Developing Measurable Objectives and Outcomes for Programs and Courses

North Dakota State University

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Workshop Presenters

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Dr. Rita Caso

- Ph.D. Applied Research and Evaluation in Education, Counseling and Psychology
- 20 + years experience in teaching, administration, research, assessment, evaluation, and accreditation-review preparation in K-12, Adult, and Higher Education, in Human Services, and National Market Research.
- 7 years specific experience assessing and evaluating University Level Engineering programs, and Science, Math, Engineering, and Technology (SMET) programs

Dr. Ann Kenimer

- B.S., M.S., Agricultural Engineering, Virginia Tech
- Ph.D., Agricultural Engineering, University of Illinois
- Teaches engineering design processes, fundamental problem solving, environmental engineering
- FC Project Manager for Assessment and Evaluation

Developing Measurable Objectives and Outcomes for Programs and Courses -- Specific questions you will answer:

- Why do program objectives matter at the course and class outcome level (Inter-dependence in the "BIG PICTURE")?
- How do we recognize ,express and track our program and course objectives in relation to measurable student outcomes?
- What does OUR "BIG PICTURE" looks like, vis a vis objectives, measurable outcomes & assessment?
- How can we identify, organize, modify and use existing mechanisms of classroom assessment and routine institutional data collection for program assessment?
- How do we construct, or adapt new assessment instruments?

Developing Measurable Objectives and Outcomes for Programs and Courses -- Workshop Objectives

(1) Help participants understand some of the basic Assessment and Evaluation terms used in this workshop

(2) Help participants distinguish between ABET 2000 Criterion 2 program objectives and Criterion 3 program outcomes.

(3) Help participants understand what student outcomes are, and how to develop them and relate them to the EC2000 Criterion 3 outcomes.

Developing Measurable Objectives and Outcomes for Programs and Courses -- Workshop Objectives

(4) Help participants develop measurable learning objectives & performance criteria for each outcome.

(5) Help participants map outcomes and topics across courses.

Developing Measurable Objectives and Outcomes for Programs and Courses -- Workshop Objectives

(6) Examine existing classroom assessment methods and tools, in order to prepare a preliminary assessment plan program.

(7) Help participants look at the various assessment methods that are available and select appropriate method(s) for each outcome.

(8) Help participants think about how to put selected assessment methods into practice.

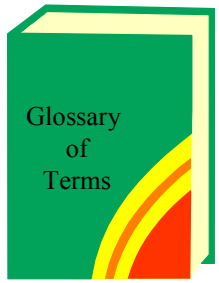
Workshop Agenda

- A&E Glossary
- Your “Big Picture”
- Classroom Objectives and Outcomes
- Program Objectives and Outcomes
- Appropriate Assessment
- Continuous Improvement

A&E Glossary

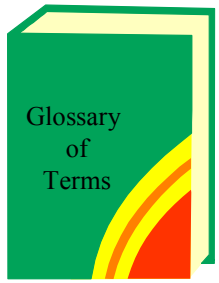
Common terms used in educational planning, assessment, and evaluation

Glossary of Terms



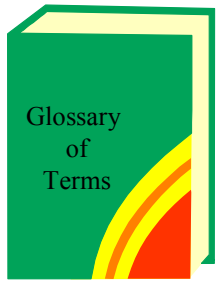
- **Objective**-statement describing desired results which is:
  - Broad
  - Likely to address multiple ABET criteria
  - Highest level for discussion
- *Example- Students will be able to communicate effectively*

Glossary of Terms



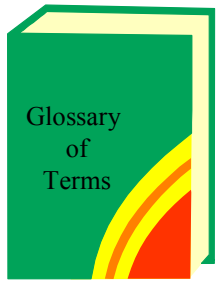
- **Outcome**-statement(s) derived from an objective
- More specific than objective
- Likely to address more than one ABET criteria
- *Example- Students will be able to plan, prepare, deliver, and assess formal and informal oral presentations*

Glossary of Terms



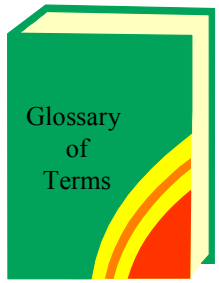
- **Performance indicators**-specific, measurable statement(s) of performance required to meet the outcome
- *Example- Students demonstrate audience awareness when they make oral presentations*

Glossary of Terms



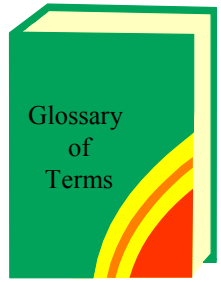
- **Strategies and Actions**-program and institutional practices designed to achieve specific outcomes.
- *Example- Inform students and faculty of presence of the Engineering Writing Center, and require its use*.

Glossary of Terms



- **Assessment Methods and Metrics**- Processes, tools, and measurement scales used to collect evidence of outcome performance.
- *Example- Individual classroom assessment using checklists and rubrics*.

A Working Definition of Assessment [for this discussion]



Assessment involves

... *Consistently,Systematically, and Meaningfully..*

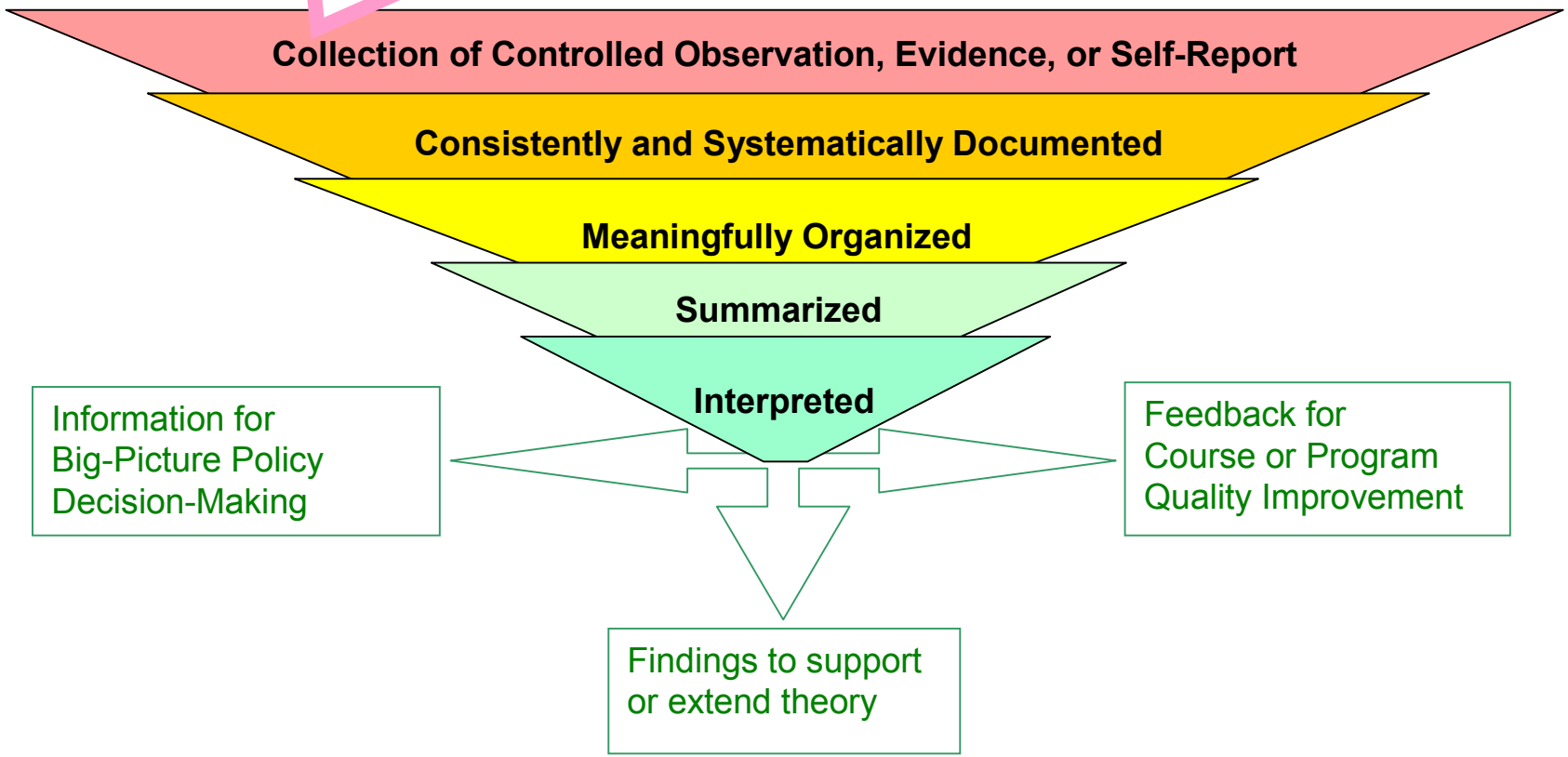
- **Capturing and Documenting**
- **Organizing**
- **Summarizing**
- **Interpreting**
- **Reporting**

