Content, Assessment and Pedagogy (CAP): An Integrated Design Approach

Instructional Team:

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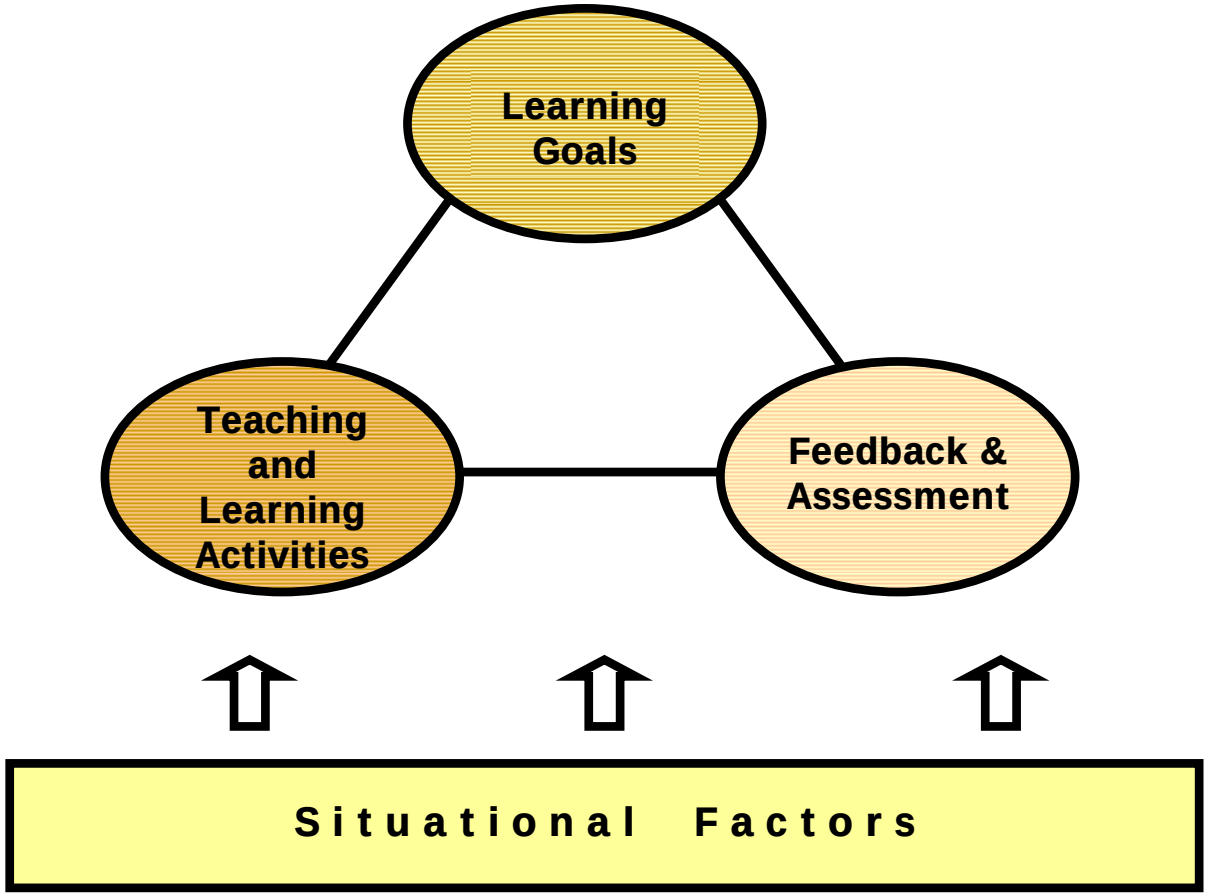
2009 Workshop for
The Committee for the Formation of Engineers Puebla-Tlaxcala

Session 2 – July 1, 2009

Backward Design Approach

- Yesterday: Desired Results (Outcomes, Objectives, Learning Goals)
  - 5 minute university
- **Today: Evidence (Assessment)**
  - Learning Taxonomies
- Tomorrow: Plan Instruction
  - Engage Students

The Key Components of INTEGRATED COURSE DESIGN



A Self-Directed Guide to Designing Courses for Significant Learning
L. Dee Fink. 2003. *Creating significant learning experiences*. Jossey-Bass.

