AP* Biology Advanced Inquiry Student Laboratory Kits Correlated to the College Board Investigative Labs

The new Flinn Scientific Advanced Inquiry Lab Kits closely follow the design and protocols of the AP Biology Investigative Labs published by the College Board. We reviewed and independently tested each lab activity provided by the College Board and then identified lab kits where we could offer teachers value in terms of planning, materials, and results.

Each Advanced Inquiry Lab write-up contains valuable background information, general procedures, and the materials needed for all students to engage in the introductory or what we call "Baseline Activity" on the topic. This Baseline Activity is followed by an "Opportunities for Inquiry" section to guide or inspire students with leading questions. The familiar Flinn "Teacher Notes" section wraps up the write-up with sample investigations and summaries of possible results teachers may expect students to observe.

Each Advanced Inquiry Lab kit includes a reproducible student write-up and enough materials for 8 groups** of students to complete the Baseline Activity. We provide extra materials for the Inquiry Opportunities where possible, with the understanding that students may choose to pursue a variety of different directions.

This publication will provide you with a short description of each Advanced Inquiry Lab kit, how the Advanced Inquiry Lab correlates to the College Board Investigative Labs, and also a list of extra materials you may need, such as various tubers for the Water Potential Lab, and turnips for the Enzyme Activity Lab. Additional required lab equipment and supplies such as balances, microscopes, spectrophotometer, colorimeters, and common laboratory glassware, are also listed. Refill kits are also available for several of the Advanced Inquiry Labs.

As always, please call or email (800-452-1261 or flinn@flinnsci.com) Flinn Scientific if you have any questions. We are here to help! *All kits are available on our website (www.flinnsci.com) and are available now!*

Big Idea 1—Evolution

- FB2036 Artificial Selection Advanced Inquiry Lab
- FB2041 Understanding Evolutionary Relationships Advanced Inquiry Activity
- FB2046 The Genetics of *Drosophila* Eye Color Advanced Inquiry Lab (not included in AP Biology bundle, FB2080)

Big Idea 2—Energy and Communication

- FB2032 Water Potential Advanced Inquiry Lab
- FB2030 Diffusion and Osmosis Advanced Inquiry Lab
- FB2034 Photosynthesis in Leaf Disks Advanced Inquiry Lab
- FB2045 Cellular Respiration Advanced Inquiry Lab

Big Idea 3—Genetics and Information Transfer

- FB2031 Environmental Effects on Mitosis Advanced Inquiry Lab
- FB2033 Cancer and the Loss of Cell Cycle Control Advanced Inquiry Activity
- FB2001 *Sordaria* Genetics Advanced Student Laboratory Kit
- FB2042 Bacterial Transformation Lab
- FB2043 Restriction Enzyme Analysis of DNA Lab

Big Idea 4—Interactions

- FB2038 Rate of Transpiration Advanced Inquiry Lab
- FB2037 Fruit Fly Behavior Advanced Inquiry Lab
- FB2039 Peroxidase Enzyme Activity Advanced Inquiry Lab

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Artificial Selection Advanced Inquiry Lab

Big Idea 1– Investigation 1

Science Practices 1, 2, 5, 7

Can we make intentional changes to an organism that will cause it to evolve? Natural selection is a driving force of evolution—a massive concept that can be difficult to study real-time in a classroom. In this Flinn Advanced Inquiry Lab, students easily explore evolution by observing artificial selection using Wisconsin Fast Plants® (*Brassica*).

The Advanced Inquiry Lab begins with a Baseline Activity that allows students the opportunity to observe, measure, and characterize the natural variation of traits in a population of Fast Plants. After selecting a trait, students limit the plants that will reproduce and then plant the second selected generation. Analysis of this selected population is used as a starting point for the Opportunities for Inquiry portion of the lab when students are tasked to develop a testable hypothesis and design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers. Students are provided guiding questions such as, "Would altering the environmental conditions affect the rate of survival for plants with a certain characteristic?" and "Could another plant be manipulated through artificial selection to enhance or eliminate a specific trait?" to help inspire the inquiry experiment.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activity and to prepare for the inquiry activity. Wisconsin Fast Plants seeds and a greenhouse with grow lights are required and available separately.

