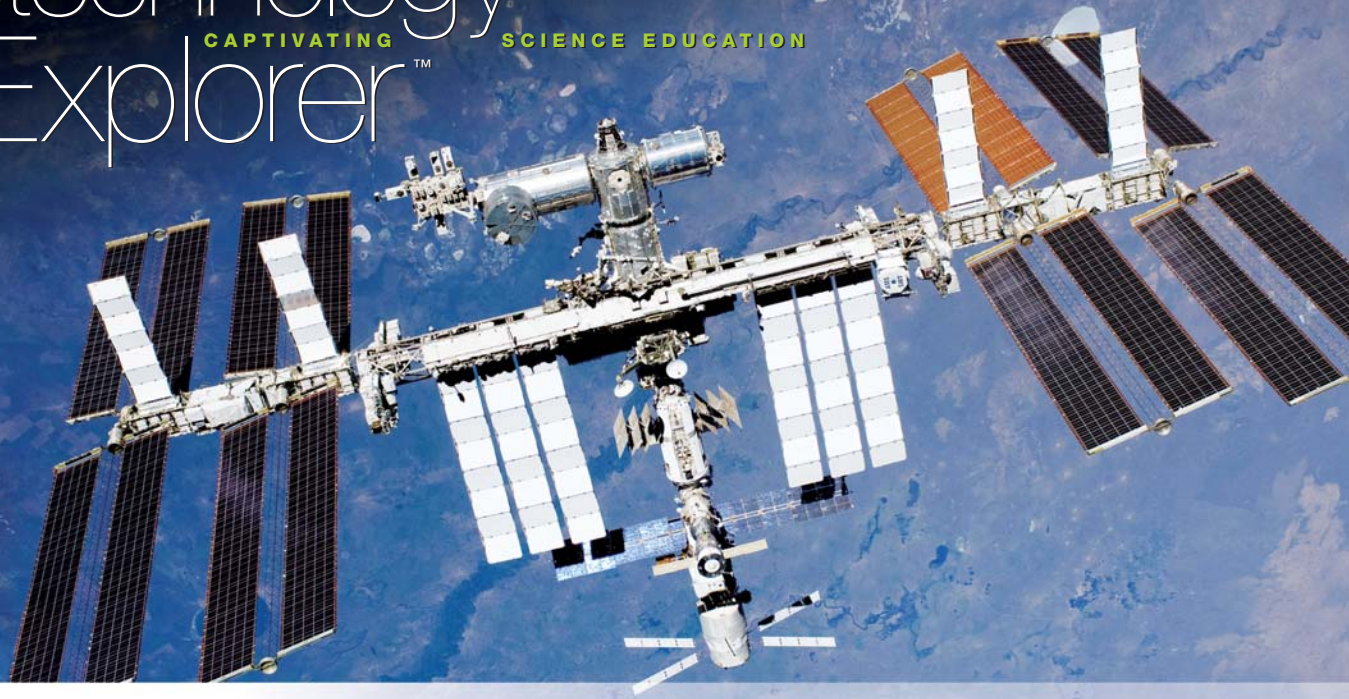


# Biotechnology Explorer™

CAPTIVATING SCIENCE EDUCATION

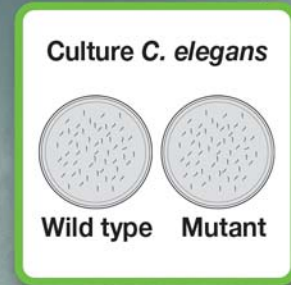
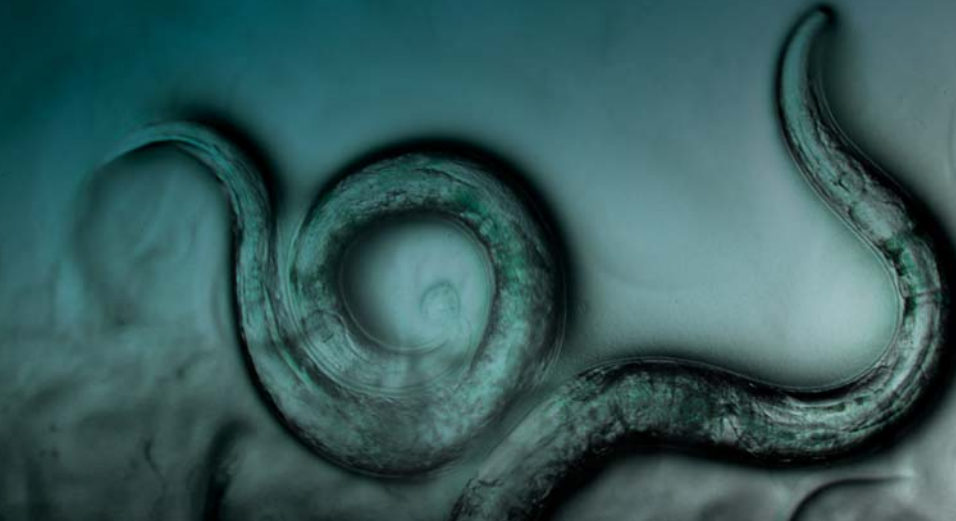


**BIO-RAD**

Successful Classroom Experiments **Glowing** Out of This World

Story on page **14**

## New and Fascinating Alternative to **AP Biology Lab 12:** Fruit Fly Behavior



### **Tired of fruit flies all over your class and school?**

*Caenorhabditis elegans* is a much better behaved model organism that your students will love to study. Explore the fascinating life cycle of *C. elegans* through microscopic examination. Check out the UCSF Legoscope project to find a great way to infuse science, technology, engineering, and mathematics (STEM) into this activity — have your students build their own microscopes using Legos ([designscience.ucsf.edu/lego](http://designscience.ucsf.edu/lego)).

**Did you know that *C. elegans* can learn?** Compare a wild-type strain and a neurological mutant to see how a loss of the *daf-18* gene impacts learning capacity through a chemotaxis experiment. Visit OpenWorm to see the entire worm connectome — you can see every neuron within the worm and how they all connect! ([www.openworm.org](http://www.openworm.org))



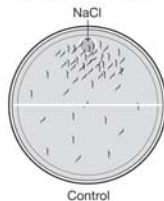
### Learn More

- Planning guide
- Kit specifications
- Aligns with AP Biology Big Ideas 1, 2, 3, and 4 (Lab Investigation 12)
- Neurobiology, BLAST analysis, and chi square statistic supplements

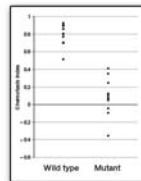
## Life cycle analysis



## Chemotaxis



## Statistical analysis of populations



**Free  
Digital  
