KIT 470134-778

AP® Biology Investigation #10:

Ecology: Energy Dynamics

Meets Revised College Board AP Biology Standards

Teacher's Guide

ward's science

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Abstract

In this lab, students investigate the factors that affect energy capture, allocation, storage and transfer in a model ecosystem. Students track changes in the mass of both autotrophs (producers) and the heterotrophs (consumers) that feed upon them, and analyze energy usage through accounting methods in the two types of interacting organisms – plants and animals (insects).

Required Prior Knowledge

Students should:

- be knowledgeable about growing and maintaining plant and animal cultures.
- understand the transfer of energy from producers to consumers in an ecosystem.

Activity Learning Objectives

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

How is energy cycled through an ecosystem?

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

Materials Checklist

Included in Kit:

** - It is recommended that you **redeem your coupon for live/perishable materials as soon as possible and specify your preferred delivery date**. Generally, for timely delivery, at least two weeks advance notice is preferred.*

- 1 Jiffy greenhouse and peat pots
- 1 pkg. hollyhock seeds
- 1 pkg. lupine seeds
- 30 butterfly cups with lids
- 1 butterfly pavilion
- 1 box Miracle Gro®
- 1 wick
- 1 live/perishable items coupon* for 300 butterfly eggs, 30 larvae, 30 butterfly cups with lids, 200 g food, 1 scoop, and 1 paintbrush
- 1 instructions (this booklet and reproducible Student Guide)

Also Needed:

- Lab notebook
- Oven
- Scale, .001g sensitivity
- Paper envelope
- 10% bleach
- Orange Gatorade®
- Plant station with grow light
- Other materials as determined by students' experiment design

Optional Materials (not provided)

- Hollyhock plant
- Additional food for butterfly larvae
- Additional cups/lids for butterfly larvae
- Soil mix
- Digital camera

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	**4**	Biological systems interact, and these interactions possess complex properties.
	2	Biological systems utilize energy and molecular building blocks to grow, to reproduce, and to maintain homeostasis.
Enduring Understandings	**2.A1**	All living systems require constant input of free energy.
	2.D1	All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.
	4.A6	Interactions among living systems and with their environment result in the movement of matter and energy.
Science Practices	**1.3**	The student can refine representations and models of natural or man-made phenomena and systems in the domain.
	2.2	The student can apply mathematical routines to quantities that describe natural phenomena.
	3.2	The student can refine scientific questions.
	4.2	The student can design a plan for collecting data to answer a particular scientific question.
	5.1	The student can analyze data to identify patterns or relationships.
	6.1	The student can justify claims with evidence.
	6.2	The student can construct explanations of phenomena based on evidence produced through scientific practices.
	6.4	The student can make claims and predictions about natural phenomena based on scientific theories and models.
	7.2	The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

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Standards *(continued from previous page)*

Learning Objectives	**2.1**	The student is able to explain how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow, and to reproduce.
	2.2	The student is able to justify a scientific claim that free energy is required for living systems to maintain organization, to grow, or to reproduce, but that multiple strategies exist in different living systems.
	2.3	The student is able to predict how changes in free energy availability affect organisms, populations, and ecosystems.
	2.22	The student is able to refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems from cells and organisms to populations, communities, and ecosystems.
	2.23	The student is able to design a plan for collecting data to show that all biological systems are affected by complex biotic and abiotic interactions.
	2.24	The student is able to analyze data to identify possible patterns and relationships between a biotic or an abiotic factor and a biological system.
	4.14	The student is able to apply mathematical routines to quantities that describe interactions among living systems and their environment, which result in the movement of matter and energy.
	4.16	The student is able to predict the effects of a change of matter or energy availability on communities.

Time Requirement

<table>
<tr><th></th><th>TIME FRAME</th><th>TEACHER TASK(S)</th><th>STUDENT TASK(S)</th></tr>
<tr><td rowspan="2">PRE-LAB PREP</td><td>At least 2 weeks before lab</td><td>Redeem coupon for live materials.</td><td rowspan="2">Read student guide and answer pre-lab questions.</td></tr>
<tr><td>1 day before lab</td><td>See page 12 to expand peat pots, mix butterfly diet, and set up plant growth area.</td></tr>
<tr><td rowspan="3">Activity 1 & 2</td><td colspan="3">The procedure is divided into two activities: one for plants (activity 1) and one for animals (activity 2). The time frame of the experiment covers weeks; however, the initial steps for both activities 1 and 2 should be done concurrently on the first day of the lab, as noted in the instructions for both activities.</td></tr>
<tr><td>Lab Day 1</td><td>Divide 30 pack of larvae into 8 lab groups. (See page 12.)</td><td>Plant hollyhock seeds. Set up larvae.</td></tr>
<tr><td>Week 1 and 2</td><td></td><td>Care for plants and larvae. Collect data (about 10 minutes/day). Analysis and assessment.</td></tr>
<tr><td>Activity 3</td><td>Week 3 (Total time depends on student/teacher scheduling and parameters of experiment.)</td><td></td><td>Depends on student/teacher scheduling and parameters of experiment.</td></tr>
</table>

Safety Precautions

Lab-specific Safety:

- If you are setting up a light system for your plants, make sure that water does not get on electrical connectors.

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 live care sheets can be found at www.**wardsci.com**. Updated SDSs can 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.