

2015 SES Education Workshop: Backward design of learner-centered soil ecology teaching activities

Loren B. Byrne

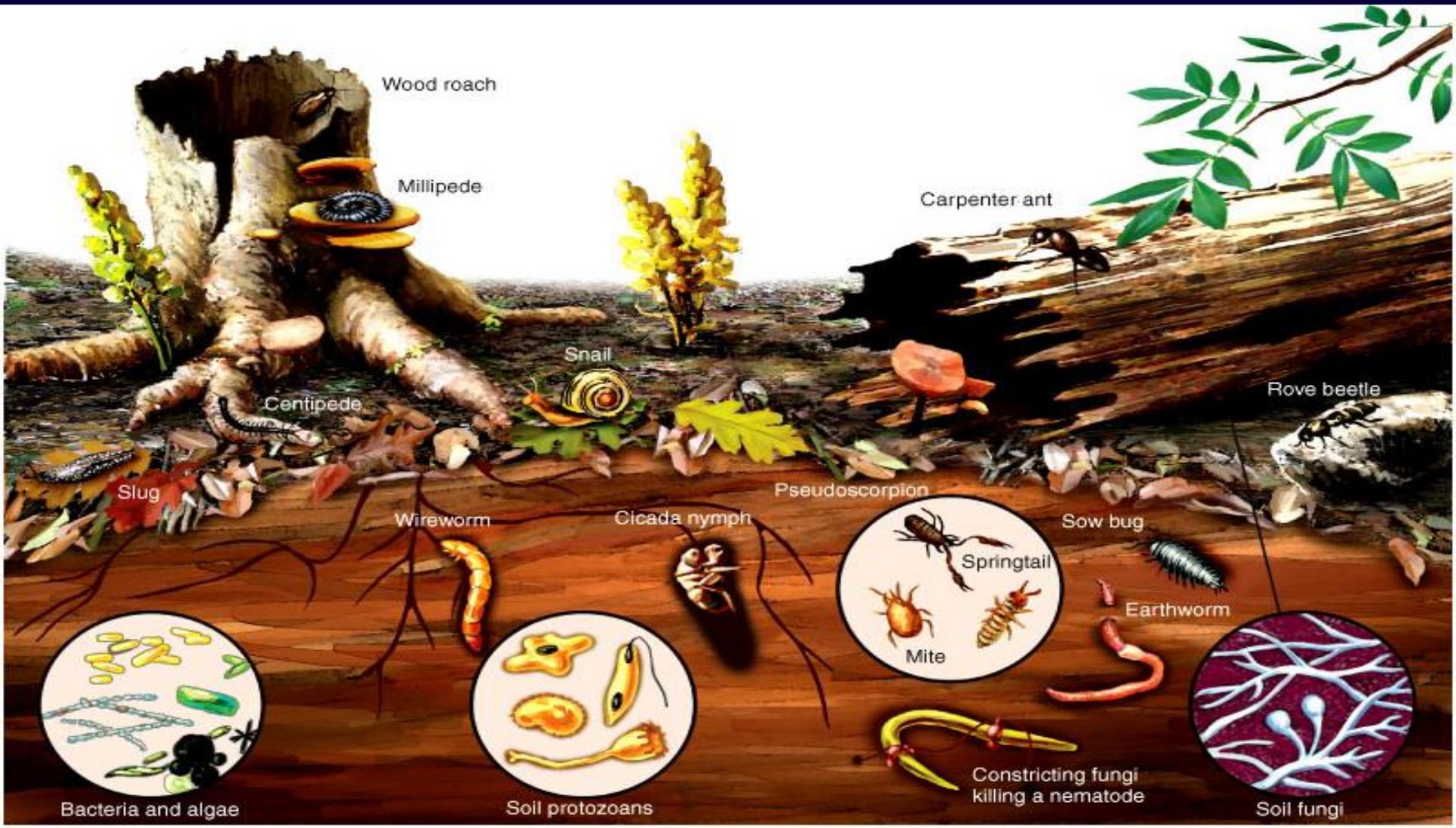
lbyrne@rwu.edu

Roger Williams University, Bristol, RI, USA

*Session
description
is on the
last slide.



What is the purpose of Soil Ecology Education?



How can educators most effectively convey information and enthusiasm about soil to students?

- What are the best approaches for soil ecology education?
- What is most effective for promoting deep, lasting learning?

Workshop goal: Promote scholarship of teaching

After this session, you should be able to employ backward design to develop learner-centered teaching activities.

What is Backward Design?

Alignment

1. Identify the end goal(s)

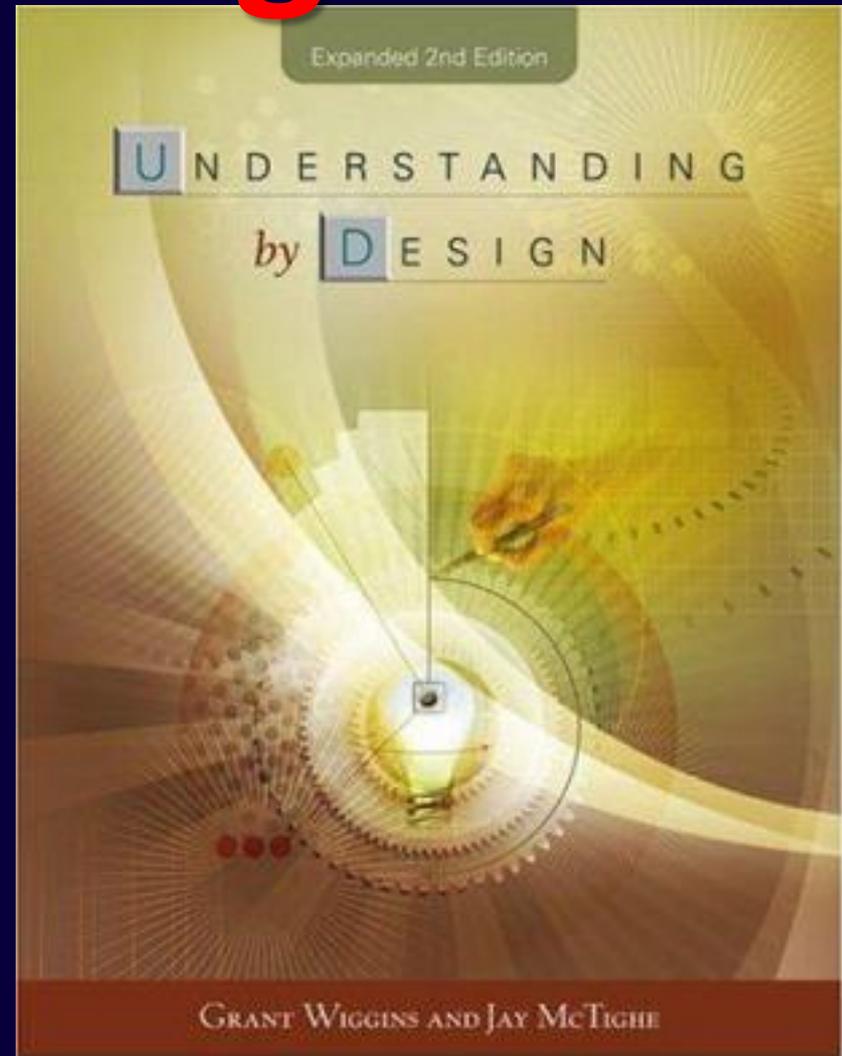
Clear, observable student-focused learning outcomes

