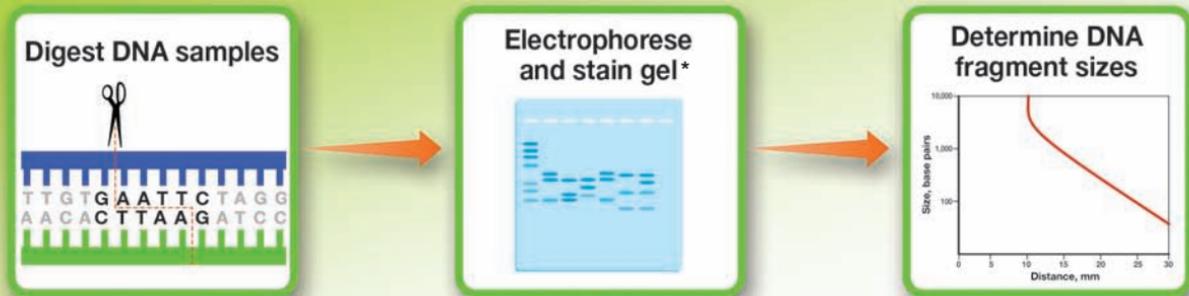
Visit bio-rad.com/pGLO1 or call 1-800-268-0213 for more information and for a list of required equipment/accessories for these laboratory activities.

Forensic DNA Fingerprinting Kit — AP Biology Big Ideas 3 and 4



Learn More

- Check out our 20 Questions to Master Inquiry
- Aligns with AP Biology Big Ideas 3 and 4



Students become inquiry investigators!

Using real DNA as evidence, your students play the role of crime scene investigators. Each sample is digested using a mixture of DNA restriction enzymes, generating a distinct pattern of DNA fragments. From their electrophoresis results, students construct standard curves, determine DNA fragment sizes, and place a suspect at the scene of the crime.

* Short on time — **check out our precast agarose gels!** Save 1–4 hours!



Ordering Information

EDU Price

166-0007EDU	Forensic DNA Fingerprinting Kit Free online curriculum manual is available.	\$179.20
166-0037EDU	Forensic DNA Fingerprinting Kit Includes printed curriculum manual.	185.60

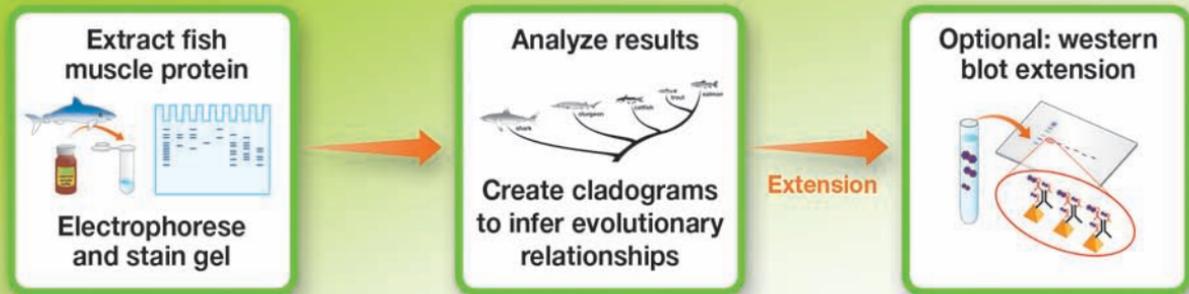
Visit bio-rad.com/DNAfingerprinting1 or call 1-800-268-0213 for more information and for a list of required equipment/accessories for these laboratory activities.

Comparative Proteomics Kits — Evolutionary! — AP Big Ideas 1, 3, and 4



Learn More

- Check out our 20 Questions to Master Inquiry
- The kit guides students through the thought processes involved in a laboratory-based scientific investigation
- Aligns with AP Biology Big Ideas 1, 3 and 4



The open-ended, inquiry-based Protein Profiler

Module moves beyond DNA and allows students

to employ the most widely used life science research technique, protein electrophoresis, to study protein structure and function.

Students learn to use SDS-PAGE to generate protein profiles from muscles of both distantly and closely related species of fish. From their results, they compare the different species' profiles to test the hypothesis that protein profiles can be indicators of evolutionary relatedness.