Pipet**

(see page 19)

## Ordering Information

EDU Price

166-5120EDU **C. elegans Behavior Kit**

\$219.20

Includes reagents for *C. elegans* life cycle analysis and wild-type versus mutant behavior analysis. *C. elegans* is provided frozen and must be kept on dry ice ( $-70^{\circ}\text{C}$  or colder). *C. elegans* will be shipped separately on requested date.

Visit us at [www.bio-rad.com/celegansbehaviorkit1](http://www.bio-rad.com/celegansbehaviorkit1) or call 1-800-268-0213 for more information.

# Investigate fish fraud in your neighborhood — become a real a-fish-ionado!



## Learn More

- Planning guide
- Kit specifications
- Flowchart
- Lab preparation checklist
- Sample data
- Aligns with AP Biology Big Ideas 1, 2, 3, and 4



**What happens if one fish gets substituted for another one?** Most of the time, the consumer won't even notice. But what happens if substituting a less expensive fish for a more expensive one becomes common practice? Or what happens if a poisonous fish like pufferfish makes it into our food supply or we deplete our oceans of critically endangered species?



## 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 us at [www.bio-rad.com/fishbarcoding1](http://www.bio-rad.com/fishbarcoding1) or call 1-800-268-0213 for more information.

# New UView™ 6x Loading Dye with Fast Dual Action



Learn More



## Dual-action DNA stain and loading dye eliminate the need for staining your gels!

UView 6x loading dye 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 will brighten your day!

