

## Bio-Rad Explorer Kit Modifications for Socially-Distanced Classrooms

Bio-Rad Explorer kits are designed to be used in a workstation format, for example 8 workstations of 4 students. Kit protocols and curricula are designed to this specification, and this is the configuration that offers the best, most comprehensive user and learning experience. To help teachers adjust and accommodate changing learning environments, however, modifications can be made to support different numbers of single-student workstations.

### Please note:

- These modifications are designed to accommodate the largest number of students as possible; workflows may be adjusted and the purchase of additional reagents or plastics may be required — those requirements are listed.
- This is a partial list of Bio-Rad Explorer kits and modifications that can be used in socially distanced classrooms or even by students at home. [Contact a Curriculum Training Specialist](#) for other options.
- Always follow your local guidelines and regulations regarding social distancing, use of shared equipment, home use of kits, and disposal of reagents.

This list will be updated frequently, so please check back. Supplementary resources, including PowerPoint presentations, links to videos, and case studies, are available online at [bio-rad.com/classroomresources](http://bio-rad.com/classroomresources).

Catalog #	Kit Name	EDU Price (USD)	In Class	At Home	# Workstations	Standard Protocol	Modified Protocol	Tradeoffs of Using Modified Protocol
<b>Photosynthesis and Cellular Respiration</b>								
<i>Do not require shared equipment</i>								
12005534EDU	<a href="#">Photosynthesis and Cellular Respiration Kit for General Biology</a>	\$145.00	X	X	Standard protocol: 24 Modified protocol: 48	Create models and design experiments with algae beads to explore photosynthesis and cellular respiration.  Each student uses 2 sets of 3 algae beads in PCR tubes with CO <sub>2</sub> indicator solution to observe both processes in parallel (saves time).  Curriculum includes: (1) Students use CO <sub>2</sub> indicator solution to observe a phenomenon and make predictions. (2) Students extract algae from beads and investigate under a microscope. (3) Students use algae beads to explore their predictions.	<b>Modifications for home use</b> Post color guides online. Lesson 1: Provide indicator solution (10 ml in a 15 ml tube - not included) and a straw. Lesson 2: Do not perform debeading activity. Lesson 3: Provide additional CO <sub>2</sub> indicator and distilled water (optional, requires additional plastics). - CO <sub>2</sub> indicator solution (10 ml in a 15 ml tube, not included) - Distilled water (10 ml in a 15 ml tube, not included) to rinse pipets.  <b>Modifications to extend number of stations</b> Students can use 1 tube of algae beads instead of 2. This necessitates, however, the observation of both processes in sequence rather than in parallel.  <b>Modifications for home use</b> Provide additional indicator solution and distilled water for inquiry investigations (requires additional plastics); no debeading activity.  <b>Modifications to extend number of stations for social distancing</b> Instead of using 2 cuvettes, use 1 cuvette with 10 algae beads to each student and investigate processes in sequence (accommodates up to 17 students). -Or- Use 5 beads in 0.5 ml CO <sub>2</sub> indicator solution (spectrometry will not be possible; accommodates 16-34 students, depending on whether each uses one or two sets of algae beads).	<b>Modifications may necessitate the following:</b> - Not performing Lesson 2 debeading and microscopy - Observation of processes in sequence, rather than in parallel (requires more time)  - Purchase of additional plastics for at-home use: - 1660475EDU 15 ml conical centrifuge tubes (50) - 2239430EDU 2.0 ml EZ Micro test Tubes (500)
17001238EDU	<a href="#">Photosynthesis and Cellular Respiration Kit for AP Biology</a>	\$145.00	X	X	Standard protocol: 8 Modified protocol: 17 or 34	Design experiments that use algae beads and CO <sub>2</sub> indicator solution to discover how environmental conditions impact both photosynthesis and cellular respiration.  Students use cuvettes containing 10 beads in 1 ml CO <sub>2</sub> indicator. Each workstation/student use 2 cuvettes to examine both processes in parallel (saves time and allows a direct comparison).		
