

Designing Effective and Innovative Courses

A Practical Strategy

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

Transforming a course

- ❖ Carol DiFilippo's Course *Audition and Spoken Language*
- ❖ For pre-service teachers who will have hearing-impaired students in class
- ❖ Goal: students will be able to analyze pupil characteristics, classroom performance, and learning environments to design, implement, and assess lesson plans that will enhance spoken language learning.

Goal: Analyze pupil characteristics, classroom performance, and learning environments to design, implement, and assess lesson plans that will enhance spoken language learning

- ❖ Previous organization
 - ❖ Around topics such as nature and physiology of hearing loss, interpreting audiograms, troubleshooting hearing aids, designing lesson plans
- ❖ New organization
 - ❖ Moderately hearing-impaired child
 - ❖ Severely hearing-impaired child
 - ❖ Profoundly deaf child

Goal: analyze pupil characteristics, classroom performance, and learning environments to design, implement, and assess lesson plans that will enhance spoken language learning

- ❖ Same topics revisited with increasing complexity in each course chunk
- ❖ Enables students to have repeated practice toward goals with increasing independence
- ❖ Same overall content but goals threaded throughout the course
- ❖ Assessment is straightforward

Transforming a course

- ❖ Aaron Kelstone's course on Deaf Heritage
- ❖ Goal: students will be able to synthesize past and present events in deaf heritage to formulate a personal understanding of their experiences as deaf or hard of hearing individuals; analyze a current event in Deaf Heritage that may generate ethical or personal issues for the future.

Goal: synthesize past and present events in deaf heritage to formulate a personal understanding of their experiences as deaf or hard-of-hearing individuals

- ❖ Previous organization
 - ❖ Chronologic history of deaf culture
- ❖ New organization: change over time in various issues
 - ❖ Issues of identity
 - ❖ Education
 - ❖ Language development
 - ❖ The arts
 - ❖ Ethics, genetics, and technology
- ❖ Assessment is straightforward

Strategy for designing effective courses

- ❖ Workshop introduces a practical strategy for designing courses that
 - ❖ gets students to think for themselves in the context of the discipline
 - ❖ stresses inquiry and de-emphasizes traditional direct instruction
 - ❖ emphasizes relevance, transferability, and future use
 - ❖ builds in authentic assessment

How are courses commonly designed?

- ❖ Make list of content items important to coverage of the field
- ❖ Develop syllabus by organizing items into topical outline
- ❖ Flesh out topical items in lectures, recitations, discussions, labs
- ❖ Test knowledge learned in course

What's missing?

- ❖ Consideration of what *your* students need or could use, particularly after the course is over
- ❖ Articulation of goals beyond content/coverage goals
- ❖ Focus on student learning and problem solving rather than on coverage of material by the instructor

An alternative goals-based approach

- ❖ Emphasis on designing a course in which:
 - ❖ Students learn significant and appropriate content and skills
 - ❖ Students have practice in thinking for themselves and solving problems in the discipline
 - ❖ Students leave the course prepared to use their knowledge and skills in the future

An alternative goals-based approach

- ❖ Brings same kind of introspection, intellectual rigor, systematic documentation, and evaluation to teaching that each of us brings to our research
- ❖ Really shakes the tree and designs the course from the bottom up
- ❖ Assessment falls out naturally

Does it work?

- ❖ An effective design template
- ❖ 12 years of course design workshops; now part of NSF-funded *On the Cutting Edge* program (<http://serc.carleton.edu/NAGTWorkshops>)
- ❖ Available as an online tutorial
- ❖ <http://serc.carleton.edu/NAGTWorkshops/coursedesign/tutorial/index.html>

An aside on terminology

- ❖ Design model is goals-focused
- ❖ Terminology: goals vs. objectives vs. outcomes vs. learning goals vs. learning objectives vs. learning outcomes
 - ❖ Geology faculty at our workshops largely not fluent in edu-speak
 - ❖ Some have encountered terms defined differently in different venues
 - ❖ Our workshop participants wasted time and energy coping with the distinctions

An aside on terminology

- ❖ For our workshops, we collapsed goals, objectives and outcomes into one standard English term “goals”.
- ❖ Goals for us will be concrete and measurable (“My goal in life is to make a million \$\$”; “My goal next year is to make the Olympic sock wrestling team.”)