Flinn Catalog Number: FB2036

Materials Included in Kit (for 8 groups of students):

- Cotton swabs*
- Cups, polypropylene*
- Fertilizer, liquid*
- Greenhouse cover
- Planting mix, light*
- Planting tray
- Pot marker labels*
- Pots, square, 2½″
- Sodium hypochlorite solution*
- Wicking cord*

Additional Materials Required:

- Bottle with cap, 2-L
- Cameras, digital (may be shared)
- Greenhouse with grow lights (such as FB1459 Grow Lab II—Compact Indoor Garden *or* FB0494 Jewel 74″ Plantmobile)
- Cork borer
- Erlenmeyer flask, 1-L
- Magnifying glasses
- Marker, permanent
- Metric ruler
- Paper towels
- Scissors
- Water, tap
- Wisconsin Fast Plants seeds (Flinn Catalog No. FB2044)

***Refill Kit:**

Refill kit is available, Flinn Catalog No. FB2085. Refill kit includes the starred items in the above materials list.

Understanding Evolutionary Relationships Advanced Inquiry Activity

Big Idea 1, Investigation 3

Science Practices 1, 5

Horses, chickens, tuna, humans, Ateles (monkeys), chimpanzees, rabbits, *Arabidopsis thaliana* (plant), rattlesnakes, frogs, dogs, bees, cows—what do all these organisms have in common? Students find out when they use BLAST (Basic Local Alignment Search Tool), a bioinformatics computer comparison tool, to research the gene sequence for a protein found in each organism. Evolutionary relationships are surprising and easy to understand with computer-generated cladograms or phylogenetic trees—we might be more alike than you think!

This Flinn Advanced Inquiry Activity begins with a Baseline Activity that uses BLAST to compile data, which the students use to develop a computer-generated cladogram that depicts evolutionary relationships. Students use this research model as a stepping off point for the second portion of the activity, Opportunities for Inquiry. Questions such as, "What other organisms have similar evolutionary patterns?" and "Are other genes conserved among organisms?" help to guide and inspire students to develop a testable hypothesis and then design a bioinformatics research project. Results provide a great topic for a mini-scientific conference, as encouraged by the AP Biology learning objectives and science practices.

Includes detailed teacher notes, reproducible student handouts, and a list of suggested genes students could explore. A computer with Internet access is required.

Flinn Catalog Number: FB2041

Materials Included in Kit (for 8 groups of students):

Online database research

Instructions and sample data for paper and pencil activity

Additional Materials Required:

Computer with Internet access

Word processing program

The Genetics of *Drosophila* Eye Color Advanced Inquiry Lab

Big Idea 1

Science Practices 1, 3, 4, 5, 6

Drosophila melanogaster, fruit flies, traditionally have brick-red colored eyes. However, some mutations cause their eyes to be different colors—even white! In this Flinn Advanced Evolution Lab, students determine which pigments are present or missing in the wild-type and mutant *Drosophila*. Students will separate and identify the pigments by creating chromatograms using paper chromatography.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the activity. To perform the activity as written the following strains of *Drosophila* are required—wild-type, white-eyed, sepia-eyed, and scarlet-eyed. The brown-eyed mutant may also be used as an optional extension to the activity. Please order *Drosophila* at least three weeks in advance. Schedule arrival one week before use as mature adult *Drosophila* are required for the activity. This kit is not included in the AP Biology kit, Catalog No. FB2080.

