



# GLOBE Carbon Cycle Plant-A-Plant: Hands-on Photosynthesis Experiments



Jana Albrechtová<sup>1</sup>, Zuzana Lhotáková<sup>1</sup>, Luboš Daněk<sup>1</sup>, Edita Tylová<sup>1</sup>, Lubomír Nátr<sup>1</sup>, Barbora Semeráková<sup>2</sup>, Dana Votápková<sup>2</sup>, Scott Ollinger<sup>3</sup>, Sarah Silverberg<sup>3</sup>, Gary Randolph<sup>4</sup>

Affiliation: 1 - Charles University in Prague, Faculty of Science, Department of Plant Physiology, Prague, albrecht@natur.cuni.cz, CZ; 2 - TEREZA Association, Prague, CZ; 3 - University of New Hampshire, Durham, NH, USA; 4 - GLOBE Program, Regional Consortia Coordinator and Carbon Cycle Project Lead, University Corporation for Atmospheric Research (UCAR), Boulder, CO, USA

## Abstract:

The Plant-A-Plant Activity is under development as a part of the Carbon Cycle Project. Plants constitute a very important part of the global carbon cycle representing a large carbon pool in their biomass.

This activity is designed for exploration and validation of necessity of sources determining plant growth and it demonstrates that CO<sub>2</sub> is incorporated into plant biomass. It will help students understand how plants grow and what resources they need for their growth and biomass accumulation.

Currently, our team is focused on the development of hands-on experiments in which students cultivate their own plants, while manipulating environmental conditions. By changing access to essential resources such as atmospheric carbon dioxide, experimental observations of a plant's requirements can be made. The first set of verified experiments is available.

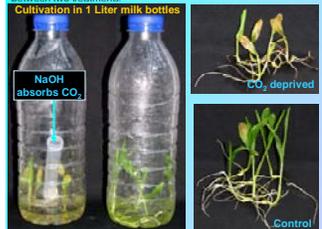
## Plant-a-Plant Objectives

Activity will lead students to:

- Formulate their own hypotheses about plant growth and effects of different sources on it
- Conduct experiments based on given information
- Record observations and measurements
- Evaluate obtained data
- Make conclusions based on obtained data and evaluate the validity of the original hypotheses

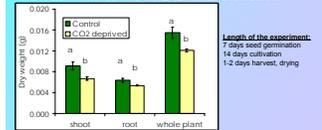
## Experiment 1 - CARBON DIOXIDE

Students explore how the amount of CO<sub>2</sub> affects maize growth. The amount of CO<sub>2</sub> is given by the air volume in the plastic bottles in which the plant is cultivated. To one set of the bottles we add small tube of vial containing absorbent of CO<sub>2</sub> (sodium hydroxide), which will reduce the carbon dioxide supply. Students then observe the plant size, color of the leaves, and compare the increase in plant dry weight between two treatments.

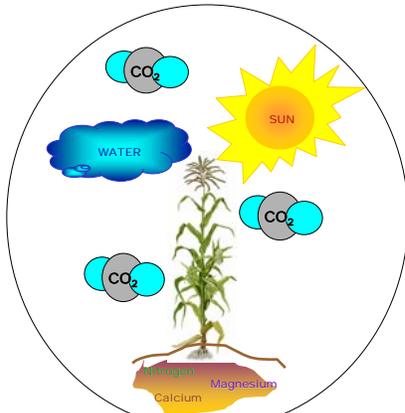


### Suggested questions:

1. How much CO<sub>2</sub> does the air contain?
2. Where is CO<sub>2</sub> stored in a plant's body?
3. Do the roots need CO<sub>2</sub> as well as leaves?



## What Do the Plants Need to Grow?



## Experiment 2 - LIGHT

In this experiment students explore how the absence of light affects maize growth. Students observe the plant size, color of the leaves and assess the increase of plant dry weight over time. One set of plants is planted in full daylight, the other set of plants is covered to prevent light access.



### Suggested questions:

1. What does the light supply to a plant?
2. Must plants have sunlight, exclusively?

## Experiment 3 - WATER

Students explore how the amount of water affects the growth of maize. They plant maize within two water supply treatments: 150 ml and 300 ml. Students observe the plant size and time until the plant has consumed the given water supply. Students harvest plants as soon as they become dry. The increase of plant dry weight is then compared between treatments. The experiment includes one control container without plants to account for simple evaporation.



### Suggested questions:

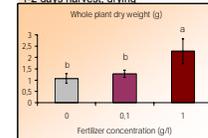
1. Are pure water and air sufficient sources for the plant growth?
2. Are the plants able to intake water by the leaves from the air?

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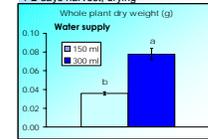
## Experiment 4 - MINERAL NUTRIENTS

Length of the experiment: 7 days seed germination, 10 days cultivation, 1-2 days harvest, drying



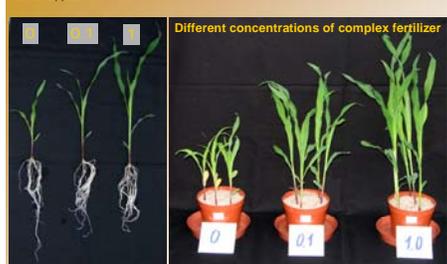
## Experiment 3 - WATER

Length of the experiment: 7 days seed germination, 11 (7) days cultivation, 1-2 days harvest, drying



## Experiment 4 - MINERAL NUTRIENTS

In this experiment students consider how the absence or addition of essential nutrients affects the growth of maize. Different dose of the complex commercial fertilizer Cristalon is applied to plants. Students observe the plant size, presence of nutrient-deficiency symptoms such as leaf yellowing, and assess the increase of plant dry weight over time. After the harvest, in addition to dry weight of whole plants, students compare the root : shoot ratio for plants treated with different nutrient supplies.



### Suggested questions:

1. What is the minimal amount of given nitrogen salt sufficient for plant to produce 1 kg of biomass?
2. Are any of the biogenous elements more important than the others?
3. Is the concentration of nutrient in soil / cultivation solution important for plants?

## Prospects and Plans:

- o The pilot set of the present experiments is going to be tested by 10 pilot schools in the U.S. and 10 in the Czech Republic during 2007/2008.
- o Development of supporting texts and materials.
- o New additional experiments of all 4 types are going to be designed and verified for different levels of difficulties during 2007/2008.