The course design process à la *Cutting Edge*

- ❖ Not meant to be the be all or end all – just one way to go about it!

Overview

- ❖ Articulating context and audience
- ❖ Setting goals
 - ❖ Setting overarching goals
 - ❖ Setting ancillary skills goals
 - ❖ Achieving goals through selecting content
- ❖ Developing a course plan with assignments, activities and assessments to achieve the goals

Step I: Context and audience

- ❖ Our course design process begins with answering the following:
 - ❖ Who are my students?
 - ❖ What do they need?
 - ❖ What are the needs of the curriculum?
 - ❖ What are the constraints and support structure?

Context & constraints

- ❖ Part 1.1
- ❖ Helps you think about:
 - ❖ What are the primary challenges posed by the context and constraints?
 - ❖ What opportunities are presented by the context and constraints that you could take advantage of in course design?

Task: context & constraints

- ❖ Go to Part 1.1
- ❖ Read through the questions
- ❖ What are the primary challenges posed by the context and constraints?
- ❖ What opportunities are presented by the context and constraints that you could take advantage of in course design?

Step 2: Setting student-focused, overarching goals

- ❖ Teaching is commonly viewed as being teacher-centered.
- ❖ Reinforced by the teaching evaluation process
- ❖ Commonly reinforced by how we phrase course goals: “I want to expose my students to....” or “I want to teach my students about...” or “I want to show students that...”

Step 2: Setting student-focused overarching goals

- ❖ “It dawned on me about two weeks into the first year that it was not teaching that was taking place in the classroom, but learning.”

Pop star Sting, reflecting upon his early career as a teacher

Step 2: Setting student-focused overarching goals

- ❖ We can't do a student's learning for him/her
- ❖ Exposure does not guarantee learning
- ❖ Students learn when they are actively engaged in practice, application, and problem-solving (NRC *How People Learn*).

Setting student-focused, overarching goals

- ❖ Shouldn't we be asking what we want the students to be able to *do* as a results of having completed the course, rather than what the instructor will expose them to?
- ❖ Need to set course goals for the *students*, not the teacher

Setting student-focused, overarching goals

- ❖ Example from an art history course
 - ❖ Survey of art from a particular period
 - Vs.
 - ❖ Enabling students to go to an art museum and evaluate technique of an unfamiliar work *or* evaluate an unfamiliar work in its historical context *or* evaluate a work in the context of a particular artistic genre/school/style

Setting student-focused, overarching goals

- ❖ Example from a bio course
 - ❖ Survey of topics in general biology
 - Vs.
 - ❖ Enabling students to evaluate claims in the popular press *or* seek out and evaluate information *or* make informed decisions about issues involving genetically-engineered crops, stem cells, DNA testing, HIV AIDS, etc.

Setting student-focused, overarching goals

- ❖ Example from an education course
 - ❖ Survey of results of research on learning
 - Vs.
 - ❖ Enabling students to design classroom activities for students that are consistent with educational theory and the science of learning.

Common denominator

- ❖ What sorts of things do *you* do simply because you are a professional in your discipline??
 - ❖ I use the geologic record to reconstruct the past and to predict the future.
 - ❖ I look at houses on floodplains, and wonder how people could be so stupid
 - ❖ I hear the latest news from Mars and say, well that must mean that....

What do *you* do??

- ❖ Physicist: predict outcomes based on calculations from physics principles
- ❖ Art historian: assess works of art
- ❖ Historian: interpret historical account in light of the source of information
- ❖ English prof: critical reading of prose/poetry

Task: What do *you* do?

- ❖ Your course should enable your students, at appropriate level, to *do* what you do in your discipline, not just expose them to what you know.
- ❖ Start by answering the question
 - ❖ In context of general course topic, what do *you* do? What does analyze, evaluate, etc. involve?
 - ❖ Alternatively, what is unique about your world view/the view of your discipline??