2. Describe evidence

- What will they produce to show the outcomes have been achieved?
- *Assessment*

3. Design learning activities

Practice, scaffolding, feedback



1. Identify the end goal(s)

Learning outcomes

What can students do if they have learned?

Students should be able to... (SSBAT)

Describe the basic biology,
taxonomy & ecology of major
groups of soil biodiversity

1. Identify the end goal(s)

Learning outcomes

What can students do if they have learned?

Students should be able to... (SSBAT)

Why bother?

- Formalize & clarify the expectations
- Guideposts & checking
 - Instructor—staying focused: does this belong?
 - Student—what are the expectations for my learning?
- Keeps everyone honest
 - e.g., exams → *does this question relate to an outcome?*

1. Identify the end goal(s)

Learning outcomes

Writing Learning Outcomes

- Use “strong” verbs

Observable (measureable) → assessment

Weak: “understand” or “know”

Action Words for Bloom's Taxonomy					
Knowledge	Understand	Apply	Analyze	Evaluate	Create
define	explain	solve	analyze	reframe	design
identify	describe	apply	compare	criticize	compose
describe	interpret	illustrate	classify	evaluate	create
label	paraphrase	modify	contrast	order	plan
list	summarize	use	distinguish	appraise	combine
name	classify	calculate	infer	judge	formulate
state	compare	change	separate	support	invent
match	differentiate	choose	explain	compare	hypothesize
recognize	discuss	demonstrate	select	decide	substitute
select	distinguish	discover	categorize	discriminate	write
examine	extend	experiment	connect	recommend	compile
locate	predict	relate	differentiate	summarize	construct
memorize	associate	show	discriminate	assess	develop
quote	contrast	sketch	divide	choose	generalize
recall	convert	complete	order	convince	integrate
reproduce	demonstrate	construct	point out	defend	modify
tabulate	estimate	dramatize	prioritize	estimate	organize
tell	express	interpret	subdivide	find errors	prepare
copy	identify	manipulate	survey	grade	produce
discover	indicate	paint	advertise	measure	rearrange
duplicate	infer	prepare	appraise	predict	rewrite

1. Identify the end goal(s)

Learning outcomes

Writing Learning Outcomes

- Use “strong” verbs
Observable (measureable) → assessment

Weak: “understand” or “know”
- 5 years from now
- What scale & level of detail?
Very specific to general & vague
Study guide
Course, module, session
- Instructor vs student use

1. Identify the end goal(s)

Learning outcomes

Example learning outcomes for soil ecology

After this course, SSBAT:

- Describe the basic physicochemical properties of soils and how and why they vary across space and time in relation to biological and ecological variables

After this lesson, SSBAT:

- Define ClOrPTT and describe each soil formation factor
- List and describe the five soil formation factors
- Describe the soil formation factors
- Explain how soil is formed
- Describe variables affecting a soil's properties over space & time
- Explain why soils are spatiotemporally heterogeneous

1. Identify the end goal(s)

Learning outcomes

Write one or more soil ecology learning outcomes

Favorite topic,

Intro bio or soils, Gen ed class, etc.

Challenging topic (for you or students)

Whole course or session

Lab, field or lecture

- Brainstorm
- Alone, pairs or groups
- Share, discuss & refine

Remember:

Use strong verbs

What level of detail? (simple & open-ended)

5 years from now...

What is Backward Design?

Alignment

1. Identify the end goal(s)

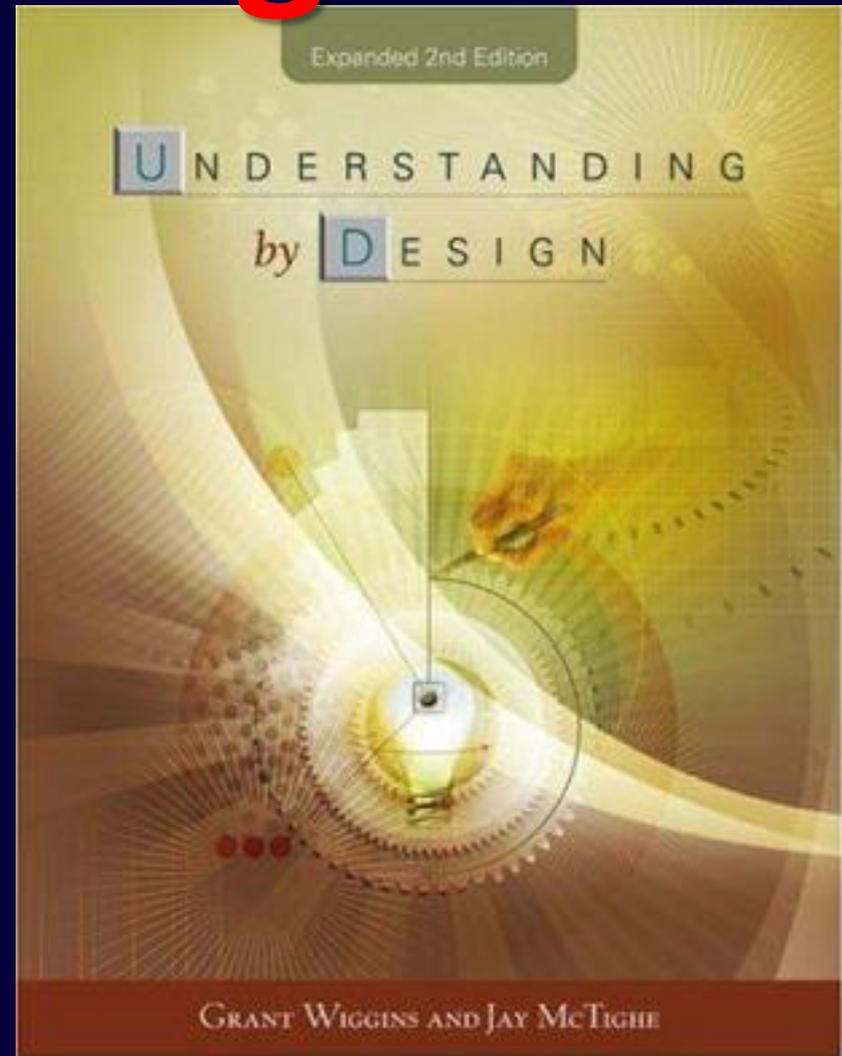
Clear, observable student-focused learning outcomes

