**Probing Understanding**  

- Understanding has many operational definitions based on subject area
  - One specific definition is not the only possible method for measuring
  - The more limited the definition, the more restricted the teaching and learning
  - There is a direct connection between forms of testing and what is taught and learned
  - A broader repertoire of teaching styles and strategies = broader understanding
  - Understanding of a concept is a continuum, not a dichotomous state
  - Understanding is too complex to be assessed by one single style of test, or satisfactorily represented by one single numerical score

- Understanding Concepts
  - A person’s understanding of a concept is the set of all memory elements they associate with the label
  - Improved by having either more memories, better connections between them, and/or more clarity in each element’s formulation
  - Must have some information in your memory about it (specifically – propositions, strings, images, episodes, intellectual skills, and motor skills)
    - Propositions – facts, opinions or beliefs (ex: “there are many forms of energy”)
    - Strings – propositions where order is imperative (ex: multiplication tables, or scientific laws)
    - Images – mental representations of sensory perceptions (ex: the feel of ‘springiness’)
    - Episodes – mental representations of events that you think you experienced (ex: recalling an experiment you performed)
    - Intellectual Skills – capacities to carry out classes of tasks, or memories of mental procedures (ex: solving equations)
    - Motor Skills – capacities to perform physical tasks, or memories of physical procedures (ex: massing an object on a balance)
  - Each person relies differently on the memory types

- Understanding Whole Disciplines (ex: physics)
  - “Did Einstein understand physics?” – “To a degree, yes.”
  - “Did Einstein understand physics better than Newton did?” – “Yes, based on their chronology.”

- Understanding of Single Elements of Knowledge (ex: Homer wrote epic poems.)
  - Relies on grasping grammar, procedures, rules and other intellectual skills

- Understanding Extensive Communication (ex: a poem, speech, painting, ballet or block of text)
  - Relies directly on a process, rather than a state or an analysis of words or symbols to make meaning
  - Non-verbal forms usually take greater time to comprehend and have intense personal meaning

- Understanding Situations
  - Seeing parallels between a situation and previous experiences; having a script for it

- Understanding People
  - Seeing parallels between a person’s actions and their previous actions, and being able to predict actions.
Alternative Techniques of Assessment

- Concept Mapping – note cards on paper where connections are drawn and explained

- Predict-Observe-Explain (POEs) – individualized experiments can be self-checked, discussed, or collected

- Interviews About Instances and Events – individualized conversation directed by initial questions usually regarding a drawing or picture

- Interviews About Concepts – individualized conversation designed to bring out knowledge of a specific concept (facts, as well as beliefs, opinions, strings, episodes, etc.)

- Drawings – shows individual ideas of a concept or subject using other-than verbal communications

- Fortune Lines – allow quick verification of students’ conception of time-dependant topics (especially stories, historical developments, but also laboratory phenomena)

- Relational Diagrams – closed figures show how students mentally overlap objects, events and abstractions

- Word Association – probes the association that students perceive for a set of concepts

- Question Production – structured and focused activity where students show their understanding in the construction of more and more probing questions
  
  - Be open to questions based on extending the ideas taught, not just recall
  
  - Demand thinking questions, not simple, fact-based or direct (one word) answers
  
  - Ask for questions started a certain way (“How would…”, “What if…”)
  
  - Provide a stimulus for questions (quotations, data table, map, diagram)
  
  - Provide an answer and fish for deep questions (“Because liquid and solid water have different densities.”)
  
  - Provide a large concept, brainstorm known material, ask for unanswered questions (“When a cell dies, does their DNA die as well?”)
  
  - “Write X questions that would test a person’s deep understanding of Y.”