Flinn Catalog Number: FB2046

Materials Included in Kit (for 8 groups of students):

- Aluminum foil
- Ammonium hydroxide solution, 3 M
- Isopropyl alcohol
- Lull-a-Fly™ solution
- n-Propyl alcohol
- Anesthetizing wands
- Chromatography paper, 10 × 20 cm
- Cotton balls
- Dissection pins, large

Additional Materials Required:

- Beakers, 2, 600-mL
- Forceps
- Graduated cylinder, 100-mL
- LM1115 Wild-type *Drosophila* (+)
- LM1117 White (w) Recessive *Drosophila*
- LM1125 Sepia (se) Recessive *Drosophila*
- LM1245 Scarlet (st) Recessive *Drosophila*
- LM1244 Brown (bw) Recessive *Drosophila* (optional)
- Stirring rod
- UV light source (Flinn Catalog No. AP1901)

Water Potential Advanced Inquiry Lab

Big Idea 2, Investigation 4

Science Practices 2, 4, 5

Interactions between selectively permeable membranes, water, and solutes are critical to all cellular and organism functions. Even ecosystems are affected by the flow of water into, through, and out of plants and animals. Water and nutrients move through plant and animal cells due to differences in water potential.

In this Flinn Advanced Inquiry Lab, students begin with a Baseline Activity that allows them to study the effect of salt on a typical plant cell using a compound microscope. Their observations provide the basis for the Opportunities for Inquiry section of the lab. Questions such as, "How can water potential be determined for living plant tissues?" and "How would cooking affect water potential?" help to guide and inspire students to develop a testable hypothesis and then design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activity and to prepare for the inquiry activity. Compound microscopes, 0.01-g precision balances, a purple onion, and various tubers are required and available separately.

Flinn Catalog Number: FB2032

Materials Included in Kit (for 8 groups of students):

- Cups, 9-oz
- Food dyes
- Pipets, Beral-type
- Sodium chloride solution, NaCl, 10%
- Sucrose

Additional Materials Required:

- Balance, 0.01-g precision
- Compound microscopes, 40X (shared)
- Forceps, 8
- Metric ruler
- Microscope slides and cover slips, 8
- Paper towels
- Purple onion
- Scalpel
- Various tubers (potatoes, yams, etc.)
- Water, deionized or distilled

Diffusion and Osmosis Advanced Inquiry Lab

Big Idea 2, Investigation 4

Science Practices 2, 4, 5

How do cell membranes help regulate internal cellular makeup? In this Flinn Advanced Inquiry Lab, students participate in two Baseline Activities that branch out with Opportunities for Inquiry during which students will develop a testable hypothesis and then design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers. In the first Baseline Activity, students study the diffusion of ions into a model cell. Questions such as "How does the rate of diffusion influence the ability of a cell to obtain needed nutrients?" and "How might the surface area-to-volume ratio affect the rate of diffusion into a cell?" help to guide the students design their own experiments.

In the second Baseline Activity, students test the ability of various substances to diffuse across a semipermeable dialysis membrane and analyze results to identify solutions as hypotonic, hypertonic or isotonic. Students use these observations and guiding questions such as, "Is the rate of diffusion directly proportional to the solute concentration?" and "How would diffusion of a starch solution be different than that of a protein?" to develop their inquiry experiments.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activities and to prepare for the inquiry activities. A 0.01-g precision balance is required and available separately.

Flinn Catalog Number: FB2030

Materials Included in Kit (for 8 groups of students):

- Agar*
- Agar trays
- Albumin*
- Cups, plastic, 10-oz
- Dextrose*
- Dialysis tubing*
- Hydrochloric acid solution, 0.1 M*
- Knives, plastic
- Phenolphthalein, 1% alcoholic*
- Rulers, metric
- Sodium chloride*
- Sodium hydroxide solution, 0.1 M*
- Spoons, plastic
- Sucrose*

Additional Materials Required:

- Balance, 0.01-g precision
- Beaker, 150-mL
- Beaker, 1-L
- Funnel
- Graduated cylinder, 25-mL
- Heat-resistant gloves
- Magnetic stirrer/hot plate, 7″ × 7″
- Paper towels
- Permanent marker
- Scissors
- Thermometer
- Volumetric flask, 1-L
- Weighing dishes, large, 12

***Refill Kit:**

Refill kit is available, Flinn Catalog No. FB2086. Refill kit includes the starred items in the above materials list.