2. Describe evidence

- What will they produce to show the outcomes have been achieved?
- *Assessment*

3. Design learning activities

Practice, scaffolding, feedback



2. Describe evidence Assessment of Learning

Gathering evidence of learning progress & gains

- Assignments
- Artifacts / products
- For grading

To evaluate learning
& To foster learning

Summative
& Formative

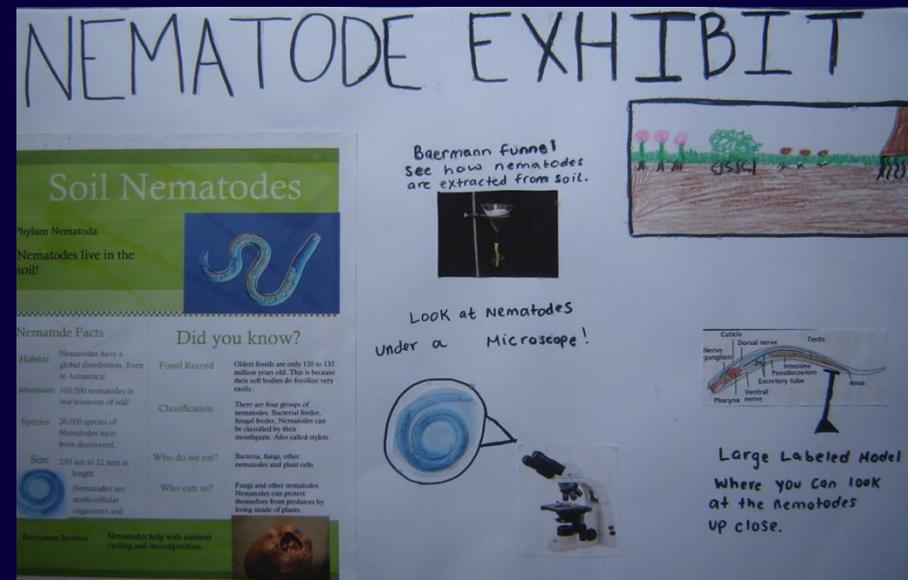
2. Describe evidence

Assessment of Learning

Examples of assignments in a soil ecology class

- Data analysis & interpretation
- Policy document
- Research proposal
- Complex exam questions
- “Professor for a day”
- Reflective essay, journaling or blog
- Soil zoo plan

“Since across the world we have variation in climate due to variation in the angle of sun rays, we end up also having variation in soil types. Now understanding the main contributions to soil formation and variation I can reflect a little on why some of the soils I’ve seen have been so different. Growing up in Connecticut,”



2. Describe evidence

Assessment of Learning

Draft a new assessment assignment → artifact

Something to grade

Be creative

Authentic → job related

Writing prompts

Complex quiz or exam question

Alignment is key

***How will you know if the student has met the outcome?
What can they do to show it?***

What is Backward Design?

Alignment

1. Identify the end goal(s)

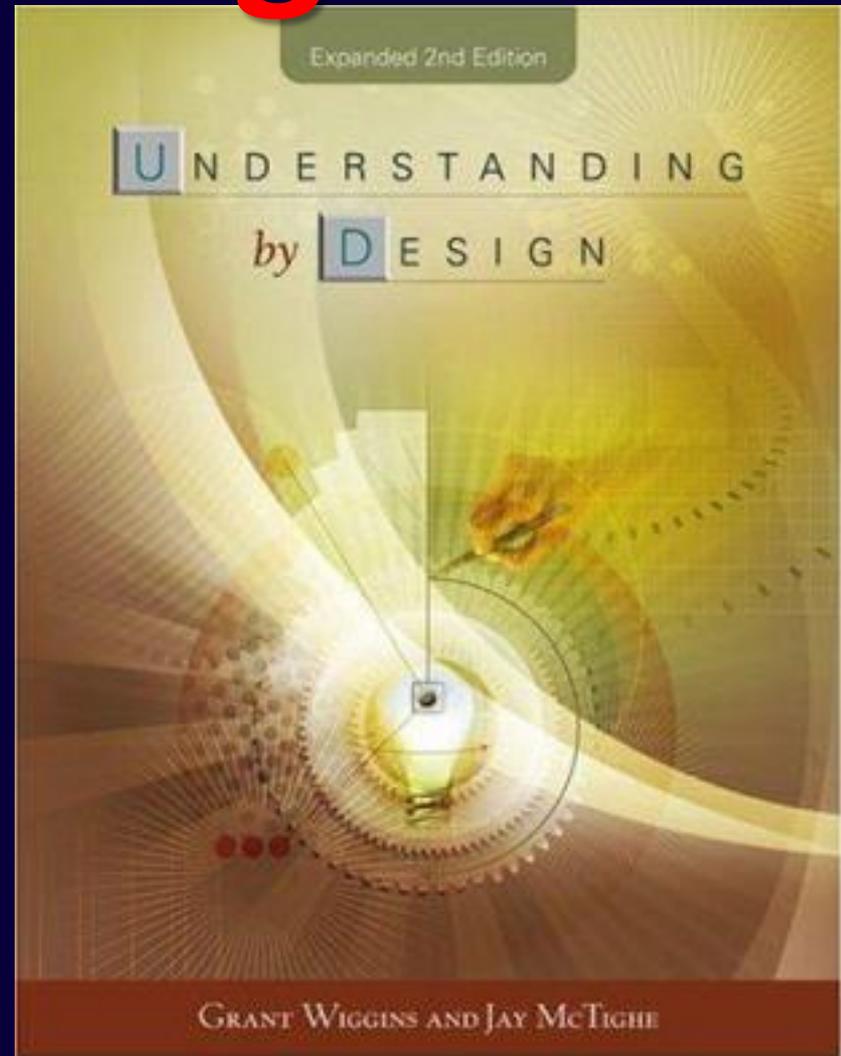
Clear, observable student-focused learning outcomes

