# Course Design

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Chuck Bailey photo

With material from David McConnell, Barb Tewksbury, Karl Wirth & Richard Yuretich

# One Course Design Process

- Consider **course context**
- Articulate **goals**
- Design **activities**
- Plan **assessment & feedback**

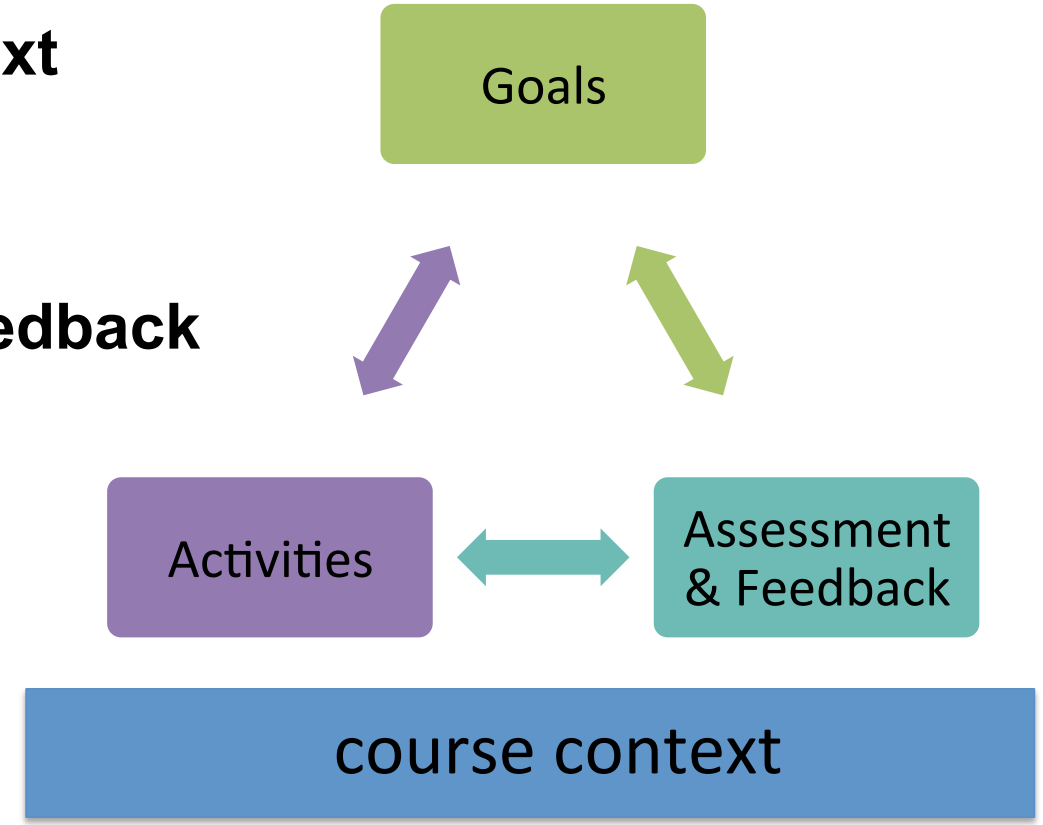



*Figure modified from D. McConnell*

http://serc.carleton.edu/NAGTWorkshops/coursedesign/tutorial/index.html

