2007 Assessment Progress Reports

For the IUPUI School of Science (SOS)

Six-Stage Assessment Strategy

Submitted by the Following Members of the

SOS Assessment Committee

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Assessment of Student Learning
Department of Biology
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted Kathleen A. Marrs, Ph.D.
(Edited by Joseph L. Thompson)
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Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

Stage 1 → Identify the program's student learning outcomes (SLOs).
Stage 2 → Link these SLOs to specific components of the program's curriculum.
Stage 3 → Identify or create methods to measure these SLOs.
Stage 4 → Collect data to determine if the SLOs are being accomplished successfully.
Stage 5 → Use the data collected in Stage 4 to make curricular changes.
Stage 6 → Repeat Stage 4 to determine if the curricular changes were effective.

These stages are comparable to the following stages in the Planning for Learning and Assessment table that has been approved and distributed by IUPUI's Program Review and Assessment Committee,

1. What general outcome are you seeking?
2. How would you know it (the outcome) if you saw it? (What will the student know or be able to do?)
3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Biology Undergraduate Program in Regard to These Stages

The Department of Biology is currently at Stage 3 in the six-stage process.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

The Department of Biology has had a long-standing set of Student Learning Outcomes (SLOs) for majors in the Department.

The **IUPUI Principles of Undergraduate Learning** are also a part of the Department's SLOs, but they were not specifically addressed in this study.

The Department's Student Learning Outcomes are detailed below.

A. Basic knowledge: "Biology graduates will have an understanding of fundamental concepts from each of the biological areas listed below, as well as the relationships among them, i.e. the continuum from the ecosystem to the molecular level. This does not imply that the student will be equally well versed in all areas, because the individual's interest in a particular part of biology is expected to drive him or her to greater achievement in an area."

1) *Molecular Biology*: how biomolecules carry out functions, control processes, and dictate inheritance

a) Structure of nucleic acids, proteins, lipids, and carbohydrates
b) Synthesis and metabolism of biomolecules, e.g. DNA replication, mRNA transcription, proteins
c) Functions of biomolecules, e.g. DNA replication and recombination in the inheritance of genetic traits, roles of cholesterol and phospholipids in biomembranes

2) *Cell and Developmental Biology*: cell structure and function; mechanisms regulating the development of multicellular organisms

a) Cell membranes and receptors
b) Cytoplasmic structure and function
c) Nuclear structure and function
d) Extracellular matrix synthesis, structure, and function
e) Cell responses to external signals, e.g. hormones, antigens, or growth factors
f) Intracellular signaling pathways
g) Metabolic pathways
h) Gamete formation and fertilization
i) Cell division: mitosis and meiosis
j) Cell differentiation, pattern formation, and morphogenesis

3) *Physiology*: how systems within an organism operate and interact to maintain short-term homeostasis of the individual and long-term survival of the species

a) Knowledge of animal and plant physiological systems, their interactions and control
b) Acclimation and adaptation of these systems to different physiological conditions, e.g. heat stress vs. cold stress, iso-osmotic vs. hypo-osmotic/hyper-osmotic environments

4) *Ecology*: how organisms interact with each other and their physical environment

a) The growth of populations and the mathematical models that describe that behavior

b) The organization of species population into communities and levels of emergent characteristics
c) Ecosystem dynamics and the evolutionary future of the biosphere

5) *Evolution*: how the incredible diversity of life on earth has evolved over the course of several billion years

a) Origin of organic molecules and the evolution of life
b) Mechanisms of natural selection and their effect on gene frequencies
c) Evolution of cellular organization
d) Evolution of functionally specific biomolecules for carrying out processes of heredity, growth and development, and homeostasis
e) Microevolution: organism survival and diversification as a function of adaptation
f) Variability of evolutionary rates

B. Applied skills

1) *Application of the scientific method*

Biology graduates will understand the theory of, and be able to apply, the scientific method in a biology setting. For this purpose, the scientific method is defined as:

a) Making an observation about a poorly understood phenomenon and researching available related information from textbooks, journals, and databases
b) Forming a hypothesis (a testable statement explaining the observation)
c) Designing an experiment to test the hypothesis
d) Analyzing and interpreting experimental data and forming conclusions about accepting or rejecting the hypothesis
e) Retesting the hypothesis, if necessary, so as to reinforce the conclusions
f) Publication of the results and/or oral presentation of the results and ideas through appropriate vehicles of communication

2) *Biotechnology*

Biology graduates will be competent in selected techniques and equipment commonly used in field and laboratory studies. The following are examples, but the list may change with the advent of new technologies:

a) Microscopy
b) Culture growth of selected organisms, e.g. bacteria, fruit flies
c) Enzyme assays
d) Biological staining techniques
e) Separation procedures for biological molecules, e.g. gel electrophoresis of protein or DNA, ultracentrifugation

Stage 2 → Link These SLOs to Specific Components of the Department's Curriculum

Faculty members in the Department of Biology were asked to respond to a table created for analysis of the SLOs in individual courses.