<b>Genetic Engineering</b>								
<i>Require water bath or heat block</i>								
1660003EDU	<a href="#">pGLO Bacterial Transformation Kit</a>	\$99.00	X	--	Standard protocol: 8 Modified protocol: 24	Use bacterial transformation with an inducible promoter to make glowing <i>E. coli</i> .  Each workstation performs four transformations: the experimental and three controls. Transformation requires use of a temperature bath, and visualization requires a UV light source.	<b>Not for home use</b>  <b>Modifications to extend number of stations for social distancing</b> Each workstation performs one of the four transformations, and the class pools their results (or groups of 4 pool results to see the complete experimental design). Students share starter plates, water bath, floats, UV light source.	<b>Modifications may necessitate the following:</b> - Division or common use of starter plates; agar plugs containing colonies can be cut out and distributed to students, if needed  - Each workstation will not see the complete experiment and will have to pool results with others to see all experimental and controls  - UV lights may need to be shared
<i>Require water bath/heat block and pipets</i>								
12012608EDU	<a href="#">Out of the Blue CRISPR Kit</a>	\$235.00	X	--	Standard protocol: 8 Modified protocol: 32	Use CRISPR-Cas9 technology to edit the <i>lacZ</i> gene in bacteria: (1) Use a paper model to understand the components of the CRISPR-Cas9 system. (2) Use CRISPR-Cas9 to edit the <i>lacZ</i> gene in <i>E. coli</i> . (3) Use bioinformatics to design Cas9 target sites in the human genome and determine risk for off-target effect.  Each workstation performs four transformations: the experimental and three controls. Transformation requires pipets, water bath.	<b>Activities for home use</b> Activities (1) and (3) can be completed at home. Both are available at <a href="http://bio-rad.com/teachCRISPR">bio-rad.com/teachCRISPR</a> .  <b>Modifications to extend number of stations for social distancing</b> Instead of performing all four experimental and control transformations, each workstation performs one of the four and the class pools their results (to see the complete experimental design). Students share starter plates, pipets and tips (or use sterile disposable pipets, purchased separately), water bath/dry bath, floats.	<b>Modifications may necessitate the following:</b> - Division or common use of starter plates; agar plugs containing colonies can be cut out and distributed to students, if needed  - Each workstation will not see the complete experiment and will have to pool results with others to see all experimental and controls  - Purchase of 1660474EDU Disposable Plastic Transfer Pipets (sterile, 500)
<i>Requires microcentrifuge, thermal cycler, electrophoresis cell, power supply, and pipets</i>								
12012607EDU	<a href="#">Out of the Blue Genotyping Extension Kit</a>	\$199.00	X	--	Standard protocol: 8 Modified protocol: 40	Use multiplex PCR and gel electrophoresis to confirm the edit to the <i>lacZ</i> gene.  Each workstation extracts DNA from bacteria from the Out of the Blue CRISPR Kit (5 samples) and analyzes them and controls by PCR (7 samples) and gel electrophoresis (8 samples).	<b>Modifications to extend number of stations for social distancing</b> Each kit contains sufficient reagents to process 8-10 complete experiments. The activity can be extended to more students if each workstation processes a subset of the samples from a complete experiment; students must pool their results to see the full picture.	<b>Modifications may necessitate the following:</b> - Each workstation will not see the complete experiment and will have to pool results with others to see all experimental and controls  - Shared use of plate D, pipets and tips, water bath/dry bath, floats, thermal cycler, gel electrophoresis apparatus
<b>DNA Extraction and Analysis</b>								
<i>Do not require shared equipment</i>								