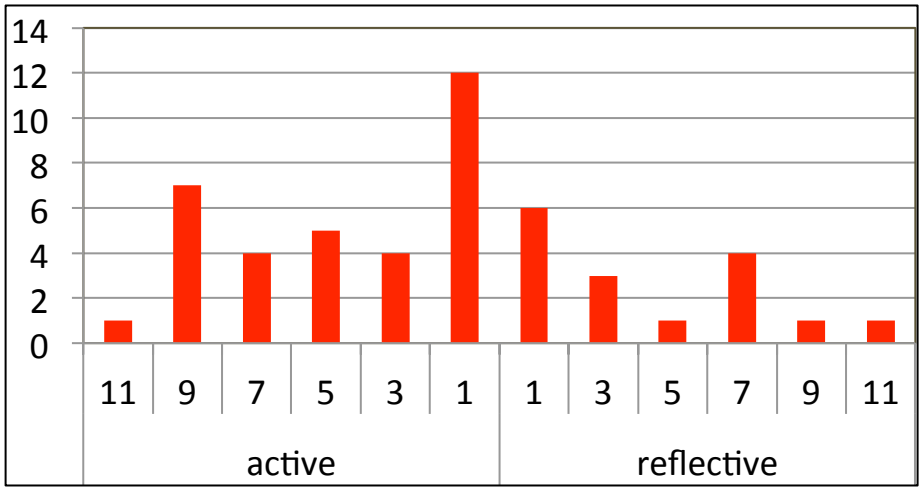
# Focus on one of your courses

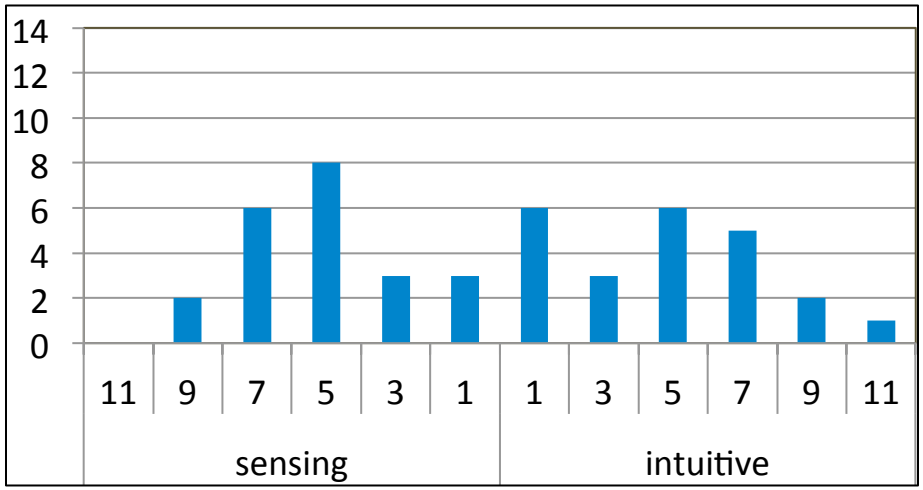
# Consider course context

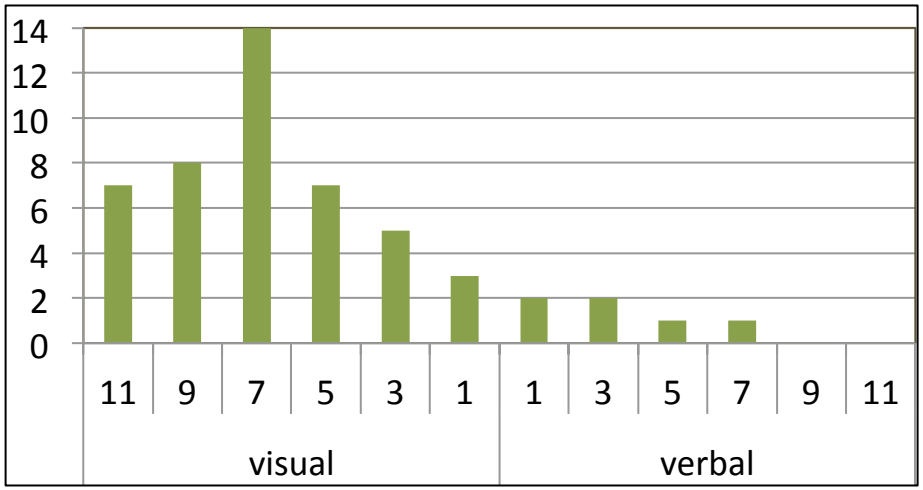
*Photo by C. Ormand, serc.carleton.edu*

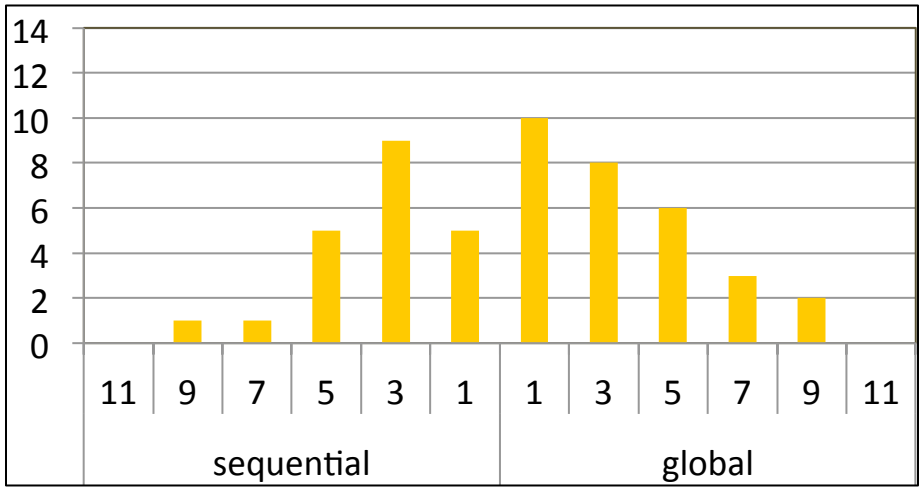
- First year seminar?
- Majors course?
- Required? Elective?
- Class size?
- Who are the students?
  - What do they want to learn?
  - What prior knowledge or misconceptions might they have?
  - How do they learn?