**Free**  
**UView Dye**  
(see page 19)



## Time Savings

Step	Other Stains (postelectrophoresis stain), min	Other Stains (in gel prep), min	UView 6x Loading Dye, 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 ←	0 ← Time savings	0
See results	1	1	1
<b>Total time</b>	<b>&gt;47 min</b>	<b>&gt;32 min</b>	<b>&gt;27 min</b>

## Ordering Information

EDU Price

166-5111EDU	<b>UView 6x Loading Dye, 0.2 ml</b>	\$31.20
166-5112EDU	<b>UView 6x Loading Dye, 1 ml</b>	95.20
166-0531EDU	<b>UView Mini Transilluminator</b>	1,120.00

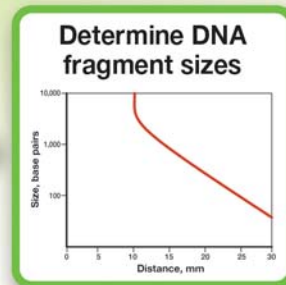
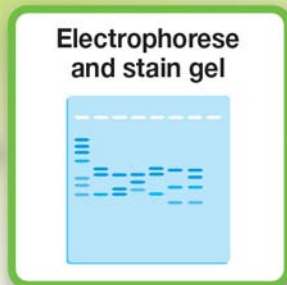
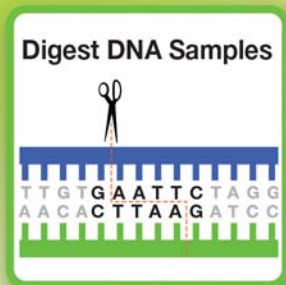
Visit us at [www.bio-rad.com/fishbarcoding1](http://www.bio-rad.com/fishbarcoding1)  
or call 1-800-268-0213 for more information.

# Forensic DNA Fingerprinting Kit — Students become investigators!



## Learn More

- Aligns with AP Biology Big Ideas 3 and 4 (Lab Investigation 9)



**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.



## Ordering Information

EDU Price

166-0007EDU **Forensic DNA Fingerprinting Kit** \$179.20  
Curriculum manual is available to download free of charge online.

166-0037EDU **Forensic DNA Fingerprinting Kit** 183.20  
Includes printed curriculum manual.

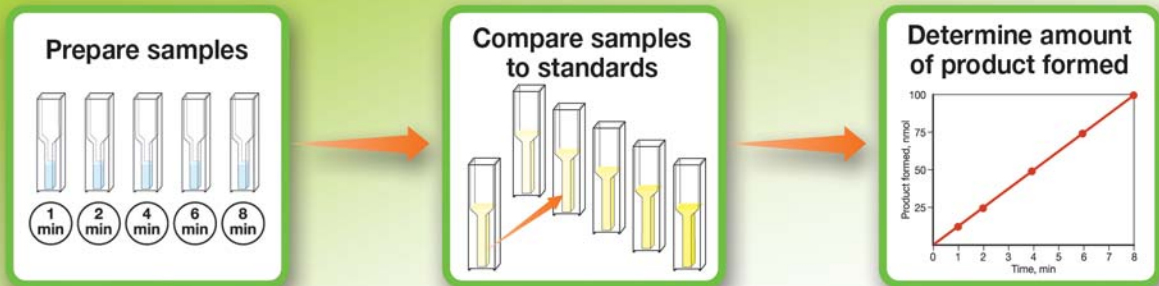
Visit us at [www.bio-rad.com/DNAfingerprinting1](http://www.bio-rad.com/DNAfingerprinting1)  
or call 1-800-268-0213 for more information.

# Biofuel Enzyme Kit — Use fungi to explore ecology and evolution.



## Learn More

- Kit specifications
- Flowchart
- Lab preparation checklist
- Aligns with AP Biology Big Ideas 1, 2, and 4 (Lab Investigation 13)
- Student inquiry using mushrooms



Cellobiase is an enzyme that breaks down cellulose, making it a useful enzyme in the production of cellulosic ethanol. **Where do you find cellobiase?** Organisms such as ruminants, termites, and fungi use this enzyme to break down cellulose from plants. Cellobiase activity varies from species to species within the fungus family. Some species 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 enzyme for investigating the role of enzymes, from ecology to evolution to industry.