1662300EDU	<a href="#">Genes in a Bottle Kit</a>	\$134.00	--	X	Standard protocol: 36 necklaces Modified protocol: 50 samples	Extract your DNA from your own cheek cells (saliva) and bottle it in a keepsake necklace.  Each kit contains sufficient reagents and amulets for 36 students (36 necklaces).	<b>Modifications for home use</b> Provide kit components and the following: - Isopropyl alcohol (10 ml in a 15 ml conical tube - not supplied) - Disposable cup (to hold 3 ml of water)  <b>Option 1:</b> Follow the protocol in Lesson 2 of the instruction manual (students add reagents independently for a more complete laboratory experience). <b>Option 2:</b> Teacher prepares the lysis buffer and protease + salt and supplies it in the 2 ml tubes that come with the kit. <b>Protocol Checklist</b>  <b>Modifications to extend number of stations</b> This kit contains sufficient reagents for 50 DNA extractions.	<b>This activity requires:</b> - Collection of saliva samples, so instructors may choose to have students perform this activity at home  - Isopropyl alcohol (not included); a vessel for transporting the alcohol to students will also be required for home use: 1660475EDU 15 ml conical centrifuge tubes (50)
1665090EDU 1665095EDU	<a href="#">STEM Electrophoresis Classroom Kit</a>	\$274.00 \$495.00	X	X	8	Each student builds a personal gel electrophoresis chamber to separate food coloring and candy dyes. The gel electrophoresis chamber is reusable (can be used for multiple classes) with purchase of additional agarose and buffer.  Each kit contains supplies for 8 separate electrophoresis chambers.	<b>Modifications for home use</b> Teachers can prepare gels (recommended). Additional plastics will be required for home use: - 50 ml conical tube - Disposable plastic transfer pipets - 9V batteries (3-5)	<b>This activity requires:</b> - 3-5 9V batteries, not included - Disposable plastic transfer pipets, 5 per station, not included: 1660480EDU Disposable Plastic Transfer pipets (500)  <b>This kit can be used with:</b> - IDEA Kit - Forensic DNA Fingerprinting Kit - Science of Opioid Dependence Kit

DNA Extraction and Analysis, continued...											
Require electrophoresis cell and power supply, micropipets											
1665075EDU 1665077EDU	<b>IDEA Kit — Inquiry Dye Electrophoresis Activity</b>	\$55.00 \$185.00	X						<p>Bridge the gap between textbook science and students' lives by using dyes extracted from candy coatings to perform agarose gel electrophoresis. This kit is a component of several STEM Electrophoresis Kit configurations. It can also be used with a commercial gel box.</p> <p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 20</p> <p>Each student extracts dyes from assorted candies and separates them as well as reference dyes by electrophoresis.</p>	<p><b>Modifications for home use</b> Students can use the electrophoresis chamber from the STEM Electrophoresis Kit.</p> <p><b>Modifications to extend number of stations for social distancing</b> Each workstation loads a subset of the samples and reference dyes: 2 of each.</p>	<p><b>Modifications may necessitate the following:</b> - Workstations processing a portion of the samples and references</p> <p>Electrophoresis chamber required, but not included.</p>
1660007EDU	<b>Forensic DNA Fingerprinting Kit</b>	\$134.00	X			Can be paired with STEM kit			<p>Use restriction enzymes and gel electrophoresis to solve a crime.</p> <p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 12+</p> <p>Each kit support the analysis of 12 sets of samples on 7x7 cm gels.</p>	<p><b>Modifications for home use</b> Students can use the electrophoresis chamber from the STEM Electrophoresis Kit.</p> <p><b>Modifications to extend number of stations for social distancing</b> Each workstation performs digests of a subset of the samples.</p>	<p><b>Modifications may necessitate the following:</b> - Workstations processing a portion of the samples and references</p> <p>Electrophoresis chamber required, but not included.</p>
17005297EDU	<b>Science of Opioid Dependence Kit Plus Fast Blast Reagents</b>	\$99.00	X						<p>Discover the many environmental, behavioral, and genetic factors that impact opioid dependence.</p> <p>(1) Explore the links between opioid dependence, genetics, the neurobiology of reward pathways, and environment factors. (2) Design a human genetic research study and experiments. (3) Analyze 48 pre-amplified PCR patient DNA samples by electrophoresis. (4) Review class and published allele frequency data with optional chi-square analysis.</p> <p><b>Standard protocol:</b> 8 workstations <b>Modified protocol:</b> 48 students</p>	<p><b>Modifications for home use</b> All activities except (3) can be performed remotely. Activity (3) can be performed by students with the electrophoresis chamber from the STEM Electrophoresis Kit. Alternatively, the instructor can perform the separation of all the samples and share the procedure and results with students virtually.</p> <p><b>Modifications to extend number of stations for social distancing</b> Each workstation performs digests of a subset of the samples - they must pool results to see the entire experiment.</p>	<p><b>Modifications may necessitate the following:</b> - Workstations processing a portion of the samples and references, or instructor performing the hands-on portion of this curriculum as a demonstration</p> <p>Electrophoresis chamber required, but not included.</p>