# Course context: Student learning styles




*Questionnaire - Barbara Soloman & Richard Felder*
*http://www.engr.ncsu.edu/learningstyles/ilsweb.html*

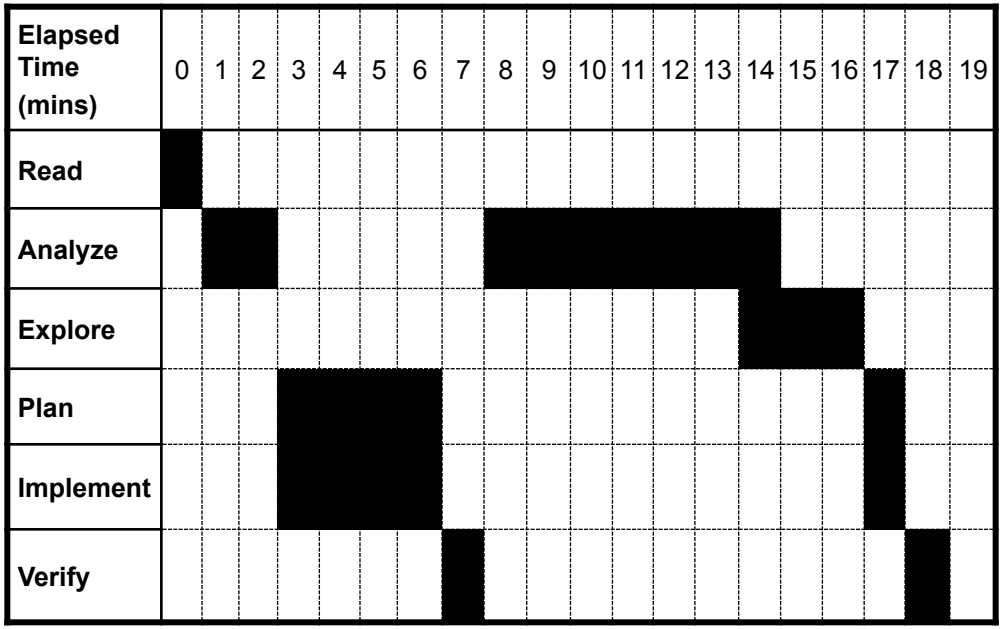
Data from 2012 Early Career workshop participants

# Course context: Students' approach

| Elapsed Time (mins) | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|
| Read | | | | | | | | | | |
| Analyze | | | | | | | | | | |
| Explore | | | | | | | | | | |
| Plan | | | | | | | | | | |
| Implement | | | | | | | | | | |
| Verify | | | | | | | | | | |