….Controlled Observation, Self-Report, or Other Evidence of Performance,Behavior, Perception or Attitude.

A Working Definition of Assessment

OUTCOMES

Performance, Behavior, Perception, or Attitude



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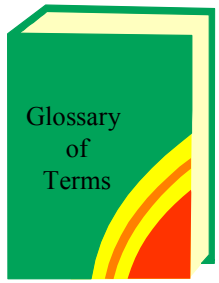
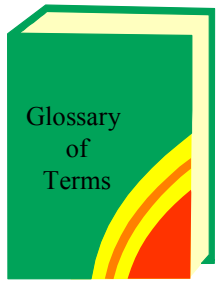


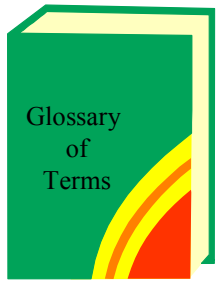
- **Evaluation**-The system of critically examining the assessment data and performance indicators to measure progress toward and improvement of program objectives.
- *Example- Committee for random sampling of graduates*.

Glossary of Terms



- **Feedback**-The application of evaluation results to the further development and continuous improvement of program objectives.
- *Example- Feedback to college or program curriculum committee to improve course outlines, topical structures within courses, and resource allocations*.

Glossary of Terms

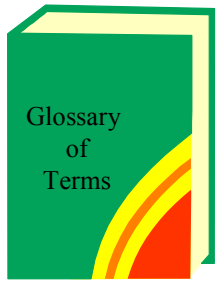


- **Terminal Outcome Assessment -** Observation, measurement and judgement of final results at the end of an education process
- **Examples:**

Assessing Ability to Design by scoring quality of Senior Design Project processes and products; or

Assessing Ability to Communicate by grading the understandability, appropriateness and correctness of English usage in a Sr. Project Presentation or Report

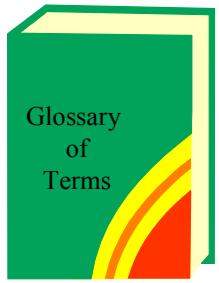
Glossary of Terms



- **Interim (Developmental, Progressive, or Incremental) Outcome Assessment -- Meaningful outcomes observed at various points in time during the course of the education and learning process, to demonstrate growth in competency through the educational process**
- ***Example***

Assessing Ability to Communicate engineering concepts with technical detail by grading engineering essays at Freshman, and Junior levels

Glossary of Terms



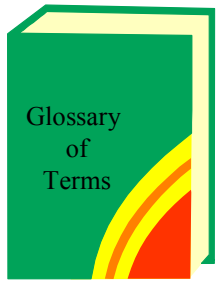
- *(Continued)* **Interim Outcome Assessment *Examples* :**

Assessment of student group projects for knowledge, skills and processing competencies recognized as salient elements of good engineering designing , at various points in the educational continuum,

Assessment of Class and Project Teamwork , at various points in the educational continuum (i.e., Faculty Assessment; Self Assessment; Group Self Assessment)

Regularly repeated Surveys (in each course, or in specifically selected courses) of Student and Faculty perceptions about instructional activities pointedly intended to facilitate learning for the Terminal Outcome

Glossary of Terms

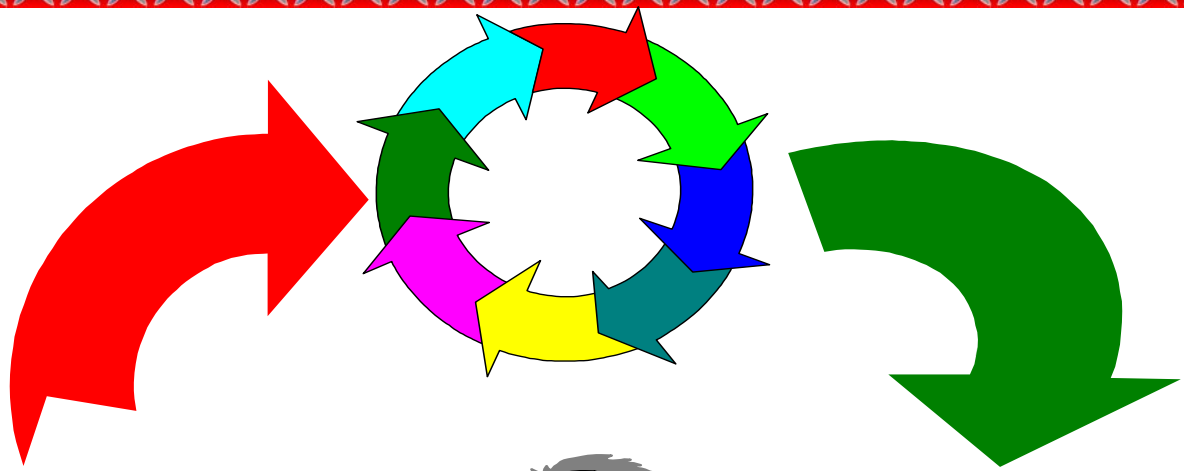


- **De-constructive vs Constructive Approaches** **May be likened, correspondingly, to Reverse Engineering vs Deduction from Theory**
- ***Example-***

Inferring course learning objectives by analyzing skill and knowledge demonstration demanded by course exams VS

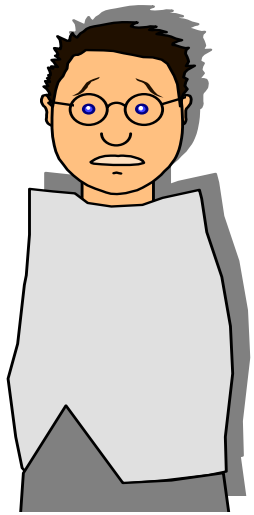
Generating exam items by deducing what will be able to perform as a result of satisfying a course learning objective