Photosynthesis in Leaf Disks Advanced Inquiry Lab

Big Idea 2, Investigation 5

Science Practices 1, 2, 3, 6, 7

Ecosystems and the Earth's atmosphere depend on photosynthesis for fuel and oxygen. The rate of photosynthesis can be measured by the production of oxygen or the consumption of carbon dioxide. Examine the factors that affect photosynthesis in land plants by using the most practical method for a school laboratory—the floating leaf disk technique.

In this Flinn Advanced Inquiry Lab, students begin with a Baseline Activity to determine the rate of photosynthesis using disks of leaf tissue that are vacuum-infiltrated to replace intercellular air with liquid. Their observations provide the basis for the Opportunities for Inquiry section of the lab. Questions such as, "Do all leaf types photosynthesize at the same rate?" and "How might biotic and abiotic factors in the environment, such as light, pH, temperature, etc. affect the rate of photosynthesis?" help to guide and inspire students to develop a testable hypothesis and then design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activity and to prepare for the inquiry activity. Ivy or fresh spinach and a 0.01-g precision balance are required and available separately.

Flinn Catalog Number: FB2034

Materials Included in Kit (for 8 groups of students):

- Cups, 10-oz
- Hole-punches, single
- Hydrochloric acid, HCl, 1 M*
- Soap solution*
- Sodium bicarbonate*
- Syringe tip caps
- Syringes, 12-mL

Additional Materials Required:

- Balance, 0.01-g precision
- Ivy or fresh spinach
- Light sources, 8
- Support stands, 8
- Timers, 8
- Water, distilled or deionized

***Refill Kit:**

Refill kit is available, Flinn Catalog No. FB2087. Refill kit includes the starred items in the above materials list.

Cellular Respiration Advanced Inquiry Lab

Big Idea 2, Investigation 6

Science Practices 1, 2, 3, 6, 7

Plants create oxygen as a waste product of photosynthesis, but do they require oxygen to live? Does respiration occur in germinating seeds? Students will answer these questions in this Flinn Advanced Inquiry Lab.

The Advanced Inquiry Lab begins with a Baseline Activity that instructs students to measure the amount of oxygen consumed by germinating mung bean seeds and control seeds. By recording and measuring any changes, students are able to calculate the respiration rate of those seedlings under specific conditions. These observations and data provide the basis for the Opportunities for Inquiry section of the lab. Questions such as, "Does the amount of time from the start of germination affect the respiration rate?" and "What environmental factors may affect respiration rate?" help to guide and inspire students to develop a testable hypothesis and then design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers.

Includes detailed teacher notes, reproducible student handouts, two additional types of seeds, and enough materials for eight groups of students to complete the Baseline Activity and prepare for the inquiry activity. A hot glue gun is required and available separately.

Flinn Catalog Number: FB2045

Materials Included in Kit (for 8 groups of students):

- Capillary tubes, both ends open, 100-mm
- Cotton balls*
- Cups, clear, 16-oz
- Fiberfill, nonabsorbent*
- Hex nuts
- Manometer fluid, red*
- Pipets, graduated*
- Potassium hydroxide solution, KOH, 15%*
- Seeds, barley, 1 oz*
- Seeds, mung bean, 4 oz*
- Seeds, sweet corn, 4 oz*
- Syringes, 5-mL

Additional Materials Required:

- Hot glue gun and glue sticks
- Lab oven
- Markers, permanent, 8
- Paper clip
- Paper towels
- Ruler, metric
- Shallow pan
- Stirring rod, glass or plastic
- Thermometers, digital, 8
- Water, tap, room-temperature, 4 L

***Refill Kit:**

Refill kit is available, Flinn Catalog No. FB2088. Refill kit includes the starred items in the above materials list.