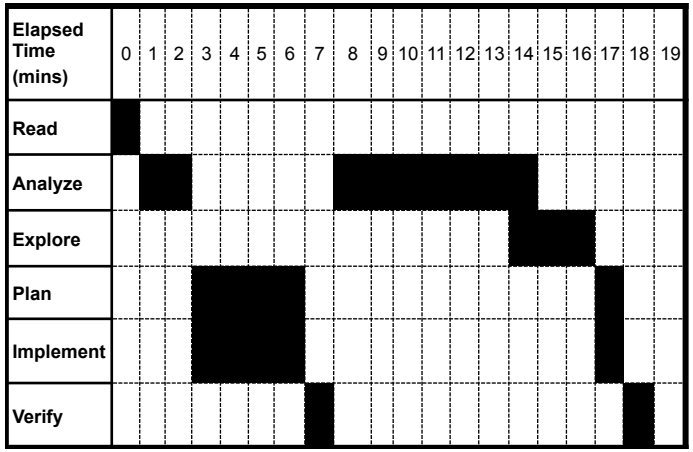
Novices

Experts




*From K. Wirth with data from Schoenfeld (1987) Mathematical Problem Solving*

# Experts' approach

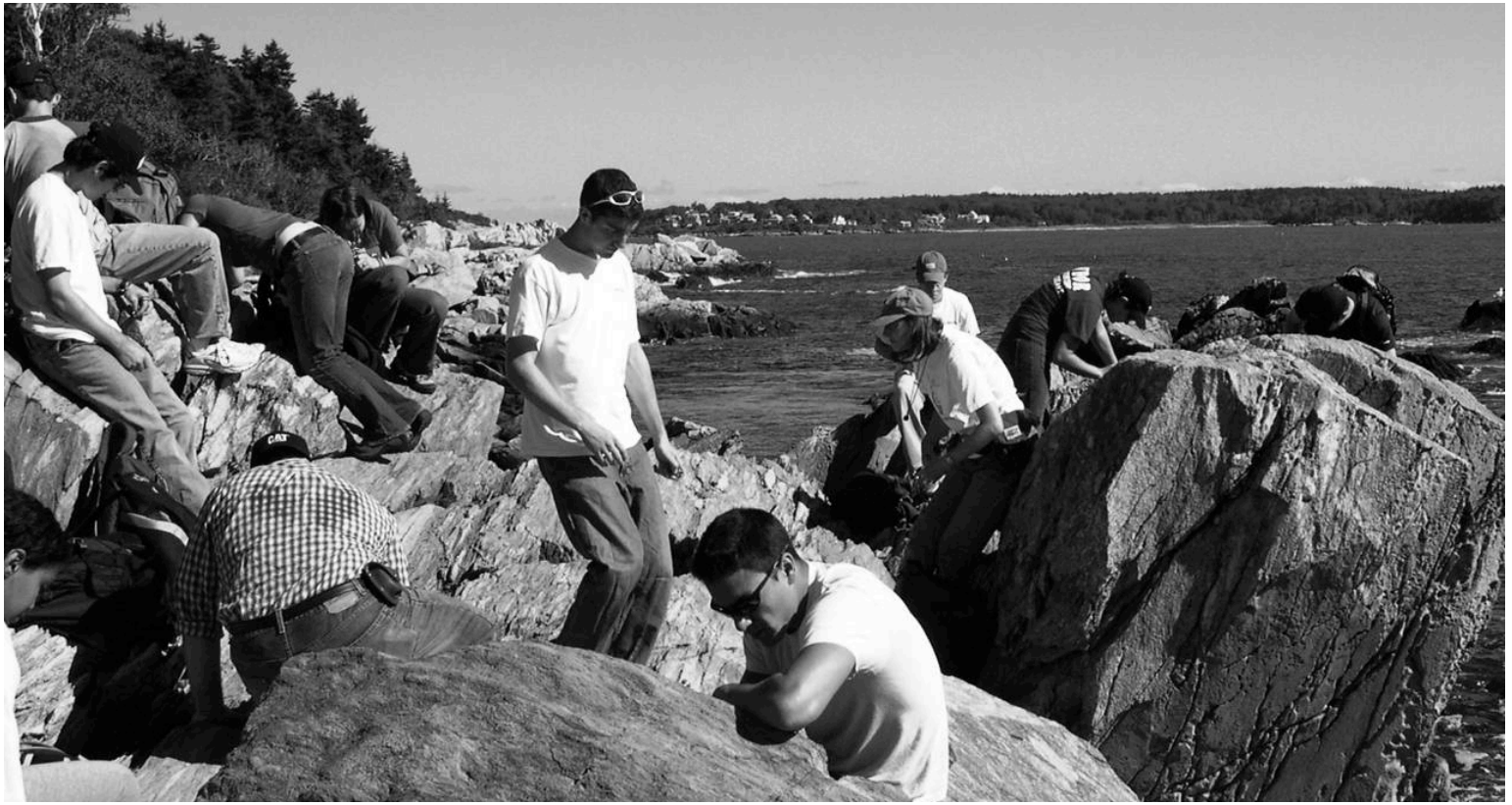



- What kind of problem is this?
- What is the best strategy for solving it?
- How will I know if I solved it?
- How could I do it better next time?
- What additional information do I need?
- What use is this new information?
- How can I use my new understanding to solve different kinds of problems?