The Trek to Accreditation
EC 2000



Prescriptive-approach to Objectives

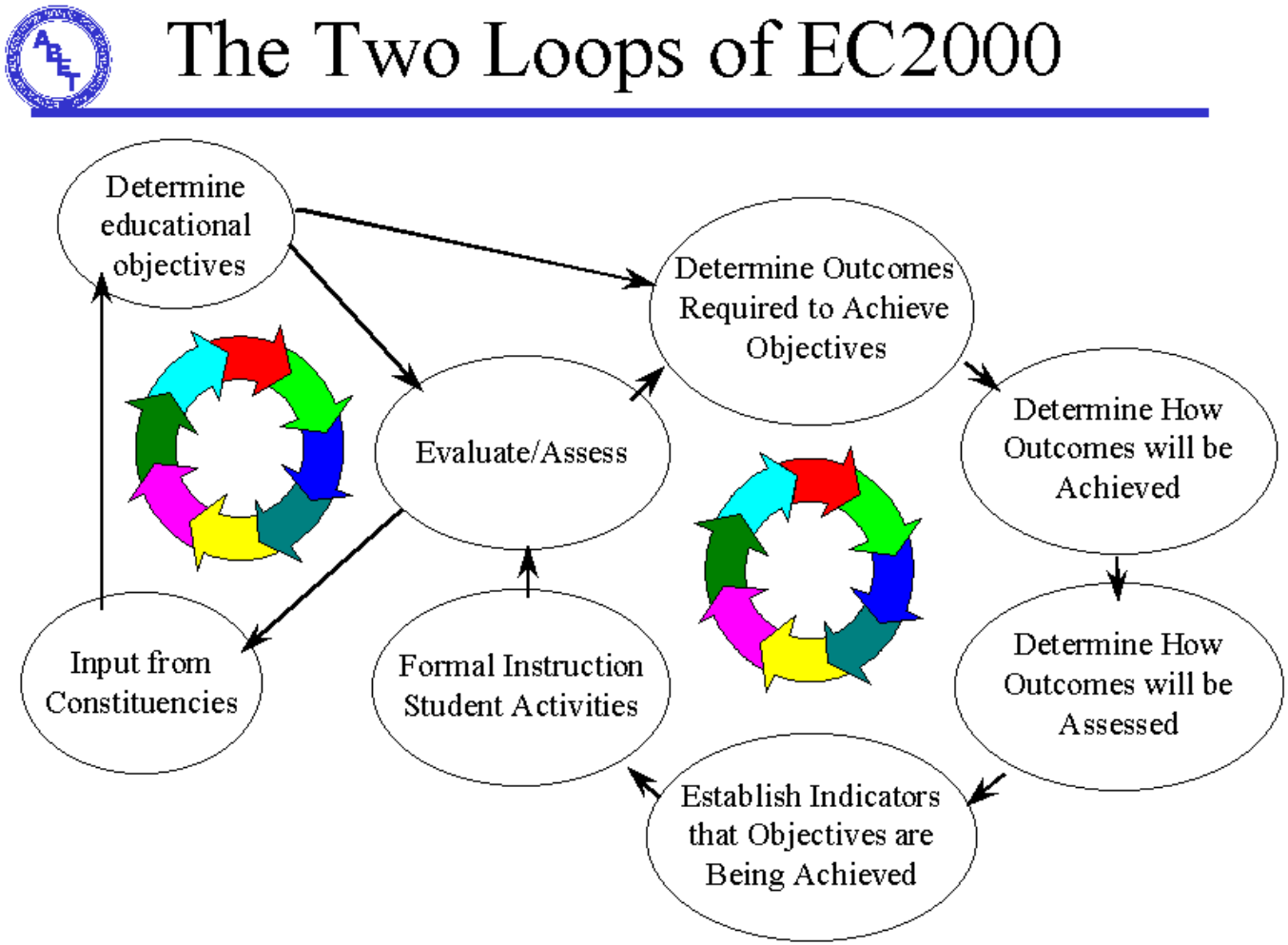
Old ABET



Performance-approach to Objectives

ABET EC 2000

ONGOING EVALUATION SYSTEM



The “Big Picture”

How the various pieces of assessment and evaluation work together

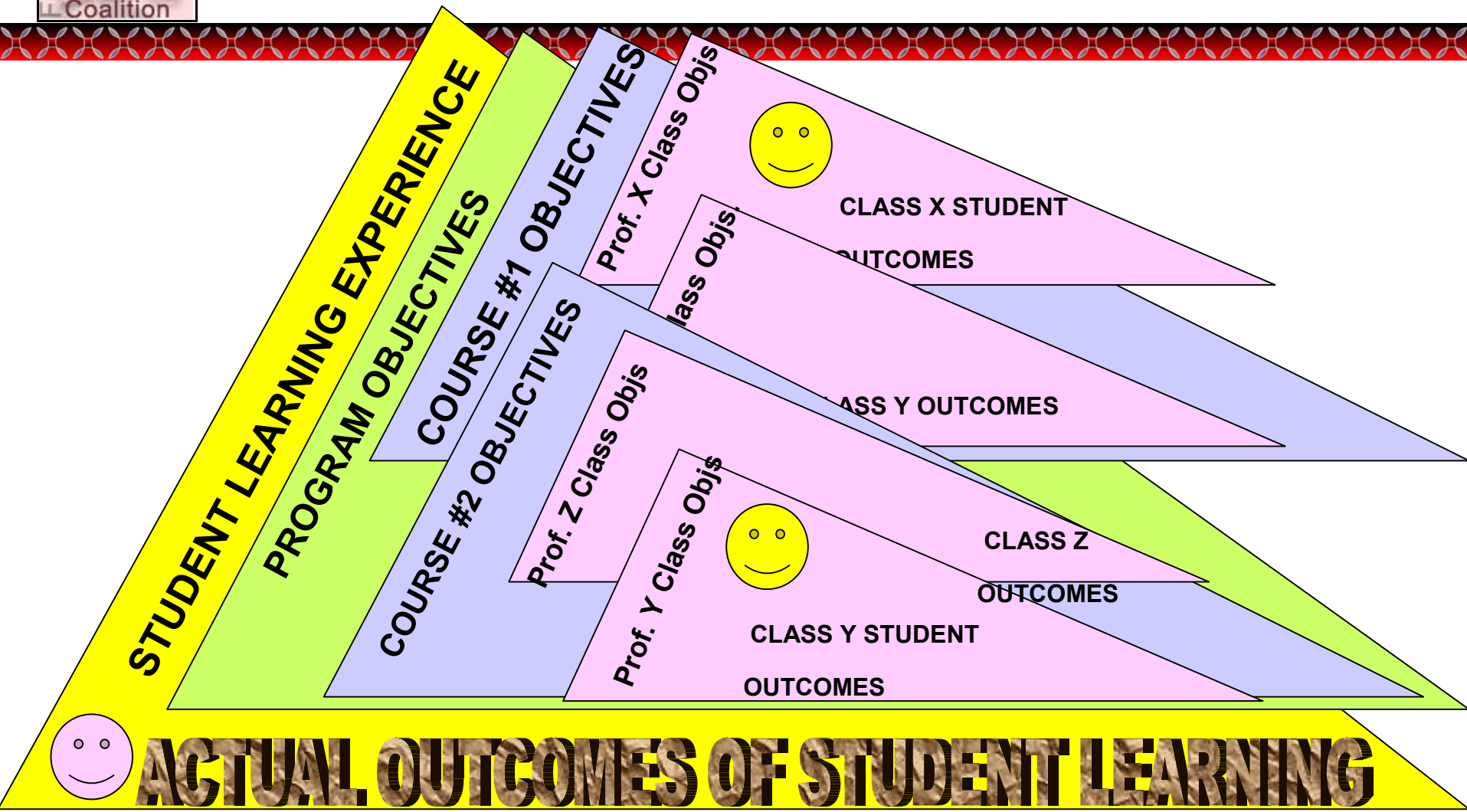
The BIG PICTURE

- **The Education System: Program, Course, and Class Inter-dependence**
  - **Objectives, Delivery and Outcomes**
  - **Where's the student?**
- **The Ongoing Evaluation System**
  - **Where the Education System and the Student fit in**

