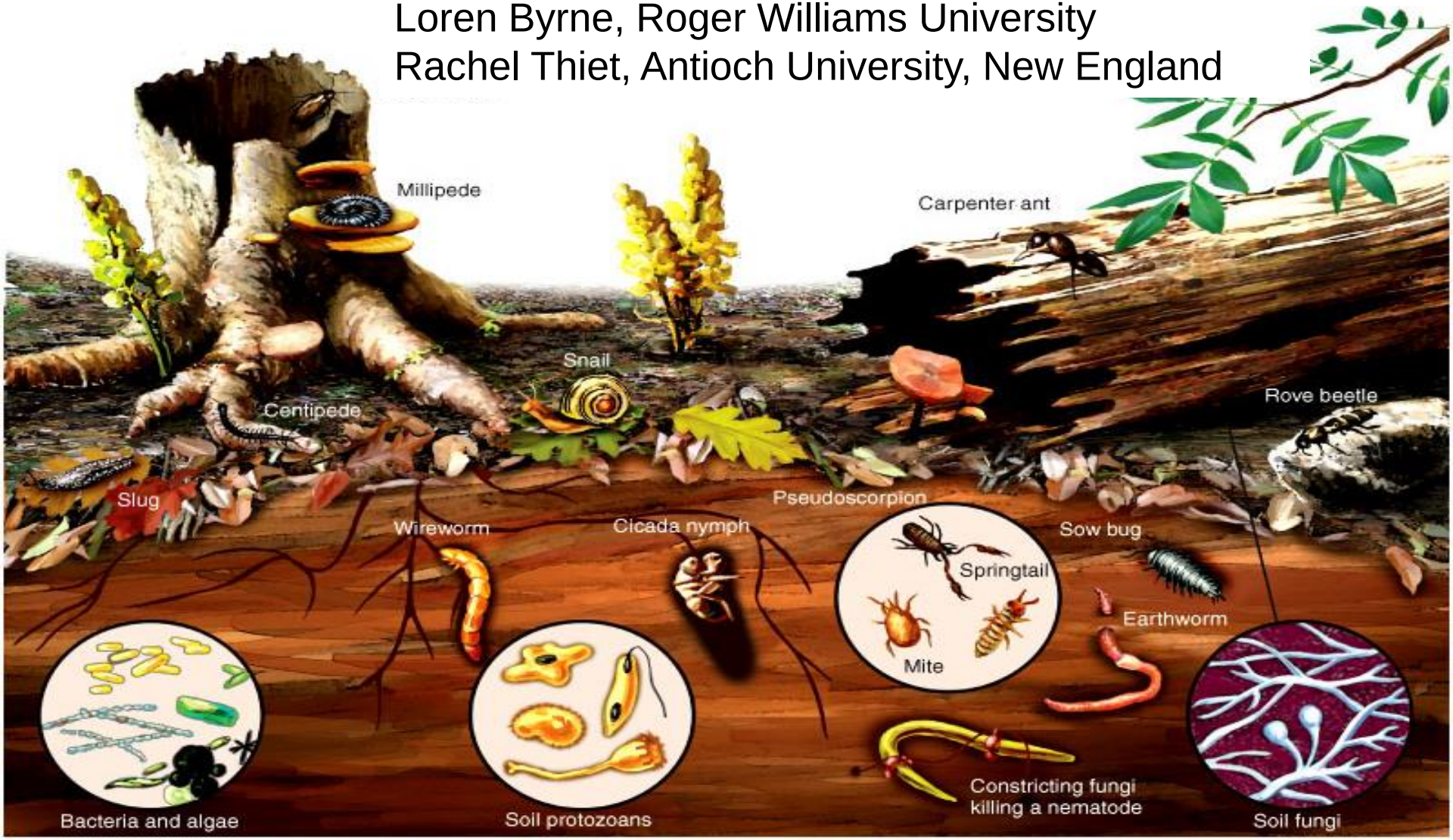
Welcome to the 2009 SES teaching workshop: Learner-centered Soil Ecology Education

Loren Byrne, Roger Williams University
Rachel Thiet, Antioch University, New England



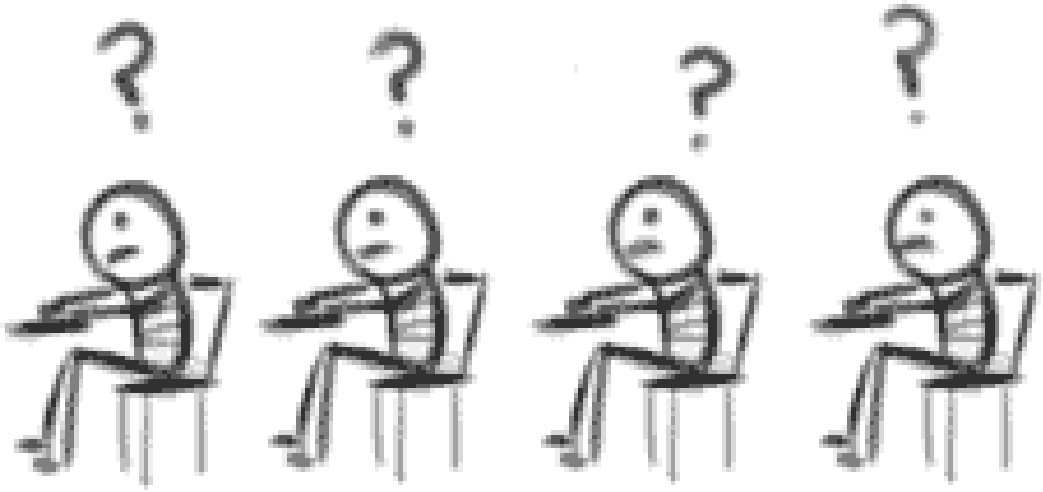
What is learner-centered teaching?

Please respond on your ½ sheet

What is *not* learner-centered teaching?

Stereotypical, Default pedagogy:

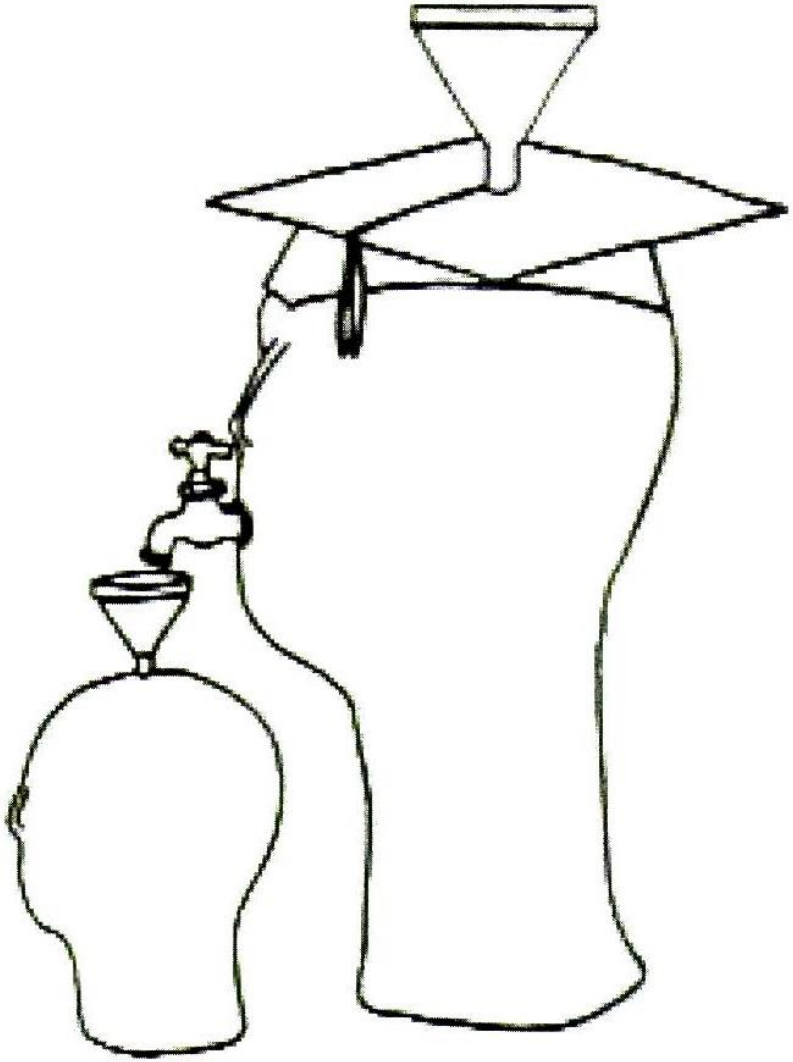
Sage on the Stage



http://tomjech.com/blog/category/images

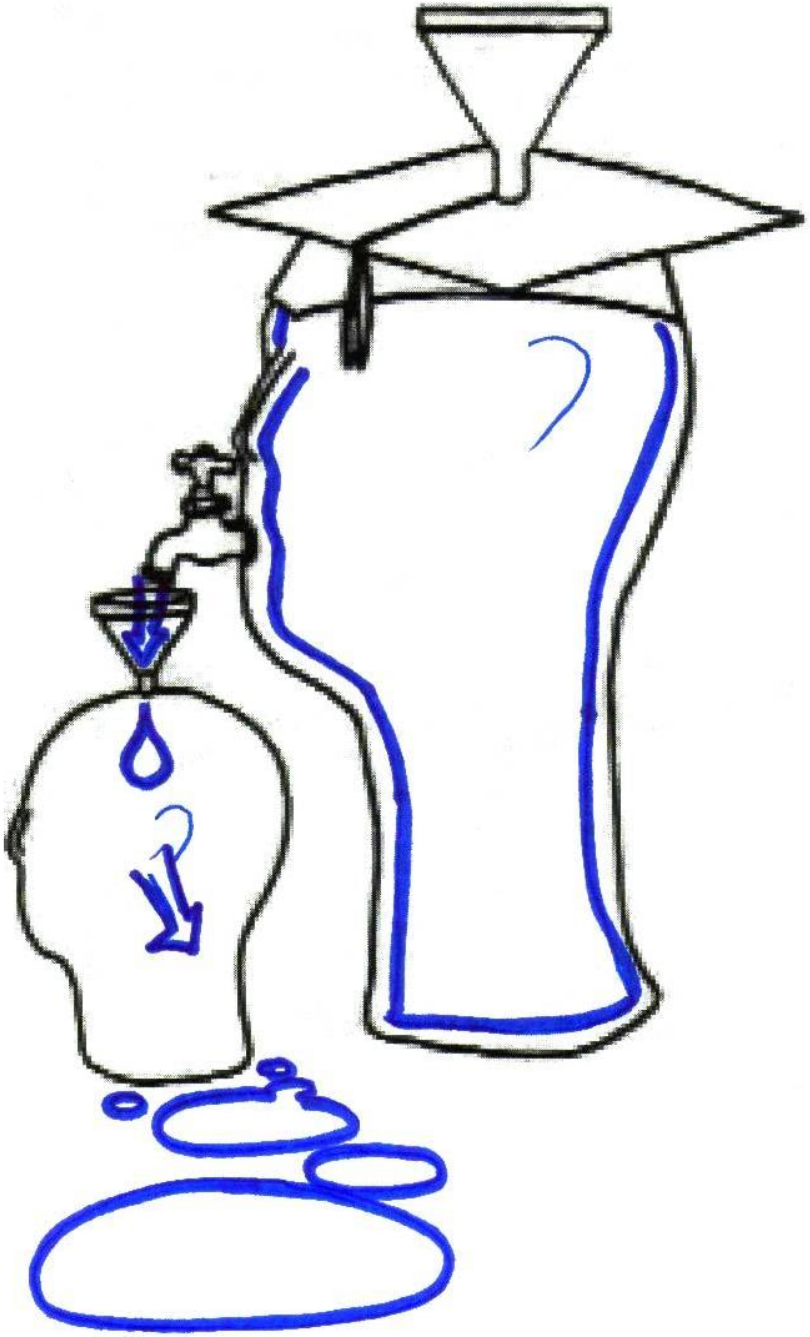
Stereotypical, Default philosophy:

Students are empty vessels to be filled with knowledge from the teacher



but…

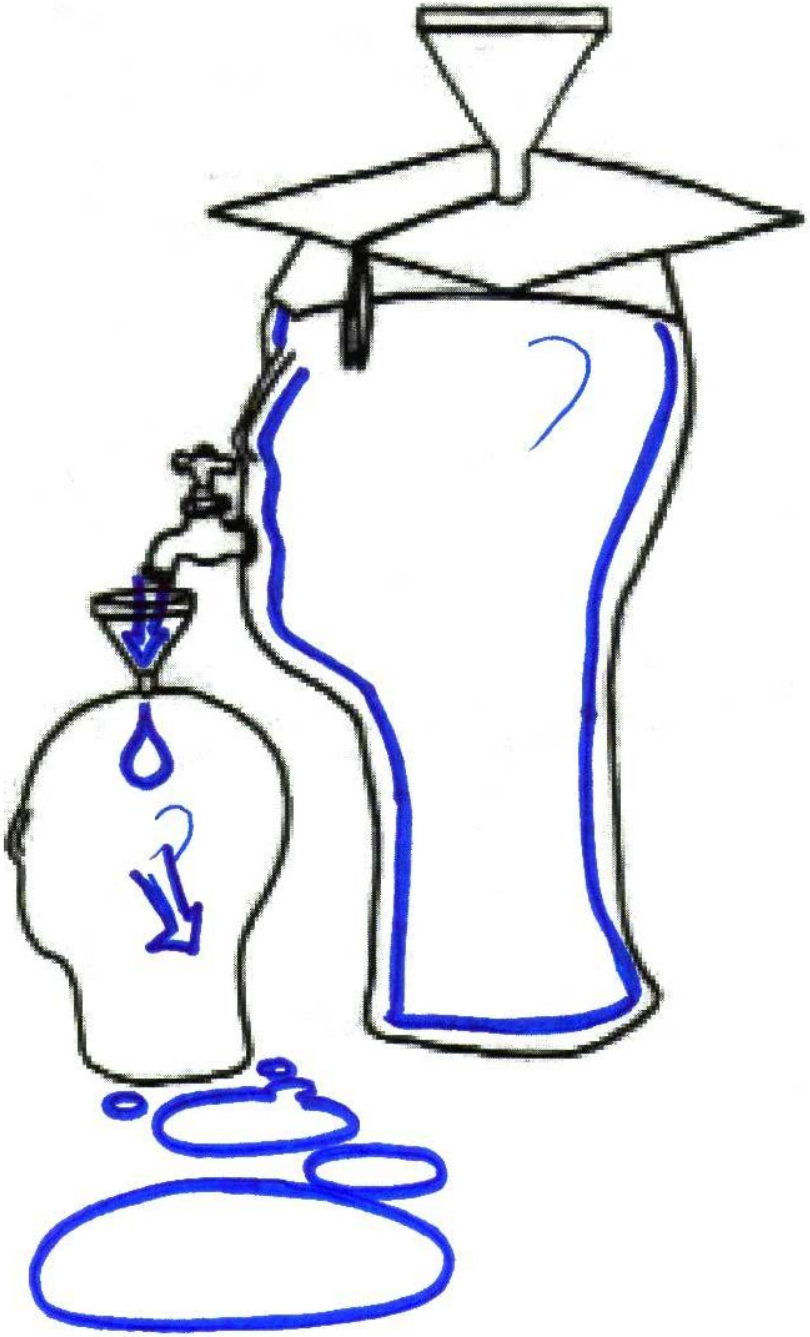
Students are leaky vessels!



