KIT 470134-780

AP® Biology Investigation #11:

Interactions: Transpiration

Meets Revised College Board AP Biology Standards

ward's science

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Abstract

This lab addresses the process of transpiration and has students explore factors that affect its rate. Students analyze stomata density in leaf types and determine the rate of transpiration in a living plant by constructing a simple potometer. Students consider how plants adapt to changing environments to regulate water loss and photosynthesis in the short term of an experiment as well as in evolutionary context.

Required Prior Knowledge

Students should:

- understand how the function of the cell is dependent on its structure.
- understand the properties of water.
- understand the processes of osmosis, diffusion, and active transport.
- be familiar with the process of photosynthesis and the molecules involved.
- understand how environment influences an organism's life processes.

Learning Objectives

This lab addresses the process of transpiration and explores factors that affect its rate.

In this lab, students will perform several activities, to help them answer the following question:

How is water cycled throughout a plant?

Activity 1 is a structured inquiry activity, in which students will make a stomata print and determine the surface area of leaves, as well as the rate of transpiration.

Activity 2 is a guided inquiry activity. Instructions are given for an experiment in which students will observe the rate of transpiration in a living plant under the conditions of an assigned environmental factor. However, students can choose some other variable and/or procedure to test in this part of the lab.

Activity 3 is an open inquiry activity, in which students will design an experiment that allows students to further explore the effects of environmental factors on transpiration, and explain how plant populations respond to changes in the environment over time.

Materials

*For a list of replacement items, visit: www.**wardsci.com**, and click on the AP Biology tab for this kit/item #.*

Included in kit:

- 1 box microscope slides
- 1 spray mist dispenser bottle
- 1 pkg. kidney bean seeds
- 8 T-connectors, 1/8"-1/4"-1/8"
- 8 lengths clear flexible tubing, 1/8" i.d.
- 1 length clear flexible tubing, 1/4" i.d.
- 8 plastic hose clamps
- 8 non-sterile pipets, borosilicate glass, 1 mL x .01
- 8 non-sterile 10-mL syringes
- 1 bag potting soil
- 8 Sutton inserts, 6-cell unit
- 1 sheet cobalt chloride paper, 8" x 10"
- 2 bottles white glue
- 8 poly bags
- 1 Instructions (this booklet and student guide)

Needed but not provided:

- Lab notebook
- Petroleum jelly
- Compound microscope
- Metric rulers, clear
- Fresh leaves
- Scissors
- Light (100 W)
- Electric fan
- Scale
- Ring stand with two adjustable clamps
- Razor blade
- Extension clamps
- Fine point forceps
- Graph paper
- Distilled water

Optional (not provided)

- Paper clips
- Other materials as determined by students' experiment design
- Thermometers

Standards Alignment

This lab activity is aligned with the 2012 AP Biology Curriculum (registered trademark of the College Board). Listed below are the aligned Content Areas (Big Ideas and Enduring Understandings), the Science Practices, and the Learning Objectives of the lab as described in AP Biology Investigative Labs: An Inquiry-Based Approach (2012). *This is a publication of the College Board that can be found at:*

http://media.collegeboard.com/digitalServices/pdf/ap/APBioTeacherLabManual2012_2ndPrt_lkd.pdf

Big Ideas	**2**	Biological systems utilize energy and molecular building blocks to grow, to reproduce, and to maintain homeostasis.
	4	Biological systems interact, and these interactions possess complex properties.
	With connections to:	
	1	The process of evolution drives the diversity and unity of life.
Enduring Understandings	**1.A2**	Natural selection acts on phenotypic variations in populations.
	2.A3	Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.
	2.B1	Cell membranes are selectively permeable.
	2.B2	Growth and homeostasis are maintained by movement of molecules across membranes.
	2.D1	All biological systems from cells and organisms to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions involving the exchange of matter and free energy.
	4.A4	Organisms exhibit complex properties due to interactions between their constituent parts.
	4.A6	Interactions among living systems and with their environment result in the movement of matter and energy.
Science Practices	**1.4**	The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.
	2.2	The student can apply mathematical routines to quantities that describe natural phenomena.
	4.1	The student can justify the selection of the kind of data needed to answer a particular scientific question.
	6.4	The student can make claims and predictions about natural phenomena based on scientific theories and models.
	7.1	The student can connect phenomena and models across spatial and temporal scales.

(continued on next page)

Standards Alignment *continued*

Learning Objectives	**1.5**	The student is able to connect evolutionary changes in a population over time to a change in the environment.
	2.6	The student is able to use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion.
	2.8	The student is able to justify the selection of data regarding the type of molecules that an animal, plant, or bacterium will take up as necessary building blocks and excrete as waste products.
	2.9	The student is able to represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth, and reproduction.
	4.9	The student is able to predict the effects of change in a component(s) of a biological system on the functionality of an organism(s).
	4.14	The student is able to apply mathematical routines to quantities that describe interactions among living systems and their environment, that result in the movement of matter and energy.
	4.15	The student is able to use visual representation to analyze situations or solve problems qualitatively to illustrate how interactions among living systems and with their environment result in the movement of matter and energy.

Time Requirements

	TIME FRAME	TEACHER TASK(S)	STUDENT TASK(S)
PRE-LAB PREP	2 weeks prior to lab (can be done by either teacher or students – see page 11)	Begin growing seedlings. Collect leaves.	Read background and answer pre-lab questions.
Activity 1	Total of 75 minutes: 1A: 30 Minutes 1B: 45 Minutes		Make stomata prints and determine the rate of transpiration.
Activity 2	Total of 50 minutes: 10 minutes set up 30 minutes observation and recording 10 minutes analysis		Explore the effect an environmental factor has on transpiration.
Activity 3	Depends on student/teacher scheduling and parameters of experiment.		

Safety Precautions

Lab Specific Safety:

- A razor blade is used in this lab. Use caution. When cutting, always move the razor blade away from you.

General Safety:

- The teacher should 1) be familiar with safety practices and regulations in his/her school (district and state) and 2) know what needs to be treated as hazardous waste and how to properly dispose of non-hazardous chemicals or biological material.
- Consider establishing a **safety contract** that students and their parents must read and sign. This is a good way to identify students with allergies (e.g., latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.
- Students should know where all **emergency equipment** (safety shower, eyewash station, fire extinguisher, fire blanket, first aid kit etc.) is located.
- Require students to remove all dangling jewelry and tie back long hair before they begin.
- Remind students to **read all instructions, SDSs and live care sheets** before starting the lab activities, and to ask questions about safety and safe laboratory procedures. The most updated versions of SDSs and live care sheets can be found at www.**wardsci.com**. Updated SDSs can also usually be found on each chemical manufacturer's website.
- In student directed investigations, make sure that collecting safety information (like SDSs) is part of the experiment procedure.
- As general laboratory practice, it is recommended that students **wear proper protective equipment**, such as gloves, safety goggles, and a lab apron.

At the End of the Lab:

- Before disposing of any chemicals in the trash or down the drain, review local regulations or consult with local authorities.
- All laboratory bench tops should be wiped down with a 10% bleach solution or disinfectant to ensure cleanliness.
- Remind students to wash their hands thoroughly with soap and water before leaving the laboratory.