Environmental Effects on Mitosis Advanced Inquiry Lab

Big Idea 3, Investigation 7

Science Practices 1, 5, 6, 7

Do different growing environments affect cell division in plants? Study the effects of biotic and abiotic factors on mitosis in onion root tips with this Flinn Advanced Inquiry Lab. The lab begins with a Baseline Activity studying cell division in two groups of onion root tips. First, students treat the root tips and create microscope slides to observe cell division. Then they perform a statistical analysis of percent mitosis in treated root tips versus a control group. This Baseline Activity provides a procedure and model for the Opportunities for Inquiry portion of the lab when students are tasked to develop a testable hypothesis and design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers. Students are provided guiding questions such as, "In areas where there are very few plants growing, what biotic and abiotic factors may be affecting the rate of mitosis and the ability of plants to thrive?" and "What chemicals may be expected to increase or decrease the rate of mitosis in plants?" to help inspire the inquiry experiment.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activity and to prepare for the inquiry activity. Compound microscopes and onion root tips are required and available separately.

Red kidney bean lectin (Phytohemagglutinin) is used in the College Board lab. Lectin is a lyophilized powder that must be kept refrigerated. It is available from Flinn Scientific as Catalog No. L0114. The recommended concentration is 10 mg in 200 mL of deionized water. Once diluted, it must be stored in the refrigerator and is only active for a few days. Lectin increases mitosis in the roots, but is also hemolytic and must be used with appropriate personal protective equipment.

Flinn Catalog Number: FB2031

Materials Included in Kit (for 8 groups of students):

- Carbol fuchsin solution
- Carnoy's plant fixative
- Cover slips
- Cups, plastic, 5 oz
- Ethyl alcohol, 95%
- Glass slides
- Hydrochloric acid, 1 *M*
- Indole-3-acetic acid, IAA
- Pipets, disposable
- Sand
- Spot plates

Additional Materials Required:

- Compound microscopes (40X)
- Dissection scissors
- Forceps
- Graduated cylinder, 10-mL
- Lectin, phytohemagglutin, 10 mg (optional; Flinn Catalog No. L0114)
- Marker, permanent
- Onion Sets, 100 bulbs (Flinn Catalog No. FB1468)
- Paper towels
- Pencils with erasers
- Plastic wrap
- Volumetric flasks, 1-L, 2
- Water, deionized or distilled
- Water, tap

Cancer and the Loss of Cell Cycle Control Advanced Inquiry Activity

Big Idea 3, Investigation 7

Science Practices 1, 2, 5, 6, 7

The cell cycle has been infiltrated, controls are failing, and cell division is out of control! Cell division is regulated by a complex set of cell signals. Three checkpoints in the cell cycle control whether the division process proceeds normally, halts for repairs, or triggers cell death. What happens when infection by a virus or radiation causes the controls to fail? What are the consequences of uncontrolled cell division?

This Flinn Advanced Inquiry Lab begins with a Baseline Activity that instructs students to compare normal karyotypes to two known cancerous karyotypes. After these karyotypes have been identified, students will evaluate and assess two unknown karyotypes. In the Opportunities for Inquiry portion of the lab, students are guided to conduct research into aneuploidy and translocation in a cancer type of their own choosing. One or more karyotypes for these other cancers can be found online. Students then prepare a mini-poster or presentation to share with their peers.

Includes detailed teacher notes, reproducible student handouts, and sample karyotypes for eight groups of students. Computers with Internet access are required for research.

