

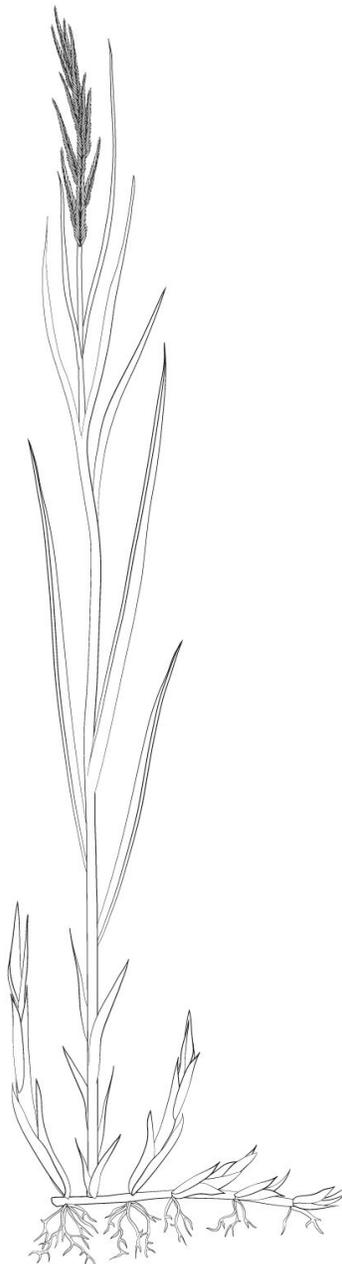
6.1: Grading Smooth Cordgrass Worksheet

*This worksheet has “grading” in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below.*

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 17 points total on this worksheet.

Draw and label arrows that represent the molecules that carbon atoms are in as they move into, through and out of the Smooth Cordgrass as it moves and grows.

Label each arrow to show the kind of molecules that the carbon atoms are in: large organic molecules (LOM), small organic molecules (SOM), or carbon dioxide (CO₂).



Your ideas about a Smooth Cordgrass' needs. Four things that Smooth Cordgrasses need to live and grow are water, soil nutrients, air, and sunlight. What are your ideas about what happens to those four things *inside* a Smooth Cordgrass plant?

What happens to *water* inside Smooth Cordgrass?

Level 4 responses could mention two main functions that water has inside the Smooth Cordgrass: 1) Water is a key reactant in the process of photosynthesis. The H atoms in glucose (and all other molecules in plants) come from water. 2) Water carries materials to plant cells; soil minerals move through the roots to all the cells of the plants dissolved in water; sugars move from leaf cells to all the cells of the plants dissolved in water.

What happens to *soil nutrients* inside Smooth Cordgrass?

Level 4 responses could mention that soil nutrients are non-organic minerals, that soil minerals dissolved in water move through the roots to all cells of the plants or that cells combine the atoms in soil minerals (N, K, P, S, etc.) with glucose molecules to make proteins and other large organic molecules.

What happens to *air* inside Smooth Cordgrass?

Level 4 responses could describe two main functions that air has inside the Smooth Cordgrass: 1) Carbon dioxide is a key reactant in the process of photosynthesis. The C and O atoms in glucose come from CO₂. 2) Oxygen is a key reactant in cellular respiration. All plant cells get their energy from the energy that is released when oxygen reacts with glucose and other organic molecules.

What happens to sunlight *light* inside Smooth Cordgrass?

Level 4 responses will identify light as the ONLY source of energy for the Smooth Cordgrass and describe how the energy in light is converted to chemical energy through the process of photosynthesis.

1 point for each correct response. 4 points total

A. Investigating how a Smooth Cordgrass grows and functions

A class is investigating how a Smooth Cordgrass grows. The teacher asks the students, "Where does most of the mass of a Smooth Cordgrass come from?"

a. Three students shared their ideas about what happened. Do you agree or disagree with what each student claims?

Agree	Disagree¹	Mitch: "I think a growing Smooth Cordgrass gains most of its mass from nutrients in the soil."
Agree	Disagree	Andrea: "I think a Smooth Cordgrass plant gains most of its mass from gases in the air."
Agree	Disagree	Jamal: "I think a Smooth Cordgrass plant gains most of its mass from the sunlight."

1 point for each correct response. 3 points total

¹ On the basis of their studies in the Plants unit, students should know that soil minerals provide only a small part of a plant's mass. But Mitch's hypothesis is reasonable, so you may want to give students credit if they agree.

b. Provide an explanation. Why did you agree or disagree with each student's claim that you did?