2. Describe evidence

- What will they produce to show the outcomes have been achieved?
- ***Assessment***

3. Design learning activities

Practice, scaffolding, feedback



3. Design learning activities

Work to Learn

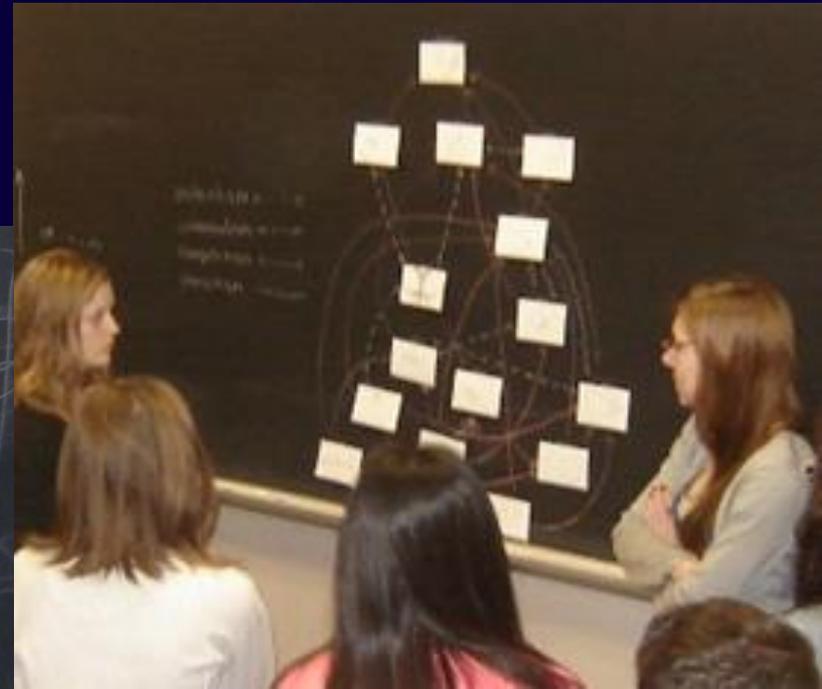
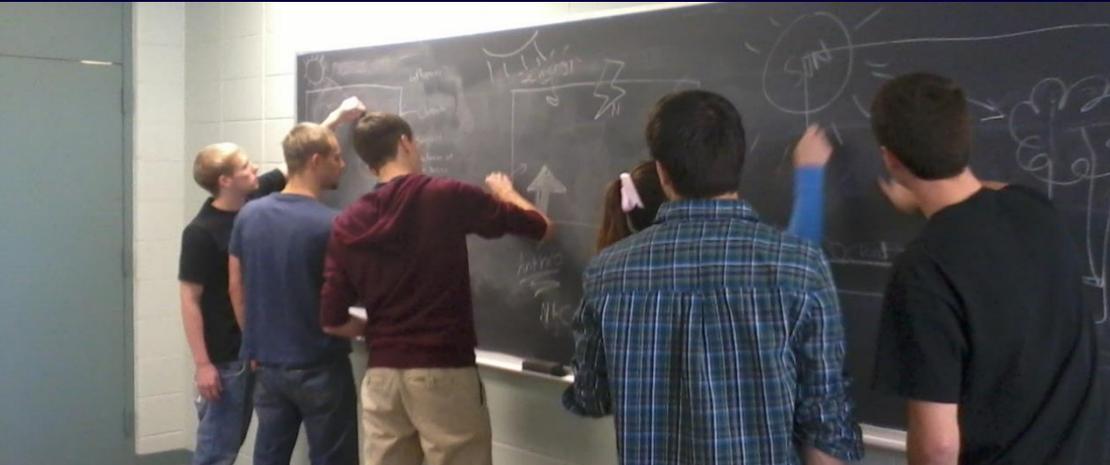
Helping students fire their synapses

How can educators help students learn best?

a.k.a. teaching, lesson plan

Day-to-day work

Formative assessment



3. Design learning activities

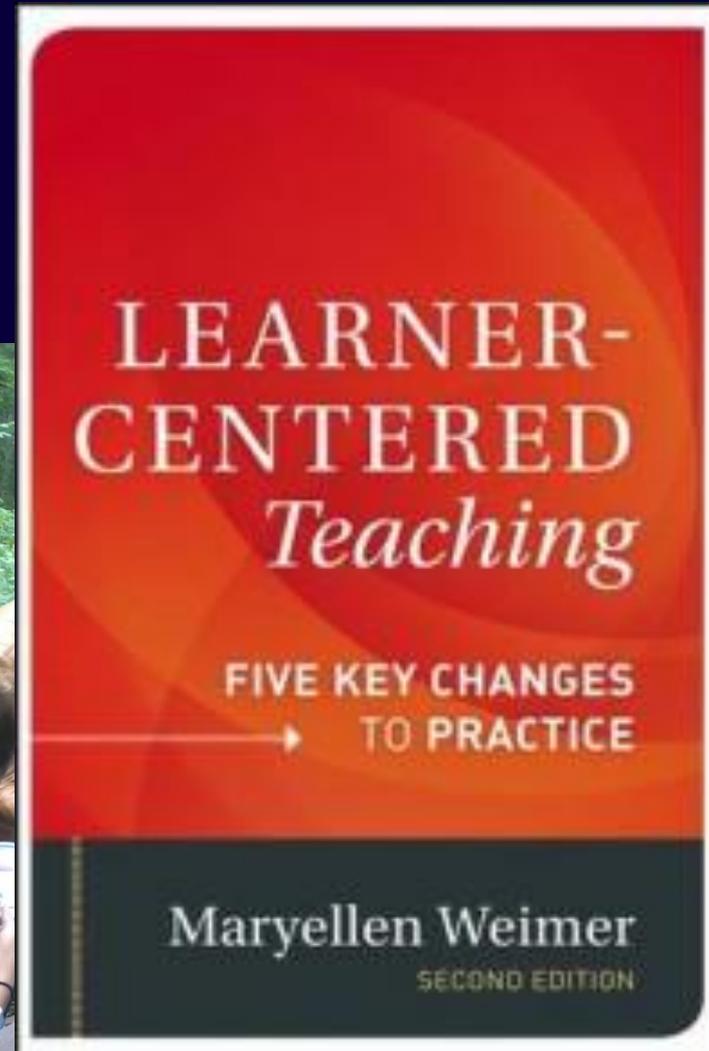
Work to Learn

What is learner-centered pedagogy?

