



North American Carbon Program

Continental Carbon Budgets, Dynamics, Processes, and Management

GLOBE



Carbon Cycle

GLOBE Carbon Cycle: Integrating NASA Carbon Cycle Science with GLOBE education

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Sarah Silverberg and Gary Randolph



The Carbon Cycle Science Team



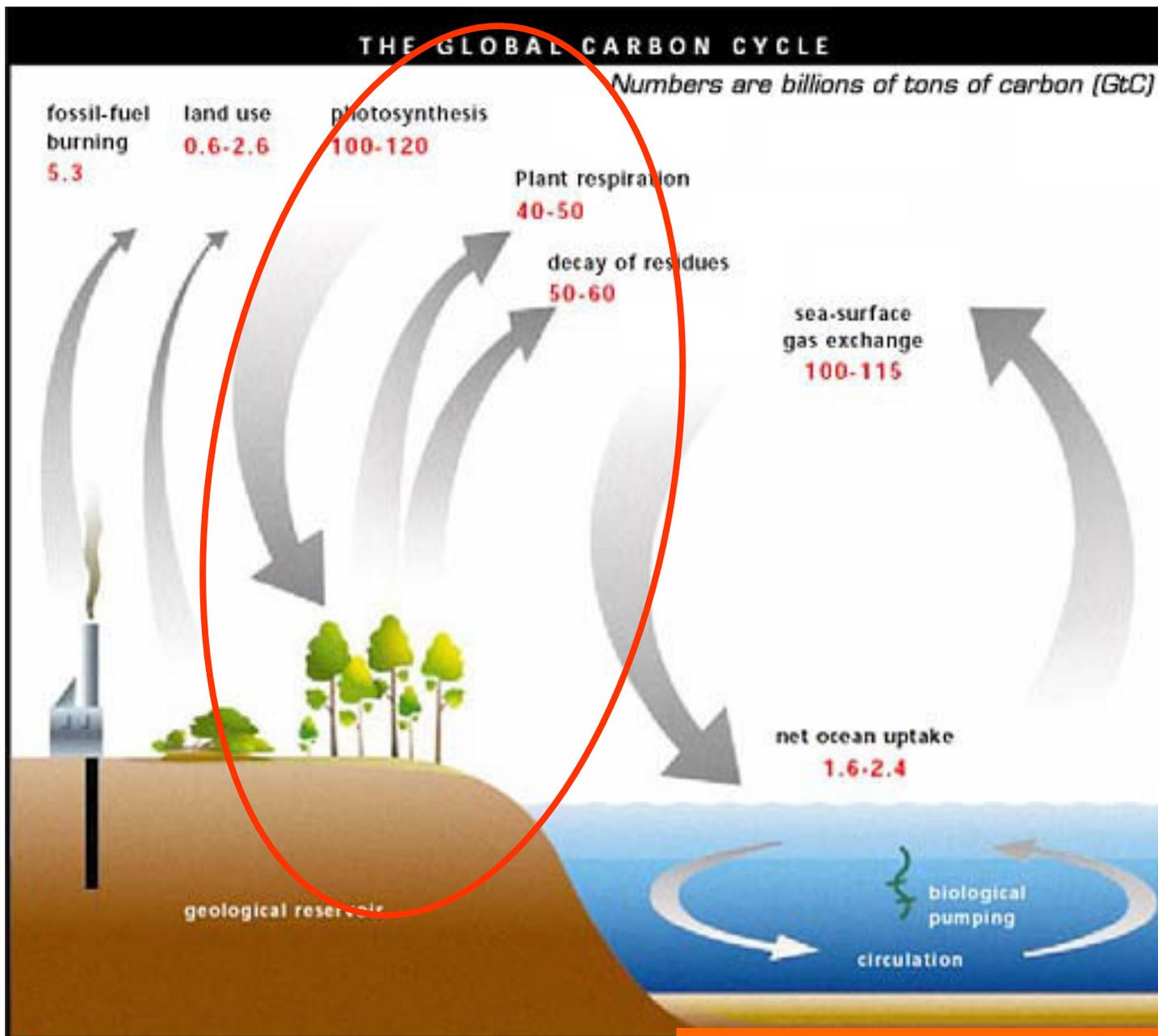
This talk: (1) Why Carbon? (2) Carbon Science in the Classroom (our vision) – proposed activities