*From K. Wirth with information from Schoenfeld (1987)*

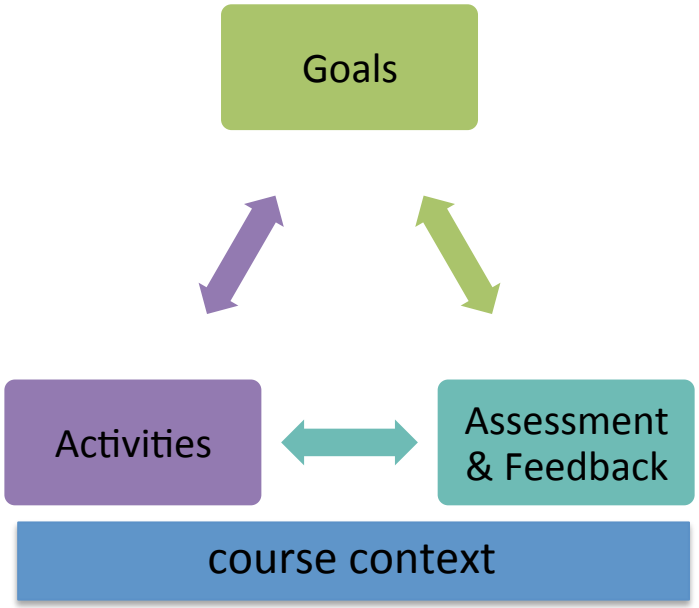
# Teaching Styles

- How do you like to teach? Why do you teach?
- How do you want to interact with your students?
- What do you find most satisfying when you teach?
- How flexible are you?



# Designing a Course

- Consider **course context**
- **Articulate goals for the course**
  - Overarching goals
  - Ancillary goals
- Design **activities**
- Plan **assessment & feedback**



# Goals-based approach

- **Emphasizes designing a course in which students**
  - Learn significant content and skills
  - Practice thinking for themselves and solving problems in discipline
  - Leave prepared to apply knowledge and skills in future

- **Sets goals that**
  - Are student centered
  - Involve higher-order thinking skills
  - Can be assessed (through problem sets, papers, exams…)

# Goals: Student-centered

- Student-centered
  - What will they learn?
- Content-centered
  - What will I cover?

*Photo by S. Fox, serc.carleton.edu*

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Example:

*I want to teach students about geologic history.*

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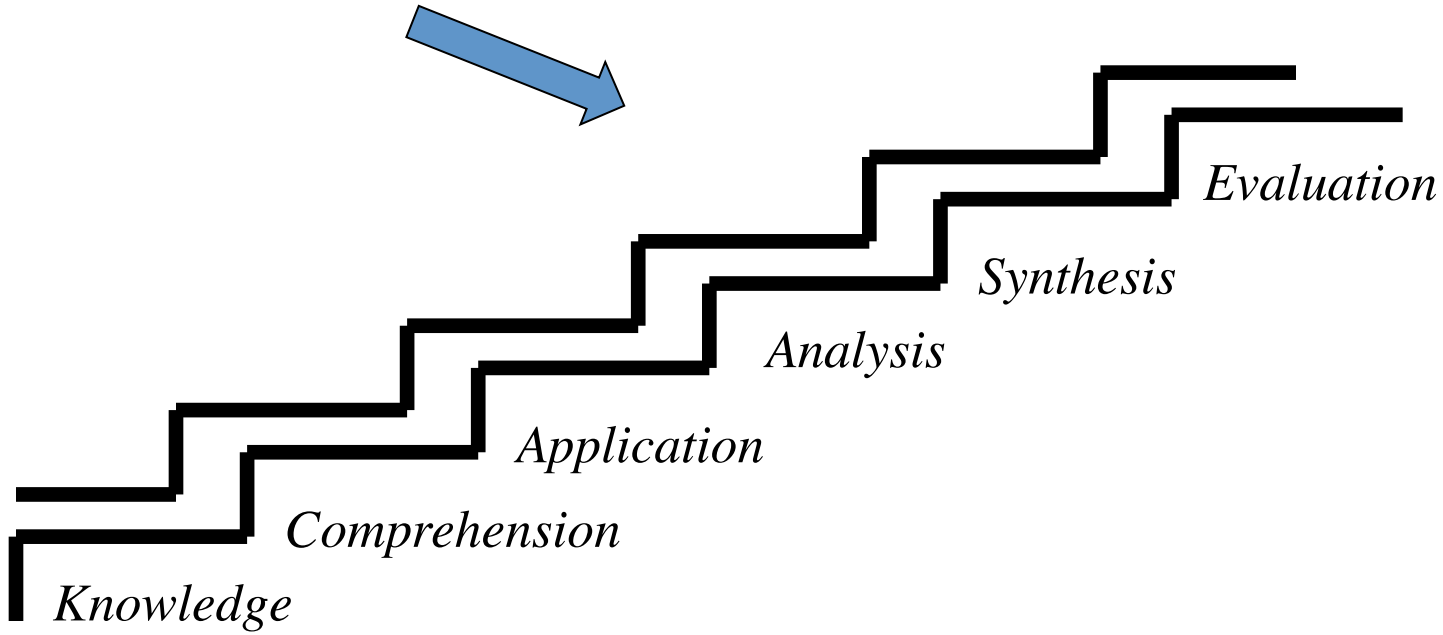
*I want to teach students about geologic history.*