Setting overarching goals for your course

- ❖ We'll set student-focused goals
- ❖ We'll answer the question what do I want my students to be able to *do*??
 - ❖ I want my students to *use* their strong background in order to ____
rather than just
 - ❖ I want my students to *have* a strong background in ____

Goals involving lower order thinking skills

- ❖ Knowledge, comprehension, application

list	explain	calculate
identify	describe	mix
recognize	paraphrase	prepare

Examples of goals involving lower order thinking skills

- ❖ At the end of this course, I want students to be able to:
 - ❖ List the major contributing factors in the spread of disease
 - ❖ Identify common rocks and minerals
 - ❖ Recognize examples of erosional and depositional glacial landforms on a topographic map
 - ❖ Cite examples of poor land use practice.
 - ❖ Discuss the major ways that AIDS is transmitted.
 - ❖ Calculate standard deviation for a set of data

Examples of goals involving lower order thinking skills

- ❖ At the end of this course, I want students to be able to:
 - ❖ Know about the role of mutations in the development of new disease strains
 - ❖ Compare and contrast the features and functions of RNA and DNA.
 - ❖ Describe how the Doppler shift provides information about moving objects, and give an illustrative example.
 - ❖ Explain how stem cells form and what applications might be developed.

Examples of goals involving lower order thinking skills

- ❖ While some of these goals involve a deeper level of knowledge and understanding than others, the goals are largely reiterative.

Goals involving higher order thinking skills

- ❖ Analysis, synthesis, evaluation, some types of application

derive	predict	analyze
design	interpret	synthesize
formulate	evaluate	create

Examples of goals involving higher order thinking skills

- ❖ At the end of this course, I want students to be able to:
 - ❖ Develop and test age-appropriate lesson plans.
 - ❖ Analyze an unfamiliar epidemic (which is different from recalling those covered in class)
 - ❖ Evaluate the historical context of an unfamiliar event.
 - ❖ Use data from recent Mars missions to re-evaluate pre-2004 hypotheses about Mars geologic processes and history/evolution
 - ❖ Frame a hypothesis and formulate a research plan.

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Examples of goals involving higher order thinking skills

- ❖ At the end of this course, I want students to be able to:
 - ❖ Make an informed decision about a controversial topic, other than those covered in class, involving hydrogeologic issues.
 - ❖ Collect and analyze data in order to ____
 - ❖ Design models of ____
 - ❖ Solve unfamiliar problems in ____
 - ❖ Find and evaluate information/data on ____
 - ❖ Predict the outcome of ____

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Examples of goals involving higher order thinking skills

- ❖ What makes these goals different from the previous set is that they are analytical, rather than reiterative.
- ❖ Focus is on new and different situations.
- ❖ Emphasis is on transitive nature of skills, abilities, knowledge, and understanding

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Why are overarching goals important?

- ❖ If you want students to be good at something, they must practice; therefore goals drive both course design and assessment

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What kind of goals to set?

- ❖ Higher order or lower order thinking skills?
- ❖ Measurable outcomes or not?
- ❖ Abstract or concrete goals?

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We'll set goals with higher order thinking skills

- ❖ Overarching goals involving lower order thinking skills are imbedded in ones involving higher order thinking skills
 - ❖ "being able to interpret tectonic settings based on information on physiography, seismicity, and volcanic activity" has imbedded in it many goals involving lower order thinking skills

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We'll set concrete goals with measurable outcomes

- ❖ Clearer path to designing a course when overarching goals are stated as specific, observable actions that students should be able to perform if they have mastered the content and skills of a course.
 - ❖ I want students to be able to interpret unfamiliar tectonic settings based on information on physiography, volcanic activity, and seismicity.
 - Vs.
 - ❖ I want students to understand plate tectonics.

We'll set concrete rather than abstract goals

- ❖ Abstract goals are laudable but difficult to assess directly and difficult translate into practical course design
 - ❖ I want students to appreciate the complexity of Earth systems.
 - ❖ I want students to think like scientists.

Do these goals meet our criteria?

- ❖ I want to expose my students to the history of economic thought.
- ❖ I want my students to understand that poverty is a complex issue.
- ❖ I want my students to be able to identify rocks and minerals.
- ❖ Students will be able to apply their knowledge of statistics to analyze reports and claims in the popular press.

Task: write overarching goals for your course

- ❖ The overarching goals are the underpinning of your course and serve as the basis for developing activities to meet those goals.
- ❖ 1-3 overarching goals is ideal.
- ❖ There is no one right set of overarching goals for a particular course topic.
- ❖ Heed the guidelines in Part 1-2c!!