but…

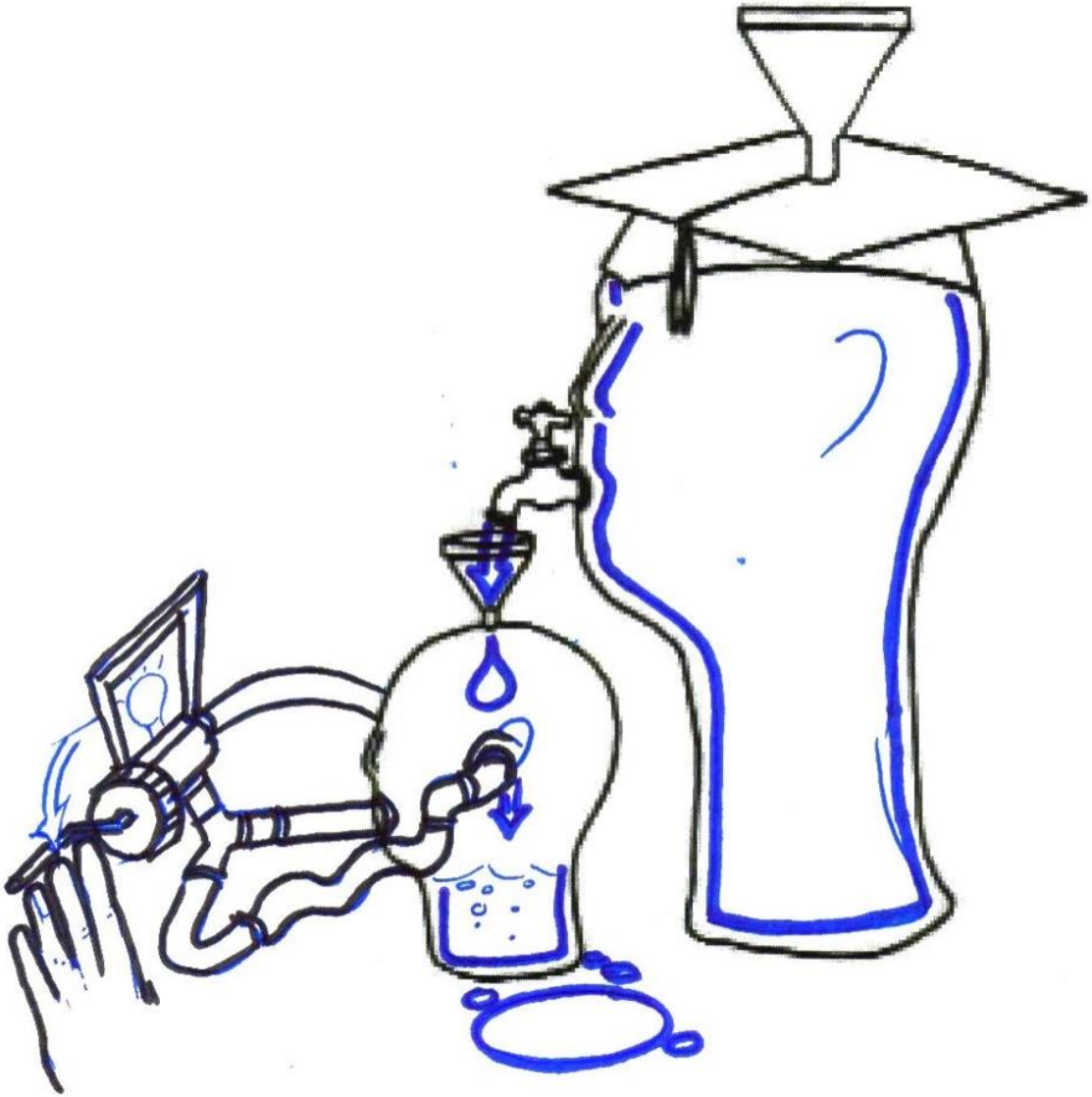
Students are leaky vessels!

"Covering" content may actually pave it over!



Emerging, research-Based philosophy:

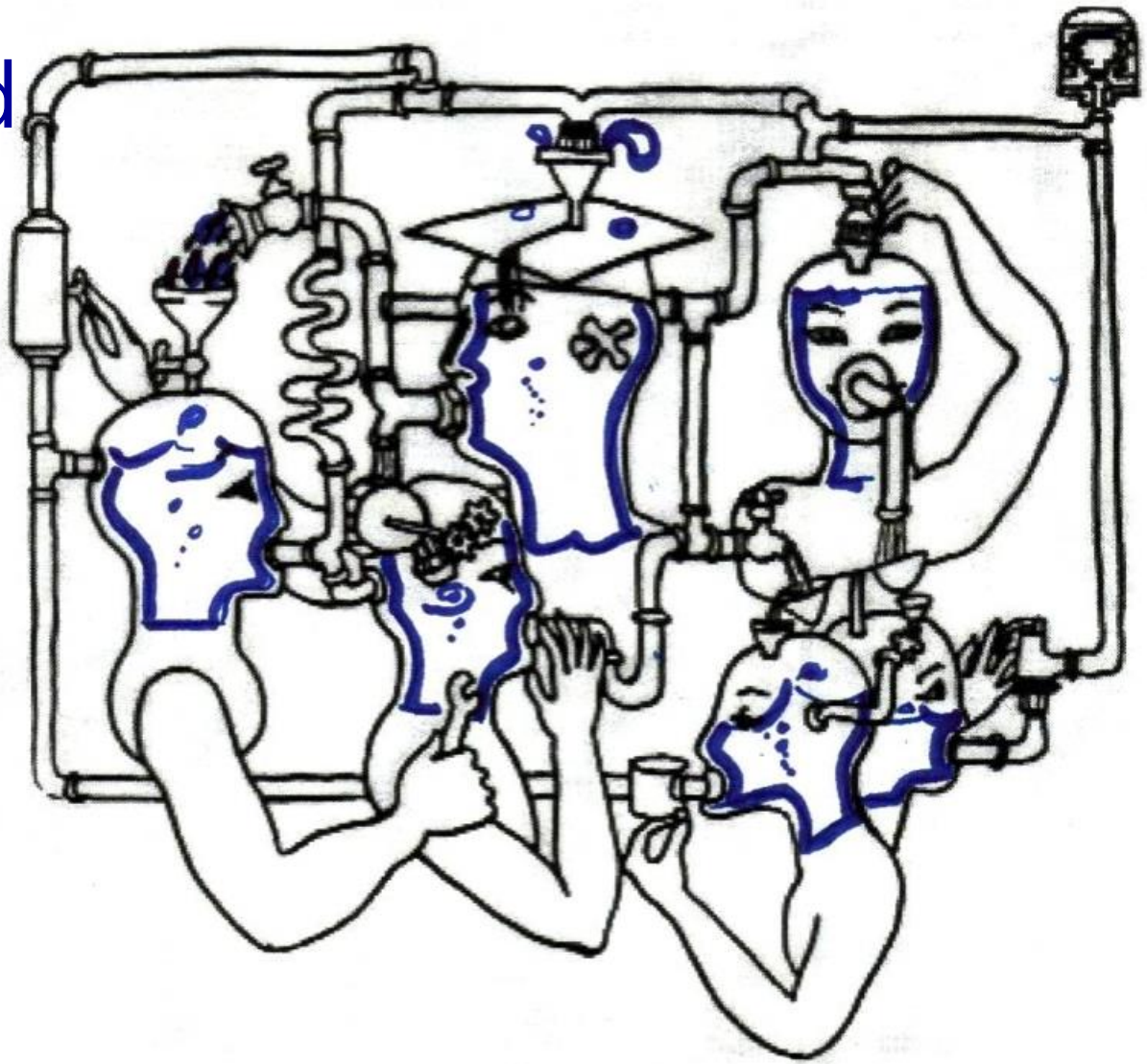
Gaining knowledge requires active engagement



by a learner who *wants* to learn!

Emerging, research-Based philosophy:

learning is an active, community-based process



with interactions & contributions from all

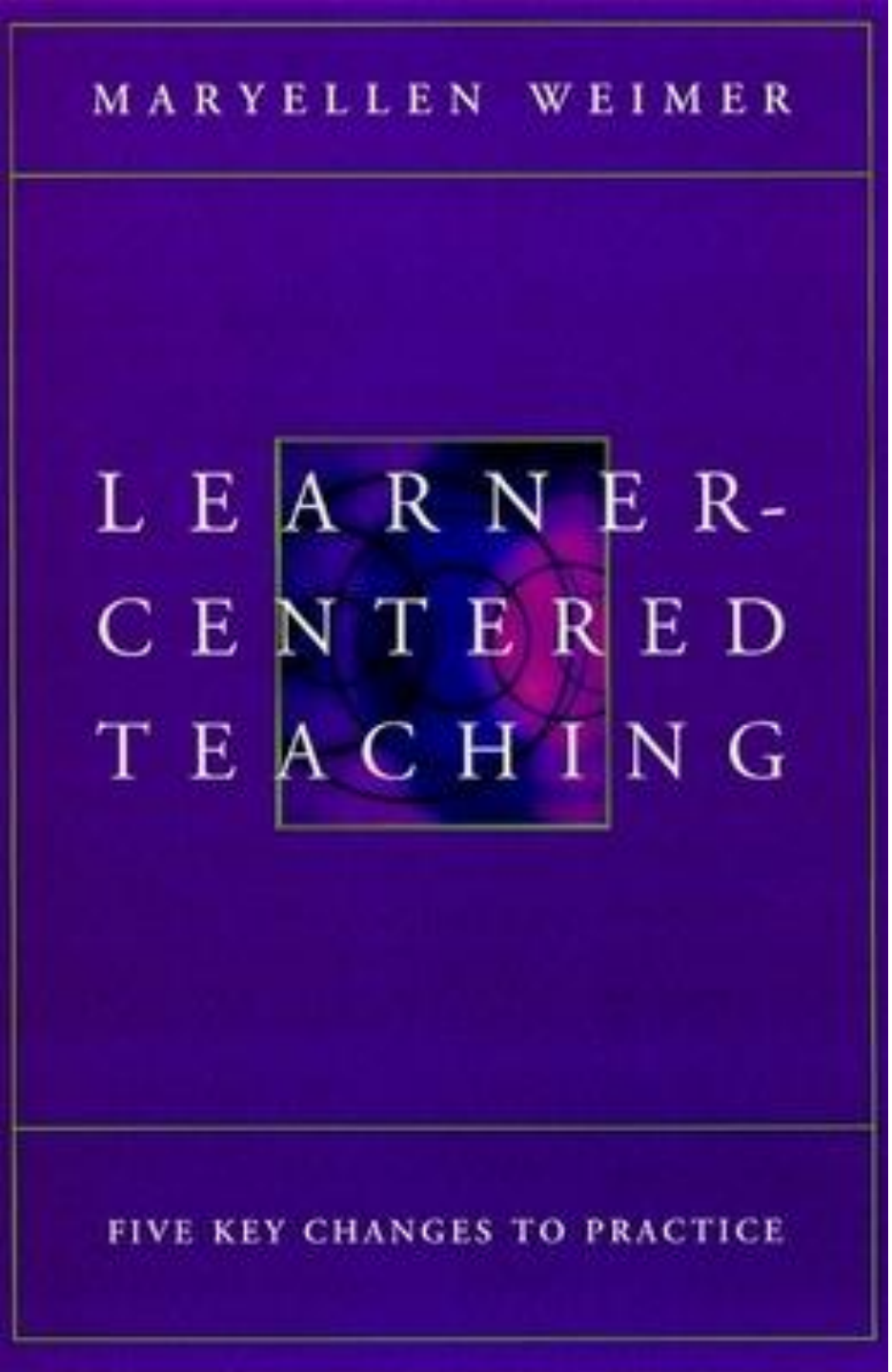
What is learner-centered teaching?

"As you enter a classroom, ask yourself this question: If there were no students in the room could I do what I am planning to do?

If your answer to that question is yes,

don't do it."