Ordering Information

EDU Price

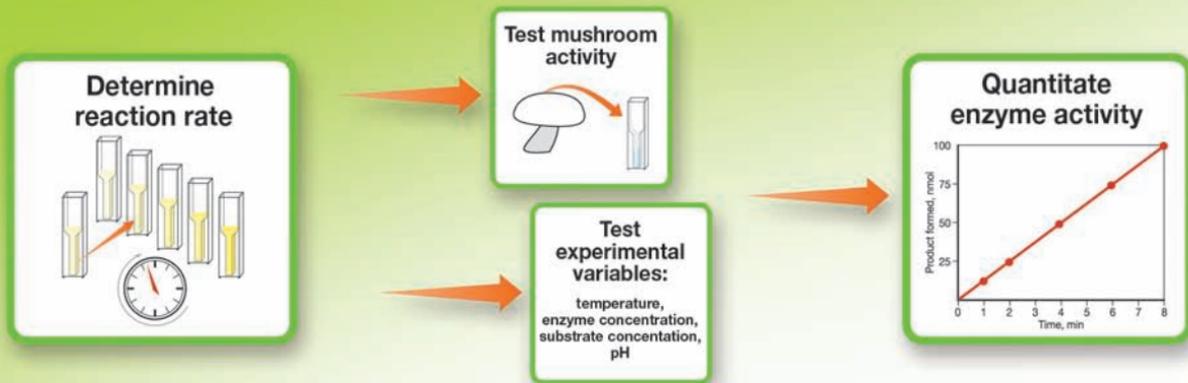
166-2700EDU	Comparative Proteomics Kit I: Protein Profiler Module	\$220.00
166-2850EDU	Comparative Proteomics Kits I and II: Protein Profiler and Western Blot Modules	453.60
166-2875EDU	Rapid Blotting and V3 Western Workflow™ Starter Kit	712.00

Visit bio-rad.com/proteinprofiler1 or call 1-800-268-0213 for more information and for a list of required equipment/accessories for these laboratory activities.



Learn More

- Aligns with AP Biology Big Ideas 1, 2, and 4
- Student inquiry using mushrooms
- Check out our 20 Questions to Master Inquiry



What do enzymes and biofuels have in common? Everything!

Organisms such as ruminants, termites, and fungi use an enzyme called cellobiase to break down cellulose from plants — a very important step in the production of cellulosic ethanol. Your students will love exploring this enzyme by studying mushrooms — inquiring about cellobiase activity, which varies within mushroom species. Some mushrooms even have varying levels of activity depending on the part of the sample being used (cap, stalk, gills). The Biofuel Enzyme Kit provides a great model for inquiry, investigation, and real data analysis of enzymes, for applications from ecology to evolution to industry.



Ordering Information

EDU Price

166-5035EDU	Biofuel Enzyme Kit	\$160.00
166-5036EDU	Biofuel Enzyme Kit Reagent Refill Pack	102.40

Visit bio-rad.com/biofuelenzyme1 or call 1-800-268-0213 for more information and for a list of required equipment/ accessories for this laboratory activity.

Fish DNA Barcoding Kit — AP Biology Big Ideas 1, 2, 3, and 4



Select fish sample



Extract fish DNA

Amplify COI gene



Perform DNA electrophoresis

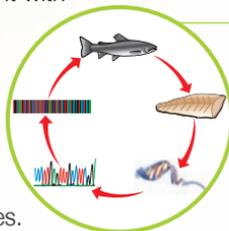
Perform sequencing and bioinformatics analysis



Learn More

- Generate your own DNA fish barcode
- Check out our fish flashcards and Jeopardy games
- Aligns with AP Biology Big Ideas 1, 2, 3, and 4

Have fun with PCR, fish flashcards, and Jeopardy to perform DNA-based identification. Your students won't even know they are learning when you use games such as fish flashcards and Jeopardy to explore barcoding of fish species. Plus, learn how to extract genomic DNA, amplify it with PCR, and classify species using sequencing and bioinformatics to determine if that fish you just bought really is what the label says it is. Also learn about the International Barcode of Life initiative, which uses this technology, and find out how your students can contribute to this global genetic repository for barcodes of all species.