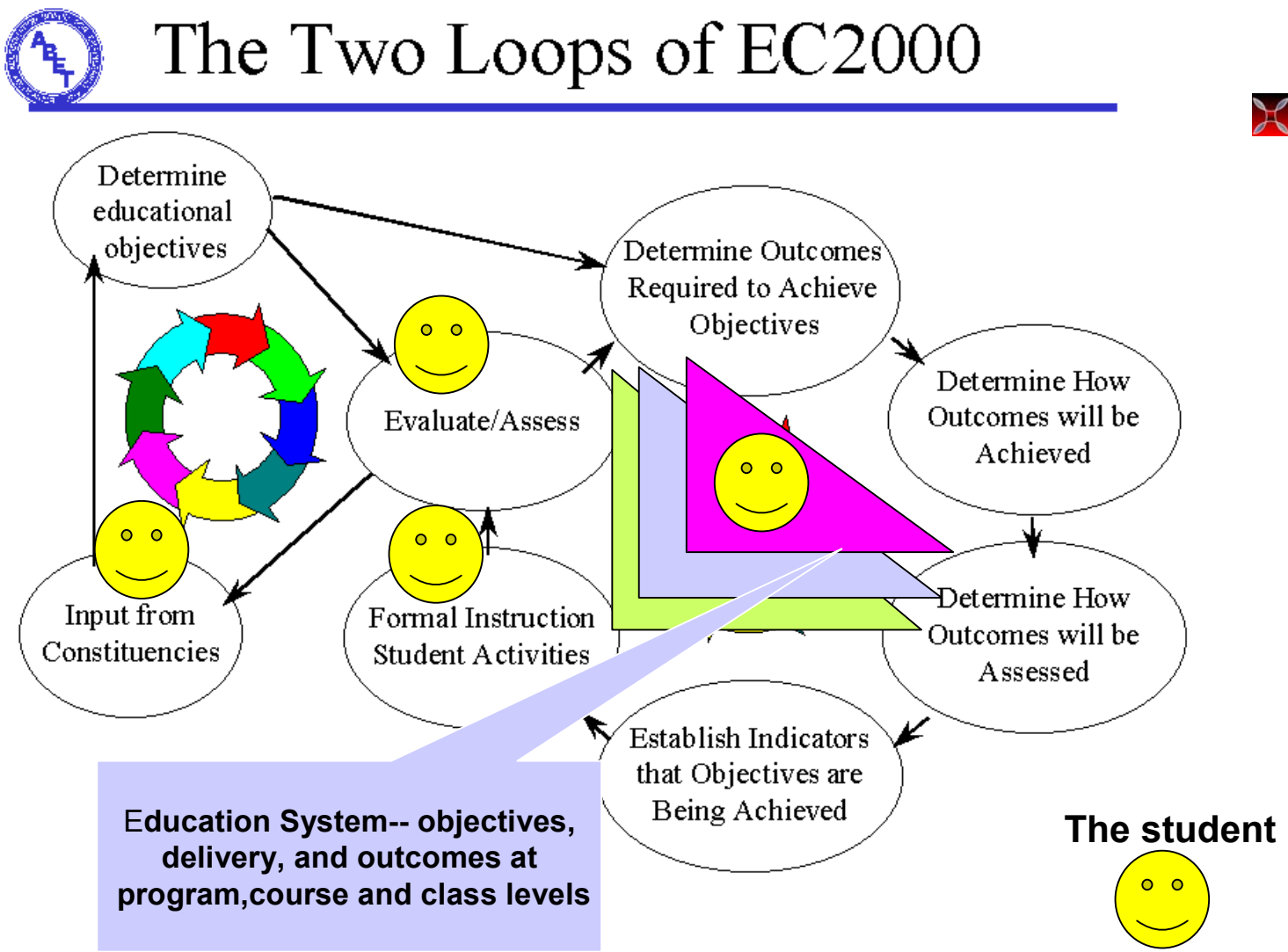
The BIG PICTURE CONT.

- **PRE-VIEW: Considering What, When, How to Implement Assessment**
  - **WHAT-- Levels of Student Learning**
  - **WHEN-- Terminal and Interim Assessment**
  - **HOW -- Using what you already have**

THE EDUCATION SYSTEM
Student Outcomes and Program, Course and Class Inter- Dependence