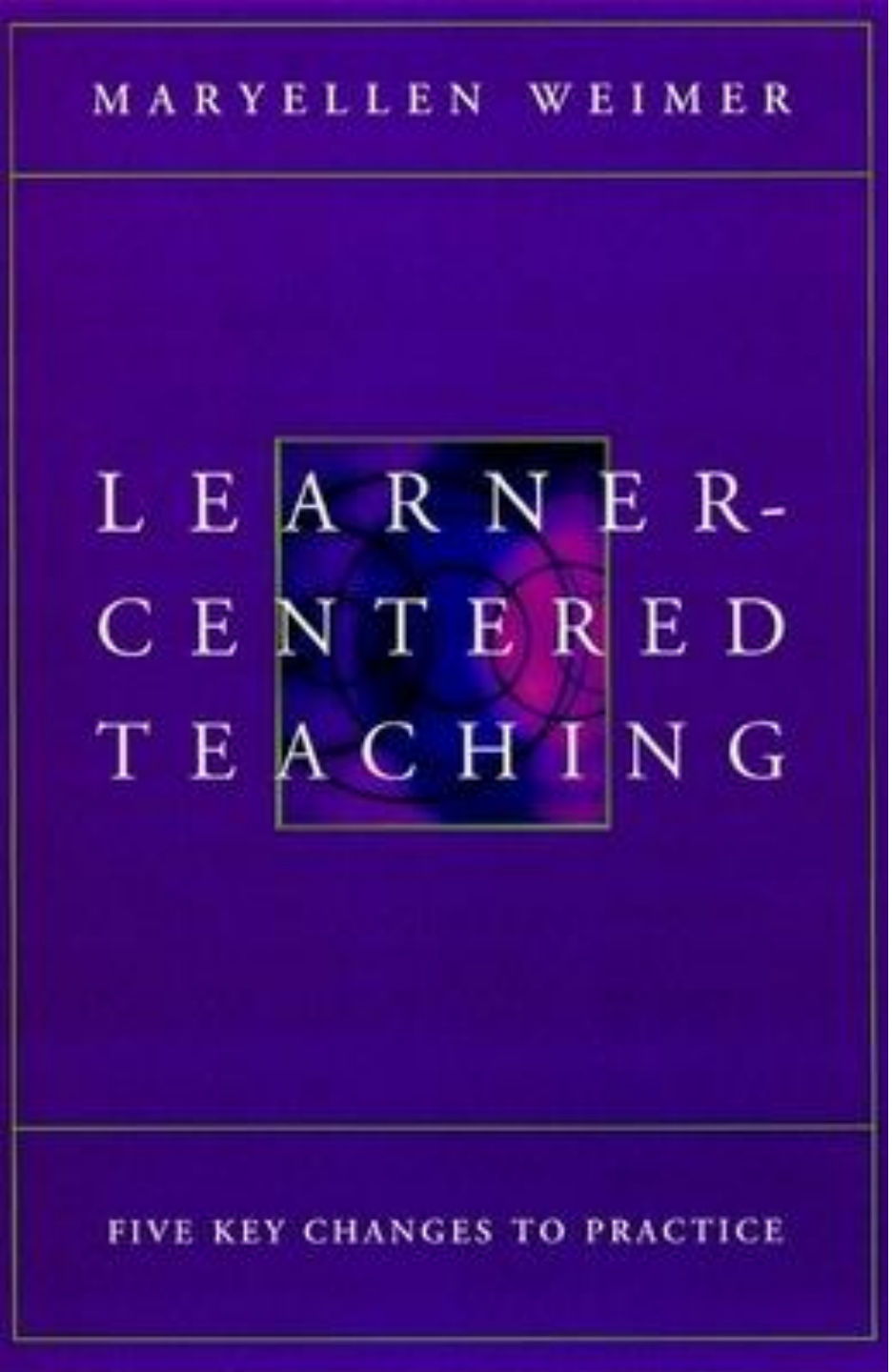
Gen Ruben Cubero, Dean of the Faculty of the USAF Academy



→ Emphasis on learners & learning

→ How can teachers facilitate learning for the learners?

→ Rather than “teach” a dog how to speak

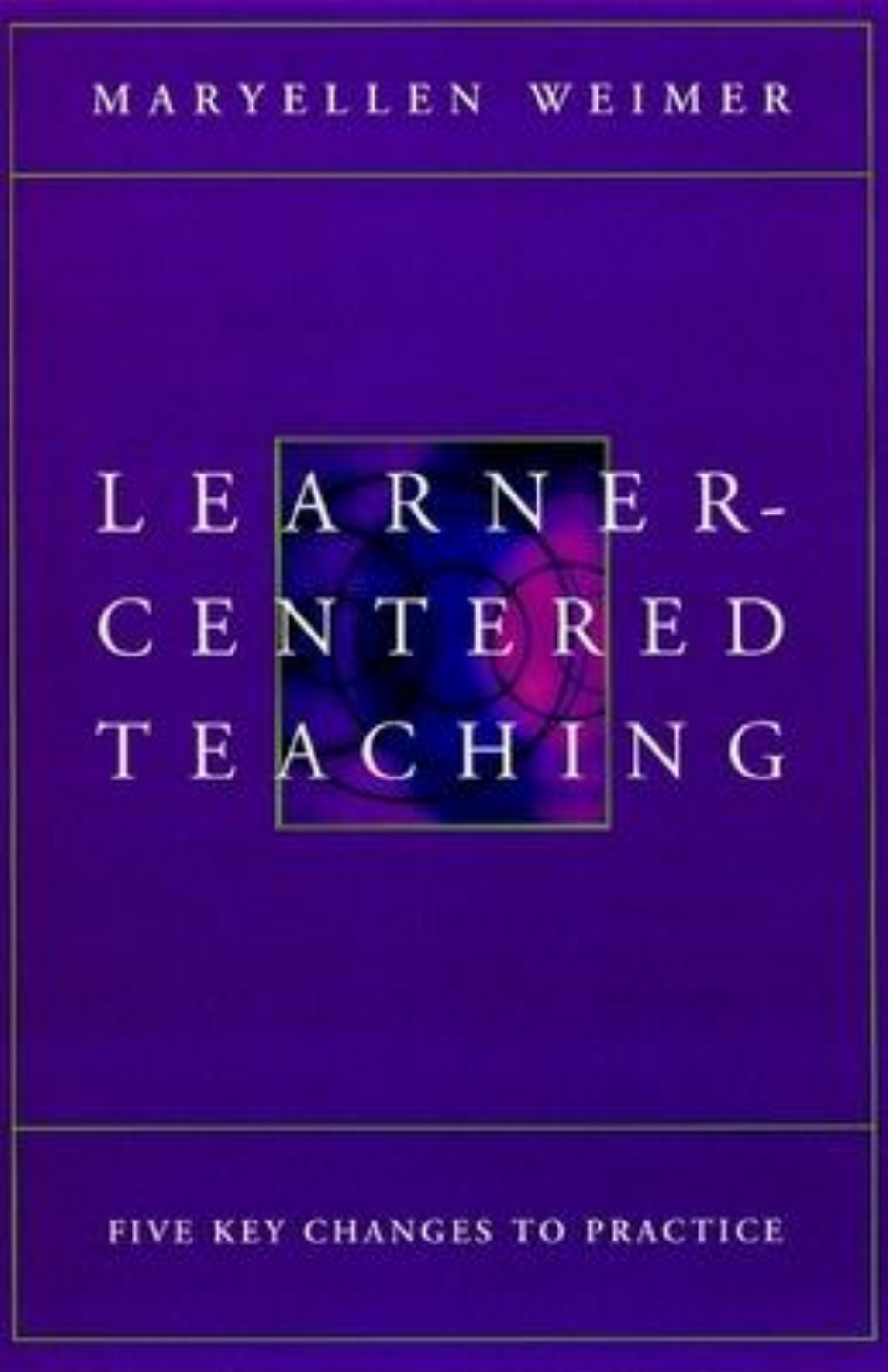


→ Emphasis on learners & learning

→ What teaching methods give students more responsibility for their own learning?

"We have expected (teachers) to *cause* learning in students, when of course learning must be *caused by* the learner."

--Novak and Gowin (Learning how to learn)



→ 5 changes

1. Shift power balance
2. Constructing content
3. Teacher = learning facilitator
4. Student responsibility
5. Assessment for learning

1. Shift power balance

Give students some/more control in the classroom

- How much?
- When?
- How?

1. Shift power balance

What do students want to learn?
How will they learn best?

Example: Soil ecology syllabus creation

	% of final grade
• Half-sheets (homework, quizzes, in-class writing	20
• Journal construction and 10 entries	15
• *"Professor for a day" biodiversity presentations*	*15*
• Term paper	20
• Term paper oral presentation	5
• Lab attendance and participation	5
• Lab response sheets and data set	10
• Aggregate project contribution	10

2. Constructing content

"Learning is a constructivist process that involves building links between new information and experiences onto the individual's existing knowledge base.

- Blumberg (Developing Learner-Centered Teaching)

2. Constructing content

“Learning is a constructivist process that involves building links between new information and experiences onto the individual’s existing knowledge base.

These links may add to, modify, or reorganize existing knowledge. In order to learn, each person needs to construct or make his own meaning of knowledge.

- Blumberg (Developing Learner-Centered Teaching)

2. Constructing content

"Learning is a constructivist process that involves building links between new information and experiences onto the individual's existing knowledge base.

These links may add to, modify, or reorganize existing knowledge. In order to learn, each person needs to construct or make his own meaning of knowledge.

Therefore, you as instructor cannot construct knowledge for your students."

- Blumberg (Developing Learner-Centered Teaching)

2. Constructing content

Helping the learner learn by exposing what s/he

- knows
- doesn't know
- misunderstands

Example: ½ sheet questions

→What is soil?

→ Name soil organisms you know.

→How do soils relate to global climate change?

3. Teacher = learning facilitator

The role of the teacher in a L-C classroom is still important:

- **To design learning experiences**
- **To empower students to learn**
- **To provide feedback (assessment)**

3. Teacher = learning facilitator

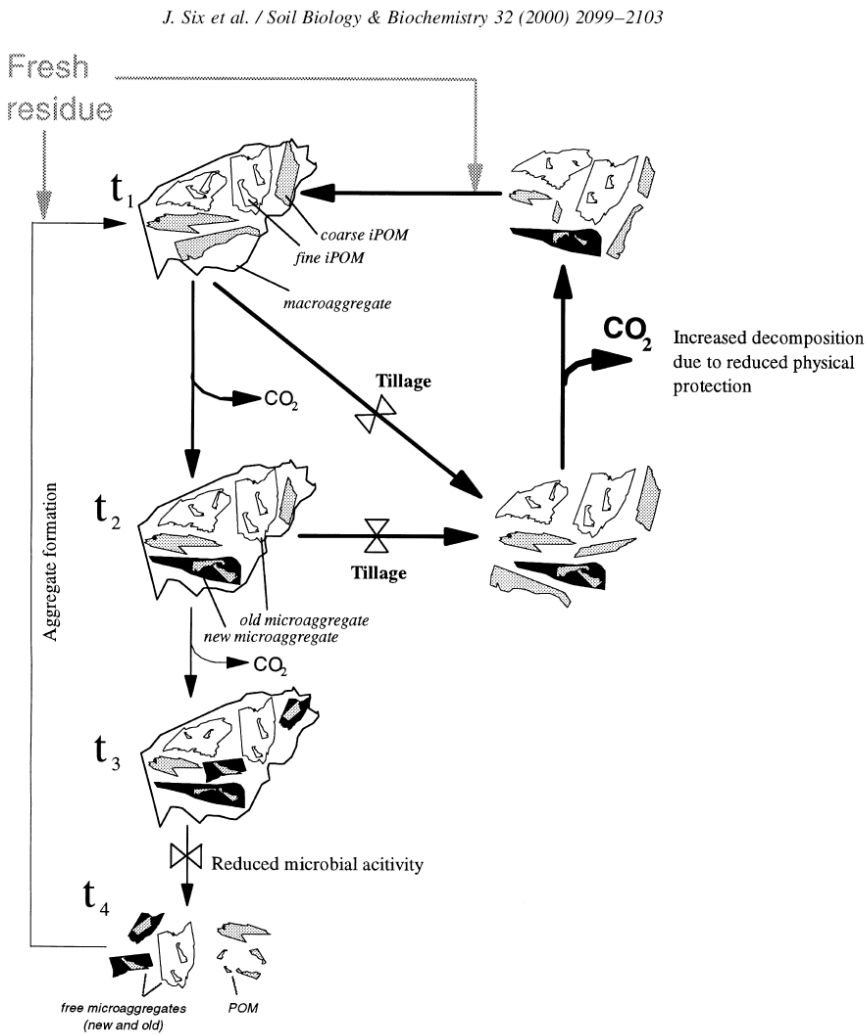
- **To design learning experiences**

Examples:

→ questions to guide independent learning from papers

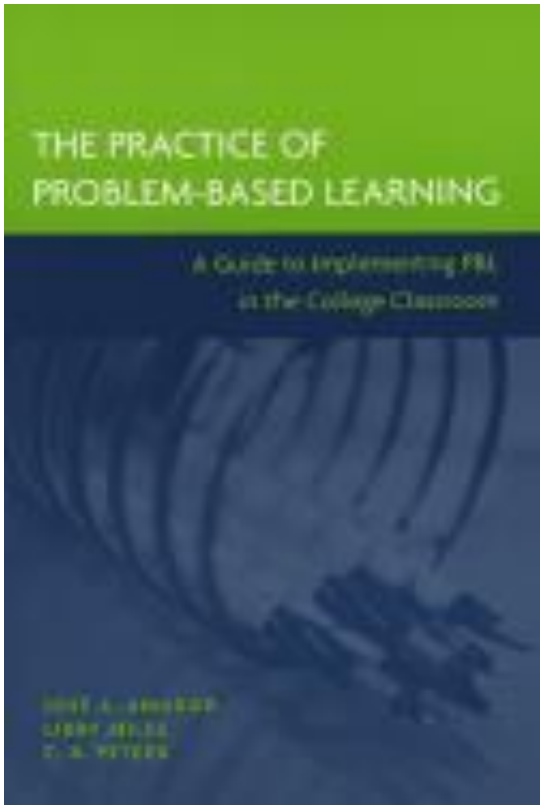
→ Soil aggregate mode

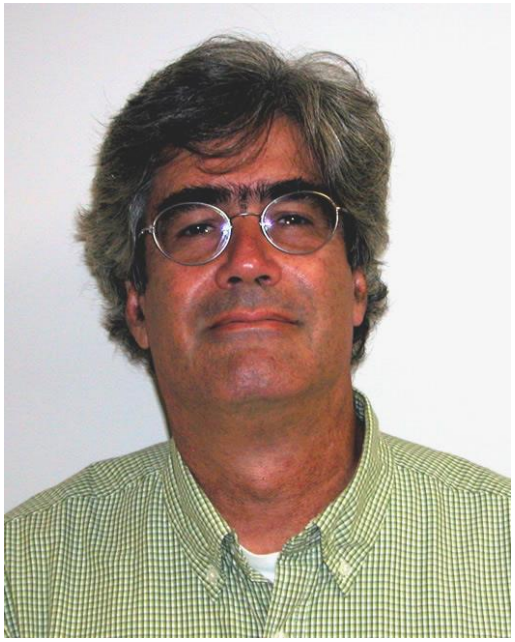
(Bruns and Byrne 2004)



Pedagogy by any other name…

Problem-Based Learning





Jose Amador
Soil ecologist at URI

Inquiry-based learning

Discovery-based learning

Socratic teaching

4. Student responsibility

for their own learning

How can dependent students be turned into independent learners?

