

Activity on Cellular Respiration and Photosynthesis

Learning Outcome: Analyze how changes in biomass depend on the balance between cellular respiration and photosynthesis in plants.

Summary: This activity uses data from Ebert-May et al. BioScience 53: 1221-1228 to help students understand how cellular respiration and photosynthesis play ... We use this activity to illustrate the interplay of cellular respiration and photosynthesis in plants and relate this to energy flow through autotrophs and heterotrophs at the ecosystem level before teaching the biochemistry of cellular respiration and photosynthesis.

Duration: 30-45 min

Material needed:

- Handout for students
- Colored cards for simultaneous response
- Slide showing
 - Table 1
 - Figure on page 2 (empty)
 - Figure on page 2 (filled)
 - Guiding questions (page 3 of handout)
 - Table 2
 - Data from paper showing change in biomass

Activity Type: TBL format question

Details for Implementation:

1. Provide students with the [handout](#).
2. Let students read and predict the answers to the questions in Table 1.
3. Clarify the answer to part 1 (germination but not the prediction of biomass under three conditions).
4. Ask students to fill out the figure on Table 2 (display this as power-point slide also).
5. Go through questions 3, 4 and 5 and let students answer as team using colored cards as simultaneous response.
6. Ask students to fill out the predicted biomass of seeds under three conditions (Table 2)
7. After discussion, display the data/figure from Ebert-May et al. BioScience 53: 1221-1228.

Plant Growth Experiment

Modified from *Plant Growth Puzzle* by Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania,
<http://serendip.brynmawr.edu/exchange/bioactivities>.

A plant physiologist investigating plant growth grew radish seeds in three growth conditions (Table 1). In each growth condition (treatment), the researcher put three replicate batches of seeds, each weighing 1.5 g. After 10 days, the biomass in each replicate was dried at 60 °C overnight to remove water and its mass was determined.

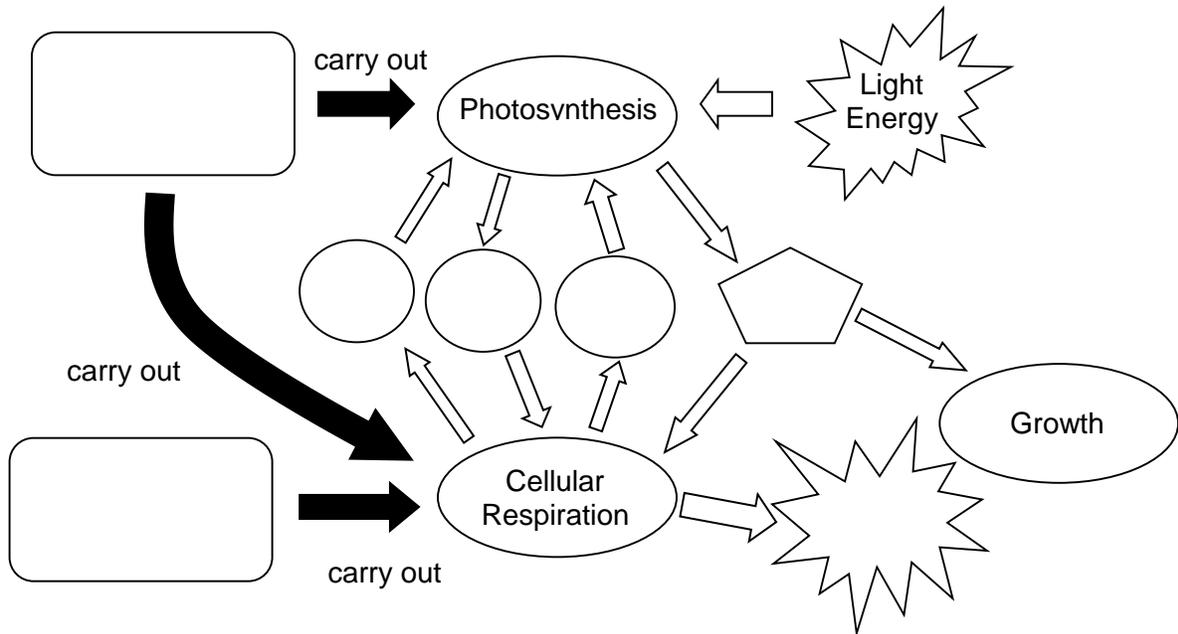
1. For each growth condition in Table 1, predict whether the seeds will germinate and grow into plants (hint: in what conditions do seeds germinate naturally).