Flinn Catalog Number: FB2033

Materials Included in Kit (for 8 groups of students):

Instructions and sample karyotypes for paper and pencil research activity

Additional Materials Required:

Paper

Scissors

Tape or gluestick

Sordaria Genetics Advanced Student Laboratory Kit

Big Idea 3, Investigation 7

Science Practices 2, 4, 5, 7

Students prepare cross plates and cross wild type and mutant strains of *Sordaria fimicola* in this advanced genetics laboratory. Daily observation of the growing culture provides an opportunity to observe the life cycle of a member of the fungal kingdom. During meiosis crossing over occurs in some of the asci. By counting the number of crossed ascospores versus uncrossed ascospores it is possible to determine the distance between the gene for spore color and the centromere of the chromosome of interest. Students collect, prepare, count, and calculate from their own cross plates.

Complete for 15 pairs of students to complete the laboratory. Wild-type and mutant cultures of *S. fimicola*, an incubator, stereomicroscopes, and compound microscopes are required and available separately.

Flinn Catalog Number: FB2001

Materials Included in Kit (for 15 groups of students):

- Cornmeal glucose yeast (CGY) agar
- Cover slips
- Glycerin solution, 50%
- Lysol®, concentrate
- Microscope slides
- Petri dishes, sterile
- Pipets, Beral-type

Additional Materials Required:

- Autoclave or pressure cooker
- Bunsen burners
- Compound light microscopes
- Dissecting needles
- Erlenmeyer flask, borosilicate glass, 1-L
- Foam plug to fit Erlenmeyer flask
- Glass stirring rod
- Gloves, heat-resistant
- Incubator (shared)
- Inoculating loops
- Lens paper
- Paper towels
- Parafilm™
- Pencils with erasers
- Permanent markers
- Safety lighters
- *Sordaria fimicola*, Wild-type (Flinn Catalog No. LM1150)
- *Sordaria fimicola*, Tan Mutant (Flinn Catalog No. LM1219)
- Spray bottles or wash bottles
- Stereoscopes
- Stir bar
- Stirring hot plate
- Water, distilled or deionized

Bacterial Transformation Lab

Big Idea 3, Investigation 8

Science Practices 1, 3, 5, 6, 7

Biotechnology raises a lot of questions about the ethics of modifying genes. One of the most powerful tools biotechnologists have is the ability to transfer DNA from one organism to another and make it function there. After the DNA is transferred, cells are able to produce new, unique proteins that they did not make previously. In this experiment, students will transform *Escherichia coli* (*E.coli*) with foreign DNA, giving it the ability to express new genetic information. The transformed cell will take up a plasmid containing the Green Fluorescent Protein (GFP) gene, which was isolated from the jellyfish *Aequorea victoria*. Transformed colonies that express the GFP protein are visibly green in normal light and fluoresce brightly when exposed to long-wave ultraviolet light. Kit includes detailed instructions and enough materials for ten groups of students. A water bath, 37 °C incubation oven, microwave or hot plate, and long-wave ultraviolet light are available separately.

Live material redemption coupon included to obtain live material. Please allow 2–3 weeks to receive live material after sending in the redemption coupon.

Flinn Catalog Number: FB2042

Materials Included in Kit (for 10 groups of students):

- Instructions
- Cells
- Plasmid DNA
- IPTG
- Ampicillin
- Transformation solution
- ReadyPour™ Agar
- Luria broth
- Petri plates
- Pipets
- Inoculating loops
- Microcentrifuge tubes

Additional Materials Required:

- Floating microcentrifuge tube racks, 4
- Heat-resistant gloves
- Incubator (shared)
- Long-wave ultraviolet light
- Marking pens
- Stirring hot plate or another method to make transformation plates
- Water baths, 2, at 37° and 42 °C

Restriction Enzyme Analysis of DNA Student Laboratory Kit

Big Idea 3, Investigation 9

Science Practices 3, 6

In this experiment, restriction enzymes are introduced as a tool to digest DNA at specific nucleotide sequences. Bacteriophage lambda DNA has a linear structure and multiple recognition sites. Separation by agarose gel electrophoresis of digests of lambda DNA will yield several bands corresponding to the DNA fragments. Students estimate the size of the fragments and determine which restriction enzyme was used to digest the DNA. Kit includes detailed instructions and enough materials for six gels. Electrophoresis apparatus, power supply, micropipets and tips, balance, microwave or hot plate, and a white light illuminator are required and available separately.