It's not an inevitable outcome

- use content to develop skills
- teaching students how to learn

4. Student responsibility

- teaching students how to learn
- use content to develop skills

4. Student responsibility

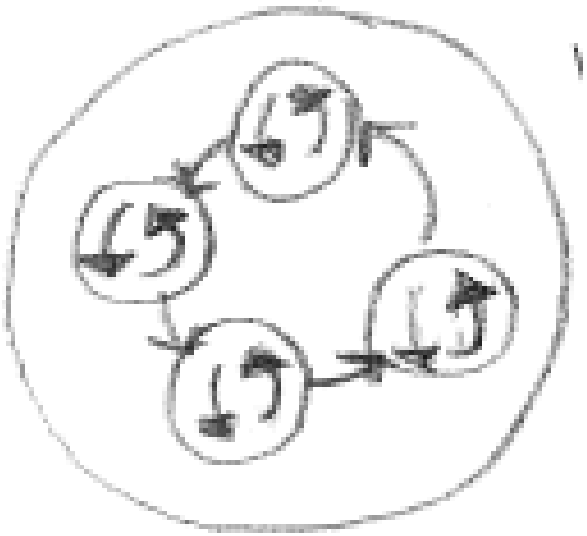
- teaching students how to learn

- use content to develop skills

Example: learning journals

"You learn something and tell me what you're learning … "

"The overall message that I've learned in soil ecology is the ideas of heterogeneity and cycles. … However, all of these small cycles come together to make one "big-picture" cycle that involves the soil and also the rest of the earth and atmosphere."



5. Assessment for learning

It's not just about tests anymore!

Summative assessment

At the end of lessons

Comprehensive

And done!

Promotes shallow learning?

5. Assessment for learning

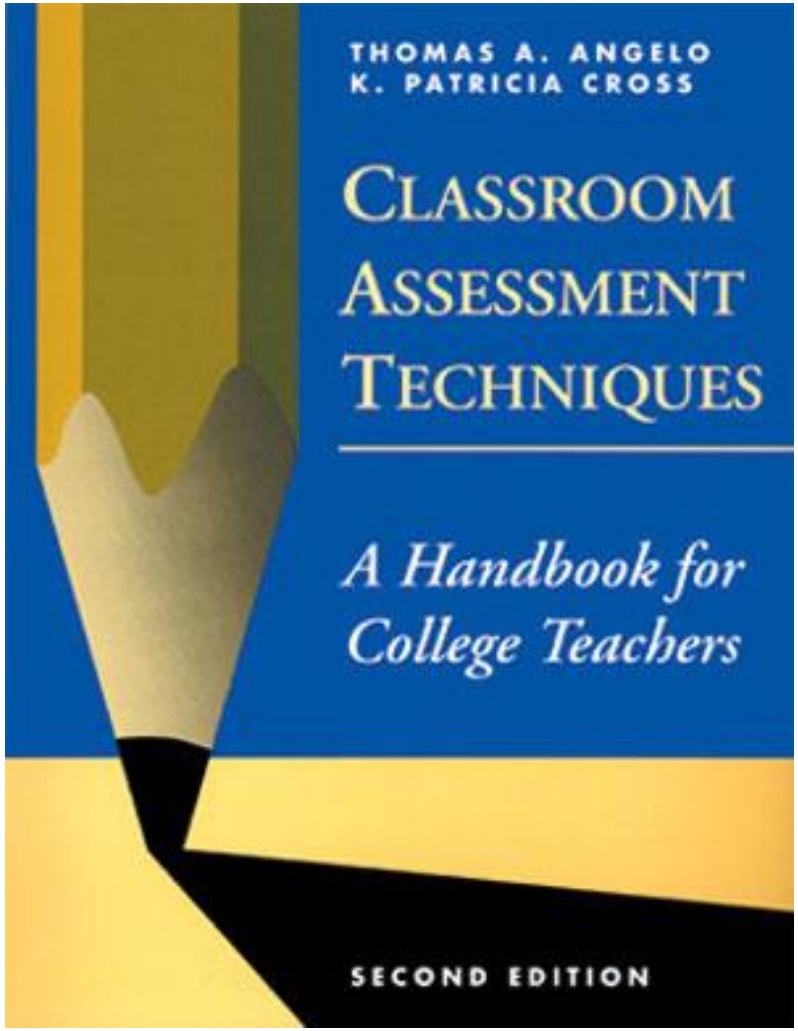
It's not just about tests anymore!

Formative assessment:

- during lessons
- often
- varied
- repetitive
- critical thinking

- Promote self-assessment:
  - students see what they need to learn
- Feedback to instructor

5. Assessment for learning



Many formative assessment methods

Example: in class ½ sheet

- What is the take-home message of the last/today's class?

Leads to deeper, constructivist learning?

Some personal conclusions

- LCT creates a more dynamic, energized classroom
- allows for more creativity & ... Fun!

Some personal conclusions

- LCT creates a more dynamic, energized classroom
- allows for more creativity & ... Fun!
- students are more engaged & focused on learning
- observe more thinking & reflection from all students

Some personal conclusions

- LCT creates a more dynamic, energized classroom
- allows for more creativity & ... Fun!
- students are more engaged & focused on learning
- observe more thinking & reflection from all students
- Tell the students what you're doing
    - they'll appreciate knowing what & why

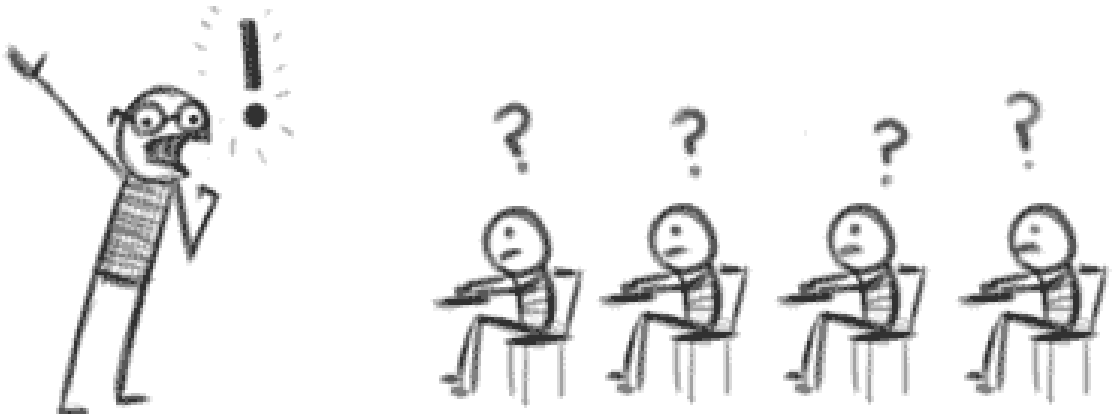
Some personal conclusions

It works!

From a soil ecology student's final journal entry:

> "To be honest, it 'freaks me out' when, after a soil ecology class, I've gone out 'into the world' and actually started applying those concepts learned in class into my everyday life.
>
> So many times walking on campus coming out of class, I've found myself staring at my feet trying to mentally visualize and recollect all the processes/insights that are happening right below."

Rather than cover content…

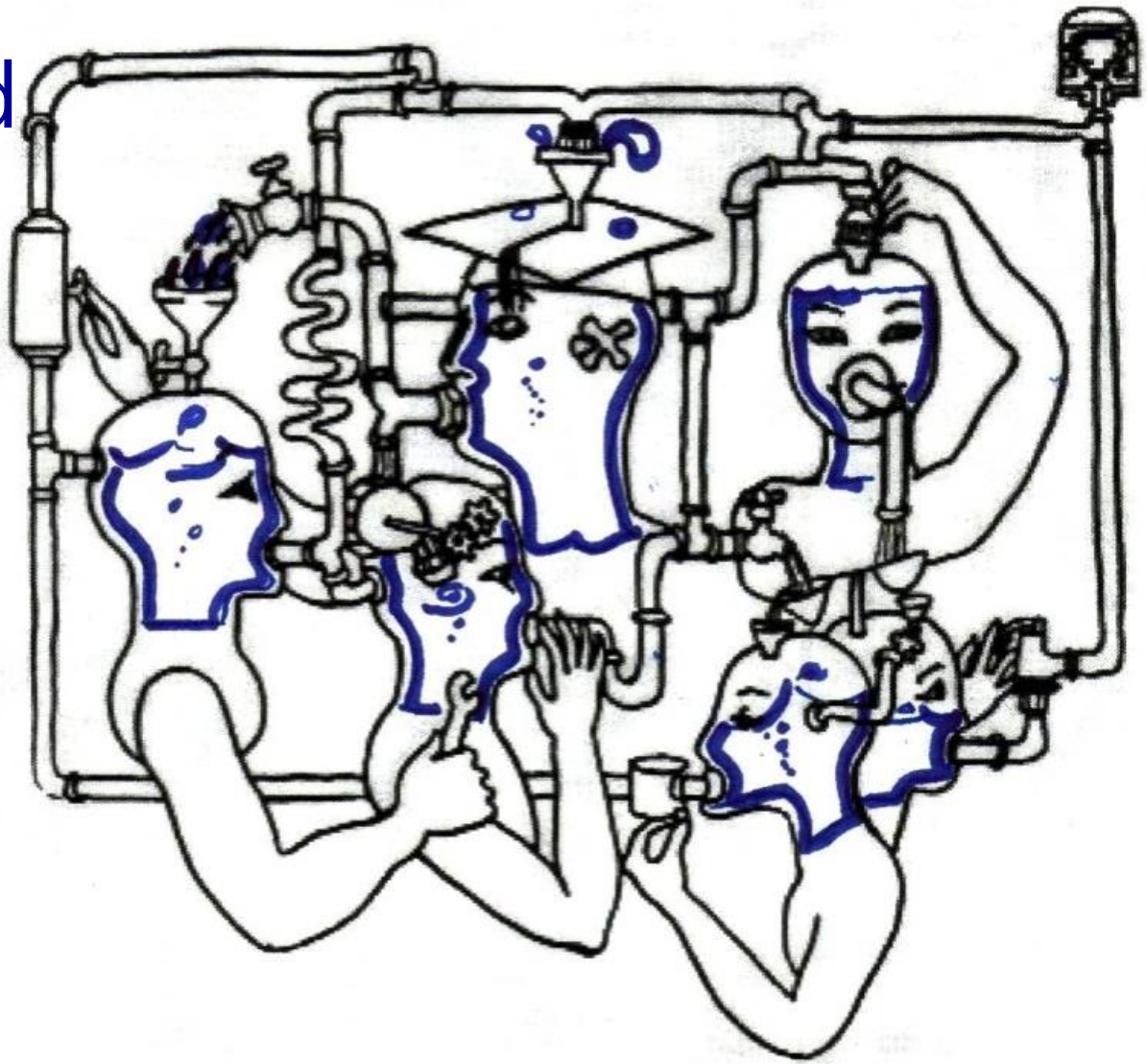


Help students un-cover it through learner centered methods!

http://tomjech.com/blog/category/images

Emerging, research-Based philosophy:

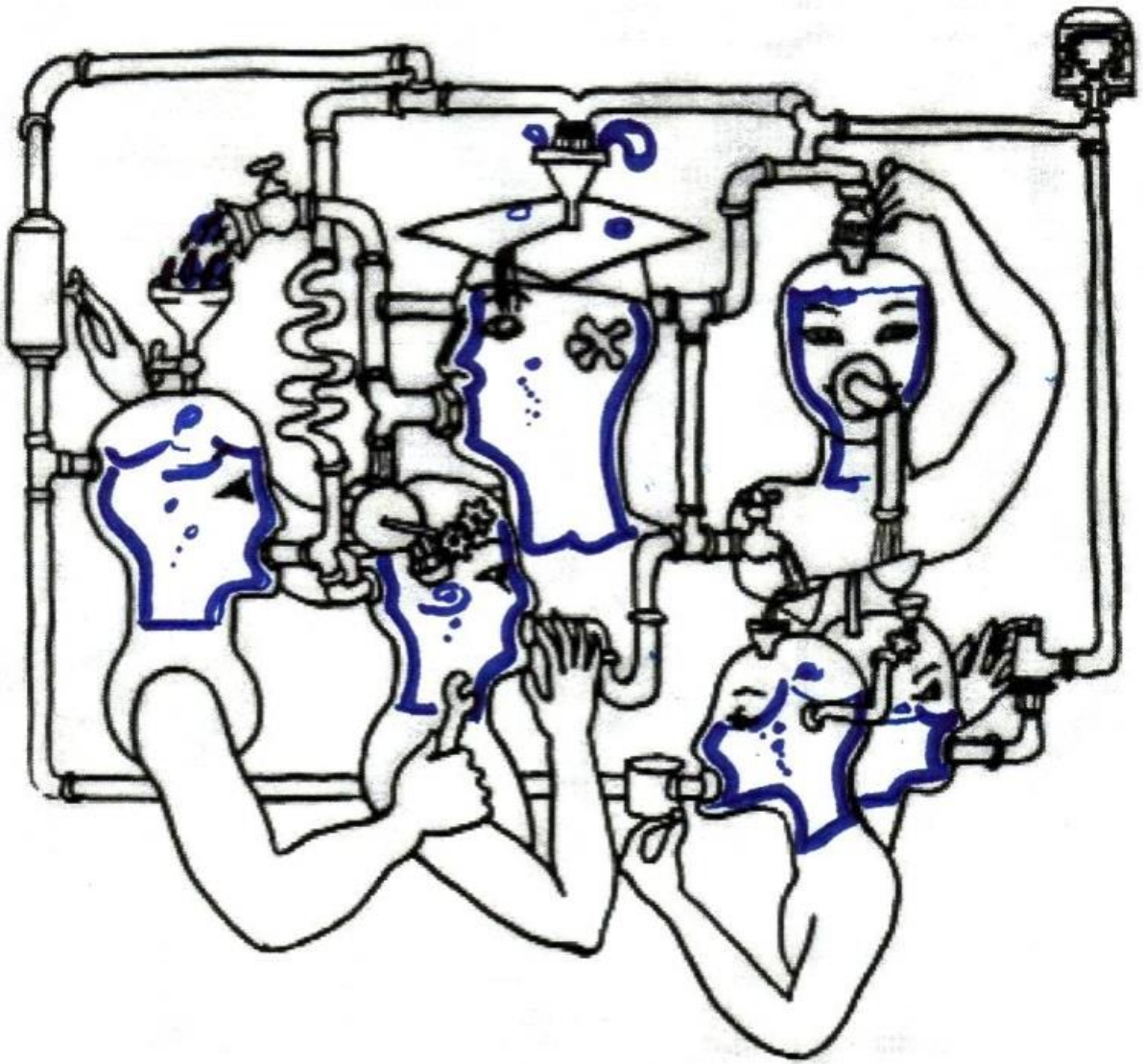
An ecology of the classroom



interactions & contributions from all

What message will you take home?