Proteins, Enzymes, and ELISA											
Do not require shared equipment											
1662400EDU	<b>ELISA Immuno Explorer Kit</b>	\$138.00	X	X					<p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 11 or 22 (22 with purchase of additional disposable plastic transfer pipets)</p> <p>Select 1 of 3 protocols to use. Each workstation analyzes positive and negative controls and two samples, each in triplicate.</p>	<p><b>Modifications for home use</b> Provide PBS wash buffer in a 50 ml tube (not provided). Use Protocol II or III. A paper model activity is available at <a href="http://bio-rad.com/classroomresources">bio-rad.com/classroomresources</a>.</p> <p><b>Modifications to extend number of stations for social distancing</b> Each workstation analyzes controls and samples in duplicate, not triplicate. Students can use disposable plastic transfer pipets instead of micropipets. Purchase additional disposable plastic transfer pipets to extend to 22 workstations.</p>	<p><b>Modifications may necessitate the following:</b> - For at-home use, provide wash buffer in a 50 ml tube (not provided) - Use of disposable plastic transfer pipets, which may impact reproducibility: 1660480EDU Disposable Plastic Transfer pipets (500) - Use of fewer replicates than are optimal for a complete experiment</p>
17002878EDU	<b>Giant Panda Problem Kit</b>	\$138.00	X	X					<p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 11 or 22 (22 with purchase of additional disposable plastic transfer pipets)</p> <p>Explore reproductive endocrinology in the context of giant panda conservation. Design hormone assays to monitor fertility using the power of ELISA.</p> <p>Each workstation performs an antibody ELISA followed by a student-designed hormone detection ELISA.</p>	<p><b>Modifications for home use</b> Provide PBS wash buffer in a 50 ml tube (not included). Paper model activity is available in the instruction manual.</p> <p><b>Modifications to extend number of stations for social distancing</b> Each workstation analyzes controls and samples in duplicate, not triplicate. Students can use disposable plastic transfer pipets instead of micropipets: transfer 2 drops of antibody and of substrate instead of 50 µl. Purchase additional disposable plastic transfer pipets to extend to 22 workstations.</p>	<p><b>Modifications may necessitate the following:</b> - For at-home use, provision of wash buffer in a 50 ml tube (not provided) - Use of disposable plastic transfer pipets, which may impact reproducibility: 1660480EDU Disposable Plastic Transfer pipets (500) - Use of fewer replicates than are optimal for a complete experiment</p>
17005278EDU	<b>Engineering Solutions for Global Health Kit</b>	\$99.00	X	X					<p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 13-24</p> <p>Through an iterative engineering design process, measure protein content in foods and design treatment plans for communities suffering from undernutrition.</p> <p>Each workstation analyzes 4 samples of unknown protein content against a set of protein standards. This activity does not require the precision of pipets; disposable plastic transfer pipets (included) are used.</p>	<p><b>Modifications for home use</b> Provide Bradford Solution in a 50 ml tube (not included).</p> <p><b>Modifications to extend number of stations for social distancing</b> Each student analyzes 1 or 2 samples of protein-containing solution. During preparation, use half the amounts of BSA and water indicated in order to provide each student with a complete set of standards. Purchase additional 15 ml conical tubes to extend to 20 (1 sample) or 24 (2 samples) students.</p>	<p><b>Modifications may necessitate the following:</b> - Purchase of additional 15 ml tubes: 1660475EDU 15 ml conical centrifuge tubes (50) - For at-home use, provision of wash buffer in a 50 ml tube (not provided) - Use of half the regular number of samples and volume of standards, impacting accuracy</p>