Session 2 Overview

- Welcome & Overview
- Minute Paper for Session 1
  - Most important thing you learned; muddiest point
- Student Learning Outcomes Development
  - Refining outcomes
- Assessing Student Learning
  - Use of Taxonomies
- Assignments & Next Steps

Minute Paper about Session 1

Reflect on session 1.

1. On one side of an index card answer this question: *What is the most important thing you learned yesterday?*

2. On the side of the index card answer this question: *What is still confusing or unclear?*

Talk with other members of your group. Share with the large group.

Collect individual cards.

Taxonomies:Think-Pair-Share

- What is a taxonomy?
- What is a learning taxonomy?
- Why might learning taxonomies be useful?

Taxonomies

- *Bloom's taxonomy of educational objectives: Cognitive Domain (Bloom & Krathwohl, 1956)*
- *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001).*
- *Facets of understanding (Wiggins & McTighe, 1998)*
- *Taxonomy of significant learning (Dee Fink, 2003)*

The Six Major Levels of Bloom's (1956)Taxonomy of the Cognitive Domain (with representative behaviors and sample objectives)

- **Knowledge.** Remembering information *Define, identify, label, state, list, match*
  - Identify the standard peripheral components of a computer
  - Write the equation for the Ideal Gas Law
- **Comprehension.** Explaining the meaning of information *Describe, generalize, paraphrase, summarize, estimate*
  - In one sentence explain the main idea of a written passage
  - Describe in prose what is shown in graph form
- **Application.** Using abstractions in concrete situations *Determine, chart, implement, prepare, solve, use, develop*
  - Using principles of operant conditioning, train a rate to press a bar
  - Derive a kinetic model from experimental data

The Six Major Levels of Bloom's Taxonomy of the Cognitive Domain (with representative behaviors and sample objectives)

- **Analysis.** Breaking down a whole into component parts *Points out, differentiate, distinguish, discriminate, compare*
  - Identify supporting evidence to support the interpretation of a literary passage
  - Analyze an oscillator circuit and determine the frequency of oscillation
- **Synthesis.** Putting parts together to form a new and integrated whole *Create, design, plan, organize, generate, write*
  - Write a logically organized essay in favor of euthanasia
  - Develop an individualized nutrition program for a diabetic patient
- **Evaluation.** Making judgments about the merits of ideas, materials, or phenomena *Appraise, critique, judge, weigh, evaluate, select*
  - Assess the appropriateness of an author's conclusions based on the evidence given
  - Select the best proposal for a proposed water treatment plant

Cognitive Process Dimension

Lower Order Skills

1. Remember
   - Recognizing
   - Recalling
2. Understand
   - Interpreting
   - Exemplifying
   - Summarizing
   - Comparing
   - Explaining
3. Apply
   - Executing
   - Implementing

Higher Order Skills

4. Analyze
   - Differentiating
   - Organizing
   - Attributing
5. Evaluate
   - Checking
   - Critiquing
6. Create
   - Generating
   - Planning
   - Producing

The Cognitive Process Dimension

Remember	Understand	Apply	Analyze	Evaluate	Create
Retrieving relevant knowledge from long-term memory	Determining the meaning of instructional messages, including oral, written, and graphic communication.	Carrying out or using a procedure in a given situation	Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose	Making judgments based on criteria and standards	Putting elements together to form a novel, coherent whole or make an original product
Recall Define Relate Review	Restate Describe Identify Express	Employ Translate Demonstrate Examine	Distinguish Compare Contrast Deduce	Select Defend Interpret Discriminate	Arrange Combine Construct Propose

A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001).

- The Knowledge Dimension
  - Factual Knowledge
  - Conceptual Knowledge
  - Procedural Knowledge
  - Metacognitive Knowledge

The Knowledge Dimension

Factual Knowledge – The basic elements that students must know to be acquainted with a discipline or solve problems in it.

a. Knowledge of terminology

b. Knowledge of specific details and elements

Conceptual Knowledge – The interrelationships among the basic elements within a larger structure that enable them to function together.

a. Knowledge of classifications and categories

b. Knowledge of principles and generalizations

c. Knowledge of theories, models, and structures

Procedural Knowledge – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.