What are your responses—positive & negative?



Homework assignment

1. Google the organism listed on your card.
2. Draw a sketch of the organism on side 1.
3. On side 2, provide the following information:

Side 1	Side 2
“Name of organism”	A. Where does your organism get energy (food)? B. What eats you? C. One “cool” fact about this organism

Interactions in a soil food web

It’s all about acquiring energy to survive (& reproduce)!

Interactions in a soil food web

- You are the organism on your card. Keep it secret.
  Who you want to find (eat) to obtain energy?
  Who do you want to hide from (so they don't steal your energy)?

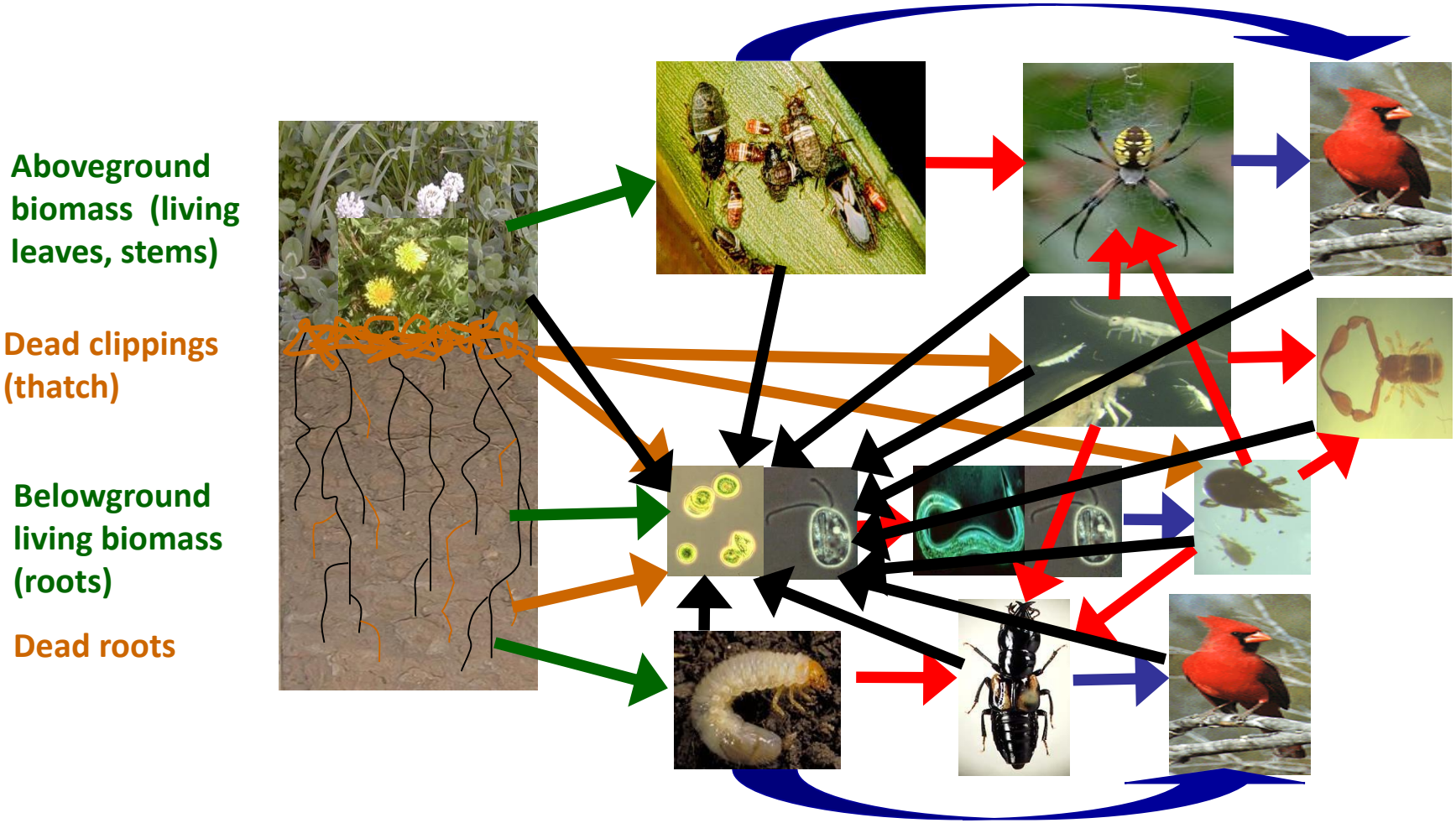
- Your candy represents energy stored in your biomass

- In groups A and B, interact with others in the food web (you cannot just hide).

- If meet an organism that you want to eat→ take their candy
- If meet an organism that wants to eat you → give up your candy

- After interactions established, draw the links and your organisms on the food web poster.

Food webs are networks of feeding relationships among species:



Patterns of transformation & flux of energy & matter among species in communities

Food webs… the circle(s) of life

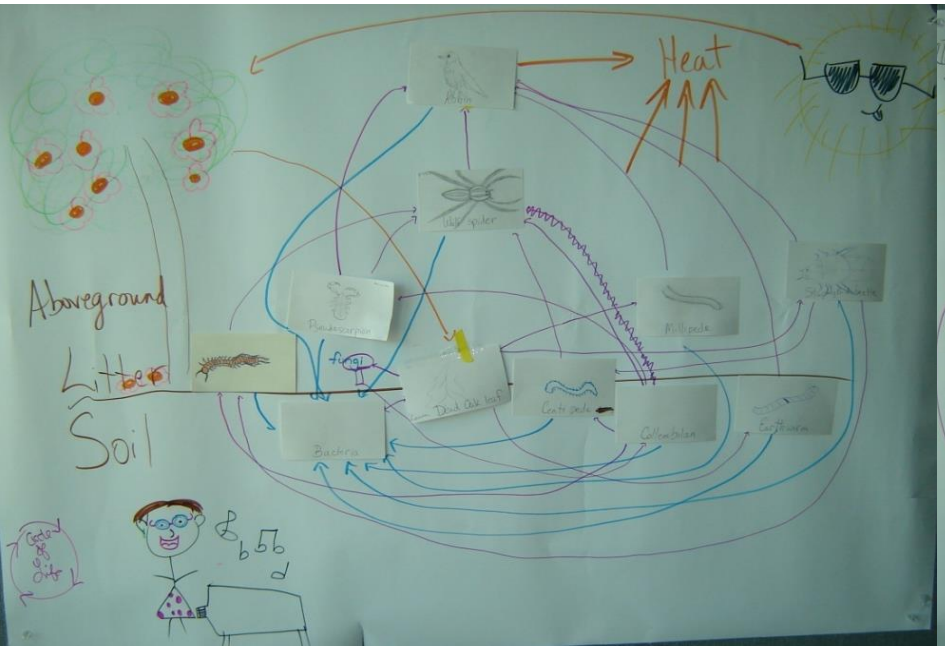
Did the food web activity change/improve your understanding of food webs?

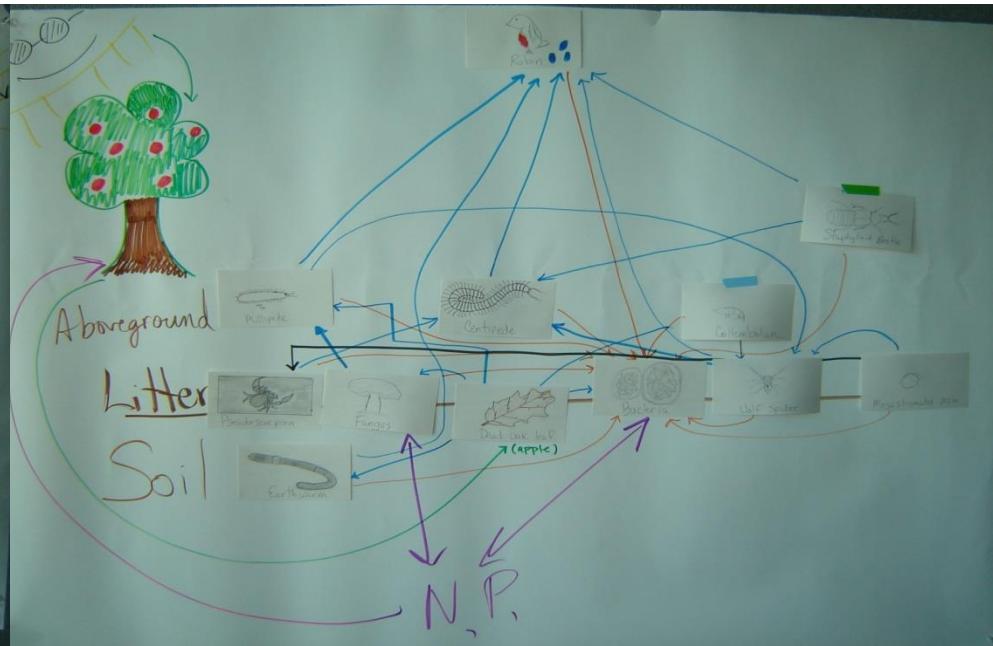
If so, how?
Or why not?

1. Food web role playing exercise

Follow-up discussion

- Biomass pyramids & 2nd law
- Trophic cascades & indirect effects
- Biodiversity loss
- Ecosystem services (e.g. pest control)





Student feedback

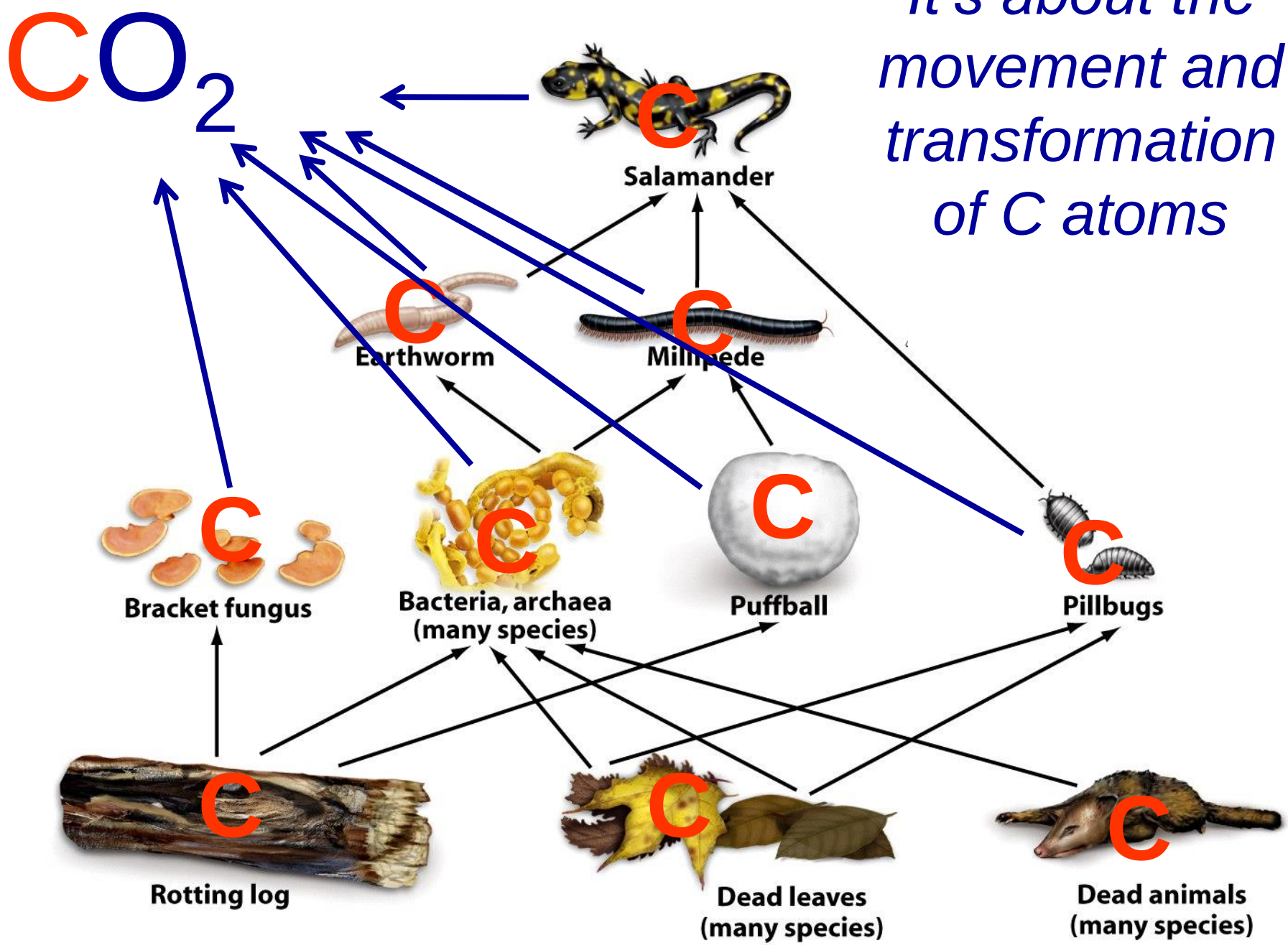
What did you learn by completing the food web activity in last class?

"By removing one part of the food web, the whole food web changes."

"That even the smallest organism such as fungus impacts the entire ecosystem."

"Can this model be applied to globalization today?"

