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SEP MOLECULAR BIOLOGY KITS

Bacterial Transformation Kit

4 Kits – Oxford Micropipets – 2 or 3 crates/kit depending on how many classes will use the kit

**pBLU option:** The pBLU® plasmid is used to demonstrate a common screening tool researchers use during transformation. The *E. coli* used in this lab has a mutation resulting in the loss of a portion of the LacZ gene. The pBLU plasmid contains the genes necessary to complete the LacZ operon and form beta-galactosidase. A functioning beta-gal enzyme cleaves X-gal, creating a blue indole molecule. This a great lab for teaching students that DNA codes for instructions that give cells visible characteristics. Teachers have the option to let students work on optimizing the transformation procedure as a second component to the lab.

**pFLO option:** Plasmids containing modified GFP genes are used to induce *E. coli* to produce colored protein products. Some need UV light to see the color. SEP has loaner hand-held UV lights which can be requested as loaner equipment. Current colors: Aqua, Daffodil, Emerald, Magenta, Raspberry

**Includes:**
- Genes-R-Us Lab and pFLO adaptation
- Oxford micropipets
- Bacteria, plasmids, reagents, and sterile LB agar

**NOTE:** Teacher supplies heat source to melt agar, ethanol or bleach, and ice.

*Supplies Only Versions are available if you have your own equipment.*
Chromatography Kit
3 Kits – 1 crate each
An introduction to separating molecules by the techniques of column chromatography and paper chromatography. The column chromatography lab uses a column of beads that separate mixtures of molecules based on their size and shape. In the paper chromatography activity, students separate ink or dye mixtures based on their chemical properties. These lab experiences illustrate different properties of molecules and commonly used separation techniques. Activities in this kit complement concepts in the Gel Electrophoresis Kit.

Includes:
- Molecular Mixtures Lab
- Columns with Bio Gel P60
- Assorted molecules for separation
- Reagent to assay for protein
- Chromatography paper

NOTE: Teacher supplies ring stands, clamps, and solvents. We recommend that students work in pairs.

DNA Extraction Kit: Strawberry DNA
4 Kits – 1 crate each
The DNA Exploration Kit offers students a chance to see DNA! Students isolate DNA from strawberries and then collect the DNA by spooling it onto wooden sticks. The kit also contains procedures for isolating DNA from other tissues as well as activities for teaching students how DNA is packaged in the cell. Other teaching tools, such as the DNA origami activity, are on SEPGuides.

Includes:
- Strawberry DNA Extraction
- Protocol Design – NEW! Challenge students to design their own extraction protocols.
- Additional extraction protocols
- DNA size activity (thread into capsules)
- DNA models; chromosome photo

NOTE: Teacher supplies strawberries, ethanol, and ice. Frozen thymus (animal DNA source) is available by request.

ELISA Kit: Enzyme Linked Immunosorbant Assay
4 Kits - 2 crates/kit: 2 Gilson/Rainin [#1-2] and 2 Oxford [#3-4]
This kit simulates detection of different viruses or biomarkers using an ELISA assay. SEP provides lessons for HIV, Avian Flu, and BRCA HR/HER2 [must be requested via email]. The kit also includes models for demonstrating how the ELISA works and for understanding antibody structure and diversity. Additional resources and references are included for students to learn about the avian flu situation across the globe. We recommend students work in pairs for the ELISA.

Includes:
- ELISA scenario and lab protocol
- Micropipets and tips
- 96-well plates, antibodies, and substrate (TMB)
- Chenille stems for antibody models
- Microfuge
- Microtubes
- Avian flu resources, posters, maps, and accessories

NOTES:
1) Teachers must attend an SEP ELISA kit-training workshop before using an ELISA Kit.
2) Teacher supplies distilled water to dilute PBS, paper towels, and timers for wash steps.
*Supplies Only Versions are available if you have your own equipment.
**Micropipet Kit**

4 Kits – 1 crate each: M1 = Ulster micropipets; M2–M4 = Rainin/Gilson

By performing the Micropipet Kit activities, students can become proficient measuring very small metric volumes using micropipets. These techniques are essential for preparing students to work with the electrophoresis kit activities since those require measuring just a few microliters of DNA. Students will work with the same micropipets and equipment used in research and biotechnology laboratories.

Includes:
- Measure for Measure
- Micropipets (8 sets), tips, and 2 microfuges
- Colored practice solutions

**PCR Kit**

3 PCR Machines **[Applied Biosystems]** and 2 MiniPCR Kits

Applied Biosystems PCR machines can accommodate 96 samples.