Level 4 responses disagrees with Jamal because matter cannot be converted into energy; agrees/not sure with Andrea that air/gases can provide mass to plants; agrees or disagrees with Mitch because soil nutrients and/or water provide mass to plants. Level 3 responses says: i) sunlight is a source of matter for plants (agrees with Jamal) AND/OR ii) disagrees with Andrea's claim that air could account for the tree's increased mass. Level 2 responses only reason about 1 or 2 of the claims. Level 1 responses reason about the claims in a force-dynamic way; e.g., i) the plant needs light, soil, water to grow, ii) air/gas cannot provide mass to the plant.

c. The class does an experiment to investigate how Smooth Cordgrass grows. They started by selecting six **identical** Smooth Cordgrass plants. Three of those plants were grown in regular soil. The other three plants had extra soil nutrients added to the soil in the pots. They put all six plants under **identical** conditions (i.e., the same light conditions, the same watering conditions) and let them continue growing for one month. At the end of the month, the class weighed each of the six Smooth Cordgrass plants and recorded their weights in the table below. They also recorded the weight of the soil nutrients added to three of the pots.

Smooth Cordgrass with regular soil		
Plant	Mass of nutrients added (grams)	Mass gained by plant (grams)
1	0	30
2	0	31
3	0	29
Average	0	30

Smooth Cordgrass with regular soil plus soil nutrients		
Plant	Mass of nutrients added (grams)	Mass gained by plant (grams)
4	3	48
5	3	41
6	3	47
Average	3	45

Whose idea do you think is best supported by the data? (Circle one choice.)

- a. Mitch's
- b. Andrea's**
- c. Jamal's

1 point for correct response.

Explain how the patterns in the data support the claim that you chose.

Level 4 responses recognizes there is an unaccounted for matter pool between the amount of soil nutrients added and their increase in growth; uses this mass discrepancy to explain why Andrea's claim is correct. Level 3 responses identifies all matter pools, or recognizes missing pools, but agrees with Jamal's claim that violates principles (Matter to Energy conversion), agrees with Mitch's claim which is inconsistent with the data, or agrees with Andrea's claim but has flaws in his/her reasoning. Level 2 responses choose Mitch's because the mass of the plant growth with added soil nutrients is greater than the increase in mass of the plant growth without soil nutrients. Level 1 responses explain that the more soil nutrients, the more it grew, recognizes relationships among some matter pools but doesn't relate them to the claims (may provide an explanation about food use for rationale), and /or uses the presence of a matter pool (i.e., added soil nutrients) to justify a claim.

1 point for correct response.

d. What additional evidence would you collect to help you show that the claim you chose is the best claim?

Level 3 responses propose questions that target limitations in the data (recognize there is an unaccounted for matter pool, i.e., gas); they focus on matter tracing and are constrained by principles such as matter to energy conversion. Level 2 responses propose evidence that partially address limitations in the data. Level 1 responses identify aspects of the system that students are curious about independent of the data, they critique the experimental design, or do not recognize that additional evidence needs to be collected.

1 point for appropriate response.

B. A question about how Smooth Cordgrass grow and function

Smooth Cordgrass needs energy to live and grow. Where does the Smooth Cordgrass get its energy?

Select True or False for the following statements:

T *F* Some of the energy in Smooth Cordgrass comes from the air.

T *F* Some of the energy in Smooth Cordgrass comes from sunlight.

T *F* Some of the energy in Smooth Cordgrass comes from water.

T *F* Some of the energy in Smooth Cordgrass comes from soil nutrients.

T *F* Some of the energy is created by the Smooth Cordgrass.

1 point for each correct response. 5 points total

Which ONE of the following do you think provides the MOST energy to Smooth Cordgrass?

a. Energy stored in the air

b. Energy from sunlight

c. Energy stored in water

d. Energy stored in soil nutrients

e. Energy that the grass created

1 point for correct response.

Explain your choices. Where does the energy in Smooth Cordgrass come from?

Level 4 responses recognize that Smooth Cordgrass gets its energy from the sun. This comes in the form of light energy and is transformed to chemical energy in the plant during photosynthesis. The energy is stored in high energy C-H and C-C bonds in organic molecules in the Smooth Cordgrass' body. Level 3 responses may suggest that a Smooth Cordgrass can make its own energy, or that some of the energy comes from air, water, or soil nutrients. Level 2 responses may suggest that the Smooth Cordgrass needs energy from all of these sources to grow.

1 point for correct response.

C. Something interesting about Smooth Cordgrass

What is something interesting that you learned about Smooth Cordgrass that makes this plant different from the radish plants you grew?

1 point for appropriate response.