* Short on time — **check out our precast agarose gels!** Save 1–4 hours!

Ordering Information

EDU Price

166-5100EDU

Fish DNA Barcoding Kit

\$344.00

Includes reagents for DNA extraction and PCR for up to 16 fish samples. Sequencing module sold separately.

Visit bio-rad.com/fishbarcoding1 or call 1-800-268-0213 for more information and for a list of required equipment/accessories for this laboratory activity.



Learn More

- Video tutorials
- PowerPoint presentations
- Webinars
- Funding resources
- Free professional development workshops

Welcome to the Explorer Community. A place where you can see what other educators are doing to engage their students, find resources to infuse inquiry into your classroom, and share and explore resources from educators and Bio-Rad.

Resources includes video tutorials, PowerPoint presentations, webinars, funding resources, and information about where we will be providing free professional development workshops.

We're sharing classroom stories and teacher spotlights to provide inspiration and facilitate networking of talented teachers throughout the country. **We'd like you to contribute** — share curricula that you use in your classroom, let us know about an outstanding teacher and what he or she is doing in the science classroom, or share your students' science artwork.



Top: Austin Community College professional development.

Above: pGLO results from Essy Levy's 7th grade class,

Bankstreet School for Children, New York.



2014 Ron Mardigian Essay Contest
Winner, **Lauren Killingsworth**

For Lauren Killingsworth, this year's winner of the **Ron Mardigian essay contest** sponsored by Bio-Rad Laboratories, the process of doing hands-on science experimentation and research is one that brims with excitement and possibility, a kind of magic that often ends up suppressed in traditional textbook-based education. In her winning essay, the recent graduate from Tamalpais High School in Mill Valley, CA, articulates the importance of hands-on science education in engaging students with science, technology, engineering, and mathematics (STEM).

Lauren's winning essay opens by capturing and sharing a pivotal moment during one of her own research projects, the kind of moment she wishes all students had the chance to experience. The gap between actively doing science and reading about science is something she has set out to change for students in her community.

Lauren states in her essay: "I envision classroom environments that ignite interest in science by entrusting students with the design of their own projects and by introducing students to advanced laboratory techniques. This can be accomplished by mandating that science fair projects are included in school curricula, providing students with science mentors, demonstrating to students that science is applicable to everyday life, and—most importantly—emphasizing the idea that the only prerequisite for science is curiosity."

Visit www.sciencebuddies.org/blog/2014/06/encouraging-interest-and-participation-in.php to read the full inspiring article on Lauren and her accomplishments in the science classroom and community written by Amy Cowen of Science Buddies.



Science Framework **Kit Selection Guide**

Visit explorer.bio-rad.com/fall2014 to learn more.



SEP: Science and Engineering Practices

Life Sciences Disciplinary Core Ideas

LS1: From Molecules to Organisms: Structures and Processes
 LS2: Ecosystems: Interactions, Energy, and Dynamics
 LS3: Heredity: Inheritance and Variation of Traits
 LS4: Biological Evolution: Unity and Diversity

Physical Sciences Disciplinary Core Ideas

PS1: Matter and Its Interactions
 PS2: Motion and Stability: Forces and Interaction
 PS3: Energy

ADV: Advanced Scientific Practices

Legend: ★ Content contained in kit curriculum ☆ Content addressed in extension activities

