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# K-12 Partnership Lesson Plan

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# *Ground Level Light and Plant Biomass Production*

## Overview

Plants need light for photosynthesis. How are plant height and stem density related to the amount of light reaching the ground? We will visit 2 field sites and measure plant biomass in relation to light availability at the soil surface. We will also examine soil and roots. We will draw conclusions about how aboveground biomass, plant height, stem density, and light availability are related.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Measure plant biomass in relation to light availability at the soil surface
* Examine soil and roots
* Draw conclusions about how aboveground biomass, plant height, stem density, and light availability are related

**Length of Lesson**

1-2 50 min class periods

**Grade Levels**

Middle school, high school

**Standards covered**

Disciplinary Core Ideas

 *Middle School*

* **MS-LS1-6:** Construct a scientific explanation based on evidence for the role of photosynthesis in the cycle of matter and flow of energy into and out of organisms
* **MS-LS2-1**: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem
* **MS-LS1-5:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms

Cross Cutting Concepts

* Patterns
* Energy and matter in systems
* Structure and function

Science and Engineering Practices

* Asking questions and defining problems
* Planning and carrying out investigations
* Analyzing and interpreting data

**Materials**

Lab/field equipment

* Clippers (1 per group)
* Plot frames (1 per group)
* Metersticks (1 per group)
* Soil corers (1 per group)
* 2 mm sieves (1 per group)
* Balances (2 per class)
* Ziplock bags (2 per group)
* Paper bags for plant biomass (2 per group)
* Meter tape and end pin (1 per site)
* Buckets or canvas bags (1 per group)
* Calculators (1 per group)
* Paper towels (same size as sieve or larger, 2 pergroup)
* Bowl or plastic utility tub or dishpan for weighing plant biomass (1 per balance)
* Light meter (1 per class)
* Computer projector
* Chalkboard or whiteboard and writing utensil

Presentation materials

* Introductory powerpoint (provided on “Light and plant biomass” lesson page on KBS GK-12 website)

Copied materials

* Instruction sheets with pre-test questions (1 per group) (listed as “Outline of Lesson” on lesson page on KBS GK-12 website)
* Datasheets (1 per group) (listed as “Datasheet” on lesson page on KBS GK-12 website)

**Background**

Tracing matter and energy through environmental ecosystems: in specific, how plant production of organic carbon (biomass) is related to availability of an essential resource for photosynthesis (light). Do taller plants produce more biomass than shorter plants? How are plant height and stem density related to the amount of light reaching the ground?

**Plants**

Height

Biomass

***Objectives***

Decide what is the most efficient way of producing plant biomass. Long and lean or short and fat?

Predict how plant height and the amount of light at the soil surface are correlated.

Predict how plant height and plant biomass are correlated.

Predict how stem density is correlated with height, biomass, and light at the soil surface.

Use a light meter to determine the amount of light intercepted by plants of different heights and densities.

Determine the amount of fresh biomass in plant communities of different heights.

### Activities of the session

1. **Introduce session in the classroom**
	1. Powerpoint (Emily’s introductory slide on resource gradient, light-plant circle diagram, question).
	2. Oral pre-test (questions below)
2. **Go in the field: Techniques and observations**
	1. Gather materials (see list above) and distribute groups among sites
	2. Lay out transect and put down plot frames
	3. Count number of stems within the frame
	4. Gather a handful of grass in each corner of the plot (within the frame) and measure the height of the tallest part of the tallest plant in the handful.
	5. Using light meter, measure light above canopy and at ground level, calculate percent of total light that reaches ground level. Record % light reaching the ground.
	6. Clip all live biomass within the plot. Do not include dead organic material (DOM) unless it is attached to a living green stem. Put it in the paper bag and label the bag with “Tall Grass Site” or “Short Grass Site” and your group number.
	7. Collect a soil core sample (approximately 30 cm deep). Observe the color and texture of the soil. Is there a soil horizon, or is the sample continuously mixed? Put core sample in plastic bag and label plastic bag with site name and group number.
3. **Return to lab and look for patterns in the data.**
	1. Mass biomass and enter data on datasheet.
	2. Enter all your data from your datasheet on table on chalkboard
	3. If time allows, pour soil sample into sieve stacked on paper towel. Gently press soil through sieve, saving roots. Put the roots from the sample back into the ziplock bag. Visually compare the amount of roots from the Tall Grass Site and the Short Grass Site.
4. **Draw conclusions, explain the pattern, and develop further inquiry questions.**
	1. Calculate means, draw conclusions.
	2. Discuss how our conclusions relate to scientific hypotheses
	3. Discuss how this lesson can be extended into your classrooms. Develop further inquiry questions as a follow-up at future concurrent sessions.

**Resources**

* Intro powerpoint, instruction sheet, and data sheet listed on “Light and Plant Biomass” lesson page on the KBS GK-12 website

**Assessment**

Pre-test (oral):

1. If we were growing grass for biomass (for example, for biofuels), would tall and skinny work better than short and fat?
2. Does the amount of ground level light affect biomass?
3. Does the amount of biomass affect ground level light?
4. In a grassland, how does the height of grass affect the ability of plants to capture sunlight?

Embedded assessment:

1. Observations
2. Gathering data in the field

Post-test:

1. Conclusions we draw in answering our question
2. Discussion in the classroom
3. Develop further inquiry questions.