a. Knowledge of subject-specific skills and algorithms

b. Knowledge of subject-specific techniques and methods

c. Knowledge of criteria for determining when to use appropriate procedures

Metacognitive Knowledge – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

a. Strategic knowledge

b. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge

c. Self-knowledge

The taxonomy table

The Knowledge Dimension	The Cognitive Process Dimension					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Metacognitive Knowledge						

(Anderson & Krathwohl, 2001)

Facets of Understanding
Wiggins & McTighe, 1998, page 44

- When we truly understand, we
  - *Can* ***explain***
  - *Can* ***interpret***
  - Can ***apply***
  - Have ***perspective***
  - Can ***empathize***
  - Have ***self-knowledge***

Sample Learning Objectives (Wiggins & McTighe, p. 87, 154)

- Facet 1: Explanation
  - Student will be able to explain that the gravitational force is an attraction between masses and that the strength of the force is proportional to the masses and weakens rapidly with increasing distance between them
- Facets 2-3-1: Interpretation-Application-Explanation
  - Apply the practice of statics (physics) to the practice of statics (physics). Build a balsa bridge to specifications in which the situational demands require adjustments to the mathematically predicted answers.

Six Facets of understanding

Six Facets	Description	Example
Explanation	To ensure students understand why an answer or approach is the right one. Students explain or justify their responses or justify their course of action.	Students develop an illustrated brochure to explain the principles and practices of a particular type of technology (i.e., transportation, construction, medical, information).
Interpretation	To ensure students avoid the pitfall of looking for the "right answer" and demand answers that are principled…students are able to encompass as many salient facts and points of view as possible.	Students develop a 'biography' of the development of a particular type of technology.
Application	To ensure students' key performances are conscious and explicit reflection, self-assessment, and self-adjustment, with reasoning made evident. Authentic assessment requires a real or simulated audience, purpose, setting, and options for personalizing the work, realistic constraints, and "background noise."	Students analyze a design of a product, taking it apart in order to determine how it works. Students design, develop, test, and revise a solution to a local issue, such as a new roadway system, a water treatment system, or long-term storage of various materials.
Perspective	To ensure students know the importance or significance of an idea and to grasp its importance or unimportance. Encourage students to step back and ask, "What of it?" "Of what value is this knowledge?" "How important is this idea?" "What does this idea enable us to do that is important?"	Students investigate about a technological artifact from the perspective of different regions and countries.
Empathy	To ensure students develop the ability to see the world from different viewpoints in order to understand the diversity of thought and feeling in the world.	Students imagine they are politicians debating the value of nuclear power. They write their thoughts and feelings explaining why they agree or disagree with the use of nuclear power.
Self-Knowledge	To ensure students are deeply aware of the boundaries of their own and others' understanding; able to recognize their own prejudices and projections; has integrity – able and willing to act on what one understands	Students reflect on their own progress of understanding about one of the standards in *Standards for Technological Literacy: Content for the Study of Technology*. They evaluate the extent to which they have improved, what task or assignment was the most challenging and why, and which project or product of work they are most proud of and why.

Source: Wiggins, G., & McTighe, J. (1998). *Understanding by Design*. p. 85-97. Alexandria, VA: Association for Supervision and Curriculum Development.

Creating Significant Learning Experiences
A TAXONOMY OF SIGNIFICANT LEARNING - Dee Fink

1. Foundational Knowledge

- "Understand and remember" learning
  For example: facts, terms, formulae, concepts, principles, etc.

2. Application

- Thinking: critical, creative, practical (problem-solving, decision-making)
- Other skills
  For example: communication, technology, foreign language
- Managing complex projects

3. Integration

- Making "connections" (i.e., finding similarities or interactions) . . .
  Among: ideas, subjects, people

4. Human Dimensions

- Learning about and changing one's SELF
- Understanding and interacting with OTHERS