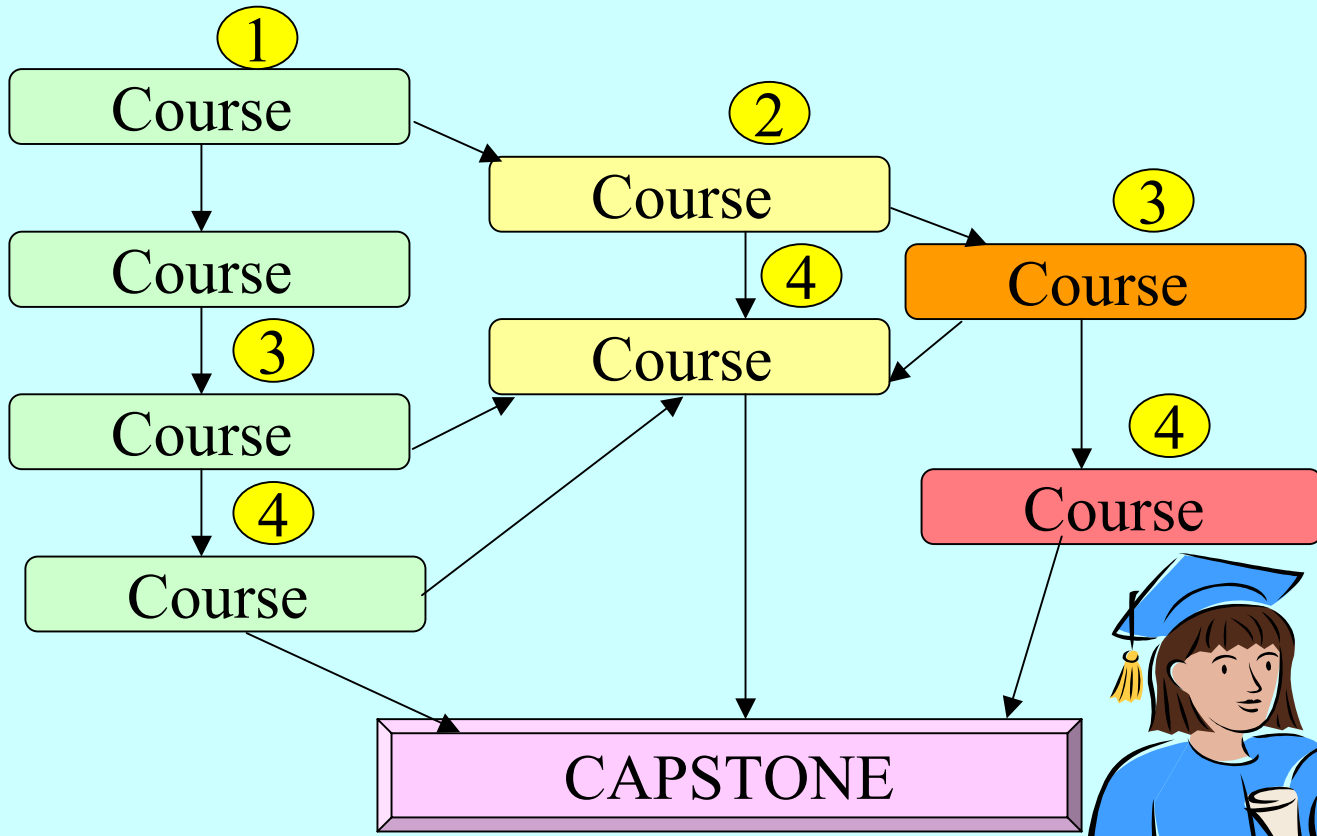


The Ongoing Evaluation System: Relationship to Education System and Student



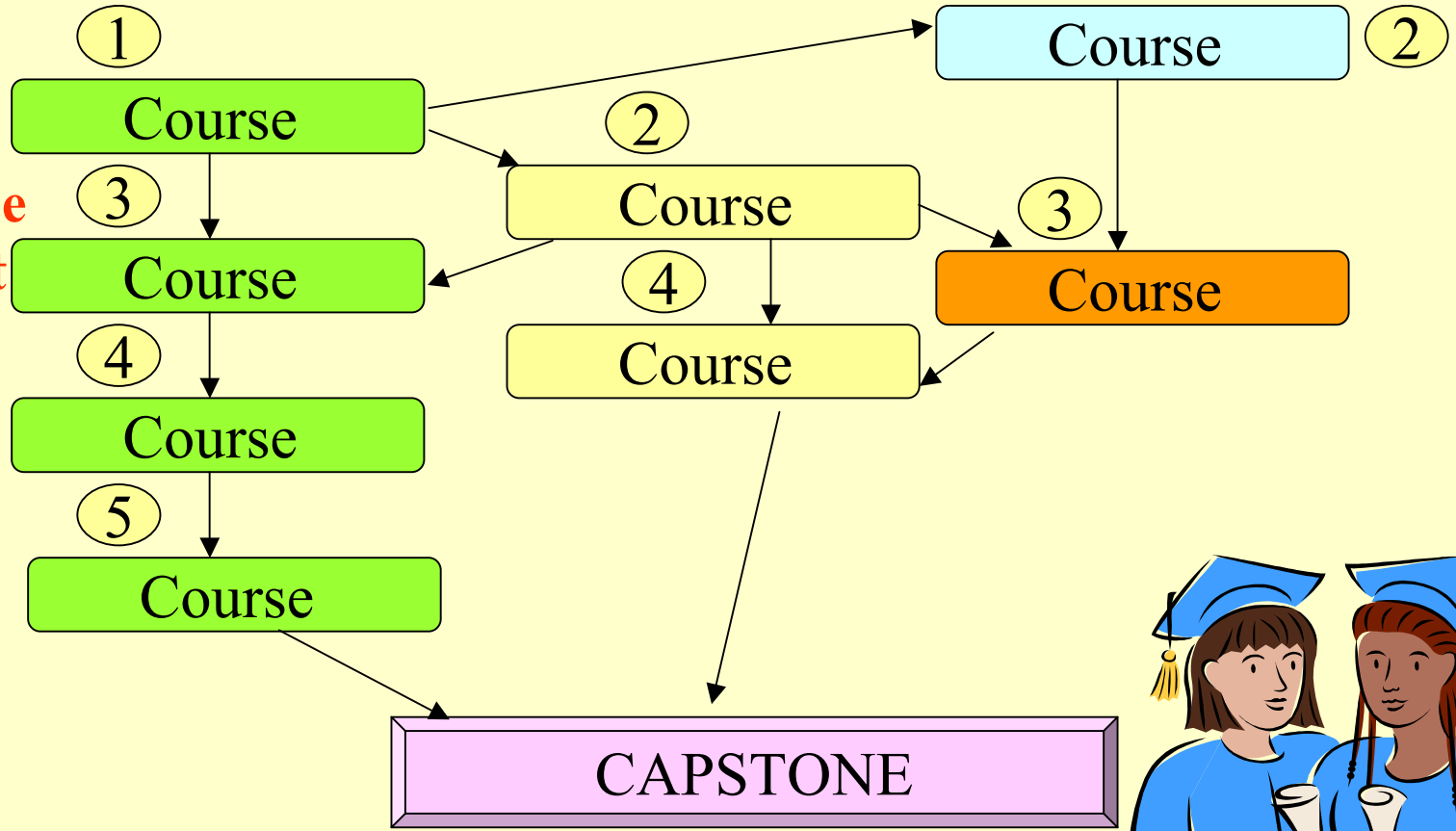
Why be concerned about Program Objectives & Program Outcomes at Course Level ??

Program Experience of Student #1:



Why be concerned about Program Objectives & Program Outcomes at Course Level ??

Program Experience of Student #2:



Sequence

Terminal Outcome Assessment Concerns:

- Collection…Great burden upon the final year or greater difficulty in observing outcomes following outcomes
- Loss of “quasi experimental controls”, threats to validity, reliability, increased expense, effort, intrusiveness
- Most terminal outcomes assumed to be cumulatively or progressively produced throughout the educational process

Developing Classroom Objectives and Outcomes

Criteria for Developing Classroom Objectives

- Align classroom objectives with College objectives
- Include faculty in the development of objectives to enable faculty ownership
- Gain support from division chair and College administration
- **Question**- What do you want students to accomplish in this course? (Physics)
  - *Example- Students will be able to use and understand Newton's Third Law (for every interaction there are two equal and opposite forces, one on each object).*

Criteria for Developing Classroom Outcomes

- **Question**- More specifically, what do you want to accomplish in this course?
- *Example-*
  - *Students will be able to identify Newton's 3rd Law pairs*
  - Students can articulate Newton's 3rd Law in their own words
  - Students can use 3rd Law in static and dynamic systems

Criteria for Developing Classroom Performance Indicators

- **Question**- What can you measure to assess student performance?
- *Example-*
  - *Students will show coordination of pre-existing tools in terms of new experiment activity*
  - *Students will be able to apply Newton's 3rd Law to new situations and approaches not presented in class*