On the large Post-It

- ❖ Your name
- ❖ Course title, level, and # of students
- ❖ Prerequisites, if any
- ❖ Does your course serve as prerequisite for other courses?
- ❖ Any other important info on context, challenges and opportunities
- ❖ First draft of overarching goals

Step 3: Setting ancillary skills goals

- ❖ Ancillary skills
 - ❖ Accessing and reading the professional literature
 - ❖ Working in teams
 - ❖ Writing and quantitative skills
 - ❖ Critically assessing information on the web
 - ❖ Self-teaching, peer teaching, oral presentation

Curb your enthusiasm!

- ❖ To improve skills, students need repeated practice and timely feedback
- ❖ Hard to provide adequate practice and feedback unless goals are limited.

Step 4: Achieving goals through selecting content topics

- ❖ Once you have goals, how do you turn your goals into a course?
- ❖ Content and approach

Choosing content topics and achieving goals

- ❖ The content you choose and the approach you use to organize content topics can have profound influence on ability to achieve the goals

Approaching existing content differently to achieve goals

- ❖ Carol DiFilippo's *Course Audition and Spoken Language*
- ❖ For pre-service teachers who will have hearing-impaired students in class
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Goal: Analyze pupil characteristics, classroom performance, and learning environments to design, implement, and assess lesson plans that will enhance spoken language learning

- ❖ Previous approach
 - ❖ Around topics such as nature and physiology of hearing loss, interpreting audiograms, troubleshooting hearing aids, designing lesson plans
- ❖ New approach
 - ❖ Moderately hearing-impaired child
 - ❖ Severely hearing-impaired child
 - ❖ Profoundly deaf child
- ❖ Provides repeated practice with increasing complexity

Choosing content to achieve goals

- ❖ New environmental geo course
- ❖ Overarching goal: students will be able to research and evaluate news reports of a natural disaster and communicate their analyses to someone else
- ❖ What content to choose?

Be able to research and evaluate news reports of a natural disaster and communicate analyses to someone else

- ❖ Instructor #1 chose four specific disasters as content topics
 - ❖ 1973 Susquehanna flood
 - ❖ Landsliding in coastal California
 - ❖ Mt. St. Helens
 - ❖ Armenia earthquake

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Be able to research and evaluate news reports of a natural disaster and communicate analyses to someone else

- ❖ Instructor #2 chose four themes as content topics
 - ❖ Impact of hurricanes on building codes and insurance
 - ❖ Perception and reality of fire damage on the environment
 - ❖ Mitigating the effects of volcanic eruptions
 - ❖ Geologic and sociologic realities of earthquake prediction

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Be able to research and evaluate news reports of a natural disaster and communicate analyses to someone else

- ❖ Instructor #3 chose to focus on a historical survey of natural disasters in Vermont
 - ❖ Historical record of flooding in NW Vermont
 - ❖ 1983 landsliding
 - ❖ 2-3 other places in Vermont that have had natural disasters of different types.

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Goals and content topics unite to provide course framework

- ❖ Previous example
 - ❖ Single goal
 - ❖ Different content topics mean that each course will be different.
 - ❖ Choice of content topics drives how the instructor will accomplish the goal.
 - ❖ Students will receive different kinds of practice during the course even though the overall goal is the same

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Goals and content topics unite to provide course framework

- ❖ How about a different goal for the same hazards course?
 - ❖ Students should be able to evaluate and predict the influence of climate, hydrology, biology, and geology on the severity of a natural disaster.
 - ❖ Could we use the same content topics? Yes!
 - ❖ How would the courses be different? In the activities developed to accomplish the goals and the type of practice students receive!!

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Intersection of context, goals, and content

- ❖ Research & evaluate news report or evaluate and predict influence of climate, hydro, geo, bio on the severity of a natural hazard?
- ❖ Which goal makes most sense for who *your* students are and what they need?
- ❖ Which content topics make the most sense for *your* students, your setting, your experience, your students' futures?

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Ways to choose content: a case study approach

- ❖ Persa Batra's course on the Human Dimensions of Climate Change at Mt. Holyoke College
- ❖ Goal: To enable students to analyze the characteristics of past societies that have been impacted by climate change in order to determine what made them vulnerable. To use this analysis in order to predict what regions of today's world are most vulnerable to future climate change. To formulate strategies for how we collectively and as individuals can take action to reduce these vulnerabilities."