## Ordering Information

EDU Price

166-5035EDU	<b>Biofuel Enzyme Kit</b>	\$160.00
166-5036EDU	<b>Biofuel Enzyme Kit Reagent Refill Pack</b>	100.00

Visit us at [www.bio-rad.com/biofuelenzyme1](http://www.bio-rad.com/biofuelenzyme1) or call 1-800-268-0213 for more information.

## New **DNA Model** — Rediscover DNA with this larger-than-life model!

As common as DNA is, it can be a tough topic to understand, but that is where this colorful and attractive DNA model comes into play!

- **A biologically correct DNA model can be built**
- **Over 2 feet tall**
- **A great way to incorporate STEM concepts through the use of modeling**



Engage your students immediately with this friendly, interactive, foam model of DNA. It's easy — just **attach** and **assemble** the DNA strands and then **twist** to transform it into the familiar double helix. Just like a puzzle — and just as in nature — this DNA model only fits together one way: adenine (A) pairs with thymine (T) and guanine (G) pairs with cytosine (C) on the sugar-phosphate backbones. Build a biologically correct DNA model that can be used in a number of fun and educational ways!

### Ordering Information

166-7015EDU **DNA Model**

*EDU Price*

**\$31.20**

Visit us at [explorer.bio-rad.com/fall2013](http://explorer.bio-rad.com/fall2013)  
or call 1-800-268-0213 for more information.



# Science Framework **Kit Selection Guide**

Learn more at [explorer.bio-rad.com/fall2013](http://explorer.bio-rad.com/fall2013).



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

Introductory

Intermediate

Advanced



# Biotechnology Explorer™ Program Educational Pricing Contract Application

## 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 L5T 1C9 Canada



**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:** \_\_\_\_\_

City/Province/Postal Code: \_\_\_\_\_

Phone number: \_\_\_\_\_ Fax number: \_\_\_\_\_

**Ship to address:** \_\_\_\_\_

City/Province/Postal Code: \_\_\_\_\_

Phone number: \_\_\_\_\_ Fax number: \_\_\_\_\_

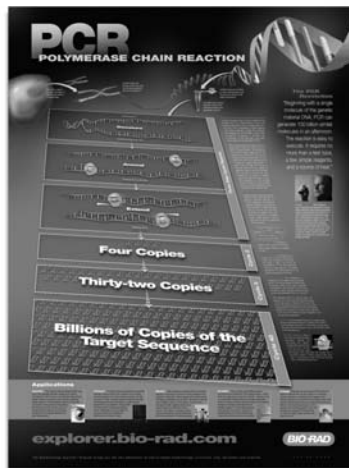
Email address: \_\_\_\_\_

Signature: \_\_\_\_\_

# Free Full-Color PCR Posters and Biotechnology Explorer Catalog

## Free Full-Color PCR Poster

See a detailed visual explanation of the polymerase chain reaction process. Learn about the PCR revolution and the hot research areas using PCR now. While supplies last, fill in and mail the attached postage-paid card to get your full-color, giant-sized **free PCR poster**.



Find out more about the **Biotechnology Explorer™ program professional development options and get some free stuff!**

20 to **40% off**  
list prices

### We want to hear from you!

What are your professional development objectives? \_\_\_\_\_

Name \_\_\_\_\_ Title \_\_\_\_\_

Institution \_\_\_\_\_

Department \_\_\_\_\_ Bldg. \_\_\_\_\_ Room no. \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Province \_\_\_\_\_ Postal code \_\_\_\_\_

( \_\_\_\_\_ )

Phone \_\_\_\_\_

( \_\_\_\_\_ )

Fax \_\_\_\_\_

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

What challenges do you face in preparing students for biotech careers? \_\_\_\_\_

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

### Free stuff and more:

- Free Biotechnology Explorer catalog (bulletin 2112)
- Free PCR poster (bulletin 5886)
- Hey! Have my Bio-Rad account representative call me
- I would like to receive the Bio-Rad eFocus email newsletter

Fill in and return this card today or, for immediate information, call **1-800-268-0213**.