SEP	LS1	LS2	LS3	LS4	PS1	PS2	PS3	ADV			
★	★	★	★	☆						C. elegans Behavior Kit (166-5120EDU) — AP Big Ideas 1, 2, 3, 4	Introductory
★					★	★	★			IDEA Kit — Inquiry Dye Electrophoresis Activity (166-5075EDU)	
★					★	★	★			STEM Electrophoresis Classroom Kit (166-5090EDU)	
★	★	★		☆						Biofuel Enzyme Kit (166-5035EDU) — AP Big Ideas 1, 2, 4	
★	★	★								Microbes and Health Kit (166-5030EDU)	
★	★		★							Genes in a Bottle™ Kit (166-2300EDU) — AP Big Idea 3	
★	★	★	★							pGLO™ Bacterial Transformation Kit (166-0003EDU) — AP Big Ideas 1, 2, 3, 4	
★	★									Green Fluorescent Protein Chromatography Kit (166-0005EDU)	
★	★									Secrets of the Rainforest™ Kit (166-0006EDU)	
★	★									Size Exclusion Chromatography Kit (166-0008EDU)	
★										Got Protein?™ Kit (166-2900EDU)	
★	★									ELISA Immuno Explorer™ Kit (166-2400EDU)	Intermediate
★	★		★	★		★				Forensic DNA Fingerprinting Kit (166-0007EDU) — AP Big Ideas 3, 4	
★	★					★				Analysis of Precut Lambda DNA Kit (166-0001EDU) — AP Big Idea 3	
★	★					★				Restriction Digestion and Analysis of Lambda DNA Kit (166-0002EDU) — AP Big Idea 3	
★	★									pGLO Kit SDS-PAGE Extension (166-0013EDU) — AP Big Idea 3	
★	★		★	★		★				Crime Scene Investigator PCR Basics™ Kit (166-2600EDU) — AP Big Idea 3	
★	★		★	★		★				Comparative Proteomics Kit I: Protein Profiler Module (166-2700EDU) — AP Big Ideas 1, 3, 4	
★	★		★	★		★				Comparative Proteomics Kit II: Western Blot Module (166-2800EDU)	Advanced
★	★	★	★	★				★		Fish DNA Barcoding Kit and DNA Barcoding Sequencing Module (166-5100EDU and 166-5115EDU) — AP Big Ideas 1, 2, 3, 4	
★	★		★	★		★				PV92 PCR Informatics Kit (166-2100EDU) — AP Big Ideas 1, 3	
★	★		★	☆		★				GMO Investigator™ Kit (166-2500EDU)	
★	★		★	★		★		★		Crime Scene Investigator PCR Basics Real-Time PCR Starter Kit (166-2660EDU)	
★	★		★			★		★		GMO Investigator Real-Time PCR Starter Kit (166-2560EDU)	
★	★		★	★				★		Cloning and Sequencing Explorer Series (166-5000EDU) — AP Big Ideas 1, 2, 3, 4	
★	★							★		Protein Expression and Purification Series (166-5040EDU, 166-5045EDU, or 166-5050EDU)	

Educational Pricing Contract Application

As an educator you are entitled to discount pricing on all Bio-Rad products. To initiate setup of a new education account, simply fax or mail this page to Bio-Rad. If you are ready to place your first order, send this page and attach a purchase order with the numbers and descriptions of the items you wish to purchase.

Biotechnology Explorer Program

Bio-Rad Laboratories, (Canada) Ltd.
1329 Meyerside Drive
Mississauga, ON L5T1C9



Fax to 1-888-913-9779.

Re: Educational Discount

We are an educational facility interested in using Bio-Rad products to teach our students. We would like to receive a teaching lab discount and understand that the Bio-Rad educational discount is available only to educators at the K-12 and undergraduate levels. This letter is our confirmation that the products we order through our educational account will be used only to educate students in a classroom or teaching lab environment and will not be used for basic scientific research. We are sending this letter in order to:

- Initiate setup of a new educational account with Bio-Rad Laboratories (if tax exempt, please include a copy of the school's tax certificate)
- Place a new order, with PO attached
- Confirm an order identification number (please fill in order number) _____

Name of contact: _____

Department: _____

School or institution: _____

We are a (please check one): High school Two-year/Community college
 College or undergraduate teaching laboratory Other _____

Bill to address: _____

Province/Postal code: _____

Phone number: _____ Fax number: _____

Ship to address: _____

Province/Postal code: _____

Phone number: _____ Fax number: _____

Email address: _____

Signature: _____

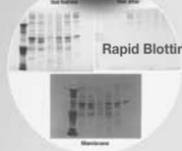
See New Kits and Products for 2014



Home Science Kits



C. elegans Behavior Kit



Rapid Blotting — V3 Western Workflow



New and Improved Genes in a Bottle Kit
with Helix Screwcap Keepsakes



IDEA and STEM Electrophoresis Kits



Fish DNA Barcoding Kit



DNA Model Kit



UView™ 6x Loading Dye and Stain
UView Mini Transilluminator



8-Channel
Professional Micropipet

BIO-RAD

New Free 2014 Biotechnology Explorer™ Catalog and more

Up to 20 to
40% off
list prices

Name _____ Title _____

Institution _____

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City _____ Province _____ Postal code _____

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Fax _____

Email _____
(By providing my email address I agree to receive email about Bio-Rad products and events.)