MiniPCR Kit contains 2 MiniOne PCR Machines [which hold 16 tubes each] and 2 Amazon Fire Tablets to run the machines. The MiniPCR kit also contains centrifuges for DNA extraction.

PCR labs provided by SEP:
- TAS (PTC Taster) – Human
- PV92 (ALU) – Human
- D1S80 (VNTR) – Human
- GMO – corn/soy
- Invasive Mussel Species – Mussels
- Lambda DNA [special request only – for building your own scenario]

[These must be ordered using the online PCR Supplies Only form]

**NOTE:** Prior attendance at an SEP PCR workshop is required to request PCR machines and supplies

**Order separately:**
- Gel kit: You will need a gel kit or your own equipment [gel boxes, power supplies, micropipets].
- PCR Reagents and consumables – order through the online Supplies Only form
- Stain/Visualization system: SYBRsafe is provided and recommended for analyzing PCR product
**Gel Electrophoresis Kit [Horizon Gel Boxes]**

12 Kits – 3 crates/kit: Micropipet type Ulster [#1-3, 6, 7]; Gilson/Rainin [#4, 5, 8-11]; Finnpipette [#12]

Supports Labs: Measure for Measure, Electrophoresis Exploration, Dye Lab, DNA Lab 1, DNA Lab 2, DNA Forensics, Elephant Ivory [Classic and the new Elephant 2.0 scenario]

This kit supports a series of labs for learning the principles and applications of gel electrophoresis. After learning the basic technique, students progress to using agarose gel electrophoresis to separate mixtures of molecules. The Dye/Indicator Lab separates various dyes/pH indicators based on charge, size, and shape. The two DNA Labs allow students to separate DNA molecules based on size. DNA Lab 1 uses pre-cut DNA samples. DNA Lab 2 incorporates restriction enzyme digestion of lambda DNA. DNA Lab 1 Forensics can be used with a DNA forensics scenario. Use of Elephant Project and Trunk assumes that you are borrowing a gel kit or have your own gel electrophoresis equipment and micropipets.

*You are making good progress on careful packing of the gel boxes so that their expensive lids don’t break. Please keep it up! Use the kit packing maps in each crate where the packing scheme places only 2 gel boxes in a stack. Please supervise if students or others repack the kits for you. Don’t overpack the space above the gel boxes. The crate lids should close completely and lie flat. Please be sure no one sits or stands on the crates.*

*Supplies Only Versions are available if you have your own equipment.*

**Includes:**

- Measure for Measure Lab
- Electrophoresis Exploration Lab
- Dye/Indicator Lab
- DNA Lab 1: Precut Lambda DNA
- DNA Lab 2: Enzyme Digestion of DNA
- 32 Micropipets [4 size ranges—8 of each]
- 8 Gel boxes [Horizon 58]
- 4 Power supplies [FB205 or equivalent]
- 1 Water bath
- Fast Blast DNA stain; new option: fluorescent green stain + blue LED illuminator
- 1 Light box
- Gloves—maybe; they are heavy & $$
- Tips for micropipets
- Microtubes
- Microfuges
- pH paper
- Acetate sheets and blotting paper
- Practice gel loading materials
- Reagents & buffers for requested labs
- Options: DNA for Elephant Project or forensic scenarios

**NOTE:** Teacher supplies distilled water to dilute TAE running buffer and a heat source [microwave] to melt agarose.

**Equipment Only Gel Electrophoresis Kits [EO Kits]**

2 Horizon Kits – 2 crates each: South Sound (SS) and 509 both have Oxford micropipets
1 MiniOne Kit – 2 crates each: North East (NE) has P20 Gilson/Rainin micropipets

These kits contain just the equipment for a regular Gel Electrophoresis Kit. Qualified users pick up their pre-requested supplies on Kit Signup Day [or other scheduled time] and obtain the kit from the previous user or designated Kit Caretaker. SEP ships DNA and enzymes by FedEx at time of use. Use is restricted to teachers in specific geographical areas; eligible teachers will be notified. To borrow these kits, you will need to contact the kit caretaker. Email SEP at SEP@fredhutch.org to get their contact information.

SS Kit Caretaker: Jen Smith, Olympic High School, Bremerton, jens@ckschools.org

- For teachers who work in Pierce and Thurston counties
MiniOne Gel Electrophoresis Kit

4 kits – 2 crates/kit [Gilson/Rainin micropipettes]

Supports Labs: Measure for Measure, Dye Lab, DNA Lab 1, DNA Lab 2, DNA Forensics, Elephant Ivory [Elephant 2.0]

This kit is much like the Gel Electrophoresis Kits that contain the Horizon Gel Boxes. The main difference is that these all-in-one gel systems do not need an external power supply, saving room and weight. Unfortunately, that means you cannot run Electrophoresis Exploration using this kit. The MiniOne System is quick and easy! The built-in blue light allows students to view the DNA as it is running [no post staining necessary]. They also run DNA faster (~20 min). However, the small size of the gels makes separation of PCR product more difficult.