It's about the movement and transformation of C atoms



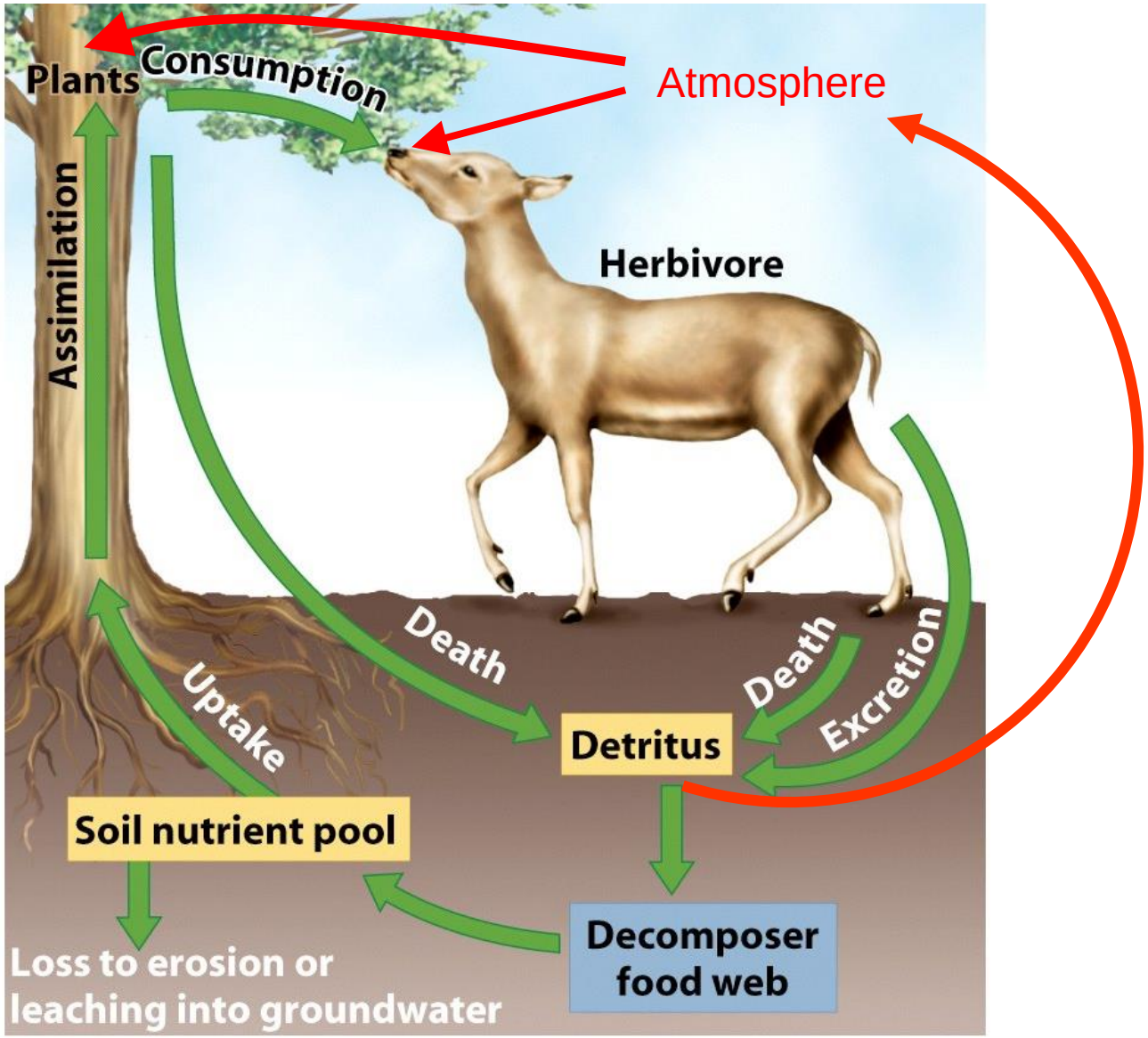
C atoms flow through ecosystems in biogeochemical cycles

From life…

To death…

Into the environment…

And back into life…



The global C cycle

What are the pools and fluxes of the C cycle?

- Pools – the different molecular forms of C
- Fluxes – the names of the processes that transform one pool of C into another

Atmosphere

Where is the world's C?

Biosphere

How much is in each place?

How and why does it move?

Ocean

Lithosphere

Creating a C Cycle diagram

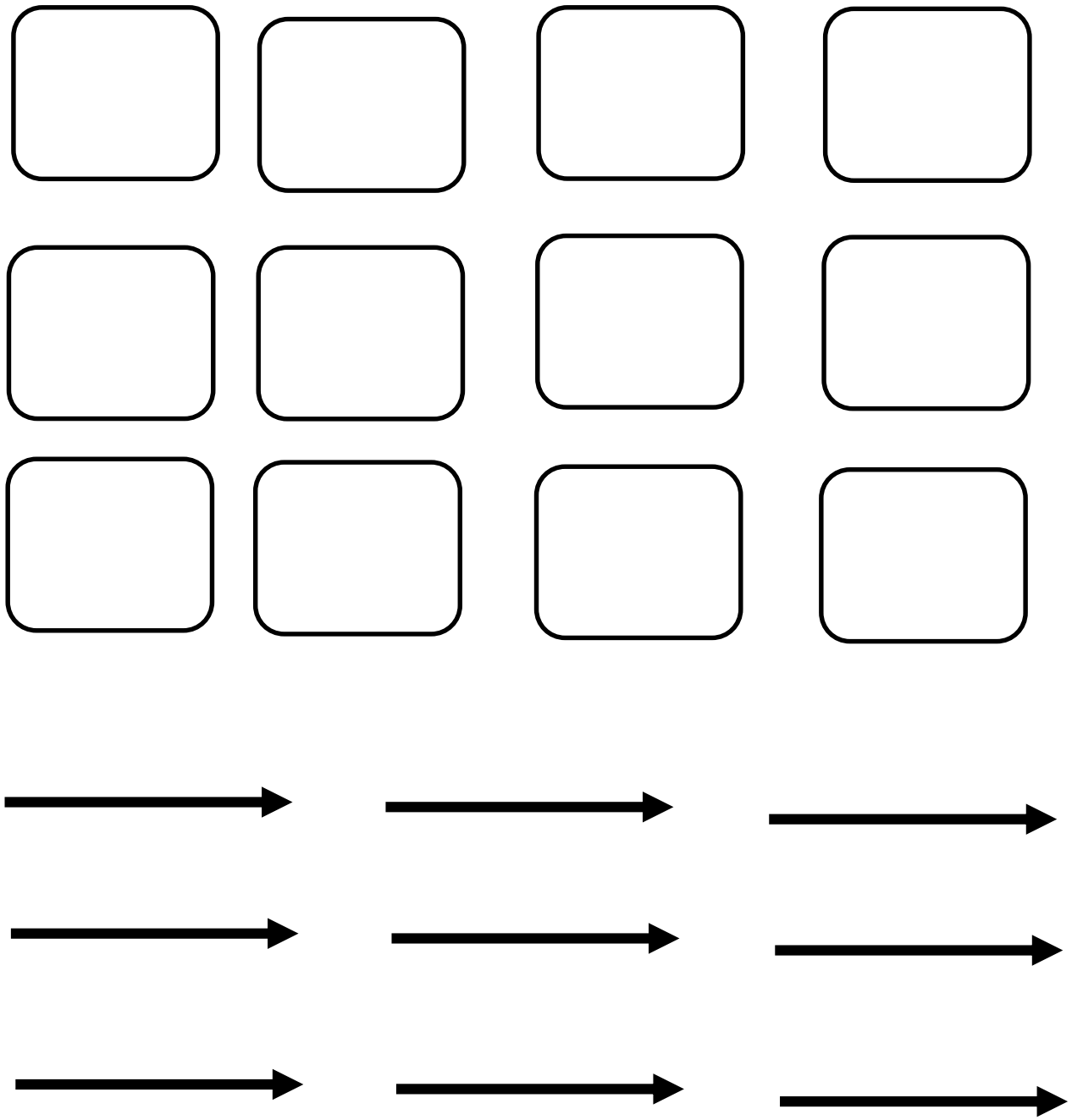
1. Compare notes with your group members and create a master list of pools & fluxes.

2. Show this to Dr. Byrne for approval.

3. Label the pools and fluxes.

4. Cut them out.

5. Arrange into a C cycle diagram.



Why are we doing this?

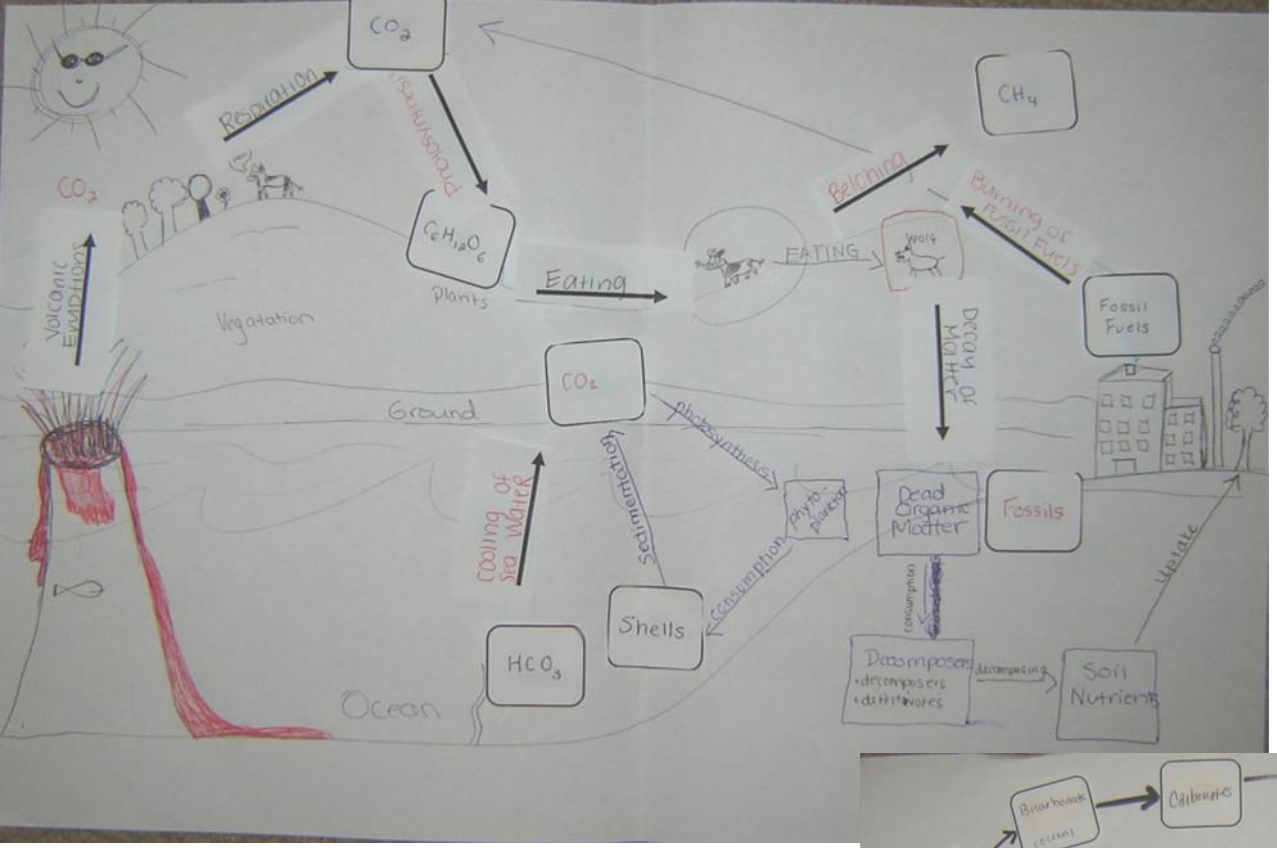
- C is essential for our bodies and health
- Fully understanding global climate change is dependent on knowing the C cycle
- Reducing the threats of climate change depend on successful management of the C cycle