Free Biotechnology Explorer catalog (bulletin 2112)

I would like to receive the Bio-Rad eFocus
email newsletter

We want to hear from you!

What science classes do you teach? _____

Which biotechnology skills would you like to see addressed
in a kit? _____

Please have a Bio-Rad curriculum training specialist
contact us about meeting our teaching goals and
professional development needs in our own district today.

Fill in and return this card today or visit us online at bio-rad.com/info/explorercatalog08
to request your free catalog. For immediate information, call **1-800-268-0123**.

Come to a **2014 Teacher Conference** and Join Us for Our Free Hands-On Workshops



2014 Teacher Conference and Workshop Schedule

Go to bio-rad.com/explorerworkshops1 for a complete schedule.



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Mississauga, ON L5T1C9

2014

October 22-24

AESTQ
Trois Rivières, QC

October 24

Catalyst
Richmond, BC

October 24

AST
Halifax, NS

November 13-15

STAO
Toronto, ON

New **UView 6x Loading Dye and Stain** — No need to stain your gels!



Learn More

- Check out our *UView 6x Loading Dye and Stain guide*



Use **UView 6x Loading Dye and Stain** for all your gel electrophoresis needs!

UView 6x Loading Dye and Stain saves you precious class time. Visualize your gel immediately using the compact UView Mini Transilluminator or other fluorescence light source. This nontoxic alternative to ethidium bromide will brighten your day!

* Short on time — **check out our precast agarose gels!** Save 1–4 hours!



Time Savings

Step	Other Stains (postelectrophoresis stain), min	Other Stains (in gel prep), min	UView 6x Loading Dye and Stain, min
Add stain to agarose gel prep	NA	5 ← Time savings	0
Add loading dye to sample, load sample, run gel	26	26	26
Stain/destain	≥20 ← Time savings	0	0
See results	1	1	1
Total time	>47 min	>32 min	>27 min

Ordering Information

EDU Price

166-5111EDU	UView 6x Loading Dye and Stain, 0.2 ml	\$31.20
166-5112EDU	UView 6x Loading Dye and Stain, 1 ml	95.20
166-0531EDU	UView Mini Transilluminator	1,120.00

Visit bio-rad.com/fishbarcoding1 or call 1-800-268-0213 for more information.

Can worms learn?

Find out with this capstone activity!

Mary Wuerth of Tamalpais High School not only uses the *C. elegans* Behavior Kit during her regular AP Biology coursework, but also sees the kit as a culminating capstone activity prior to the AP exam. Mary says it is a great tool for the study and review of the concepts that her students have learned throughout the year and brings real-world relevance by enabling discussion around the Nobel prize winning science that this model organism has enabled (e.g., interfering RNA). She says there are not many other activities that allow you to tie together neurobiology, physiology, genetics, statistics, and more:

- **Diffusion** — students prepare their own salt gradients
- **Kinesis** (movement) — students perform the chemotaxis activity
- **Genetics, mutations, and the effects of mutations** – types of mutations (point mutations, substitutions, deletions, insertions, and gene duplications)
- **Human genome** — relative to the worm connectome
- **Cell signaling, reception, transduction, and the response pathway** — how mutations interfere with these processes
- **Enzymes** — the mutant *daf-18* gene codes for an enzyme
- **Artificial selection** — comparing the first and second generation of worms
- **Inquiry** — lets students inquire and discover more about animal behavior and learning



Mary Wuerth

Tamalpais High School
AP Biology teacher
AP Biology reader
AP Summer Institute trainer



- **Statistics** — chi-square analysis using Bio-Rad's supplemental extension activity and then comparing this to the use of the *t* test

Mary loves that her students get to experiment with a real living model organism and feels it is easier to prepare and see the results than the fruit fly laboratory. This lab also allows her students to explore more molecular topics and she feels that the quantitation and statistical analysis are easier for her students to perform.