Carbon: A building block of life



- The most abundant element in living things
- Accounts for 45-50% of the total mass of the biosphere.
- Also present in the Earth's, atmosphere, soil, oceans, and crust





Source: <http://www.esd.ornl.gov/iab/iab2-2.htm>

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Proposed Activities Under Development

1. Global Carbon Model

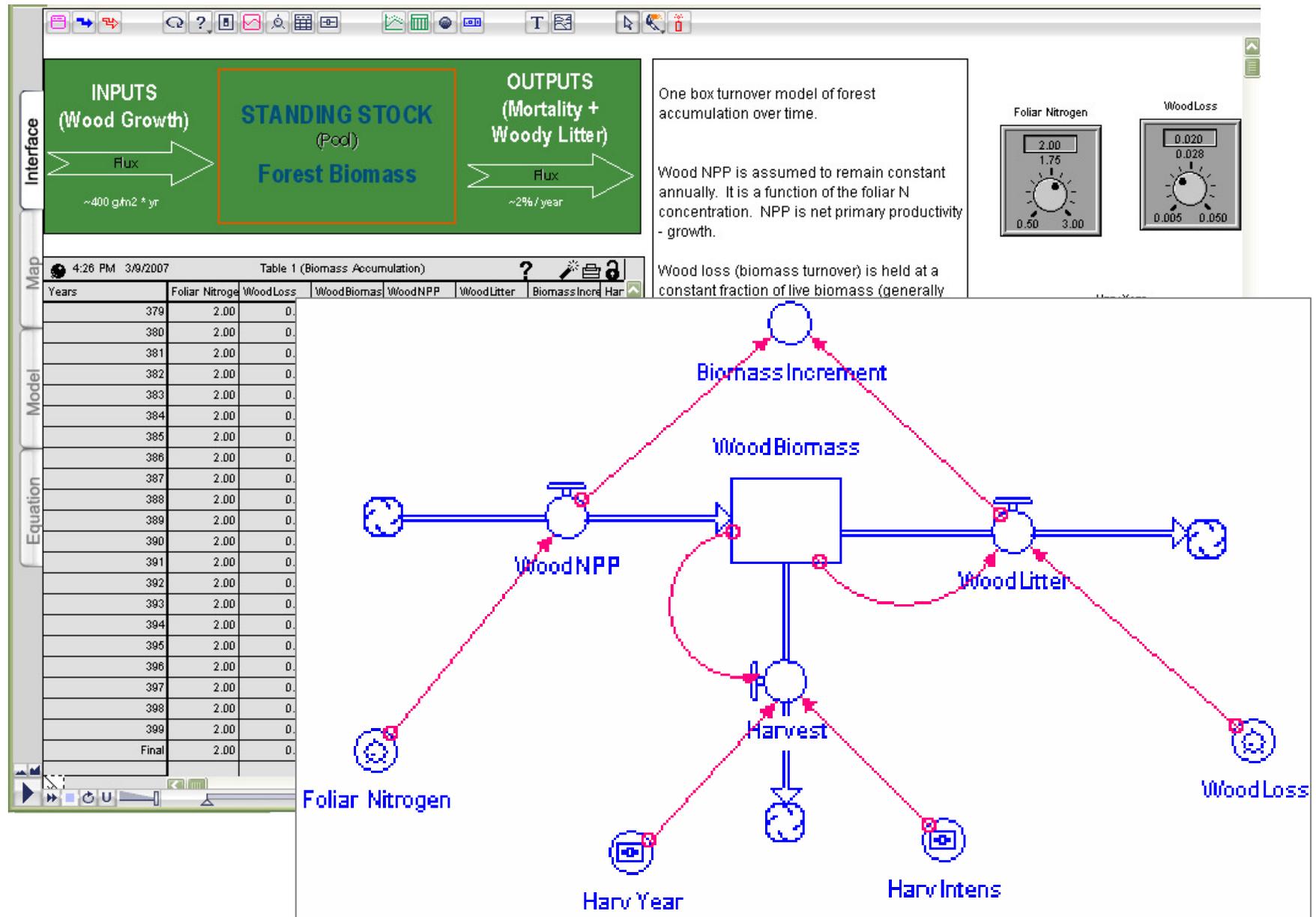
- **First major initiative of the Carbon Cycle project**
- **Easily used to teach the carbon cycle**
- **Introduces students to the use of modeling in science**
- **Applicable to students around the world, regardless of where they live**