Criteria for Developing Classroom Strategies, Actions

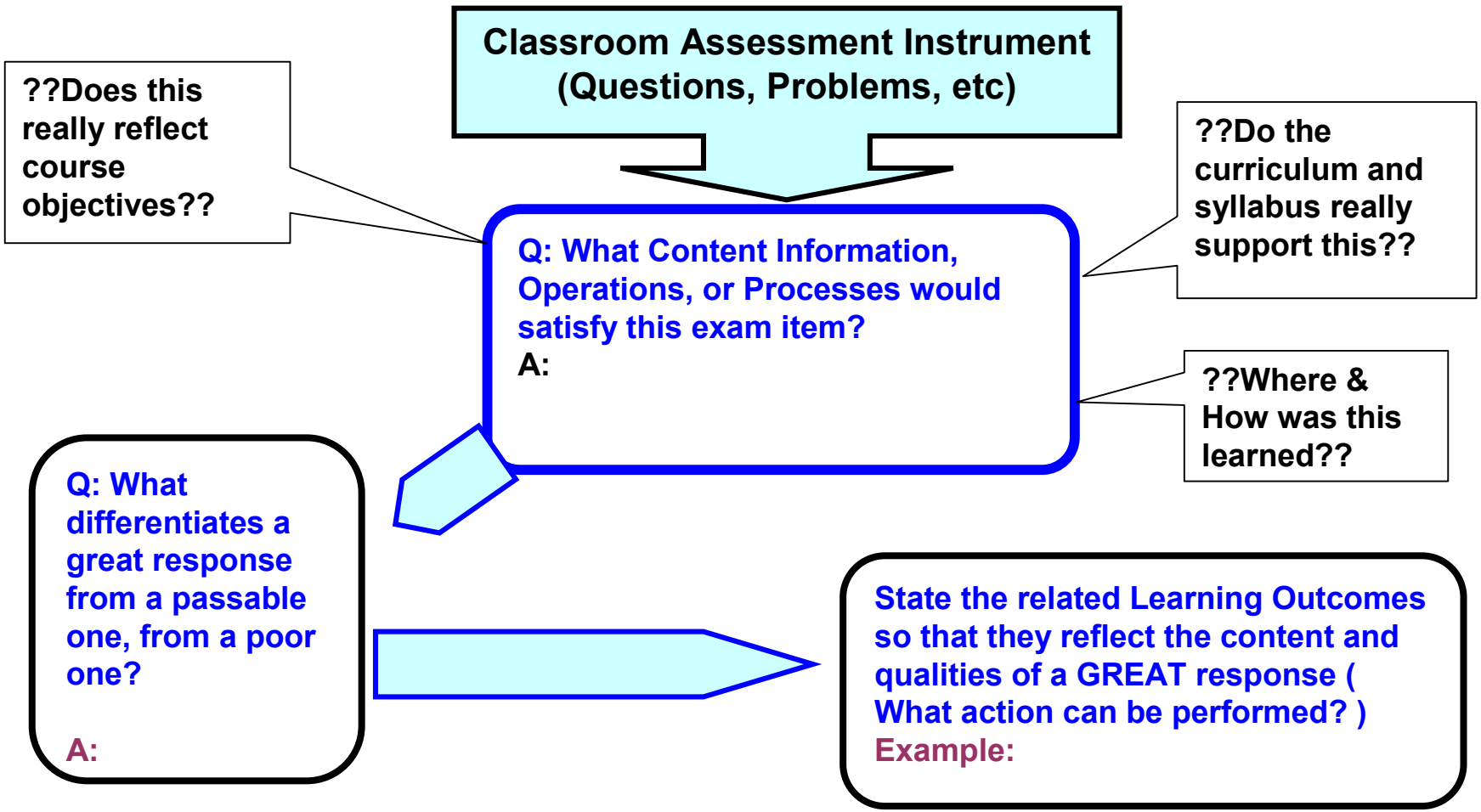
- **Question**- What specific practices and processes are necessary to achieve outcomes?
- *Example-*
  - *Provide time for group discussions of perceptions associated with Newton's 3rd Law before instruction (preconceptions)*
  - *Interactive demos of collisions with force probes*
  - *In class group work aimed at concepts of 3rd law and tools for using it*
  - *Student led post discussions of results of experience, demo and group work*

Group Activity

Reverse Engineering YOUR Course Objectives

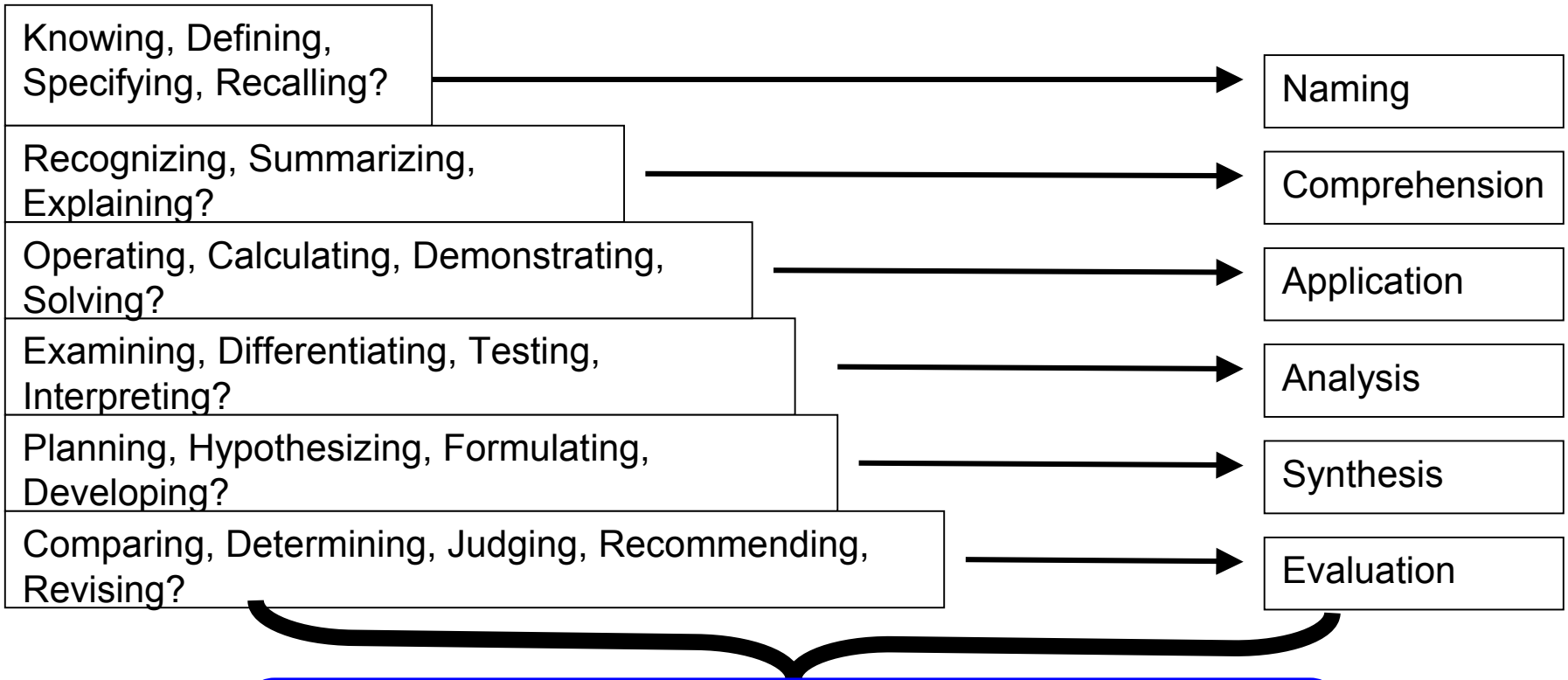
- Use your goals for student learning in a course you teach to develop objectives and outcomes for that course

Q & A Guide for Generating Learning Objectives-to-Learning Outcomes: Flow Chart for De-constructive Approach



Q & A Guide for Generating Learning Objectives-to-Learning Outcomes: Flow Chart for De-constructive Approach (Cont'd….)