Ordering Information

EDU Price

166-5120EDU **C. elegans Behavior Kit** \$219.00

Visit bio-rad.com/celegansbehaviorkit1 or call 1-800-268-0213 for more information and for a list of required equipment/accessories for this laboratory activity.

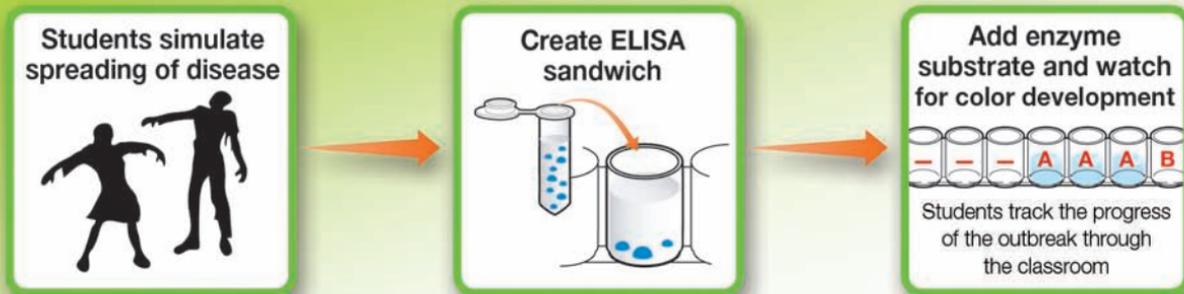
This classroom has a special connection to the **Biotechnology Explorer Program**. Before founding the Biotechnology Explorer Program, Ron Mardigian taught biology at Tamalpais High School. This year, Ron's nephew August (at microscope), was a senior at Tamalpais High School and a student in Mary's classroom — learning from the very kits and products that Ron made available to students and educators throughout the world.

Hunt for the Zombie Apocalypse Pathogen Using the **ELISA Immuno Explorer Kit**

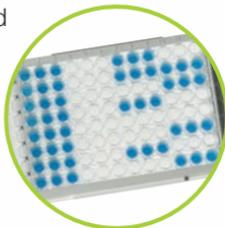


Learn More

- Check out our *Zombie Apocalypse workshops* this fall at bio-rad.com/en-us/applications-technologies/keeping-current



Are your students interested in the Zombie Apocalypse? Have your students identify patient zero with the power of ELISA — the same way you can teach your students how human immunodeficiency virus (HIV), bird flu, mad cow disease, genetically modified organisms, and the molecular markers of cancer, pregnancy, or drug use are detected — in the real world using real antibodies. **Enzyme-linked immunosorbent assay (ELISA)** is a powerful antibody-based biodetection tool used to hunt for pathogens. It facilitates teaching about immune system functions and about the unique properties of antibodies that have revolutionized medicine, epidemiology, and life science research. Science is fascinating and when paired with a fun fictional story (zombies), or a relevant, real-world topic, your students will not only be interested but will learn more.



Ordering Information

EDU Price

166-2400EDU **ELISA Immuno Explorer Kit** \$176.80

Visit bio-rad.com/elisakit1 or call 1-800-268-0213 for more information and for a list of required equipment/accessories for this lab activity.



Extract Amplify

Clone and Sequence

Bioinformatics Submit to GenBank

Cloning and Sequencing Explorer Series

- Extract genomic DNA
- Perform nested PCR and amplify a gene
- Clone and transform
- Sequence and analyze*
- Bioinformatics

Express Proteins

Purification

Purify and Analysis

Protein Expression and Purification Series

- Protein purification (chromatography)
- Enzymatic analysis
- Research and development processes
- Industrial technology and bioinformatics
- Purify cancer treatment targets

Learn More

- Project-based learning

Give your students the opportunity to engage and perform real-world biotechnology research

using our innovative and complete series kits. From exploring the process of cloning and sequencing using a novel plant source chosen by your students to the exploration of protein purification to produce biopharmaceuticals, the Cloning and Sequencing Explorer Series and the Protein Expression and Purification Series will engage and inspire an understanding of science beyond a textbook. Introduce your students to a variety of professional biotechnology techniques.