**2013–14 Teacher Conference and Workshop Schedule**

A complete schedule can be found on the Web at [www.bio-rad.com/explorerworkshops1](http://www.bio-rad.com/explorerworkshops1).



1000003545-L5T1C9-BR01



BIO-RAD LABORATORIES LTD  
1329 MEYERSIDE DR  
MISSISSAUGA ON L4Z 9Z9

**2013**

**October 25**  
AST, Halifax, NS

**October 25**  
STAM-SAG, Winnipeg, MB

**October 25**  
Catalyst, Richmond, BC

**November 6–8**  
AESTQ, Rivière-du-Loup, QC

**November 14–16**  
STAO, Toronto, ON

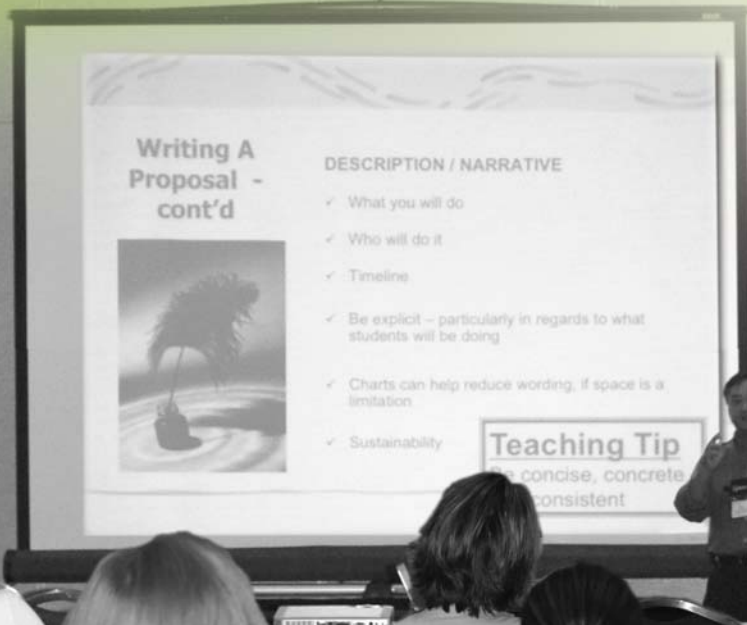
## Easy to Find **Grant Writing Web Resources**



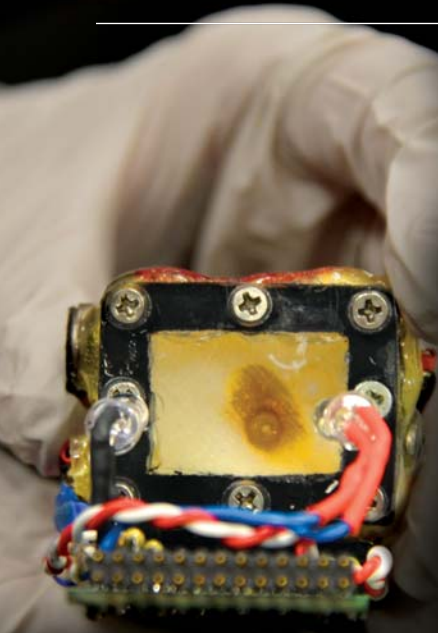
**Grant writing  
webinar**

**Getting a grant can open doors** to make your class more engaging and enriching, and allows your students to learn more with hands-on laboratory experiments. The extra effort up front to write a grant may seem daunting, but it can actually make it easier for you in the long run.

For expert help at writing a grant and a grant writing toolkit, check out our Grant Writing webinar.



## pGLO in Space and Beyond with the Valley Christian High School AMSE Institute



**Back from space,** the experiment module's inner chamber.

The desire to give students professional and real-world technical skills led to the development of a program where Valley Christian High School sends experiments to space by partnering with **NASA and the International Space Station (ISS)**. The Valley Christian High School ISS biology team investigated the effects of microgravity on luminescent *Escherichia coli* strain HB101 K-12 with the overall objective of examining and comparing the growth rates of *E. coli* on earth and in a microgravity environment. The team hypothesized that the *E. coli* would grow more rapidly in a microgravity condition because the bacteria are able to utilize the entire volume available inside the growth chamber.