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Goals: Analyze characteristics of past societies to determine what made them vulnerable to climate change; predict what regions of today's world are most vulnerable to future climate change.

- ❖ Case study approach: analysis of archaeological and historical reconstructions of societies impacted by climate change, and comparison to those more able to adapt
 - ❖ Neolithic Kebaran people of southwest Asia
 - ❖ Akkadians of ancient Mesopotamia
 - ❖ Classic Maya
 - ❖ Iceland, France, England and Ireland during the Little Ice Age
 - ❖ India during the 1876-78 famine.

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Ways to choose content: connecting to faculty expertise

- ❖ Wendy Panero's Course *Mineralogy* at SUNY Oswego
- ❖ Required course for geo majors
- ❖ Goal: Students will be able to synthesize mineralogical data (visual inspection, petrographic microscopy, XRD and SEM/EDS) to address specific geological problems.

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Goal: synthesize mineralogical data (visual inspection, petrographic microscopy, XRD and SEM/EDS) to address specific geological problems.

- ❖ Previous organization
 - ❖ Around topics such as crystal chemistry, Miller indices, systematic mineralogy, lattice structures, space groups, etc.
- ❖ New organization
 - ❖ Core
 - ❖ Mantle
 - ❖ Crust

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Ways to choose content: emphasizing relevance

- ❖ Megan Longtine-Jones' course on Physical Geology at North Hennepin Community College; Gen Ed course
- ❖ Goal: Students will be able to integrate different types of data (e.g. topographic maps, geologic maps, cross-sections, stratigraphic columns, photographs, diagrams and/or tables and figures) to reconstruct scenarios that reflect the internal and/or surficial processes that create the widely varying landscapes that we see today and to evaluate potential hazards associated with them.

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Goals: Integrate data to reconstruct processes that create landscapes that we see today and to evaluate potential hazards associated with them.

- ❖ Previous organization
 - ❖ Around topics such as igneous, metamorphic, and sedimentary rocks, geologic time, plate tectonics, surficial geology, hydrogeology, etc. (standard textbook items)
- ❖ New organization: Minnesota focus
 - ❖ Modern processes and consequences (surficial processes including flooding & mass movement, hydrogeology, land use, seismicity)
 - ❖ Processes and results in recent past (Pleistocene processes and landform interpretation, etc.)
 - ❖ The rock record of past events in Minnesota

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Ways to choose content: implementing a "just in time" approach

- ❖ Linda Reinen's course on Tectonics at Pomona College
- ❖ Goals:
 - ❖ Read and interpret the scientific literature in order to identify, list, and synthesize information relating to a specific topic and/or question
 - ❖ Collect and analyze data to address a scientific question. This includes: formulating a data-collection plan, collecting data, graphing data, identifying patterns within the data, and quantifying results)
 - ❖ Synthesize data collected from a variety of sources to test current tectonic models for the southern California region.

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Goals: synthesize info from literature, collect & analyze data, carry out project on California neotectonics

- ❖ Initial thoughts on organization
 - ❖ Long intro background section on solid Earth geophysics and plate tectonics before tackling California issues
 - ❖ Then tectonic geomorphology, crustal movement (geodesy, etc.), then seismicity
- ❖ Revised organization: ditch the long background section and integrate it "just in time"; invert order of topics
 - ❖ Seismicity
 - ❖ Crustal movement
 - ❖ Tectonic geomorphology

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Ways to choose content: challenging assumptions

- ❖ Brad Hubeny's course on Historical Geology at Salem State College
- ❖ Goals:
 - ❖ When faced with a new piece of geologic information, students will be able to determine HOW we know this information and what the assumptions are in the analysis
 - ❖ Students will be able to cite examples from the past and make an informed prediction when asked about Earth's future.
 - ❖ Students will be able to synthesize the geologic history of a particular area by interpreting the regional geologic evidence and be able to put this information in the context of Earth history

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Goal: Analyze *how* we know "pieces of information", make predictions about the future w/r/t changes in Earth systems, and interpret regional geologic histories from data

- ❖ Initial thoughts on organization
 - ❖ March through time using traditional stratigraphic sequences in N. America
 - ❖ Concerns: students need a chronologic perspective
- ❖ Revised organization: take systems approach; focus on topics that address change over time, hang an updatable timeline in the classroom
 - ❖ Sea level changes
 - ❖ Mass extinctions
 - ❖ Climate change
 - ❖ Chemical cycles
- ❖ Integrate a more local focus
- ❖ Still a work in progress