Includes:
- Measure for Measure Lab
- Dye/Indicator Lab
- DNA Lab 1: Precut Lambda DNA
- DNA Lab 2: Enzyme Digestion of DNA
- P20 Micropipets [P10, P200, P1000 for teacher]
- 8 Gel boxes [MiniOne]
- Gloves—maybe; they are heavy & $$$
- Tips for micropipets
- Microtubes
- Microfuges
- Reagents & buffers for requested labs
- 1 Water bath

NOTE: Teacher supplies distilled water to dilute TAE running buffer and a heat source [microwave] to melt agarose.

Add-on: Elephant Trunk
Add-on to MiniOne Kit, Gel Kits, or Gel supplies-only - 6 Trunks

NOTE: You must order Gel Kits or Gel Supplies SEPARATELY from the Elephant Trunk! The trunk does not come with gel kits or DNA.

The Elephant Trunk includes Wildlife Conservation: Ivory Cache (2018) and The Elephant Project (2001) curriculum and the supplementary resources to enrich The Elephant Project experience. This problem-based curriculum integrates Internet research, DNA analysis, and bioethical issues as students track down the origins of confiscated ivory. Students discover how modern biomolecular research tools can help to conserve endangered species—in this case, African elephants.

Includes:
- The Elephant Project curriculum with updated scenario & online resources
- Books, maps, and DVDs on Africa and African elephants
- Simulated ivory carvings and elephant tooth
- Elephant Stamps and Ink
- Elephant photos and links on SEPGuides

Add-on: Gel Imaging Systems
Add-on to Gel kit or Supplies-Only - 2 Systems

We have new Sapphire LED blue light transilluminators from Edvotek. When the blue light is on, you use your cell phone to photograph through the orange light box cover. SYBRSafe must be requested when ordering gel supplies.
MOLECULAR MODELING KITS

SEP has adapted lessons and teaching tools developed by our colleagues at the Center for Biomolecular Modeling (CBM). More information about these and many other modeling sets can be found at CBM’s website: http://cbm.msoe.edu/ and at the site of 3-D Molecular Designs, the sister company that sells many of the modeling supplies: http://www.3dmoleculardesigns.com/. Teaching resources are available at the 3DMD site.

Water Kit
4 kits, each with 18 cups – 2 additional kits coming soon!

The Water Kit is a fun tool to help teach water concepts. In this kit, SEP provides a pre-lab, in which students use actual water to generate questions. All the material for the different stations, including pennies and soap for testing water tension, are provided. The magnetic water models can then be used to illustrate water molecule behavior on the molecular level. The student booklets provided in each kit contains different activities designed to model concepts like hydrogen bonding. Each water kit contains 18 cups filled with magnetic water models.

Materials for Water Olympics [pre-lab activity]
18 Student Booklets
1 Teacher’s Guide

Molymod® Model Amino Acid Kit
2 Kits — 1 crate each

The Molymod® Model Kit gives students the chance to explore amino acid structure using engaging Molymod® models. Each tube contains enough parts to assemble 2 amino acids [students work in pairs]. The models provide a strong 3-D visual representation of amino acid structure. Additional tutorial sheets are provided for teachers to help explain electrons and bonds, amino acid structure, and protein folding.

Includes:
- 20 tubes containing model parts (atoms and bonds) and extra parts
- Amino Acids R Us Poster
- Instructions and handouts

Insulin Modeling Kit: Focus on the Central Dogma
2 Kits — 1 crate each

Insulin mRNA to Protein, a paper bioinformatics and mini-Toober folding activity.
Pizza Pan Amino Acid Starter Kit©

3 Kits – 1 crate each

This Amino Acid Starter Kit© allows your students to explore how the unique chemical properties of the 20 amino acids help determine protein folding and shape. Mini-Toobers, colored-coded amino acids, and a magnetic “chemical properties” circle (pizza pan) help engage students in a hands-on folding activity and visually build their understanding of protein structure and function. Additional guide sheets are provided for teachers to help explain electrons and bonds, amino acid structure, and protein folding.