Models Don't Need to be Complex to be Useful

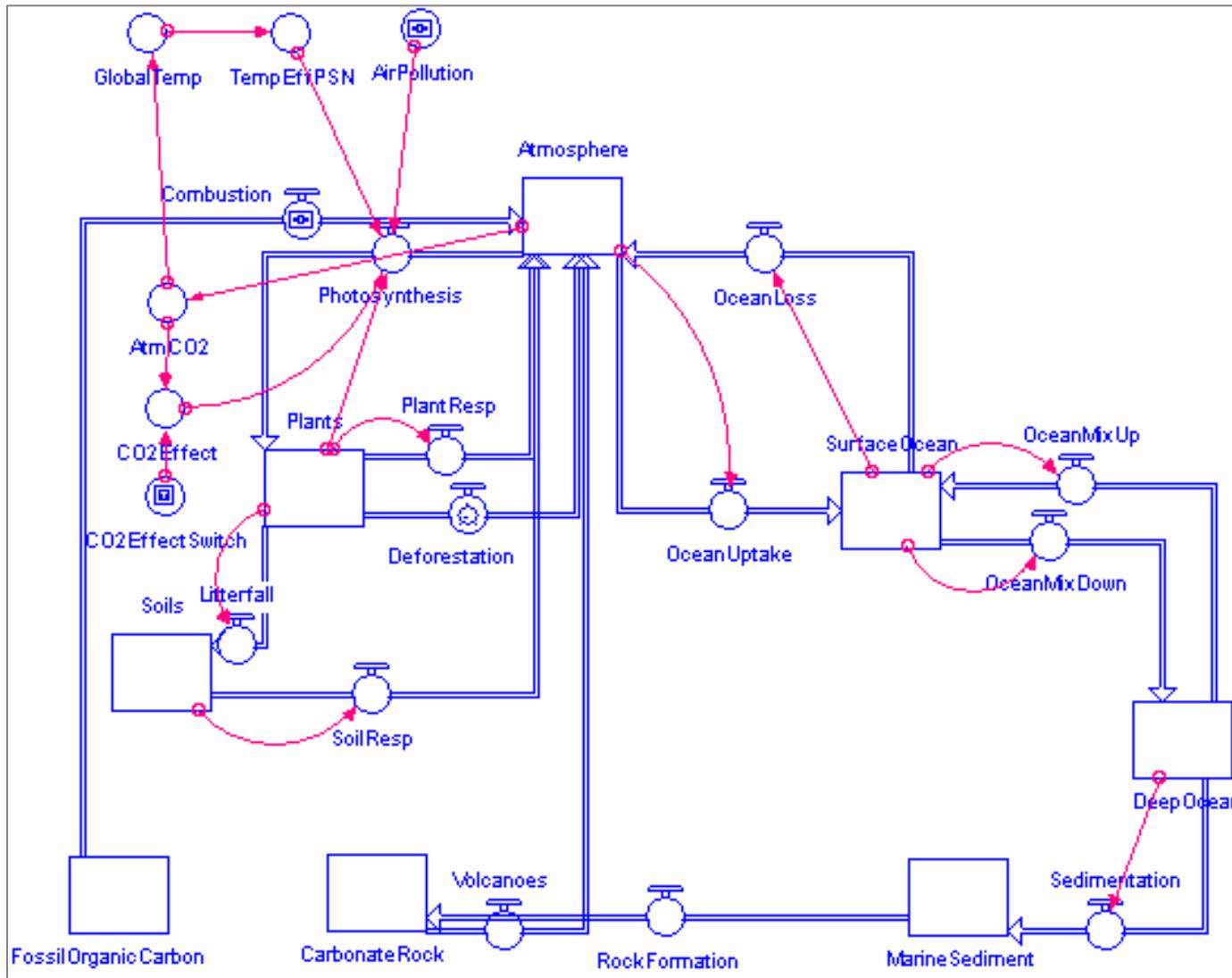
A "Box and Arrow" or "Pool and Flux" model



1 Box Forest Biomass Model- STELLA



Global Carbon Model- STELLA (in progress...)



