Evaluation Guide

What are concept inventories? (Excerpted from presentation by J. Knight, UC Boulder).

- Multiple choice (usually) instruments that address fundamental concepts and contain known student misunderstandings
- Developed through an iterative process that includes gathering evidence of validity and reliability through student and faculty interviews
- Diagnostic: can identify specific misunderstandings and measure student learning over time
- Objective: not tied directly to a course, but rather to a set of concepts

Guidelines for using concept inventories (*Dirks, Wenderoth, Withers Assessment in the College Science Classroom, 2013*).

- Protect the test!
  - Must be given in a proctored environment to keep questions from getting out to students.
- Use for evaluation only
  - Not a learning tool.
- When used for pre-/post-testing
  - Use the same testing context
  - Can use same or isomorphic questions (Resource: Research Methods Knowledge Base – W. Trochim, 2013)
  - Normalized learning gain
    - <g> = (%post - %pre)/(100-%pre)

Content-independent metrics

- Typically assess skills or affective domain
  - Critical thinking, views of science, enthusiasm for the discipline…
  - Can be used as pre/post, but typically post only
- Resource: FLAG – Field-tested Learning Assessment Guide - http://www.flaguide.org/index.php
- Mental Measures Yearbook http://buros.org/mental-measurements-yearbook
- http://www.salgsite.org/
- https://www.tntech.edu/cat/
- http://www.criticalthinking.org/pages/critical-thinking-testing-and-assessment/594
- https://www2.viu.ca/studentsuccessservices/learningstrategist/documents/MetacognitiveAwarenessInventory.pdf

Other Resources

- Summer Institutes website: http://www.summerinstitutes.org/
- University of Colorado – SEI: http://www.colorado.edu/sei/
- SERC: https://serc.carleton.edu/index.html
  - https://serc.carleton.edu/NAGTWorkshops/departments/degree_programs/metrics.html
- UW BERG: http://uwberg.com/teaching-resources/

Table from Dirk et al., (2014) *Assessment in the College Science Classroom*, Ch7 Appendix A; Freeman, NYC.

Concept Inventories in Astronomy	
Astronomy Diagnostic Test (ADT) Lunar Phases Light and Spectroscopy	Hufnagel 2002 Lindell and Olsen 2002 Bardar et al., 2007
Concept Inventories in Biology	
Genetics Concept Inventory (GCA) Genetics Literacy Assessment Instrument 2 (GLAI-2) Conceptual Inventory of Natural Selection (CINS) Biology Literacty (http://bioliteracy.net/) Diagnostic Question Clusters: Biology Host Pathogen Interactions (HPI) Introductory Molecular and Cell Biology Assessment (IMCA)	Smith et al., 2008 Bowling et al., 2008 Anderson et al., 2002 Klymkowsky et al., 2010 Wilson et al., 2006; D'Avanzo 2008 Marbach-Ad et al., 2009 Shi et al., 2010
Concept Inventories in Chemistry	
Chemistry Concept Inventory	Mulford and Rbonison 2002 Krause et al., 2003
Concept Inventories in Engineering	
Engineering Thermodynamics Concept Inventory Heat Transfer Materials Concept Inventory Signals and Systems Concept Inventory Static Concept Inventory Thermal and Transport Science Concept Inventory (TTCI)	Midkiff et al., 2001 Jacobie et al., 2003 Krause et al., 2003 Wage et al., 2005 Steif et al., 2005 Streveler et al., 2011
Concept Inventories in Geoscience	
Geoscience Concept Inventory (GCI)	Libarkin and Anderson, 2005
Concept Inventories in Math and Statistics	
Statistics Concept Inventory (SCI) Calculus Concept Inventory (CCI)	Allen 2006 Epstein 2005
Concept Inventories in Physics	
Force Concept Inventory (FCI) The Force and Motion Conceptual Evaluation (FMCE) Thermal Concept Evaluation Brief Electricity and Magnetism Assessment (BEMA) Conceptual Survey in Electricity and Magnetism (CSEM)	Hestenes et al., 1992 Thornton and Sokiloff 1998 Yeo and Zadnick 2001 Ding et al., 2006 Maloney et al., 2001
Measuring Students Science Process and Reasoning Skills	
Rubric for Science Writing Student-Achievement and Process Skills Instrument	Timmerman et al., 2010 Bunce et al., 2010
Measuring Student Attitudes about Science, Research or Study Methods	
Colorado Learning Attitudes about Science Survey (CLASS) Revised Two-Factor Study Process Questionnaire Student Assessment of Their Learning Gains (SALG) Instrument Survey of Undergraduate Research Experiences Views About Science Survey (VASS)	http://www.colorado.edu/sei/class Biggs et al, 2001 http://www.salgsite.org/ Lopatto 2004 Halloun and Hestenes 1998