5. Caring

- Identifying/changing one's feelings, interests, values

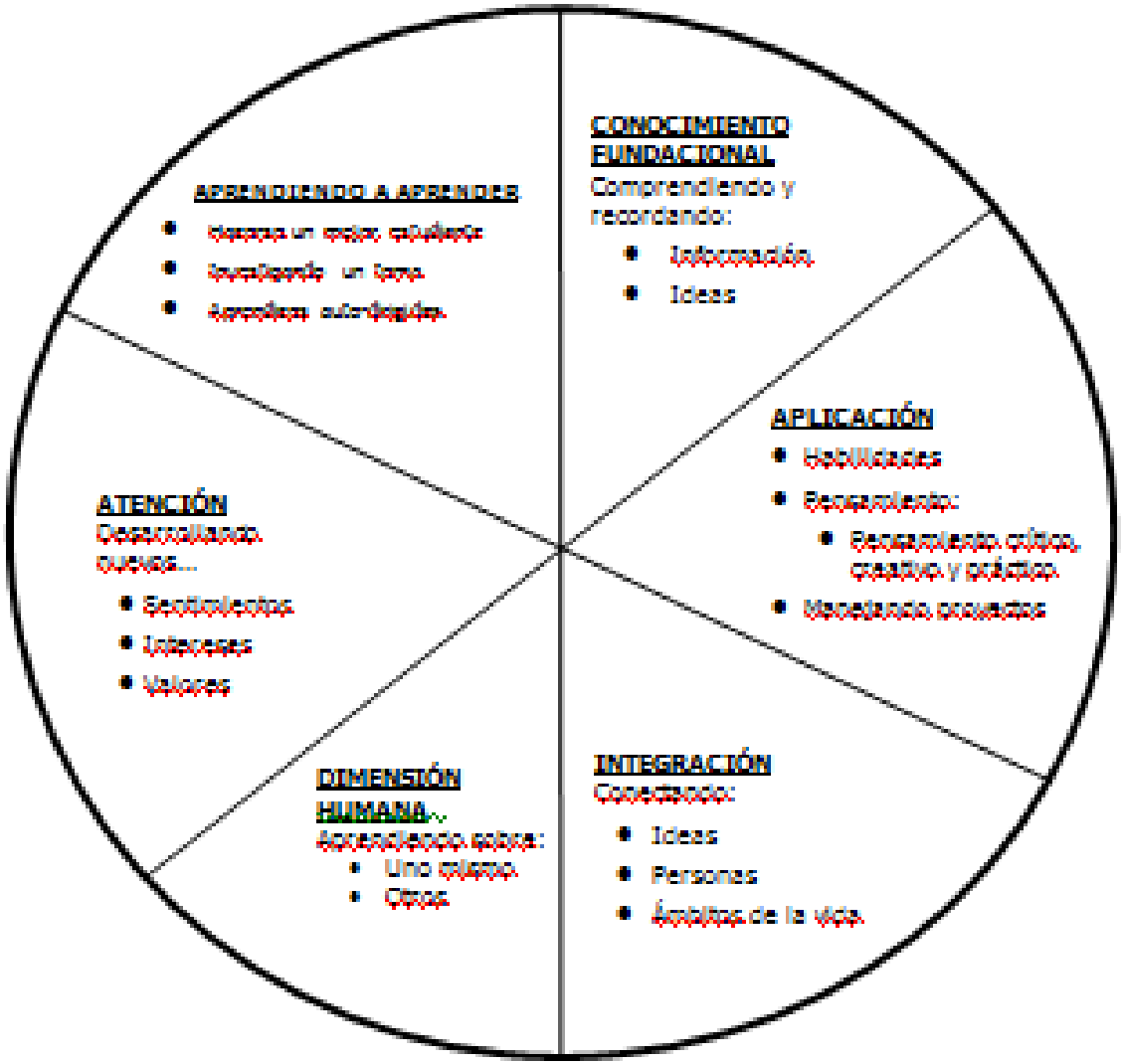
6. Learning How to Learn

- Becoming a better student
- Learning how to ask and answer questions
- Becoming a self-directed learner

Creating Significant Learning Experiences
A TAXONOMY OF SIGNIFICANT LEARNING - Dee Fink

UNA TAXONOMÍA DEL APRENDIZAJE SIGNIFICATIVO

Page 9



Fink - Step 2. Worksheet (p. 11)

- Individually complete all the applicable categories
- Share with your neighbors

Refining your learning objectives

- Individually take a couple of minutes to review your current learning goals.
- Share your draft with your neighbors.
- Provide feedback to your neighbors' drafts too.
- How will you assess whether your learning goals have been achieved?

Some Important Principles About Learning and Understanding

- .