Ordering Information

EDU Price

166-5000EDU	Cloning and Sequencing Explorer Series*	\$1,906.40
	– All eight modules <i>(sequencing service not included)</i>	
	Protein Expression and Purification Series	
166-5040EDU	Option 1: Centrifugation Purification Process	723.20
166-5045EDU	Option 2: Hand-Packed Purification Process	915.20
166-5050EDU	Option 3: Prepacked Purification Process	915.20

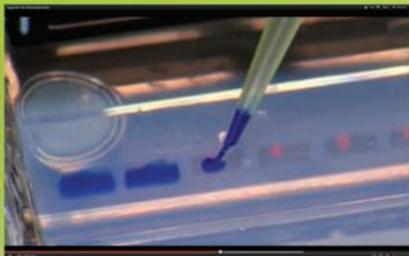
Visit bio-rad.com/explorerseries or call 1-800-268-0213 for more information and for a list of required equipment/accessories for these laboratory activities.

* Sequencing service not included.



Learn More

- The technique videos are also posted online



New teaching resources developed by the author of **Biotechnology: A Laboratory Skills Course** are available in a DVD set included with the Teacher Edition. The DVD can also be purchased separately.

30 videos provide classroom guidance for:

- Demonstrations of key techniques
- Highlights of important safety points

43 PowerPoint presentations provide classroom instruction for:

- Chapter backgrounds
- Textbook laboratory activities

Whether you have a complete biotechnology course or wish to add a few biotech activities to your life science class, our comprehensive resources provide ready-to-go support.

Ordering Information

EDU Pricing

166-1027EDU	Teacher Edition Includes 166-1025EDU, 166-1026EDU, and 166-1052EDU.	\$150.40
166-1025EDU	Student Edition	117.60
166-1026EDU	Teacher Supplement Teacher reference guide.	44.00
166-1051EDU	Laboratory Notebook	19.20
166-1052EDU	Supplementary Materials DVD Set	16.00

Visit explorer.bio-rad.com or
call 1-800-268-0213 for more information.



Visit bio-rad.com/explorerpromotions1 ▶
for ordering details

Save
\$1,980⁰⁰



TC20™ Automated Cell Counter

Buy a TC20 Automated Cell Counter (145-0102EDU) (USB flash drive and cable, 30 TC20 dual-chamber counting slides (60 counts), and 1.5 ml TC20 trypan blue dye) for only \$2,970 — a \$1,980 savings. Must use quote #14-Q36094 when ordering.

Save On
the **SmartSpec Plus Spectrophotometer**



Save More Than Bench Space with a
\$2,592⁸⁰ Savings!

Buy a SmartSpec™ Plus Spectrophotometer (170-2525EDU) for only \$3,889.20 — a \$2,592.80 savings. Must use quote # 14-Q36094 when ordering.

Free
Micropipet
with Purchase Offer



End-of-Year
\$159²⁰ Savings!

Buy a *C. elegans* Behavior Kit (166-5120EDU) for \$219.20 and get one free Classroom 100–1,000 µl Digital Micropipet (166-0553EDU) — a \$159.20 savings. Must use quote #14-Q36094 when ordering.

Limit one per customer. Discounts and specials may not be combined with other promotional offers. For the free item, you must include the catalog number as a separate item on your order. Promotional offers expire December 31, 2014. Call 1-800-268-0213 to order or visit bio-rad.com/explorerpromotions1 for more information.

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Forensic DNA Fingerprinting Kit + Inquiry, page 3

Comparative Proteomics Kits + Inquiry, page 4 page 4.

Biofuel Enzyme Kit + Inquiry, page 5

Fish DNA Barcoding Kit, page 6

AP Students Learn from Worms, page 14

ELISA Immuno Explorer Kit with Zombies, page 16

Science is fun! While your students are having fun creating artwork with microplates, they're also practicing core laboratory skills such as pipetting. Use one of our free downloadable templates or create your own. This is a great activity to do before any lab activity requiring pipetting. Don't forget to submit pictures of your students' artwork to share with our **Explorer Community!**



Check out our Explorer Community —

where you can find great resources, see what other educators are doing, see the great science artwork that students are creating, and more!



Follow us on Instagram, Twitter, and Pinterest @BioRadEducation to get the latest in science news, stories, and events.

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BIO-RAD

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