<http://www.iseesystems.com/>

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Proposed Activities Under Development

1. Global Carbon Model

2. Field Measurements

- **Designed similarly to existing GLOBE protocol**
- **Comparison of measurements between schools**
- **Allow students to make connections between the global C cycle and their own schoolyard**
- **Used in conjunction with the Remote Sensing Toolkit**
- **Used as inputs to the PnET Ecosystem Model**

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Proposed Activities Under Development

1. Global Carbon Model

2. Field Measurements

3. Remote Sensing Toolkit

- **Learn the nature of remote sensing and satellite imagery as a tool for looking at the world**
- **Understand how scientists use maps and satellite images to estimate global carbon storage**
- **Use remotely sensed images for specific investigation**
 - § **Comparison of carbon between locations**
 - § **Relationship to field measurements**
 - § **Change in the landscape over time and its effect on carbon**

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Proposed Activities Under Development

1. Global Carbon Model

2. Field Measurements

3. Remote Sensing Toolkit

4. PnET Ecosystem Model

- **Further exploration of modeling**
- **Understand changes in carbon storage at the ecosystem rather than global level**
- **Connection field collected data**
- **Enables individual investigations**

Change in carbon with change in environmental conditions

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Proposed Activities Under Development

1. Global Carbon Model

2. Field Measurements

3. Remote Sensing Toolkit

4. PnET Ecosystem Model

5. Plant-a-Plant Experiments

- o **Hands-on activities: range of cultivation experiments with real plants**
- o **Experiments are designed for different levels of difficulties**
- o **Exploration and validation of necessity of sources determining plant growth**
- o **Demonstration that CO₂ is incorporated into plant biomass**
- o **Understand changes in carbon storage at the ecosystem rather than global level**

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Czech Collaboration - Project team



Charles University of Prague, Faculty of Science, :

Project coordinator and PI: Jana Albrechtová,

Associate Professor, Head of the Department of Plant Physiology

Administration: Zuzana Lhotáková



TEREZA Association,

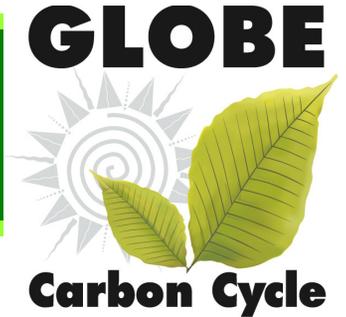
NGO focused on environmental education, coordinator of GLOBE project in Czech Republic; www.terezanet.cz

Project coordinator: Dana Votápková

Administration: Kateřina Čiháková, Barbora Semeráková

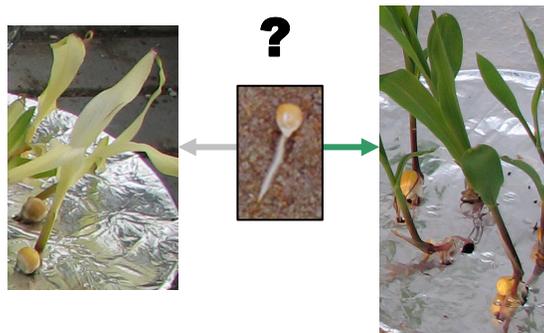


„Plant a Plant“ activity

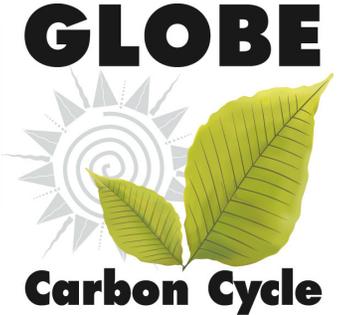


Developing easy experiments which should allow students to:

- formulate hypotheses about plant growth based on given information
- conduct an experiment, make measurements and record observations
- understand how plants grow and what sources including CO₂ they need to grow



„Plant a Plant“ activity



Preconditions of the experimental design:

1. Selected plant species should be available worldwide
2. Experiments should last up to 14-20 days or more
3. Low cost, high availability materials

Solutions:

1. Maize, beans, horseradish, etc
2. Tests in progress
3. Materials: laboratory or kitchen scale, plastic pots or containers, plastic bottles, sand, ruler, paper bags....
commercially available fertilizer is being tested

„Plant a Plant“ activity



Experiments on:



Mineral nutrition (Experiment 1)

Results available, fertilizer adjustment in progress



Light access (Experiment 2)

Results available



Carbon dioxide supply (Experiment 3)

Adjusting conditions, growing media, plant species

„Plant a Plant“ activity

Mineral nutrition (Experiment 1)