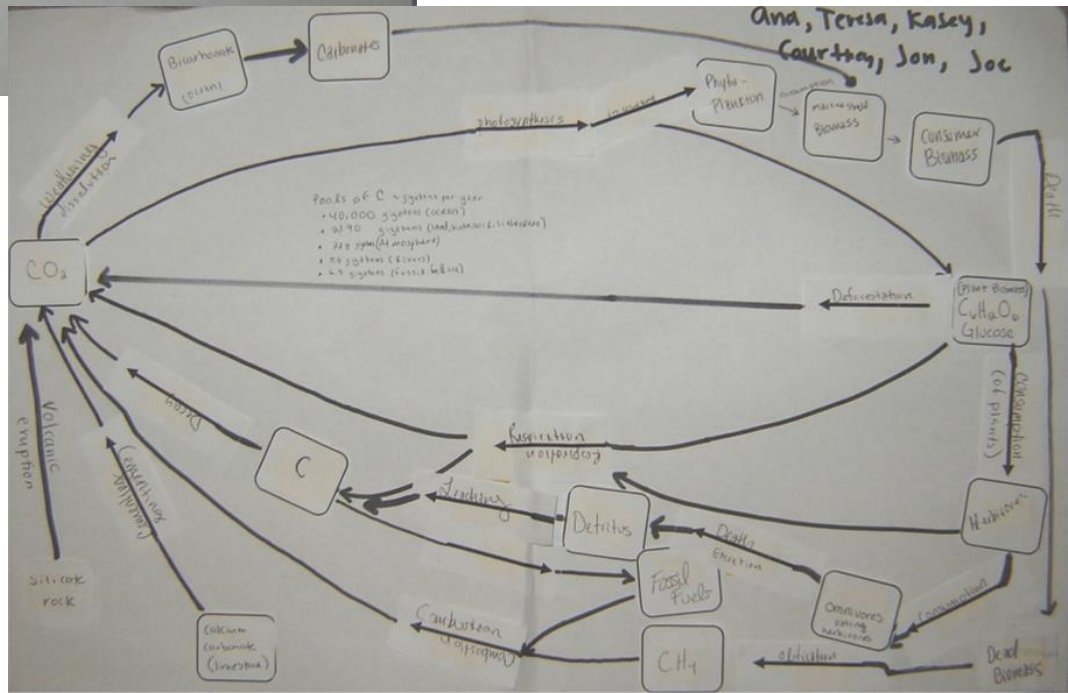
Creating a C Cycle diagram

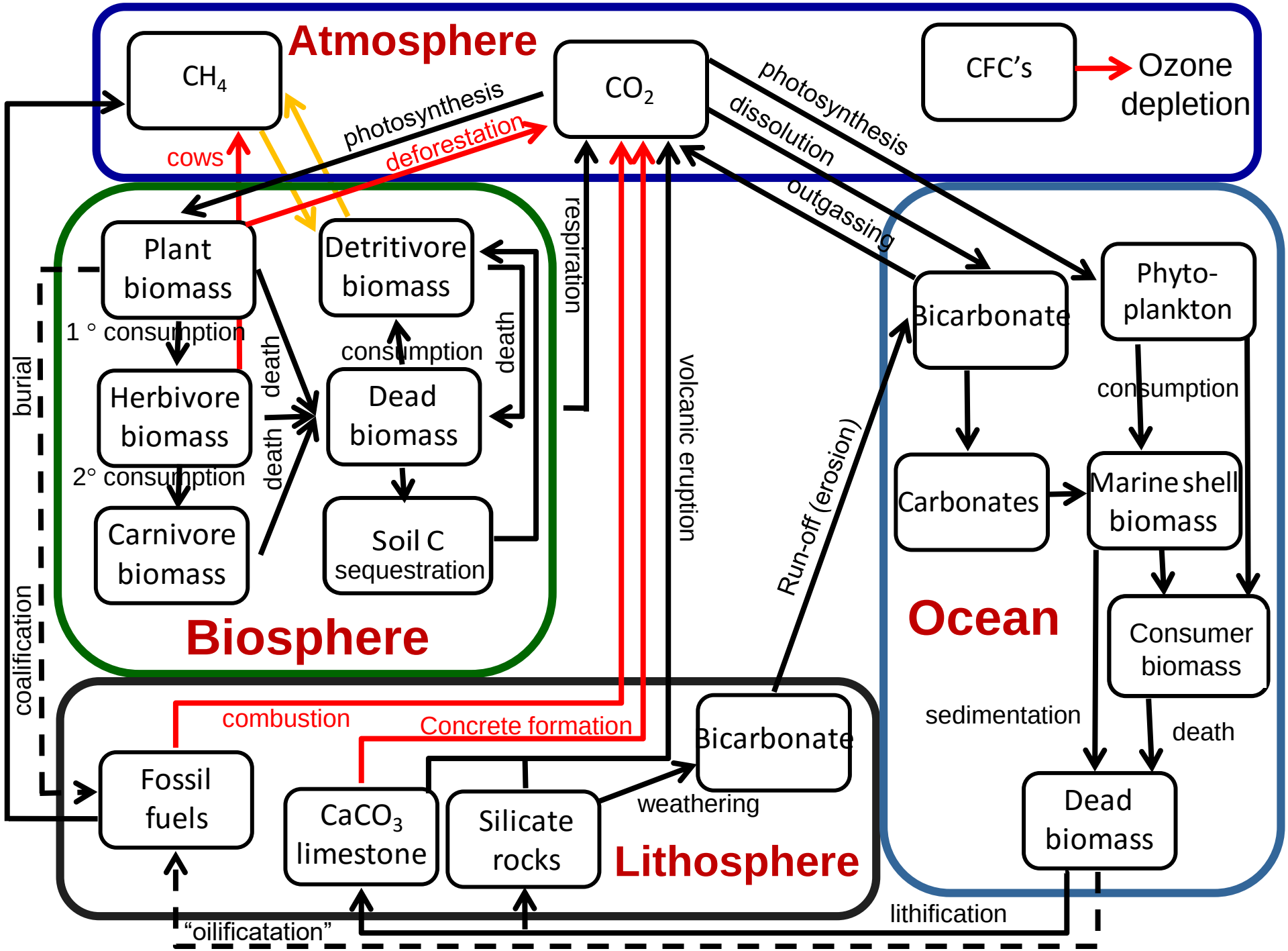
2. Add missing pools to your list from this list:

CO_2
CH_4
Plant biomass
Herbivore biomass
Carnivore biomass
Dead biomass
Detritivore biomass

Soil C
Fossil Fuels
$CaCO_3$
Biocarbonate (ocean)
Biocarbonate (terrestrial)
Dead biomass (ocean)
Carbonate (ocean)
Phytoplankton
Marine shells
Consumer biomass (ocean)


CO_2
Respiration
Photosynthesis
CO_2
Volcanic Eruptions
Vegatation
$C_6H_{12}O_6$
Plants
Eating
EATING
wolf
Belching
CH_4
Burning of Fossil Fuels
Fossil Fuels
Decay of Matter
CO_2
Ground
Photosynthesis
Phyto-plankton
Dead Organic Matter
Fossils
Uptake
Cooling of Sea Water
Sedimentation
Consumption
Shells
HCO_3
Consumption
Decomposers
• decomposers
• detritivores
decomposing
Soil Nutrients
Ocean


Ana, Teresa, Kasey, Courtney, Jon, Joe
Bicarbonate (ocean)
Carbonate
Photosynthesis
Phyto-Plankton
Microscopic Biomass
Consumer Biomass
Death
Pools of C
• 40,000 gigatons (ocean)
• 3190 gigatons (soil, [illegible])
• 720 gigatons (atmosphere)
• 88 gigatons (biomass)
• 4.5 gigatons (fossil fuels)
CO_2
Deforestation
Plant Biomass
$C_6H_{12}O_6$
Glucose
Consumption (of plants)
Herbivores
Respiration
Respiration
C
Decay
Detritus
Decay
Fossil Fuels
Death
Eruption
Omnivores eating herbivores
Consumption
Volcanic eruption
Silicate rock
Calcium carbonate (limestone)
Combustion
Combustion
CH_4
Dead Biomass


Atmosphere
CH_4
CO_2
CFC's
Ozone depletion
photosynthesis
cows
deforestation
photosynthesis
dissolution
outgassing
respiration
volcanic eruption
Run-off (erosion)
Plant biomass
Detritivore biomass
1 ° consumption
consumption
death
death
death
Herbivore biomass
Dead biomass
2° consumption
Carnivore biomass
Soil C sequestration
Biosphere
burial
coalification
Bicarbonate
Phyto-plankton
consumption
Carbonates
Marine shell biomass
Ocean
Consumer biomass
sedimentation
death
Dead biomass
combustion
Concrete formation
Bicarbonate
Fossil fuels
$CaCO_3$ limestone
Silicate rocks
weathering
Lithosphere
lithification
"oilificatation"

Student feedback

"I liked when we did … the carbon cycle, it allowed me to see it visually and ask questions if I didn't understand something."

What was effective for your learning?

"The group projects where we have to put a chart or diagram together force you to think about the topic which was very effective."

Student feedback

Non-major student's journal entry:

"Before learning about the carbon cycle in class and doing the hands-on activity, I never realized how complex the carbon cycle was and how many relationships were involved in it.

After learning about it I can see how (the pools) all relate and how one change in the cycle has a ripple of effects to other parts of the cycle."

Different types of urban land cover have different habitat structure characteristics…

A.

B.

C.

D.

…and thus differential effects on soil variables.

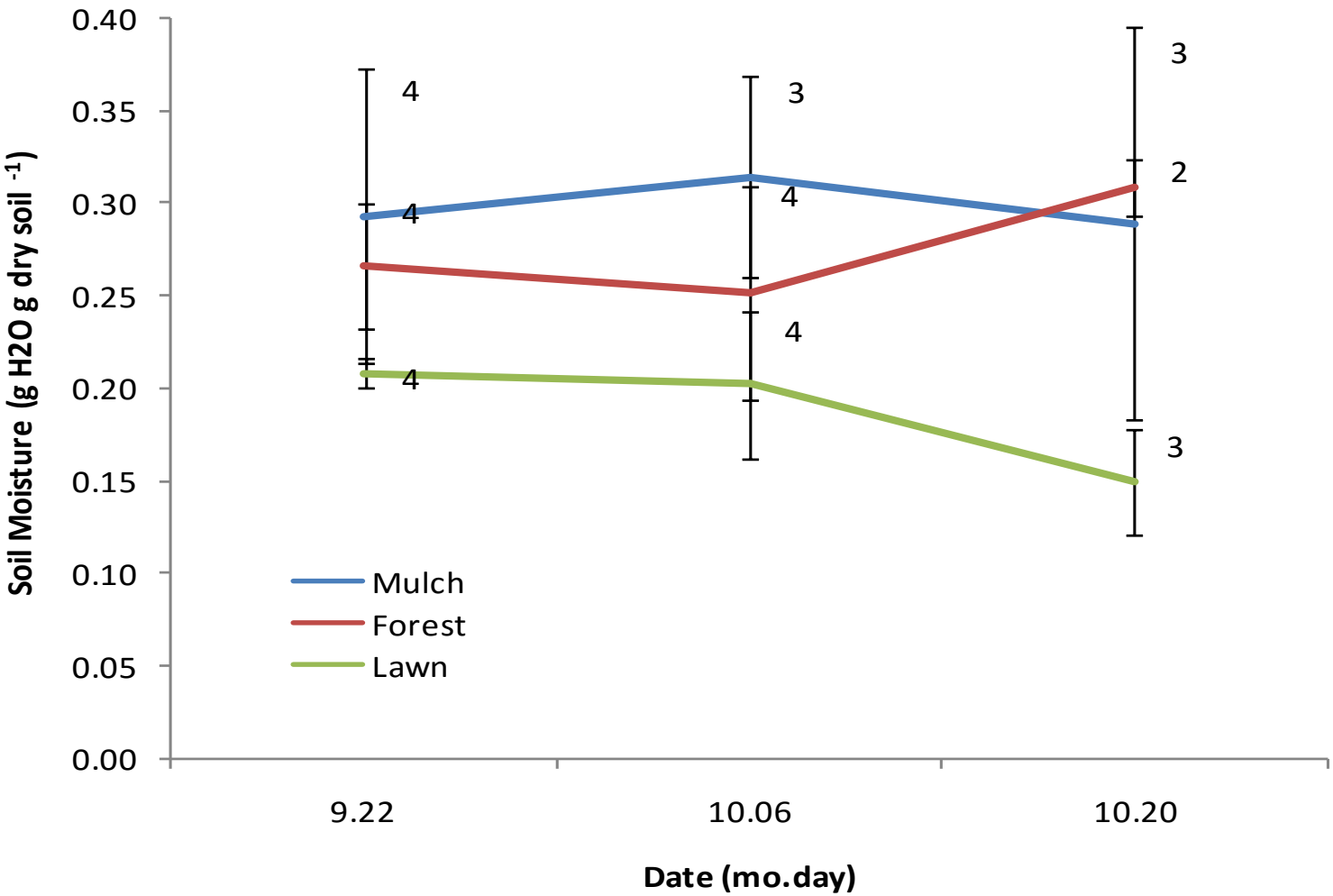


Figure 1. Temporal variation in mean (± SE) soil moisture content across three ground cover types. Blue, red, and green bars represent mulch, forest, and lawn ground cover, respectively. Numbers above error bars represent sample sizes per ground cover per date.

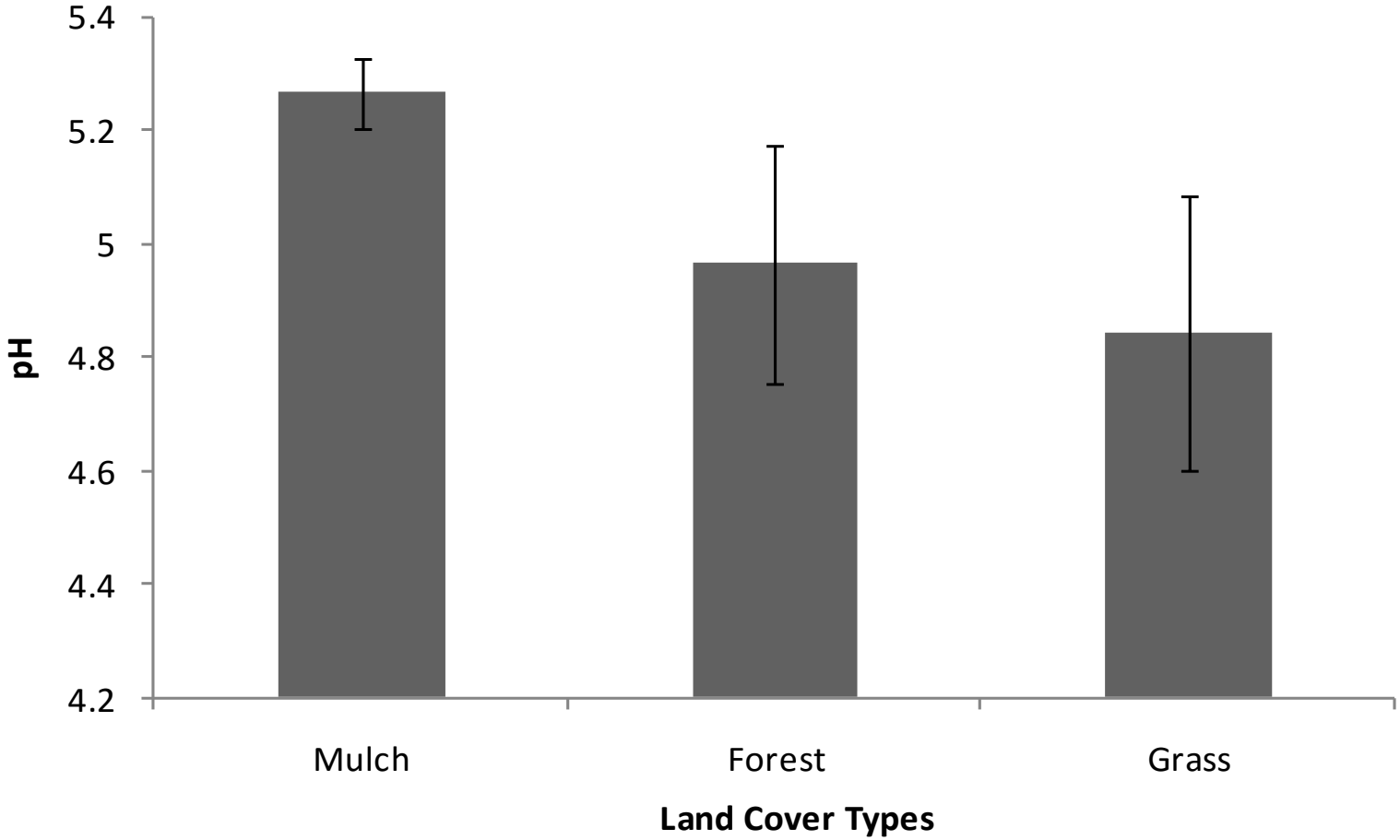


Figure 2. Mean (+ SE) pH measurements of three land cover types. N=4 per land cover type.