Table 1. Experimental growth conditions for radish seeds.

Growth Condition	Will plants germinate?	Predicted Biomass at 10 days
Light, no water	A. yes B. no	A. < 1.5 g B. ~1.5 g C. > 1.5 g
Light, water	A. yes B. no	A. < 1.5 g B. ~1.5 g C. > 1.5 g
No light, water	A. yes B. no	A. < 1.5 g B. ~1.5 g C. > 1.5 g

2. The net effect of two processes, photosynthesis and cellular respiration affect the final biomass of the radishes in each growth condition. Complete the following concept map to show the interconnections between photosynthesis and cellular respiration.

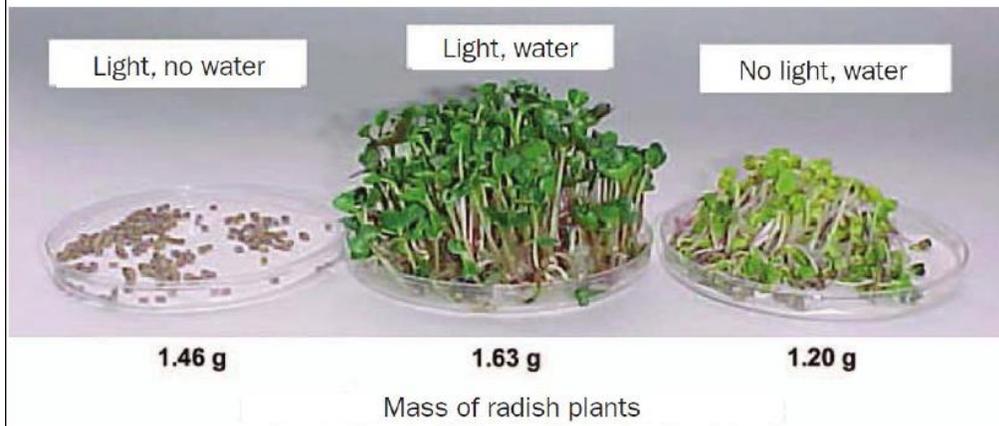
- Rectangles represent a type of organism. Label each box with photoautotrophs (plants, algae, bacteria) or heterotrophs
- White arrows indicate a molecule is produced or consumed.
- All other shapes represent products or reactants. Label each shape.



3. Which molecule in your concept map can be used to *directly* produce organic molecules such as cellulose and starch that become part of the plant's biomass OR used as a fuel for cellular respiration?
- CO₂
 - C₆H₁₂O₆
 - O₂
 - H₂O
4. _____ has the potential to increase plant biomass by incorporating _____ molecules from the air into plant biomass.
- cellular respiration, CO₂
 - photosynthesis, O₂
 - cellular respiration, O₂
 - photosynthesis, CO₂
5. _____ has the potential to decrease plant biomass and results in _____ diffusing from the plant cells as biomass is lost.
- cellular respiration, CO₂
 - photosynthesis, O₂
 - cellular respiration, O₂
 - photosynthesis, CO₂
6. Seeds contain a lot of starch and oil to provide energy during germination and initial growth. Think about the change in biomass you expect to observe for seeds in the three different growth conditions. Based on your answers to previous questions, predict for each growing condition in Table 2 the average biomass of the three replicates after 10 days (hint: seeds have very little water, so each batch of seeds began with ~1.5 g of dry biomass).

Table 2. Predicted biomass changes for radish seeds in three growth conditions.

Growth Condition	Predicted Biomass at 10 days			Observed Biomass
Light, no water	A. < 1.5 g	B. ~1.5 g	C. > 1.5 g	_____ g
Light, water	A. < 1.5 g	B. ~1.5 g	C. > 1.5 g	_____ g
No light, water	A. < 1.5 g	B. ~1.5 g	C. > 1.5 g	_____ g



Ebert-May et al. BioScience 53: 1221-1228