# Focus on goals that involve higher-order thinking skills




**Bloom's Taxonomy**
Taxonomy of Educational Objectives (1956)

# Goals: Focus on higher order thinking

**derive, predict, analyze, design, interpret, synthesize, formulate, plan, correlate, evaluate, create, critique, adapt**

Example:

*I want to teach students about  geologic history.*

Reworked:

*Students will synthesize the geologic history of the Virginia coastal plain.*

# Overarching Goals

*What do you want students to be able to do as a result of having taken your course?*

- What do you do?
- What kinds of problems do you want students to be able to tackle?
- How might students apply what they have learned?
- How will they be different at the end of the course?

*Photo by C. Field*

# Consider your course…

**What are the overarching goals?**

For the goals, consider

*"When students have completed my course, I want them to be able to…"*

# Review overarching goals

- Does the goal focus on higher order thinking?

  (e.g. *derive, predict, analyze, design, interpret, synthesize, formulate, plan, correlate, evaluate, create, critique*, *adapt)*

- Is the goal student-focused?

- Could you design an activity/assignment that would allow you to determine whether students have met the goal or not?

  *(does the goal have "measurable outcomes"?)*

# Ancillary goals

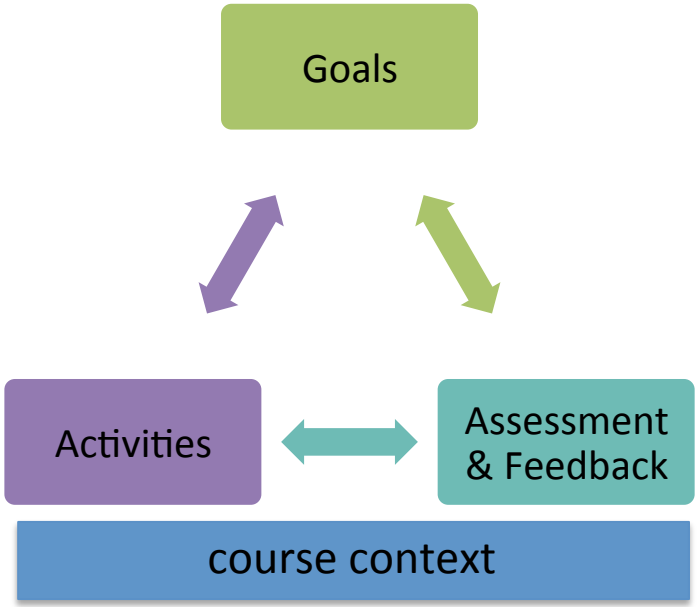
- Skills
  - Reading the professional literature
  - Working in teams
  - Writing and quantitative skills
  - Critically assessing information from the web
  - Laboratory technique
  - Self-teaching, peer teaching, oral presentation
  - …….

*Practicing oral presentations, www.bowdoin.edu, academic spotlight*

# Course design: activities and assignments

- Consider **course context**
- Articulate **goals**
- Design **activities and assignments**

  Students learn when they are actively engaged in practice, application, and problem solving (NRC, 1999 *How People Learn*)
- Plan **assessment & feedback**



# Designing Activities

*Consider whether an activity or assignment…*

- has an effective "hook" that engages students?
- places new knowledge, tasks, and experiences into the context of what students already know?
- requires students to synthesize, discuss, extend, or reflect on what they have learned?
- meets the stated goals?
- has a way to assess whether students have met the goals?

*5 E's approach: Engage, Explore, Explain, Elaborate, Evaluate*
*Bybee, 1989*

# Designing Activities

**Often many ways to design activities to meet a goal.**

If I want students to be able to analyze map data, I might:

- Prepare a Gallery Walk of maps around the classroom
- Ask a series of directed questions about a map (in lecture or as homework)
- Have students prepare clay models of topo maps and share them with the class
- Ask students to complete an interpretative cross-section during lab
- Have students prepare a map of their hometown using GIS and identify possible hazards

**Provide repeated opportunities to practice, with feedback.**

# Designing Activities

**Often many ways to design an activity to meet a goal.**

Start early; allow yourself time to think of ideas for activities.

*For a start…*

What are several activities might you design to meet one of the overarching goals you wrote for your course?