Flinn Catalog Number: FB2043

Materials Included in Kit (for 6 gels):

- Instructions
- Ready-to-Load™ DNA samples
- UltraSpec–Agarose™ powder
- Practice gel loading solution
- Electrophoresis buffer
- InstaStain® Blue and FlashBlue™ Stain
- Calibrated pipet
- Graduated cylinder, 100-mL
- Microtipped transfer pipets

Additional Materials Required:

- Balance, 0.01-g precision
- Electrophoresis apparatus
- Floating racks
- Heat-resistant gloves
- Light box
- Power supply
- Stirring hot plate or another method to make gels

Rate of Transpiration Advanced Inquiry Lab

Big Idea 4, Investigation 11

Science Practices 1, 2, 4, 5, 6

Plants absorb nutrients, ions, and water from surrounding soil and air by osmosis, diffusion, and active transport. Transpiration is the main method for pulling water from the roots to the leaves. Study how transpiration is regulated by observing, counting, and quantifying the stomata in plant leaves.

This Flinn Advanced Inquiry Lab begins with a Baseline Activity that instructs students to determine the approximate leaf area and therefore the approximate number of stomata for each plant. This study of stomata and leaf area serves as a foundation for the Opportunities for Inquiry portion of the lab when students are guided to develop their own testable hypothesis and open-inquiry experiment. Questions such as the following help to guide and inspire students as they plan, discuss, evaluate, execute, and finally justify their experiment and results to their peers.

- How does the weather and environment affect transpiration?
- Are there ways to increase transpiration rate?
- How does the number of stomata per square meter of leaf area affect the transpiration rate?
- How does coating the leaves or otherwise compromising the plant affect transpiration rate?

Includes detailed teacher notes, reproducible student handouts, instructions for both the whole plant and the potometer methods, and enough materials for eight groups of students to complete the Baseline Activity and to prepare for the inquiry activity. A 0.001-g precision balance and greenhouse with grow lights are required and available separately.

Flinn Catalog Number: FB2038

Materials Included in Kit (for 8 groups of students):

Fingernail polish*
Greenhouse cover
Petroleum jelly*
Pipets, serological, 1-mL
Planting tray
Planting tray insert
Polyethylene bags*
Potting soil*
Rubber bands*
Seeds, red bean*
Syringes, 12-mL
Tubing, latex, amber
Tubing, plastic, clear

Additional Materials Required:

Balance, 0.001-g precision
Calculator
Clamps, test tube or thermometer
Compact greenhouse with grow lights
Dissecting needle or small paper clip
Fan
Light source with 150-W bulb
Metric ruler
Pans for water
Paper towels
Scalpels
Scissors
Support stands
Water, tap

***Refill Kit:**

Refill kit is available, Flinn Catalog No. FB2089. Refill kit includes the starred items in the above materials list.

Fruit Fly Behavior Advanced Inquiry Lab

Big Idea 4, Investigation 12

Science Practices 1, 3, 4, 5, 6, 7

What makes a fruit fly tick? Students construct a choice chamber tube to study fruit fly behavior and investigate what environmental factors trigger a fruit fly response.

In this Flinn Advanced Inquiry Lab, students begin with a Baseline Activity that instructs them to construct a choice chamber tube. Then, they transfer fruit flies to the tube and observe their behavior as they present different options in the choice chamber. This procedure serves as a starting point for the Opportunities for Inquiry section of the lab that guides students to develop a testable hypothesis and then design an experiment that they can plan, discuss, evaluate, execute, and finally justify to their peers. Questions such as, "What types of foods or condiments found in households might attract or repel the fruit flies?" and "How might *Drosophila* react to dilute acids or bases?" help to inspire the inquiry experiment.