The project was designed such that the bacteria would be contained within a small chamber within the MicroLab module that was sent to the ISS. The students designed this special chamber to have two pumps — one which provided nutrients for the bacteria and the other which was designed to hold waste products. The students measured the bacterial growth by visualizing the production of **green fluorescent protein (GFP)** produced by the bacteria that were transformed with Bio-Rad's pGLO plasmid.

Kelsey Jiang, the co-project manager, states that “Our mentor, Mr. Saldana, reached out to multiple science companies and managed to contact Bio-Rad. **Bio-Rad understood what we needed** and they helped us out every step of the way. The bacterial process was complicated, to say the least, but we were offered tremendous help from Bio-Rad's scientists.” Jose Lopez, a Biotechnology Explorer program scientist, was able to help in the design of the experiment so students could send the transformed bacteria to the ISS and visualize the glowing bacteria once in space.

**Learn More**  
about the Valley  
Christian High School  
AMSE Institute at  
[www.vcs.net/mathscience](http://www.vcs.net/mathscience)





Each year the students in the ISS program examine the results returned from the ISS and will build upon those results to answer new questions the next year. Kelsey sums up her experience by saying “The ISS program has given me an outlet to pursue what I love and that is biology. To me, this program has been one of the defining moments in my life, and it has taught me life lessons that I will carry with me even after my journey at Valley Christian High School.”

To perform pGLO bacterial transformation with your class here on earth, order the pGLO Bacterial Transformation Kit without manual (166-0003EDU, \$115.20) or the kit with printed curriculum manual (166-0043EDU, \$119.20).

“The ISS program has given me the opportunity to develop my interest in biology and has inspired me to pursue it in college.”

**Kevin Tahara**, VCHS AMSE co-project manager



“Our dream experiment became a reality with Bio-Rad’s support.”

**Angie Chen**, VCHS AMSE participant

**The underlying principles of electrophoresis were developed in the 1930s, and in the 1950s**, scientists started to use starch as a separation medium. In the 1970s, agarose electrophoresis became better established as a system for DNA separation. Since then, this technique has essentially stayed the same.

Horizontal gel electrophoresis is now used as a routine technique in the molecular biology laboratory. Users don't think too much about it, as long as they get results. But it's an excellent STEM case study for students and teachers who want to learn an established method and understand how it works.

If you think about how electrophoresis really works, you will start asking all sort of questions related to chemistry, physics, engineering, and mathematics. **Ask yourself, why do you...**

- ... use TAE buffer to run your DNA agarose gels?**
- ... use agarose as your separation matrix?**
- ... make gels with TAE buffer?**
- ... perform electrophoresis at a certain voltage?**

Some of these questions have the same answer, "Because that's how I've always done it!"





**Learn More**

- *Kit specifications*
- *Flowchart*
- *Lab preparation checklist*

**Using Bio-Rad's STEM electrophoresis kits** you can take electrophoresis to another level, dive deep to try to find answers to these questions, and discover what happens if you change something, such as:

**Chemistry:** Design a new buffering system which

- Has a high heat capacity
- Has a high buffering capability

**Chemistry and Math:** Design a new electrode system which

- Does not react electrochemically
- Does not cost a lot

**Chemistry and Physics:** Design a new molecular sieve system which

- Separates molecules of the appropriate size
- Separates molecules in a shorter time

**Engineering:** Optimize the above and put it all together

Next time you're looking for a **great interdisciplinary activity**, connect your science departments with electrophoresis!



**Ordering Information**

*EDU Price*

166-5080EDU **STEM Electrophoresis Teacher Demonstration Kit** \$124.00  
 Enough materials to build 2 complete gel electrophoresis chambers. Includes STEM curriculum instruction manual. Download IDEA kit manual online. Batteries not included.