# Designing Activities

1. Individually, read one of the scenarios.

2. As a table, discuss the problems.

# Designing Activities

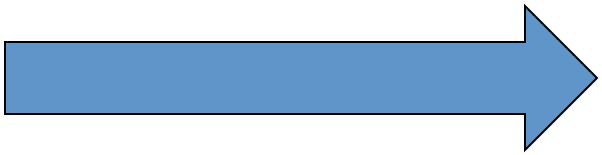
## To promote characteristics of self-regulated learners and experts, we should guide students in metacognition.

Metacognition is broadly defined as thinking about thinking.

For students, this can be “learning to learn.”

| Elapsed Time (mins) | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|
| Read | ■ | | | | | | | | | |
| Analyze | | | | | | | | | | |
| Explore | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Plan | | | | | | | | | | |
| Implement | | | | | | | | | | |
| Verify | | | | | | | | | | |

| Elapsed Time (mins) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Read | ■ | | | | | | | | | | | | | | | | | | | |
| Analyze | | ■ | ■ | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |
| Explore | | | | | | | | | | | | | | | ■ | ■ | | | | |
| Plan | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | ■ | | |
| Implement | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | ■ | | |
| Verify | | | | | | | | ■ | | | | | | | | | | | ■ | |



# Teaching students metacognitive approaches

Three basic steps to teaching students metacognition:

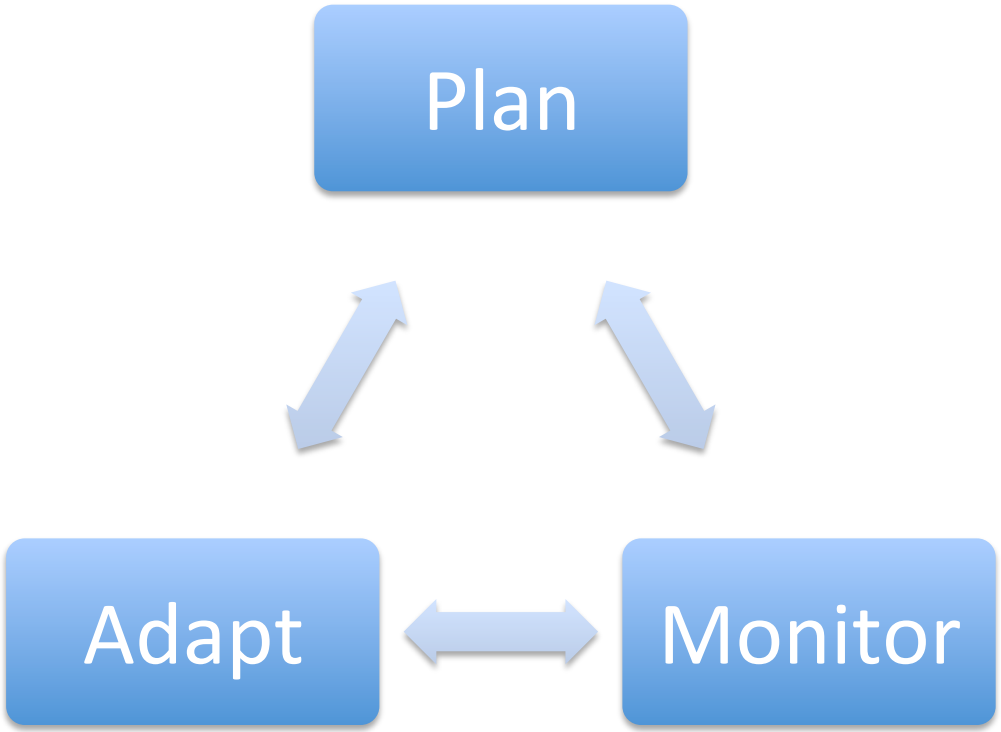
1. Teach students that their ability to learn can be changed
2. Teach planning and goal-setting
3. Give students opportunities to monitor their learning and adapt as necessary

Summarized from Lovett, 2008,
Educause Learning Initiative Conference

http://serc.carleton.edu/NAGTWorkshops/metacognition/index.html

# Designing activities to support metacognition

- Think Aloud
- Questioning
- Reciprocal Teaching
- Reading Reflections
- Wrappers
- …




http://serc.carleton.edu/NAGTWorkshops/metacognition/tactics.html

# Reading Reflections

- What is the main point of this reading?
- What did you find surprising? Why?
- What did you find confusing? Why?

Example from K. Wirth
http://serc.carleton.edu/NAGTWorkshops/metacognition/activities/27560.html

- Why is the research significant?
- What is the main argument of the paper?
- What is the evidence?
- How are the data presented and why?
- Are the assumptions reasonable?
- Are the interpretations consistent with what we know?
- Could alternative hypotheses be derived from the data?