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activity and prepare for the inquiry activity. Sample data for different fruit and environmental conditions tested by Flinn Scientific is included in the teacher notes. Wild-type *Drosophila* is required and available separately. Order *Drosophila* three weeks in advance with arrival one week before the lab as this activity requires adult fruit flies.

Flinn Catalog Number: FB2037

Materials Included in Kit (for 8 groups of students):

- Choice chamber tubes
- Cotton balls
- Dissection pins
- Foam plugs

Additional Materials Required:

- Substances for inquiry testing
- Wild-type *Drosophila* (Flinn Catalog No. LM1115)

Peroxidase Enzyme Activity Advanced Inquiry Lab

Big Idea 4, Investigation 13

Science Practices 4, 5, 6, 7

Enzyme activity—how the rate of an enzyme-catalyzed reaction depends on concentration, pH, temperature, metal ions, etc.—provides the central basis for understanding how enzymes function. Among the thousands of different enzymes in a single cell, peroxidases are among the most active and the most widely distributed. Peroxidases protect plants and animals against cell damage by catalyzing the breakdown of hydrogen peroxide, a natural but toxic by-product of aerobic respiration. In this Flinn Advanced Inquiry Lab, students investigate the activity of turnip peroxidase by measuring its rate of reaction with hydrogen peroxide and a natural reducing agent called guaiacol.

The Advanced Inquiry Lab begins with a Baseline Activity. Students measure the absorbance or color intensity of the orange product formed from guaiacol as a function of time for three different enzyme concentrations. Graphical analysis gives the rate of the reaction—and the first clue for a model of enzyme action. Using this general procedure students continue in the Opportunities for Inquiry portion of the lab to design experiments in search of additional evidence that may support or refute the mechanism of enzyme action. What does substrate concentration reveal about enzyme-substrate binding? How does the effect of pH illustrate the essential nature of protein and enzyme structure?

Includes detailed teacher notes, reproducible student handouts, and enough materials for eight groups of students to complete the Baseline Activity and additional inquiry activities, including the variable discussed above. A blender and spectrophotometer are required and available separately. Fresh turnips are also required and available from a local store.

Flinn Catalog Number: FB2039

Materials Included in Kit (for 8 groups of students):

- Buffers, pH 3–9
- Guaiacol solution
- Hydrogen peroxide
- Serological pipets, 2-mL and 5-mL

Additional Materials Required:

- Blender
- Filter paper
- Flask, Erlenmeyer, 500-mL
- Fresh turnips (store item)
- Funnel
- Ice
- Spectrophotometers
- Test tube racks
- Test tubes
- Timer

Tips

- We recommend purchasing **four** *Drosophila* cultures for 8 groups of students in a class. The price is listed per culture. Fewer cultures will be needed if the teacher or students can subculture the flies.
- The Investigation numbers refer to the Investigative Lab manual published by the College Board. Please note that Investigation 2 is not included in this list because it is a computer program simulation of Hardy Weinberg principles. Investigation 10 is also not included, which uses butterflies.
- AP and College Board are trademarks of the College Board, which was not involved in the production of, and does not endorse, these products.

Materials for the updated 2012 AP Biology Curriculum are available from Flinn Scientific, Inc.

Catalog No.	Description
FB2036	Artificial Selection Advanced Inquiry Lab
FB2041	Understanding Evolutionary Relationships Advanced Inquiry Activity
FB2046	The Genetics of Drosophila Eye Color Advanced Inquiry Lab
FB2030	Diffusion and Osmosis Advanced Inquiry Lab
FB2032	Water Potential Advanced Inquiry Lab
FB2034	Photosynthesis in Leaf Disks Advanced Inquiry Lab
FB2045	Cellular Respiration Advanced Inquiry Lab
FB2031	Environmental Effects on Mitosis Advanced Inquiry Lab
FB2033	Cancer and the Loss of Cell Cycle Control Advanced Inquiry Activity
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