- A third critical idea about how people learn is that a “metacognitive” approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.

- Jim Pellegrino – Rethinking and redesigning curriculum, instruction and assessment: What contemporary research and theory suggests

Understanding Understanding

- **Stage 1**. Identify Desired Results

  Focus Question: What does it mean to “understand”?

- **Stage 2**. Determine Acceptable Evidence

  Focus Questions: “How will we know if students have achieved the desired results and met the standards? What will we accept as evidence of student understanding and proficiency (Wiggins & McTighe)

Minute Paper Results
Most Important

- Prioritizing the objectives
- The CAP (backward design) model
- Working with (and agreeing with) people from other universities
- Importance of acknowledging the values and other affective outcomes, and not only the cognitive outcomes

Minute Paper Results
Most Confusing

- How to place things in the “onion” diagram
- How to write learning objectives, how to know if they are right and enough
- How this process improves the course/syllabus {Instructional team – especially student learning}
- Assessment Techniques & Pedagogy Examples
- **CAP** elements and how they align
- How to complete the Fink Table 1
- How to incorporate the “whole person” outcomes

Some Important Principles About Learning and Understanding

- The first important principle about how people learn is that students come to the classroom with preconceptions about how the world works which include beliefs and prior knowledge acquired through various experiences.

- Jim Pellegrino – Rethinking and redesigning curriculum, instruction and assessment: What contemporary research and theory suggests

Understanding Misunderstanding

- *A Private Universe* – 21 minute video available from www.learner.org
- Also see *Minds of our own* (Annenberg/CPB Math and Science Collection – www.learner.org)
  - Can we believe our eyes?
  - Lessons from thin air
  - Under construction

Teaching Teaching & Understanding Understanding - http://www.daimi.au.dk/~brabrand/short-film/index-gv.html

Understanding Misunderstanding

- Common misunderstandings or misconceptions among students in your course
- Individually reflect
- Share with others

Backward Design

Stage 2. **Determine Acceptable Evidence**

Types of Assessment (Wiggins & McTighe, p. 14)

Quiz and Test Items:

Simple, content-focused test items

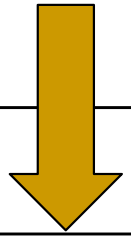
Academic Prompts:

Open-ended questions or problems that require the student to think critically

Performance Tasks or Projects:

Complex challenges that mirror the issues or problems faced by graduates, they are authentic

Worksheet for Designing a Course/Class Session/Learning Module

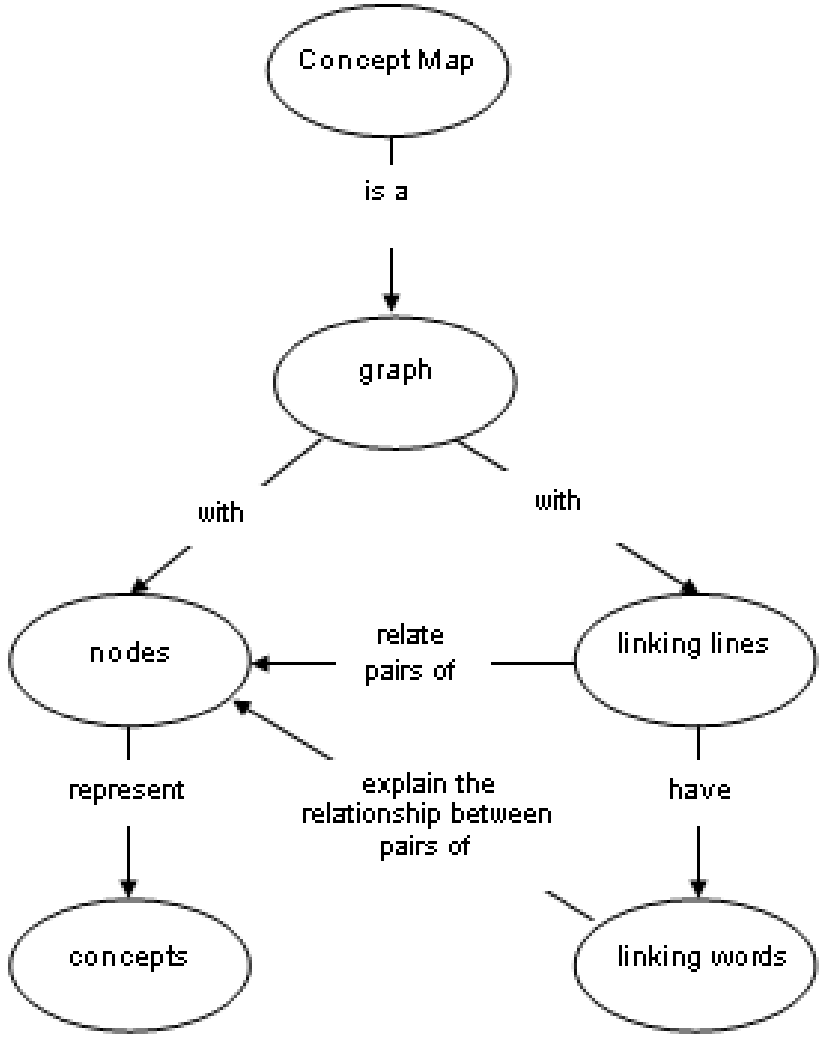
	Ways of Assessing	Actual Teaching-Learning	Helpful Resources:
Learning Goals for Course/Session/Learning Module:	**This Kind of Learning:**	**Activities:**	(e.g., people, things)
1.			
2.			
3.			
4.			
5.			
6.			