Anything but straight, simple lecture

Students doing the work

Taking responsibility for their own learning

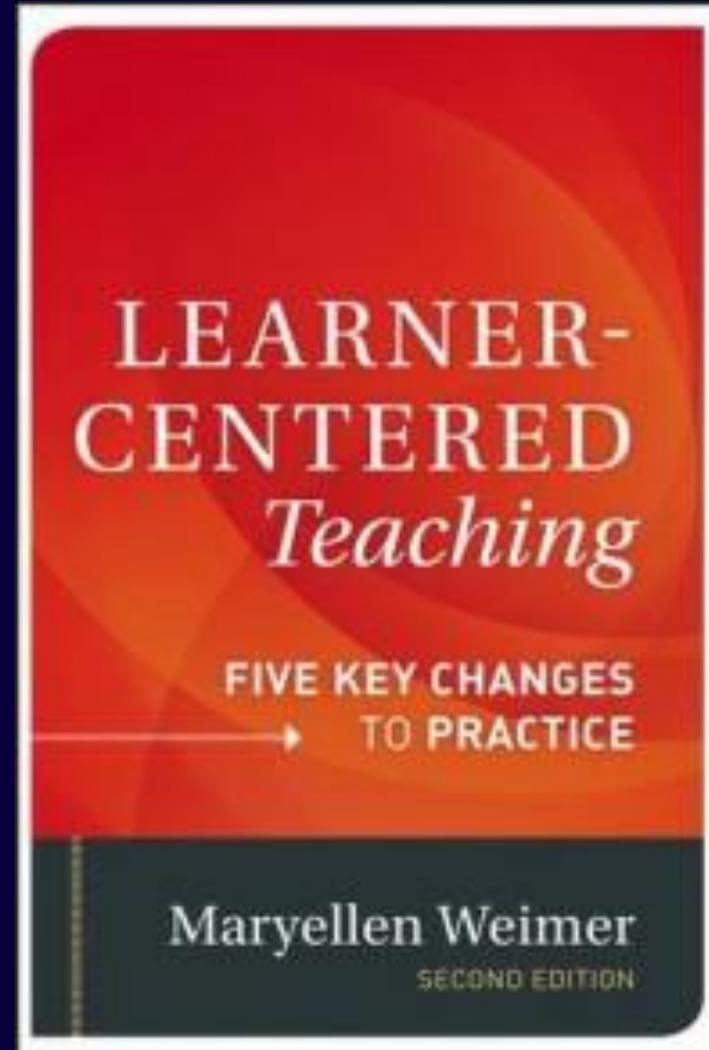


3. Design learning activities

Work to Learn

Why active, learner-centered pedagogy?

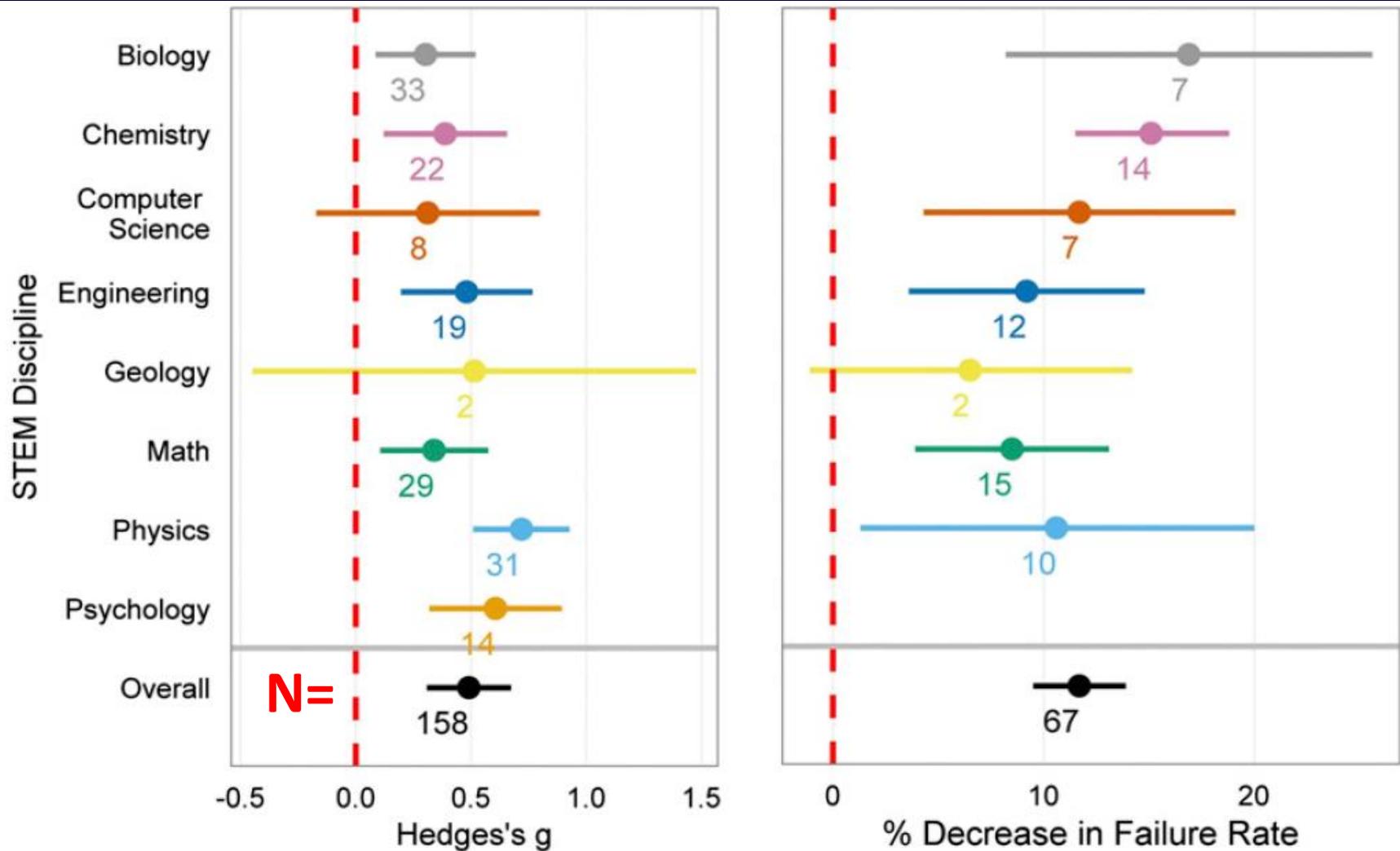
- More engaging, dynamic, energized classrooms
- Prevents sleeping
- Group work
- Skill development
- Serendipity & fun
- **It's better than lecturing**