Includes:
- Amino Acid Starter Kit© CD [containing all handouts]
- 8 Mini-Toobers
- 8 Magnetic “Pizza Pans”
- Amino acids [20], clips, and hydrogen bond parts [upgraded]
- Amino Acids R Us Poster plus guide sheets and handouts

Toober Modeling Kit

2 Kits – 1 crate each

The Toober Model Kit is another kit designed for students to explore protein folding. The large “Toober” represents a polypeptide chain [protein] backbone and the colored tacks symbolize the amino acid side chains. Students fold their own unique protein Toober using their understanding of the chemical properties of amino acid side chains [tacks], and then compare the shape of their toober with those of other students. Additional tutorial sheets are provided for teachers to help explain electrons and bonds, amino acid structure, and protein folding.

Includes:
- 22 Toobers and tacks [for 15 Tacks and a Toober activity]
- Amino Acids R Us Poster plus Instructions and handouts

DO-IT-YOURSELF KITS

We’ve included assorted lessons and protocols, but no explicit SEP designed lab activities.

The Private Eye®

2 Kits – 1 tub/kit

The Private Eye® is about the drama and wonder of looking closely at the world, thinking by analogy, changing scale, and theorizing. Designed to develop higher order thinking skills, creativity, and scientific literacy, it is an excellent way to introduce the power of learning by asking questions and making analogies. Using magnifying loupes, students look closely at familiar objects and use analogies to connect form and function. A great activity for all age groups! Learn more at http://www.the-private-eye.com.

Includes:
- The loupe—a 5X magnification tool; 36 loupe set
- Natural specimens to observe
- Powers of 10 video available online; see also http://learn.genetics.utah.edu/content/begin/cells/scale/
- Private Eye® guidebook
- 6–well plates for student samples—take a quick outdoor field trip and gather samples
Fly Genetics
3 Kits – 1 crate/kit. Loan period is 6 weeks.

Students work with the fruit fly *Drosophila melanogaster*, one of the best model organisms for studying genetics, development, and behavior. In addition to basic information on handling the flies, the kit notebook has a number of interesting investigations that can be adapted for use with your students. Some recommended activities are genetic crosses, polytene chromosome squashes, fly sperm observation, sexing flies, and testing fly behavior.

Includes:
- Fly food and anesthetic
- Great collection of teaching slides
- Magnifying loupes, small Petri dishes, general fly handling supplies
- Fly culture vials and stoppers
- Incubator

NOTE: NO Flies in Kit!! To arrange for flies, contact:
Celeste Berg Lab, University of Washington, Genome Sciences
caberg@u.washington.edu; or berg@gs.washington.edu  [206] 543-1622
Order online:
http://depts.washington.edu/cberglab/wordpress/outreach/fly-stocks-for-teachers/
OR
FlyBase: http://flybase.bio.indiana.edu/stocks/

Allow at least 4 weeks for the order: 2 weeks to receive the flies plus 2 weeks to propagate them for class use.

LOANER EQUIPMENT & MODELS

- Microcentrifuge, BHG Hermle high speed
- Microcentrifuge, Eppendorf high speed
- Microfuge, personal low speed
- Heat block with insert for 1.7 ml tubes
- Incubator, HovaBator Styrofoam
- Microscope, Compound
- Microscope, Dissecting
- Microscope, Doubleheader
- Microscope, Inverted
- Light Source for Dissecting Microscope
- Electrophoresis Power Supply
- Electrophoresis Power Supply Life Tech 250EX
- Gel Box, Horizon 58
- Gel Box, vertical X-Cell SureLock [8]
- Light Box, Large
- Light Box, Mini

- Micropipets, Large/P1000: 200 µl-1000 µl
- Micropipets, Medium/P200: 20 µl-200 µl
- Micropipets, Medium/P20: 2 µl-20 µl
- Micropipets, Small/P10: 0.5 µl-10 µl
- Micropipets, Finnpipette P10 for PCR only [8]
- Micropipets, Rainin P2 for PCR only [8]
- Model: DNA, wooden, flexible
- Model: DNA, candy looking, Molymod
- Rocker platform
- Rotator platform
- Spectrophotometer, visible light range
- Transilluminator, Blue LED IO Rodeo
- Transilluminator, UV for pFlo art projects
- UV Light, hand-held (for GFP and pFlo labs)
- Vortex Mixer
- Water bath
Thank you to our Major 2018 Funders

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Stack Family Foundation
Straws Foundation
Dean Witter Foundation
ZymoGenetics [Bristol Myers Squibb]

**National Institutes of Health**
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**We thank all our incredible 2018 partner sites!**
Shoreline Community College
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