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Fleshing out content topics

- ❖ Higher order thinking skills goals have imbedded in them lower order thinking skills goals
- ❖ Broad content topics have imbedded in them many concepts and content items that would be covered in a standard survey course

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Fleshing out content topics

- ❖ Geology and Development of Modern Africa
- ❖ Not a "Geology of Africa" course
- ❖ Overarching goal: students will be able to analyze the underlying influence of geology on human events
- ❖ Context is Africa, although goal is more general

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Overarching goal: students will be able to analyze the underlying influence of geology on human events

- ❖ Content topic #1: influence of climate change on prehistoric settlement patterns in North Africa
- ❖ Imbedded content items
 - ❖ Geologic content knowledge: ¹⁴C dating, fossils, lacustrine sedimentation, stratigraphic columns, using sedimentary rocks to interpret paleoenvironments, geologic time scale,....

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Overarching goal: students will be able to analyze the underlying influence of geology on human events

- ❖ Content topic #2: influence of development of East African Rift on hominid evolution
- ❖ Imbedded content items
 - ❖ Geologic content knowledge: formation and evolution of continental rifts, radiometric dating, rift volcanisms, stratigraphic columns, fossils, using sedimentary rocks to interpret paleoenvironments, geologic time scale, fluvial and alluvial processes, faulting, geologic history of East Africa, evolution

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Breadth vs. depth

- ❖ A course that is not a survey course can be content-rich
- ❖ Courses with depth rather than breadth are viable alternative
- ❖ Topic coverage doesn't have to be linear

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Meeting expectations

- ❖ Can meet content expectations for subsequent courses if topics selected carefully
- ❖ Combination of clearly-stated goals and specific content topics provides clear pathway to designing practice for students in tasks related to the goal

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Task: choose content topics to achieve overarching goals

- ❖ Go to Part 1.4.
- ❖ List your overarching goal(s).
- ❖ For each, list possible broad content topics that you could use to achieve that goal.
- ❖ On your sheet, list name and course title, revised goal(s), broad content topics, and a first stab at an overall course plan (Part 2.1)

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Importance of having a teaching toolbox

- ❖ If all you have is a hammer, everything looks like a nail.
- ❖ Same goes for teaching. If the only tool in your teaching toolbox is lecturing, then....

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Importance of having a teaching toolbox

- ❖ *As you enter a classroom, ask yourself this question: "If there were no students in the classroom, could I do what I am planning to do?" If the answer to the question is yes, don't do it.*

General Ruben Cubero, Dean of the Faculty, United States Air Force Academy (Novak et al., 1999, Just-in-Time Teaching)

Importance of having a teaching toolbox

- ❖ Learn about successful student-active assignment/activity strategies
 - ❖ think-pair-share, jigsaw, discussion, simulations, role-playing, concept mapping, concept sketches, debates, long-term projects, research-like experiences....
 - ❖ assignments involving writing, poster, oral presentation, service learning....
- ❖ Make deliberate choices of the best strategy for the task.

Aligning assessments and goals

- ❖ What students receive grades on must be tasks that allow you to evaluate whether students have met the course goals
 - ❖ If students are graded largely on their abilities to *recall, define, recognize, and follow cook-book steps*, you have not evaluated their progress toward goals involving higher order thinking skills.
- ❖ Don't assess what is easily measured – assess what you value

Aligning assessments and goals

- ❖ Example: Students will be able to evaluate and predict the influence of climate, hydrology, biology, and geology on the severity of a natural disaster.
 - ❖ Give students an unfamiliar example
 - ❖ Can they do it??

How well does this process work?

- ❖ Goals-setting is *hard but worth the effort*
- ❖ Once the goals are set (provided that they are specific, measurable, higher order thinking skills goals), the course and the assessment “falls together”

How well does this process work?

- ❖ Authentic assessment is easy to integrate if goals are kept in mind
- ❖ Workshop participants' ideas about course design are completely transformed.
- ❖ Participants report applying the same design principles to other courses and to department curricula.

Course Design Tutorial

- ❖ <http://serc.carleton.edu/NAGTWorkshops/coursedesign/tutorial/index.html>