Active learning increases student performance in science, engineering, and mathematics

PNAS 2014: 111,
pp. 8410-8415

Scott Freeman^{a,1}, Sarah L. Eddy^a, Miles McDonough^a, Michelle K. Smith^b, Nnadozie Okoroafor^a, Hannah Jordt^a, and Mary Pat Wenderoth^a



Studio Structure Improves Student Performance in an Undergraduate Introductory Soil Science Course

Sarah E. Andrews* and Serita D. Frey

Nat. Sci. Educ. 44:60–68 (2015)

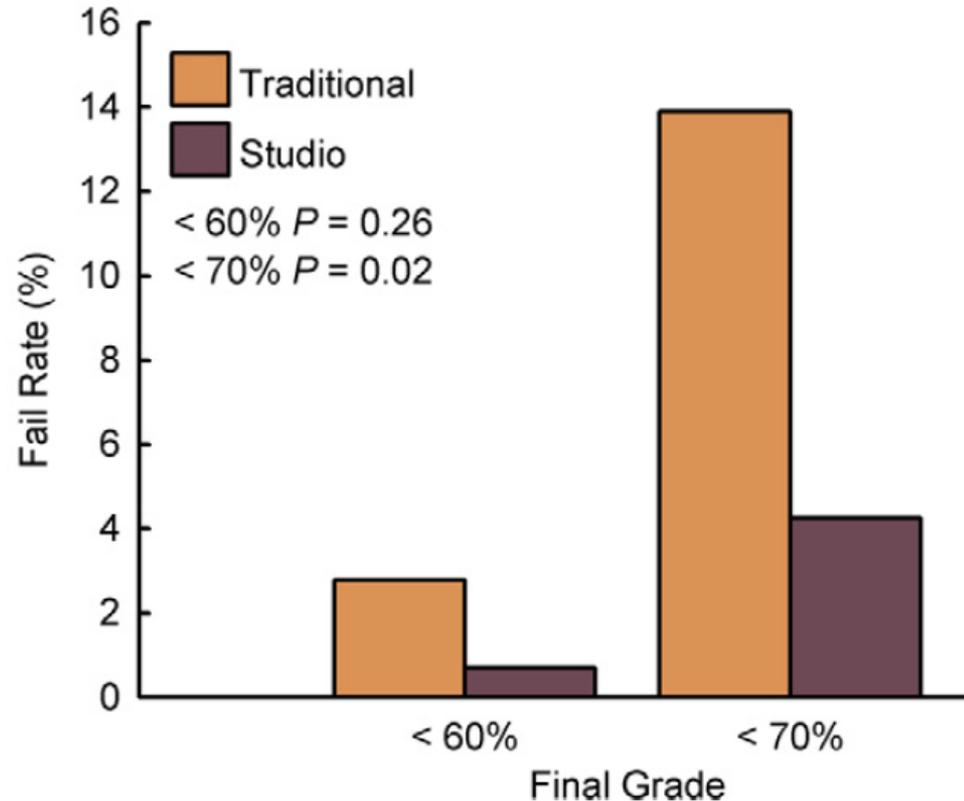


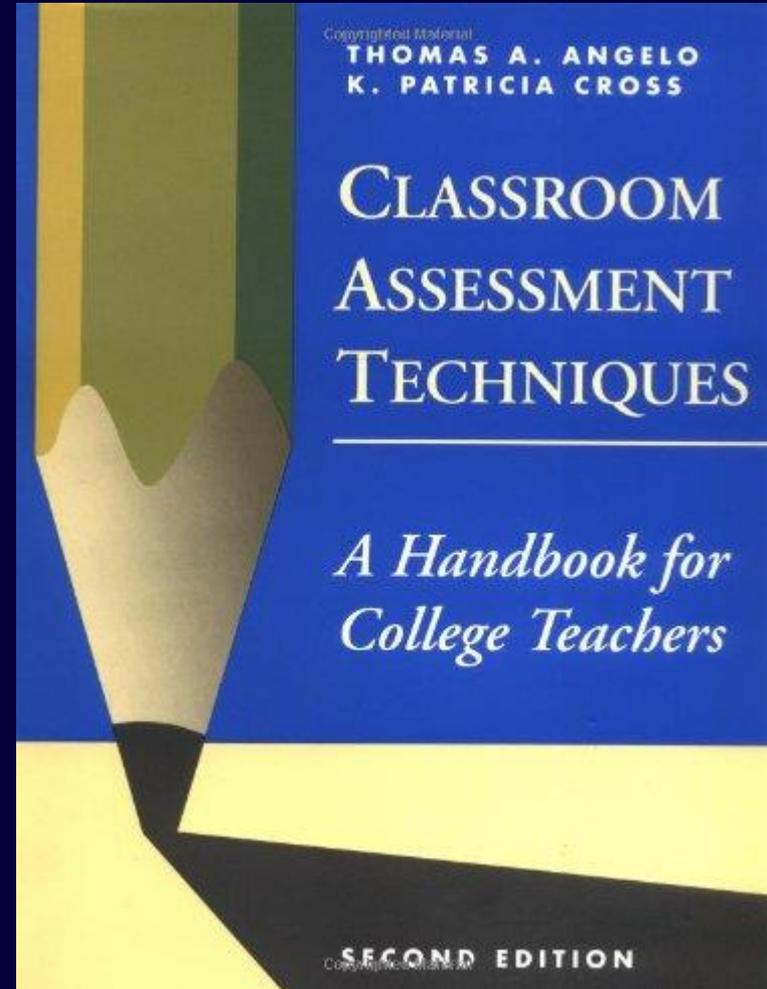
Fig. 4. Fail rate by course structure. Less than 60% is a failing grade for any student; less than 70% is a failing grade for any student majoring in environmental conservation and sustainability ($n = 213$).