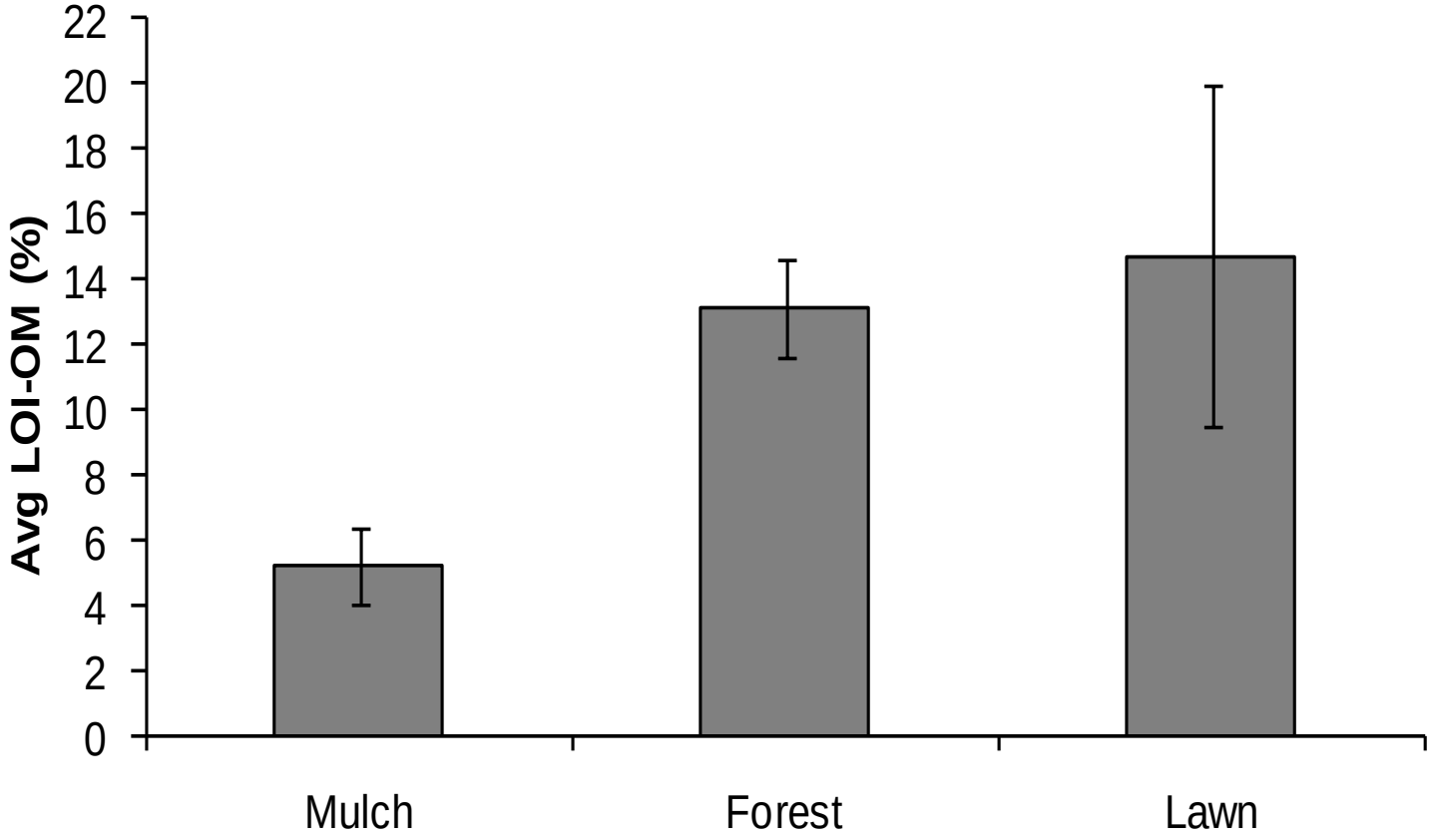


Figure 5. Average loss on ignition of percent organic matter (SE) in three different terrestial land covers at Roger Williams University.

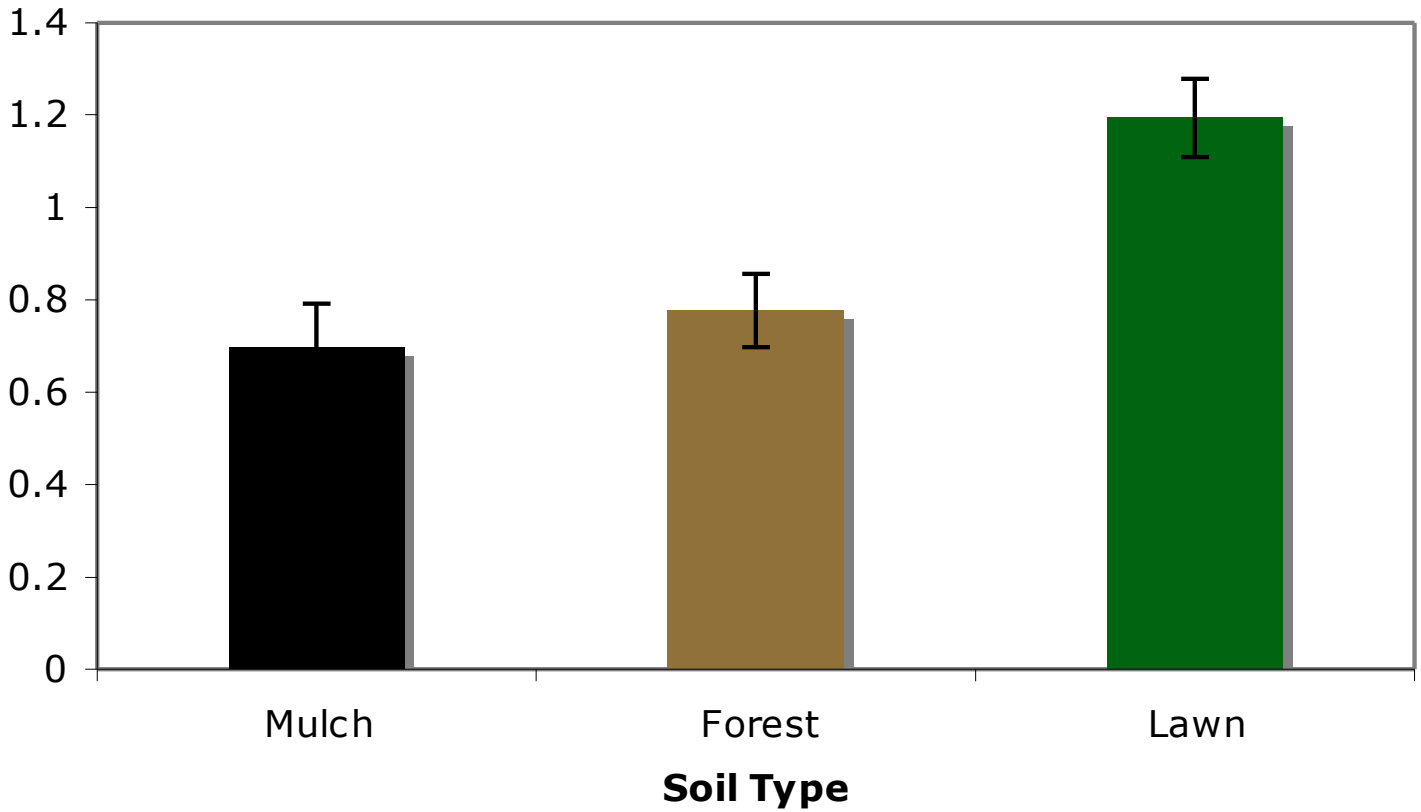


Figure 6. The Average (± SE) Bulk Density in Soil Types Around the RWU Campus, 2008. The three soil types on the x-axis are Mulch, Forest, and Lawn. The average bulk density (± SE) was calculated for each soil type from four locations (n = 4).

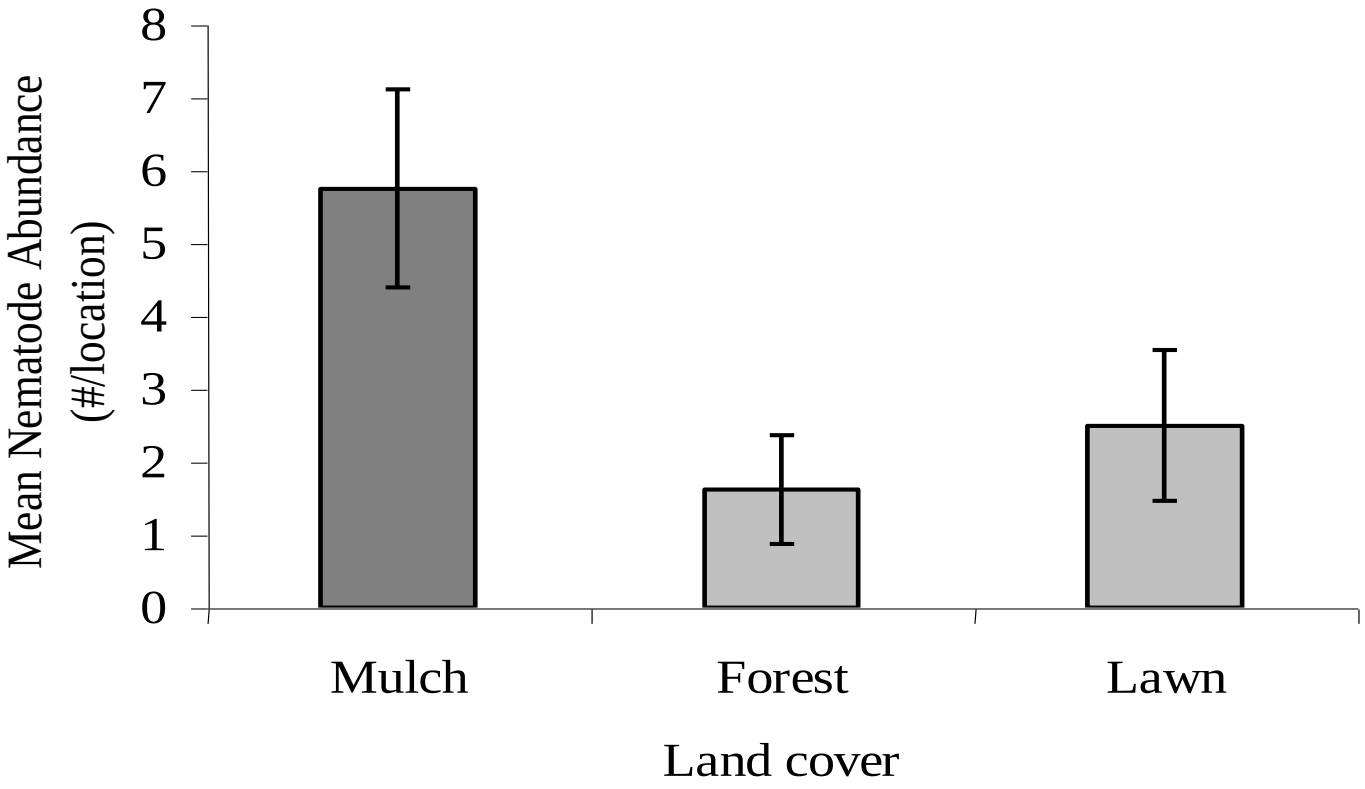


Figure 9: Mean (± SE) number of nematodes per location. N = 4 for each land cover type. Mean nematode abundance count per cumulative land cover values. Each column reflects the mean values of each land cover type across four data sites.

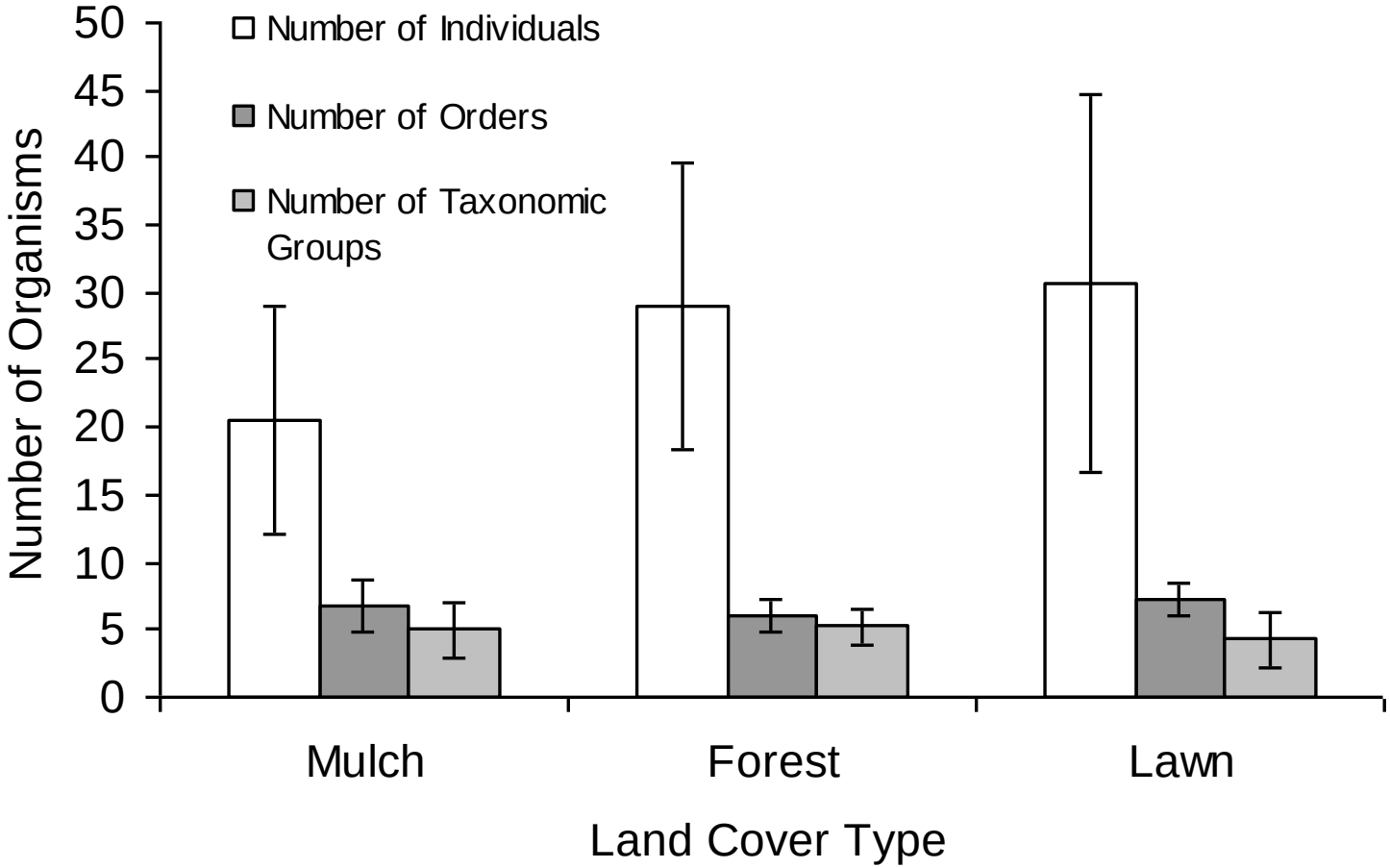


Figure 8: Mean (± SE) number of values for each category. N = 4 for each land cover type. Mean abundances for numbers of individuals, orders, and taxonomic groups.