Course Concept Mapping

- Construct a concept map (visual organizer) that represents the key elements and relationships between these key elements for the course you are re-designing

How to construct a concept map

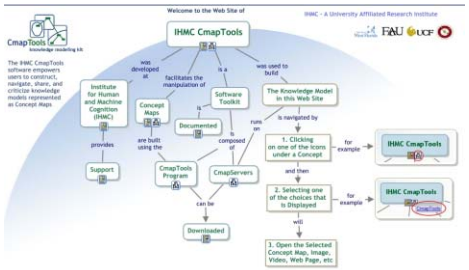
- Central Node
  - BIG idea at the heart of the discipline
  - Most important outcome for the course
- Surrounding Nodes
  - Related ideas, topics, etc.
- Nature of the connection (relationship) between the nodes



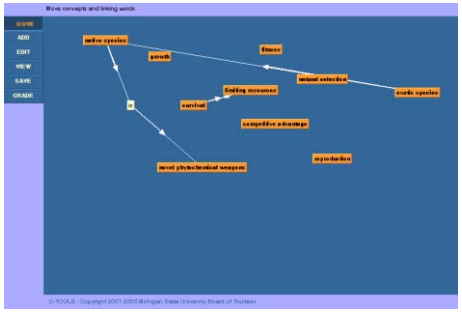
Ruíz-Primo, M. (2000). On the use of concept maps as an assessment tool in science: What we have learned so far. *Revista Electrónica de Investigación Educativa*, *2* (1).

Concept Maps Software Tools

- Cmap Tools (http:// cmap.ihmc.us)
  - Institute for Human &Machine Cognition
  - Free downloadable program



- C-Tools (http://ctools.msu.edu)
  - Michigan State University (NSF)
  - Free web-based Java applet



- SMART Ideas (http://www2.smarttech.com)
  - SMART Tech
  - Free trial version (30 days)

Visual Organizer

- Share your elaborated concept map or other visual organizer with your neighborhood. Get feedback from your neighbors.

- Participants may have a chance to share their concept map with the another group.

Backward Design Approach

- Desired Results (Outcomes, Objectives, Learning Goals)
  - 5 minute university
- Evidence (Assessment)
  - Learning Taxonomies
- **Plan Instruction**
  - Engage Students

Worksheet for Designing a Course/Class Session/Learning Module

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1.			
2.			
3.			
4.			
5.			
6.			

Backward Design

Plan Learning Experiences & Instruction

- What enabling knowledge (facts, concepts, and principles) and skills (procedures) will students need to perform effectively and achieve desired results?
- What activities will equip students with the needed knowledge and skills?
- What will need to be taught and coached, and how should it be taught, in light of performance goals?
- What materials and resources are best suited to accomplish these goals?
- Is the overall design coherent and effective?

Assignments & Next Steps

- For tomorrow
  - Revise the assessment column of your worksheet
  - Begin to plan Instruction
    - See questions on previous slide