3. Design learning activities

Work to Learn

What are active, learner-centered techniques?

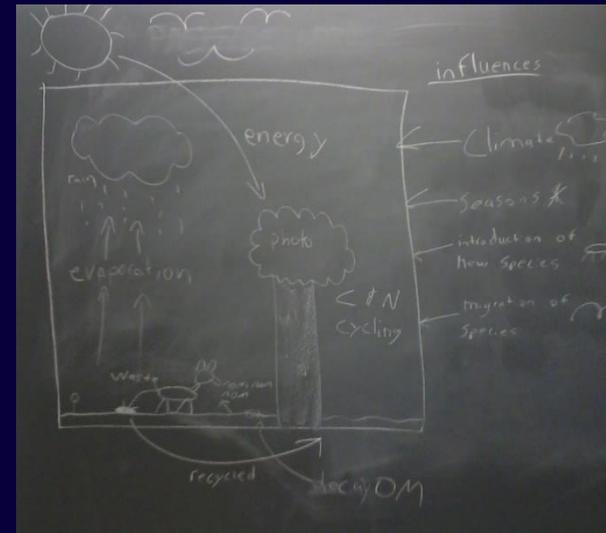
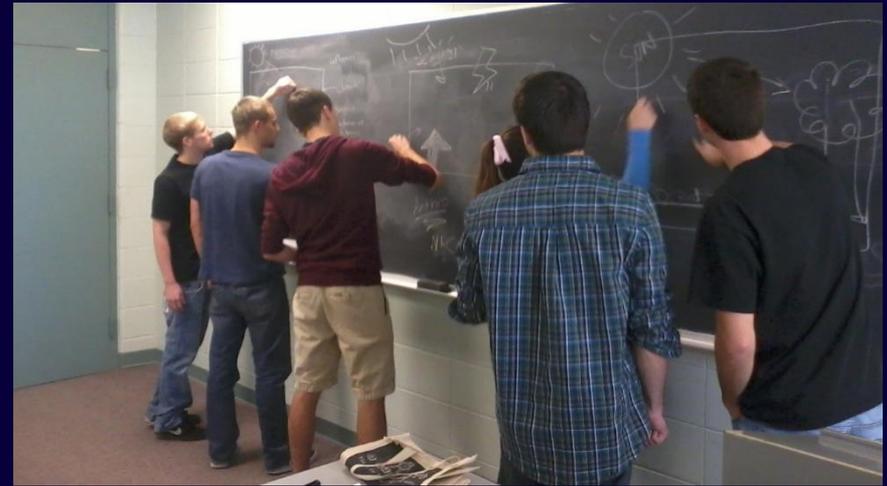
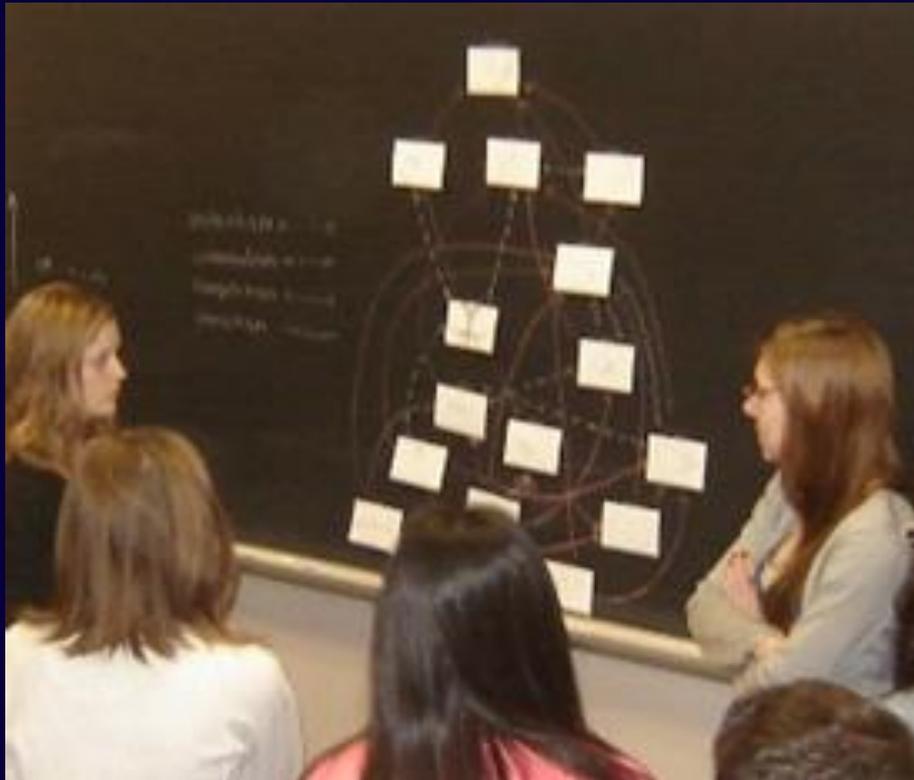
- Pre- & post-quizzes
- Minute papers
- Jigsaw
- Problem solving
- Data analysis & synthesis
- Concept mapping
- Clicker questions
- Reading worksheets
- Letter writing
- Self-reflection
- Surveys
- Open-ended, provocative questions
- Discussions