[Bloom's Taxonomy- Levels of Cognitive Learning]



Q: What specific learning / instruction activities will facilitate learning this content, operation, or processes at the desired level?
A:

Discussion

Aligning YOUR Course Objectives with Those of Your Colleagues: Sharing and Discussing

- Select one representative from your group to share your activity results

Developing Program Objectives and Outcomes

Program Educational Objectives

Each engineering program must have in place:

(a) detailed published educational objectives that are consistent with the mission of the institution and these criteria

(b) a process based on the needs of the *program's various constituencies* in which the objectives are determined and periodically evaluated

(c) a curriculum and process that ensure the achievement of these objectives

(d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve effectiveness of the program

II. 3. Program Outcomes and Assessment

Need to "Demonstrate" Abilities of Graduates to:

Apply math, science and engineering principles **a**	Design and conduct experiments **b**	Design a system, comp., or process **c**
Function in teams **d**	Solve engr'g problems **e**	Be profess'nal and ethical **f**
Communicate effectively **g**	Understand global and societal impact **h**	Learn life-long **i**
Understand contemporary issues **j**	Use modern engineering tools **k**	

Objective Template

A Workshop Activity Product

Objective:

Outcomes	Performance Indicators	Strategies & Actions	Assessment Methods & Metrics	Evaluation	Feedback	ABET 2000 criteria & links to University, College & Depts

Professionalism & Ethics Objective

Example for Workshop Activity

Professionalism & Ethics Objective: Students will understand and practice professional and ethical responsibility

Outcomes	Performance Indicators	Strategies & Actions	Assessment Methods & Metrics	Evaluation	Feedback	ABET 2000 criteria & links to University, College, Depts
Students are aware of engineering as a profession, identify as a member, and demonstrate collegiality in the profession	Participation in local and or national student societies. Participation in field trips (plant tours) Participate in multi-disciplinary experiences. Share professional experiences	Provide resources for local/national professional societies Provide resources and planning assistance for tours Encourage use of multi-disciplinary experiences	Collect data regarding memberships and participation. Number of students participating Performance evaluation using established standards and rubrics	Set goals for membership and participation Panel of evaluators go over the evaluations	Data and evaluations go to departments & associate dean for action . Evaluations also go to instructors who teach courses to enable course modifications	ABET: f, I, j College: Professionalism, Technical Competence, Life-Long Learning

Group Activity

- As a large group:
  - develop 1 program objective
  - refine language

- Break into teams to:
  - develop that program objective using the matrix/template handout
  - fill in the matrix/template cells

Discussion

- Select one representative from your group to share your activity results

What Does Your BIG PICTURE Look Like ?

GROUP ACTIVITY

- Identify which courses can provide baseline indicators of major student competencies targeted by program objectives
- Identify which courses can produce student outcomes demonstrating progress towards objectives
- Identify which courses can produce student outcomes demonstrating most complete satisfaction of particular program objectives

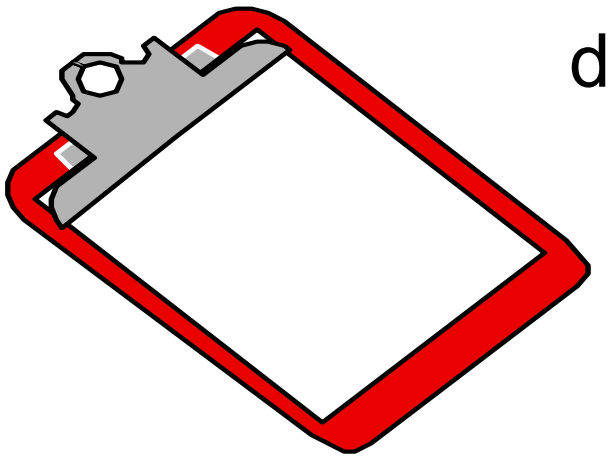
What Does Your BIG PICTURE Look Like ?

GROUP ACTIVITY

- List your major program objectives and program competency ‘threads’
- List the courses which deliver those competencies
- Chart the progression of your program through successions of courses

Appropriate Assessment

Selecting and implementing data collection methods



Using What You Have to Assess Your BIG PICTURE

Institutional Data Resources

- Institutional data is an invaluable source of historical and longitudinally stored student and program information, such as..
  - **DEMOGRAPHICS**
  - **SAT SCORES**
  - **H.S. STANDING**
  - **COURSES TAKEN IN YOUR PROGRAM**
  - **GPA AND COURSE GRADES**
  - **ENROLLMENT AND MAJOR INFORMATION**

Using What You Have to Assess Your BIG PICTURE

Institutional Data Resources: Student Outcomes

- **Institutional data can be used to compute outcome indicators such as**
  - **RETENTION -- IN COLLEGE, IN MAJOR, ETC**
  - **PROGRESSION AND GRADUATION RATES**
  - **GPA IN CORE MAJOR COURSES**
  - **UP-LINE IMPACT OF SPECIFIC PRECURSOR COURSES UPON SUCCESSOR COURSES**
  - **SPEED OF PROGRESSION THROUGH CORE MAJOR COURSES AND SPEED OF PROGRESSION TO GRADUATION**
- **In addition, IR may also administer course evaluation, student satisfaction and alumni follow-up surveys**

Using What You Have to Assess Your BIG PICTURE

Institutional Data Resources

- Identify and learn about your Institutional Research personnel
- Identify what raw data your institution routinely collects
- Identify what reports the IR group routinely generates and for whom and when
- Discuss your evaluation needs with them

Using What You Have to Assess Your BIG PICTURE

Institutional Data

Brain-storm discussion on using institutional data as part of the assessment and evaluation loop

Using What You Have to Assess Your BIG PICTURE

SUGGESTION FOR FUTURE GROUP ACTIVITIES

- Gather and generate classroom assessment questions, problems and performance assignments from courses identified for producing competency outcomes for
  - baseline
  - interim progress
  - terminal satisfaction