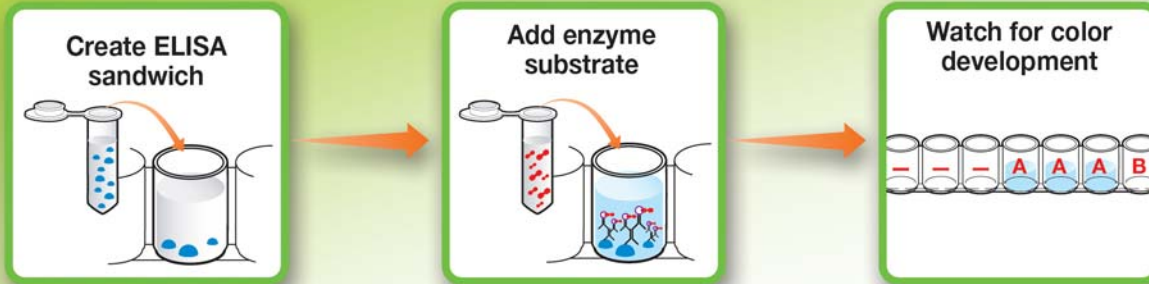
166-5090EDU **STEM Electrophoresis Classroom Kit** 332.00  
 Enough materials to build 8 complete gel electrophoresis chambers. Includes STEM curriculum instruction manual. Download IDEA kit manual online. Batteries not included.

Visit us at [www.bio-rad.com/stemkit1](http://www.bio-rad.com/stemkit1) or call 1-800-268-0213 for more information.

# Hunt for Pathogens Using the **ELISA Immuno Explorer Kit**



Learn More



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.



## Ordering Information

EDU Price

166-2400EDU **ELISA Immuno Explorer Kit** \$170.40

Visit us at [www.bio-rad.com/elisakit1](http://www.bio-rad.com/elisakit1)  
or call 1-800-268-0213 for more information.



Visit our promotions page online for ordering details ▶

## Free UView™ Dye with Purchase Offer



An Incredible **\$95<sup>20</sup>** Savings!

Buy a UView Mini Transilluminator (166-0531EDU) for \$1,120 and get one free UView 6x Loading Dye, 1 ml (166-5112EDU) — a \$95.20 value. Must use quote #13-Q39700 when ordering.

## Free Micropipet with Purchase Offer



Huge Back-to-School  
**\$157<sup>60</sup>** 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 \$157.60 value. Must use quote #13-Q39700 when ordering.

## Free Power! with Purchase of 4 DNA Gel Boxes Offer



**\$396** in High Voltage Savings

Buy four Mini-Sub® Cell GT Cells for \$353.60 each (166-4000EDU); each comes with tank, lid, 7 x 10 tray, two 8-well combs, no casting gates) and get one free PowerPac™ Basic Power Supply (164-5050EDU) — a \$396 value. Must use quote #13-Q39700 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, 2013. Call 1-800-268-0213 to order or for more information visit [www.bio-rad.com/explorerpromotions1](http://www.bio-rad.com/explorerpromotions1)

**Some of What's Inside This Issue** — *And there's more!*

**New *C. elegans* Behavior Kit**, see page 2.

**New Fish DNA Barcoding Kit**, see page 4.

**UView 6x Loading Dye**, see page 5.

**Forensic DNA Fingerprinting Kit**, see page 6.

**Biofuel Enzyme Kit**, see page 7.

**New DNA Model**, see page 8.

**Grant Writing Web Resources**, see page 13.

**pGLO in Space**, see page 14.

**A STEM Story**, see page 16.

**ELISA Immuno Explorer Kit**, see page 18.

**Special Offers**, see page 19.

**Check out this ready-to-go solution to complement your course or help start a new one — Biotechnology: A Laboratory Skills Course. Visit us at [www.bio-rad.com/textbook1](http://www.bio-rad.com/textbook1) for more information about the book and new supplementary materials DVD set.**



**BIO-RAD**

**Bio-Rad Laboratories (Canada) Ltd.**

1329 Meyerside Drive  
Mississauga, ON L5T 1C9

1-800-268-0213