3. Design learning activities

Work to Learn

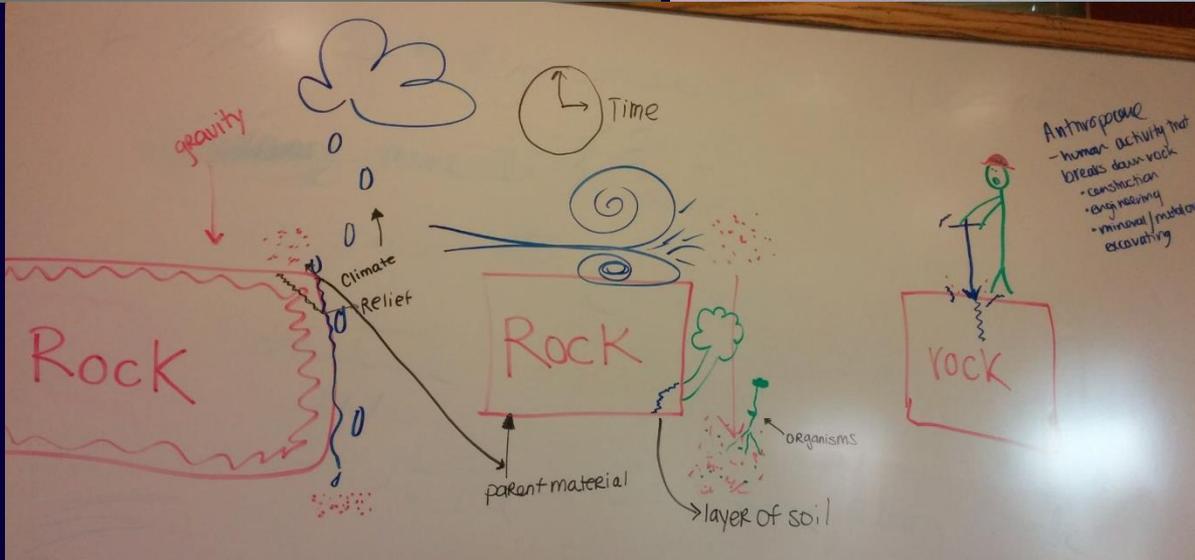
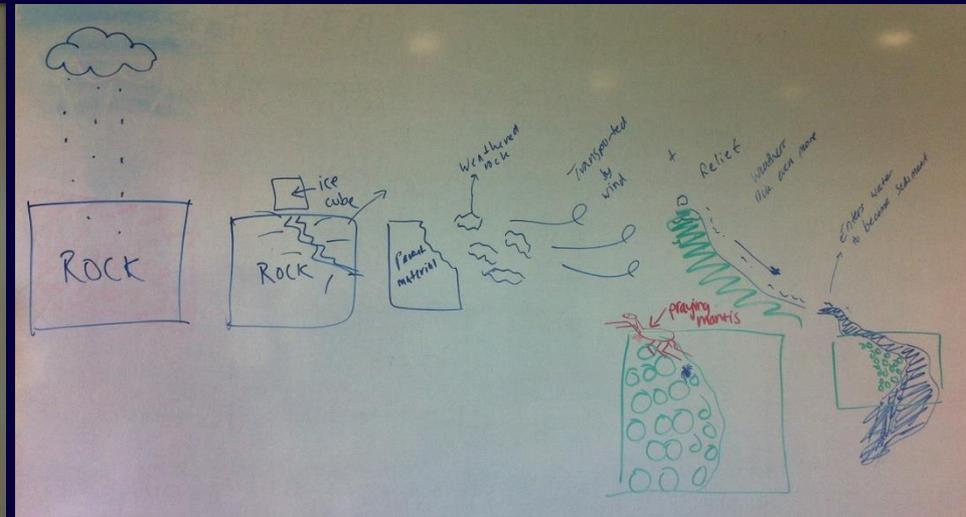
Examples of learner-centered soil ecology



3. Design learning activities

Work to Learn

What are active, learner-centered techniques?



3. Design learning activities

Work to Learn

Design an active, learner-centered activity

Start with the outcomes

Think about (formative) assessment

Authentic:

What do we want them to do 5 yr from now?

What can students do to achieve the outcomes?

Practice, scaffolding, feedback

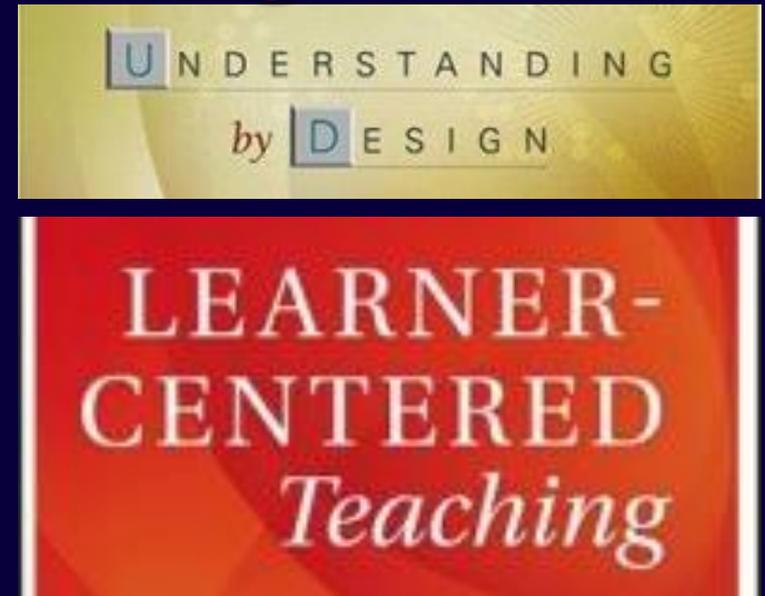
Oh joy, what have we done...

1. Identify the end goal(s)
2. Describe evidence
3. Design learning activities

Share & Discuss

Variations, extensions & synthesis

Alignment



Thanks for your engagement & participation!!

lbyrne@rwu.edu



Workshop goal: Promote scholarship of teaching

After this session, you should be able to employ backward design to develop learner-centered teaching activities.

Session description from the program:

Soil ecology knowledge is crucial for cultivating healthy, sustainable human societies. In addition, soils and their diverse organisms are fascinating and fun to learn about. How can educators most effectively convey this information and an enthusiasm for soils to students? In this workshop, participants will learn about and engage in the backward design approach for creating engaging, learner-centered teaching activities for soil ecology. The session will include brief introductory presentations, participant-led development of education materials, and group discussion. Presentations will describe the backward design approach which emphasizes starting with the end goals for student learning in mind, i.e., by identifying clear, observable learning outcomes. The roles and approaches of assessment to foster and measure those outcomes will be reviewed followed by an overview of active learning techniques that promote student responsibility and engagement for ensuring their achievement of the outcomes. Soil ecology examples for these three aspects will be shared. Working in small groups, participants will develop outcomes, assessment materials, and teaching activities for a soil ecology topic (for one or multiple classes). Time will be dedicated to sharing and discussing them, along with brainstorming variations and extensions. Throughout the conversations, participants will be encouraged to consider how soil ecology topics can be used to promote general scientific and liberal educational outcomes such as numeracy, critical thinking, and connecting basic research and theory with applications to societal challenges. This examination emphasizes how soil ecology education can be used in many courses and contexts beyond those focused on soils. With a broader focus and innovative, engaging teaching techniques, soil ecologists will be better able to help students become more scientifically and environmentally literate while also ensuring that they learn about the wonders and vital characteristics of soils and their organisms that support ecosystems and human well-being.