Using What You Have to Assess Your BIG PICTURE

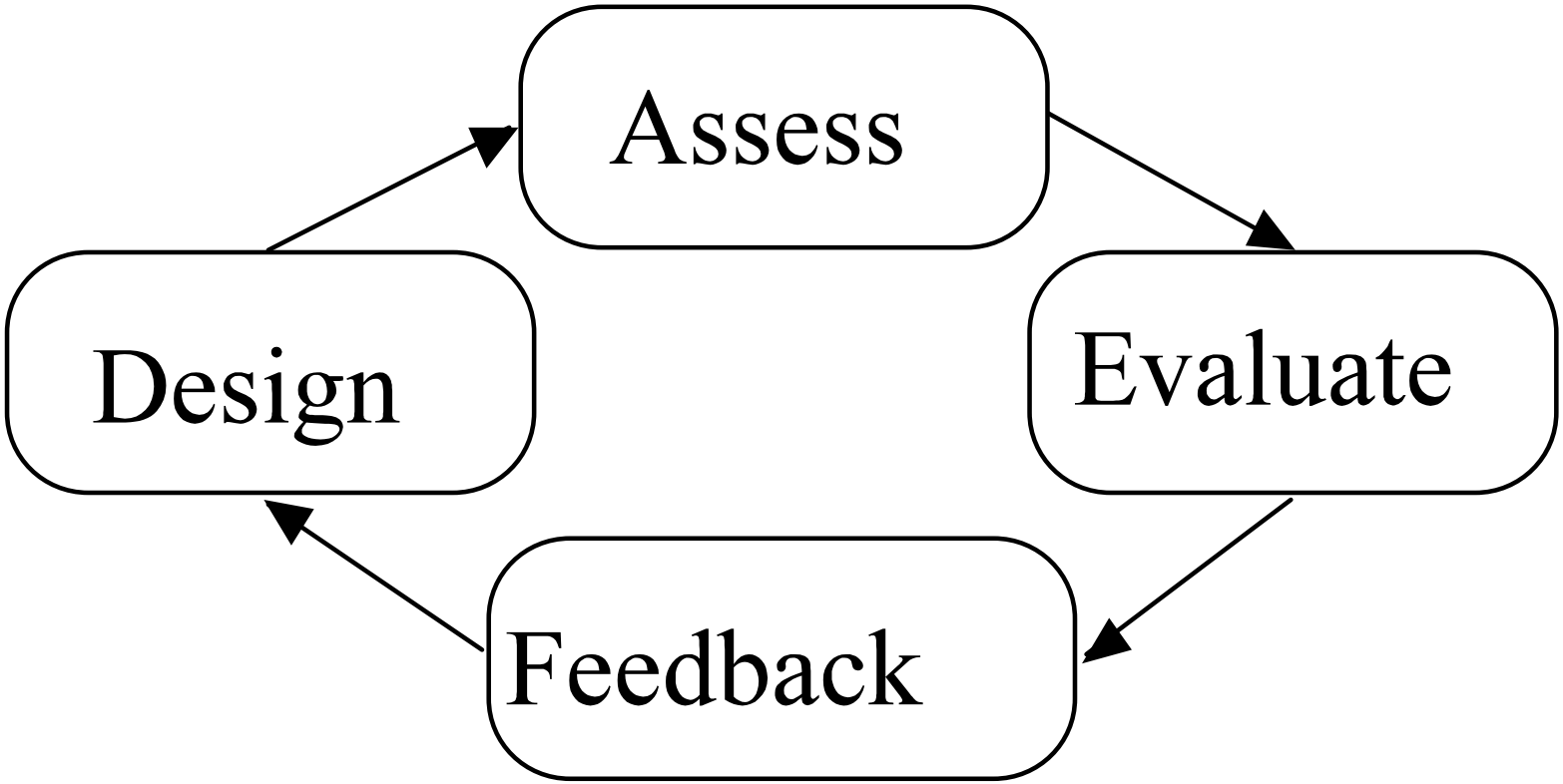
SUGGESTION FOR FUTURE GROUP ACTIVITIES

- Develop consensus about consistently adopting some common classroom assessment questions, problems, or project assignments with fixed scoring instructions
- Develop and maintain a pool of assessment items, scoring instructions and examples of A,C and Unsatisfactory student performance and categorize items by program objective, course objective and level of learning

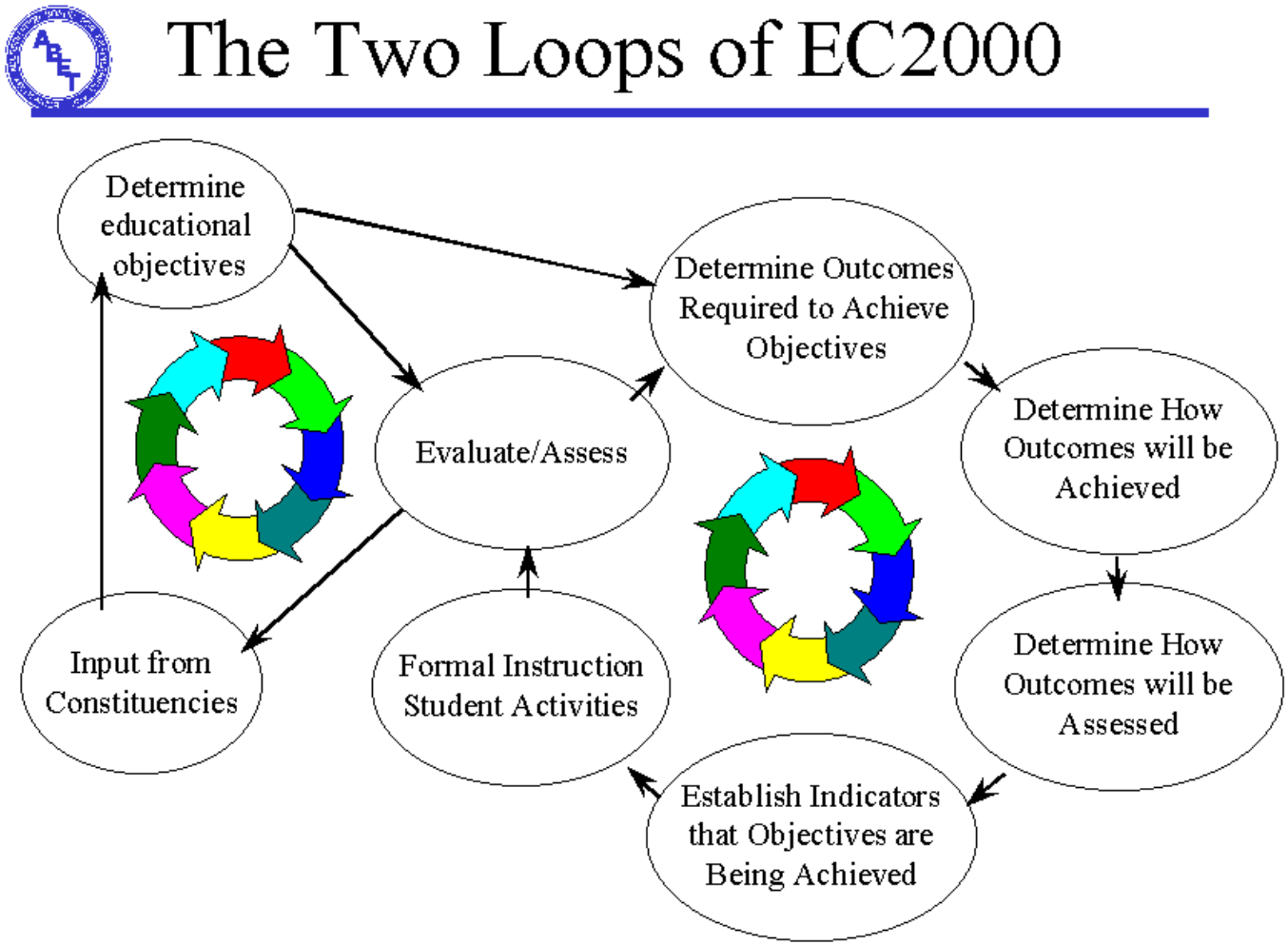
Develop an Assessment Tool

- **It should be:**
  - Informal but systematic--all students
  - Identify strengths & weakness
  - It should inform improvement
- **Types of assessment tools**
  - Products--reports, papers, tests
  - Product substitutes (self-assessments, attitudes)
  - Process--how students work

Continuous Improvement Loop



ONGOING EVALUATION SYSTEM



You Are in Control

- You choose what to measure
- You choose how to measure it
- You evaluate the results
- You change the course

Closing the Loop

- Evaluate the assessment results
- Reflect on how to improve course
- Write an implementation plan
- Repeat closing the loop for the assessment itself

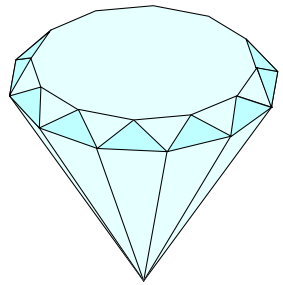
Comments on Course-based Continuous Improvement

- Goal is not rigorous, scientific evaluation
- Goal is to find something useful that will help you improve your course
- Best assessment is one that tells you about the "why"
- This is you & the students building a better course

Group Activity

- Examine sample tools
- Adopt, adapt, or replace
- Imagine varying results with tool
- How would results provide basis for improvement of curriculum?
- Reflect on work
- Present work to whole group

Four Gems of Wisdom



- Adopt a common language
- Content experts must determine the objectives and outcomes
- Align assessment with objectives and outcomes up-front!
- Show how assessment enables change