Example questions developed by Rose, Sablock, Jones, Mogk, Wenk, Davis at 2008 workshop, The Role of Metacognition in Teaching Geoscience
http://serc.carleton.edu/NAGTWorkshops/metacognition/group_tactics/28890.html

# Research Project Wrapper

- What did you learn about research & about minerals through this project?
- What did you learn about your own research habits and preferences?
- When were you excited and/or frustrated during the project?
- If you did a similar project in the future, would you approach the project the same or differently?

**I really like that you have us write these reflections for all of the projects throughout the semester and similarly with the lectures. It makes me appreciate and understand everything that I did and learned.**

Student comment at the end of her reflection.

Example from R. Beane upper-level "Research in Mineral Science" course

# Exam Wrapper

1. Approximately how much time did you spend preparing for this exam?

2. What percentage of your time was doing the following:
   a. Reading textbook sections for the first time
   b. Rereading textbook sections
   c. Practicing problems
   d. Reviewing notes
   e. Reviewing class materials
   f. Other (specify)

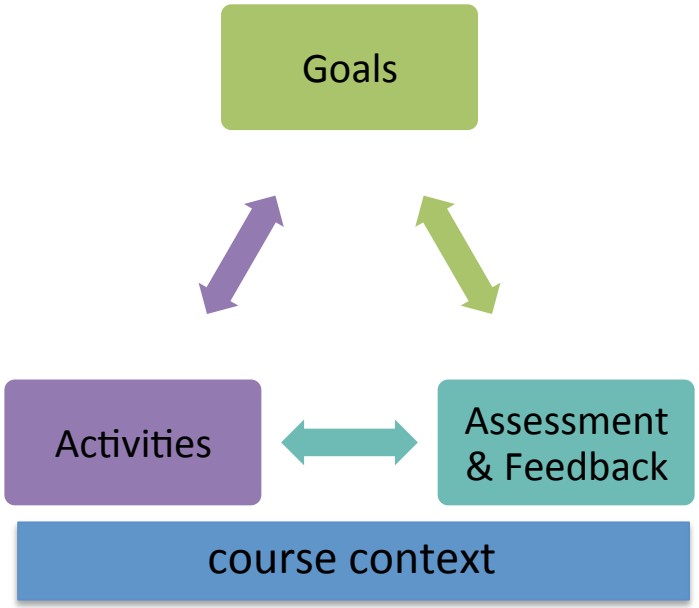
3. After reviewing your graded exam, estimate the percentage of points lost due to the following:
   a. Lack of understanding the concept
   b. Not knowing how to approach the question/problem
   c. Carelessness
   d. Other

4. Based on your responses above, how do you plan to prepare differently for the next exam?

Modified from S. Ambrose et al., 2011, How Learning Works

# Assessment

- Consider **course context**
- Articulate **goals**
- Design **activities**
- Plan **assessment & feedback**
  - Formative assessment
  - Summative assessment



# Assessment: Minute Paper

- What was the most important thing you learned in today's class?
- What question do you have about today's class?
- What was the muddiest point of today's class?

http://www.flaguide.org/cat/minutepapers/minutepapers1.php

# Assessment: Two-stage cooperative exam

- **Goal:** Exam is learning experience where students work problems & understand the process of their reasoning
- **Method:** Students take exam first individually, then again collaboratively
- **Grading:** Weighted average of individual and collaborative components

Photo by Mark Leckie.

http://nagt.org/files/nagt/jge/abstracts/Yuretich_v49n2p111.pdf
http://serc.carleton.edu/NAGTWorkshops/earlycareer2011/cooperative_exams.html

# Assessment: Rubrics

| Criteria | Exemplary | Good | Acceptable | Unacceptable |
|---|---|---|---|---|
| Organization | | | | |
| Figures | | | | |
| Interpretations | | | | |
| … | | | | |

"Learning increases when learners have a sense of what they are setting out to learn, a statement of explicit standards they must meet and a way of seeing what they have learned." *Loaker, Cromwell and O'Brien (1986)*

Rubrics improve consistency & efficiency when grading.

http://serc.carleton.edu/NAGTWorkshops/assess/rubrics.html

# Assessment


http://serc.carleton.edu/NAGTWorkshops/assess/types.html

# Context for Today's Sessions

- Articulate goals when designing courses
- Design & adapt activities and assessments with goals in mind
- Design activities to foster self-regulation & help students "learn to learn"
- Expand your "toolbox" of teaching & assessment strategies