DAY 1



Maize seeds prepared for germination on water saturated sand

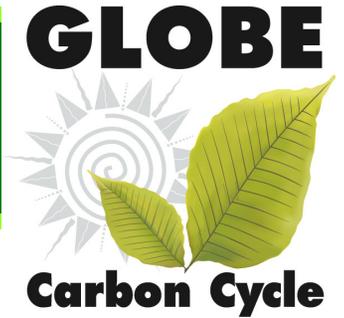
DAY 7



Maize seeds prepared with root elongated enough to plant in cultivation media

„Plant a Plant“ activity

Mineral nutrition (Experiment 1) DAY 12



0.1 g/l of fertilizer

distilled water

„Plant a Plant“ activity

Mineral nutrition (Experiment 1)

DAY 16

Hydroponical planting (without soil)

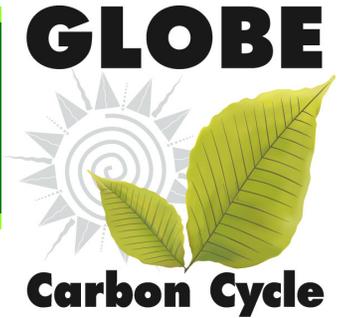


distilled water

0.1 g/L fertilizer

„Plant a Plant“ activity

Mineral nutrition (Experiment 1)



Planting in sand



0.1 g/l fertilizer

0.2 g/l fertilizer

0.5 g/l fertilizer

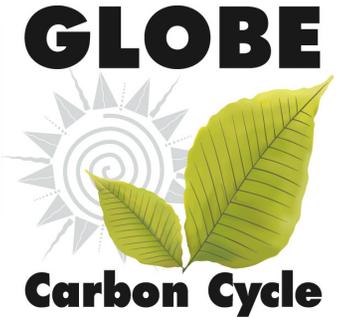
„Plant a Plant“ activity

Light access (Experiment 2)