17001235EDU	<b>Biofuel Enzyme Reactions Kit for AP Biology</b>	\$135.00	X	X					<p>Extract cellulase from mushrooms to discover one way that nature uses enzymes. Then test hypotheses about enzyme function under different environmental conditions — temperature, pH, and concentrations — that influence enzyme function.</p> <p>Each workstation designs experiments using mushroom extracts.</p>	<p><b>Modifications to extend number of stations for social distancing</b> Workstations work with 1 set of standards (accommodates 8 students). Students are provided a piece of mushroom to extract using a microcentrifuge tube and pipet tip as mortar and pestle - or - teacher provides extracts. Students perform Activity 1 and have the option of performing one of the optimization activities; class can pool results. In class, with shared components, accommodate up to 12 workstations at a time. Reagents sufficient for 3 sessions with 12 workstations are provided (rinse plastics and cuvettes in between each set).</p>	<p><b>Modifications may necessitate the following:</b> - Purchase of pipet tips (2239040EDU BR-40 pipet tips, 500) to use as mortar and pestle</p>
1665035EDU	<b>Biofuel Enzyme Kit</b>	\$135.00	X	X					<p>(3) Test the ability of an enzyme to increase the conversion rate of a colorless sugar substrate (p-nitrophenyl glucopyranoside) to a colored product (p-nitrophenol and glucose). Test the effects of various conditions, such as pH, enzyme concentration, substrate concentration, and temperature, on the rate of enzyme-catalyzed reactions. In addition, guide students through an independent inquiry that tests fungal sources for cellulase activity</p> <p>Each workstation designs experiments using purified enzyme and optional mushroom extracts.</p>		
PCR Amplification											
Require microcentrifuge, thermal cycler, electrophoresis cell, power supply, and pipets											
1662100EDU	<b>PV92 PCR Informatics Kit</b>	\$210.00	X	--					<p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 40</p> <p>Use PCR and gel electrophoresis to analyze your PV92 Alu repeat allele.</p>	<p><b>Modifications for social distancing</b> Each student extracts their own DNA using the hair follicle DNA extraction protocol (purchase of protease required). Workstation setup can be modified to enable each student to work independently. Some reagents will be shared.</p>	<p><b>Modifications may necessitate the following:</b> - Purchase of 1662003EDU Protease (1.3 ml)</p>
1662500EDU 1662550EDU	<b>GMO Investigator Kit</b>	\$187.00 \$234.00	X	--					<p>Use PCR and gel electrophoresis to determine if food you eat contains a GMO.</p> <p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 20</p> <p>Each workstation prepares and analyzes a complete set of 3 samples with two sets of PCR primers (test and control).</p>	<p><b>Modifications for social distancing</b> Each workstation prepares and carries 1 sample through the procedure (2 PCR reactions).</p>	<p><b>Modifications may necessitate the following:</b> - Purchase of microcentrifuge tubes (2239480EDU 1.5 ml EZ Micro Test Tubes) and pipet tips (2239040EDU BR-40 pipet tips, 500) to use as mortar and pestle - Use of fewer samples per workstation</p>
1662600EDU 1662650EDU	<b>Crime Scene Investigator PCR Basics Kit</b>	\$149.00 \$195.00	X	--					<p>Students analyze samples from a crime scene and four suspects by PCR and gel electrophoresis to solve a crime in your classroom.</p> <p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 12</p> <p>Each workstation of 4 students analyzes a complete set of 5 samples.</p>	<p><b>Modifications for social distancing</b> Each workstation prepares and carries 1 sample through the procedure.</p>	<p><b>Modifications may necessitate the following:</b> Use of fewer samples per workstation</p>
1665100EDU	<b>Fish DNA Barcoding Kit</b>	\$249.00	X	--					<p>Extract DNA, perform PCR and DNA sequencing (optional) to determine the species of a fish sample based on its DNA sequence of the cytochrome c oxidase I gene.</p> <p><b>Standard protocol:</b> 8 <b>Modified protocol:</b> 16</p> <p>This kit provides sufficient materials for processing up to 16 fish and control samples (8 workstations, 2 samples per workstation, 2-4 students per workstation).</p>	<p><b>Modifications for social distancing</b> Each workstation prepares and carries 1 sample through the procedure.</p>	<p><b>Modifications may necessitate the following:</b> - Purchase of microcentrifuge tubes (2239480EDU 1.5 ml EZ Micro Test Tubes) and pipet tips (2239040EDU BR-40 pipet tips, 500) to use as mortar and pestle - Use of fewer samples per workstation</p>