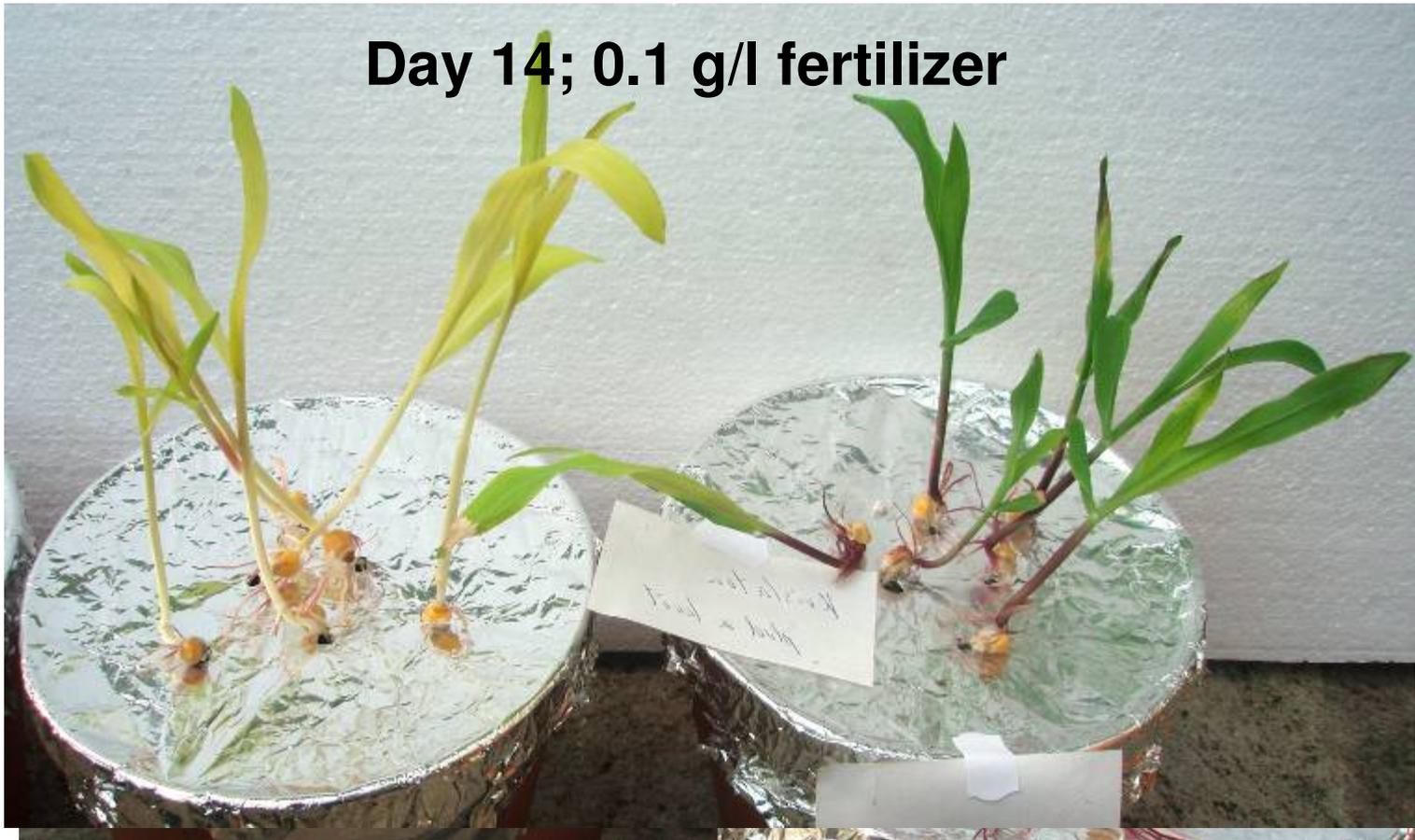


„Plant a Plant“ activity

Light access (Experiment 2)



Day 14; 0.1 g/l fertilizer



„Plant a Plant“ activity

Carbon dioxide supply (Experiment 3)



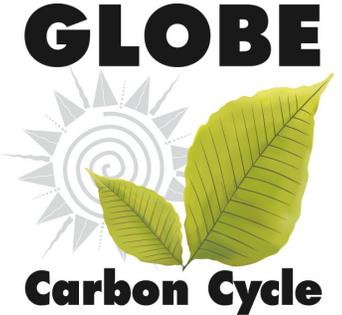
Day 14 (7th in the bottle)



Bean Bottle test



„Plant a Plant“ activity



Conditions and Reliability of Experiments have just been tested at the Department of Plant Physiology, Charles University, Prague

The first results are now available (will be presented)

Manuals and work sheets for teachers and students are under preparation - an early version was presented at the Teacher's Think Tank in Prague 24th-25th March 2007

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Teachers' Think Tank Workshop

Demonstration of Plant-a-Plant Activities



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Teachers' Think Tank Workshop



GLOBE Carbon Cycle Project Czech Republic

Teachers' Think Tank Workshop

March 24-25, 2007, Prague

**Charles University of Prague, Faculty of Science
Department of Plant Physiology**

TEREZA Association (GLOBE coordinator in Czech Republic)

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Carbon Cycle

Teachers' Think Tank Workshop

Carbon Cycle Project Participants

= students and teachers of secondary schools experienced in GLOBE activities

Pilot 10 schools:

- from the Czech Republic and from the USA
- participate in evolving and testing new GLOBE protocols and activities of Carbon Cycle Project



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Czech Collaboration –

Pilot Schools – Carbon Cycle Project participants

Schola Humanitas, Litvínov

www.humanitas.cz

Střední lesnická škola, Šluknov

www.lesnicka-skola.cz

Střední odborná škola a Gymnázium, Staré Město

www.szesgsm.cz

Česko-anglické gymnázium, České Budějovice

www.caq.cz

Gymnázium Kadaň

www.gymnazium-kadan.cz

Střední vinařská škola, Valtice

www.svisv.cz

SPŠP - COP, Zlín

www.isstzlin.cz

ISS - COP, Valašské Meziříčí

www.isscopvm.cz

Střední průmyslová škola, Karviná

www.sps-karvina.cz

Purkyňovo gymnázium, Strážnice

www.gys.cz



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Czech Collaboration – Web site

<http://kfrserver.natur.cuni.cz/globe/>

A banner for the GLOBE Carbon Cycle Project. On the left is a circular logo with the text 'The GLOBE Program' and an image of a person holding a globe. In the center, the text 'Carbon Cycle Project' is written in blue. On the right, a list of joint project partners is provided, and a small drawing of a girl holding a globe is on the far right.

Joint Project

- GLOBE
- University of New Hampshire, USA
- Charles University of Prague, CZ
- Tereza Association, CZ

sdružení
TEREZA

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Carbon Cycle Team – We get ready!



Albrechtova, Ollinger, Votapkova et al.: GLOBE Carbon Cycle Project, Budapest, 29th March 2007