Faculty were asked to state whether the SLO was actually a part of their course and, if so, at what "level" it was presented. This analysis enabled the Department to determine (1) where each SLO was being taught in the curriculum and (2) at what level faculty determined whether the students understood the concept.

Questions asked were:

1. Is this topic specifically addressed in your course?

2. If YES, how do you determine whether students understand the concept?
   - M/C: Multiple-choice exam
   - E: Essay / short answer exam
   - Q: Quizzes
   - W: Writing assignment (lab report, research paper)
   - L: Laboratory exercise
   - P: Presentation to class
   - I: In-class (group or individual) activity – recitation of lecture
   - O: Other (please list in row mentioned)

The results of this curriculum audit are given in **Appendix A**.

Stage 3 → Identify or Create Methods to Measure These SLOs

As part of a BIOL-K493 Undergraduate Research Project, Dr. Marrs and Winta Haile, an undergraduate biology major, developed a senior biology major exit survey. This survey reproduced the Department's SLOs in the form of a user-friendly "Survey Monkey" designed for student use. Students were able to select whether they had experienced each of the SLOs in their classes and at what "level" they felt they understood this topic, based on a Lickert scale. Joseph Thompson, with the School of Science Academic Office, sent the link for this survey to all graduating biology majors and over 125 responses were generated. One interesting finding was, that while the Department's faculty place a high emphasis on research and applied skills, students did not believe that they received emphasis on this in their undergraduate curriculum, as detailed in **Appendix B**.

In the future, the Department would like students completing this survey to be able to provide written feedback on the SLOs they experienced – for example, identifying particular classes or assignments that helped them to accomplish certain SLOs and to provide feedback to the Department that would help future biology majors accomplish the SLOs that current biology majors indicated they had not successfully accomplished. These data would provide the Department with information to answer the following questions:

1. How do biology majors compare their ability to accomplish the Department's SLOs with what the faculty believe is their emphasis on the SLOs in their course?
2. How could the Department's curriculum be examined or revised in light of these perceptions?
3. Of the SLOs that students believe they have not successfully accomplished, how can the Department use student suggestions to better the biology curriculum such that these SLOs are accomplished successfully?

The Department can use the answers to these questions to make data-driven changes to the curriculum.

Prepared by Kathleen Marrs
May 2007

	K101 Biology I Marrs	K103 Biology II Yost	K322 Genetics Bard	K323 Genetics Lab Frey	341 Ecology Wang	342 Ecology lab Clark	K324 Cell Biology Watson	K325 Cell Lab Frey
1) ***Molecular Biology***: how biomolecules carry out functions, control processes, and dictate inheritance		MC	M/C; problems P,T/F, fill in blank F	E			M/C Exam	L, M/C, E
a) Structure of nucleic acids, proteins, lipids, and carbohydrates	M/C, Q, L, I		M/C; P ,T/F, F	E			M/C Exam	L, M/C, E
b) Synthesis and metabolism of biomolecules, e.g. DNA replication, mRNA transcription, proteins	M/C, Q, L, I		M/C; P ,T/F, F	E, L			M/C Exam	L, M/C, E
c) Functions of biomolecules, e.g. DNA replication and recombination in the inheritance of genetic traits, roles of cholesterol and phospholipids in biomembrane	M/C, Q, L, I, W		M/C; P ,T/F, F	E, L, W			M/C Exam	L, M/C, E
2) ***Cell and Developmental Biology***: cell structure and function; mechanisms regulating the development of multicellular		MC, Q,L	M/C; P ,T/F, F					
a) Cell membranes and receptors	M/C, Q, L, I	MC, Q						L, M/C, E
b) Cytoplasmic structure and function	M/C			E, L				
c) Nuclear structure and function	M/C, Q,		M/C; P ,T/F,	E, L				L, M/C, E
d Extracellular matrix synthesis, structure, and function	M/C							
e) Cell responses to external signals, e.g. hormones, antigens, or growth	M/C, Q, L, I, W	MC, Q, P	M/C; P ,T/F, F				M/C Exam	L, M/C, E
f) Intracellular signaling pathways	M/C, Q	MC, Q, P	M/C; P ,T/F,				M/C Exam	L, M/C, E
g) Metabolic pathways	M/C, Q, L, I	MC, Q, P	M/C; P ,T/F,	E, L			M/C Exam	
h) Gamete formation and fertilization	M/C, Q, L, I	MC, Q	M/C; P ,T/F,	E, L			M/C Exam	
i) Cell division: mitosis and meiosis	M/C, Q, L, I	MC, Q	M/C; P ,T/F,				M/C Exam	L, M/C, E
j) Cell differentiation, pattern formation, and morphogenesis		MC, Q					M/C Exam	

	K101 Biology I Marrs	**K103 Biology II Yost**	**K322 Genetics Bard**	**K323 Genetics Lab Frey**	**341 Ecology Wang**	**342 Ecology lab Clark**	**K324 Cell Biology Watson**	**K325 Cell Lab Frey**
3) ***Physiology*****:** how systems within an organism operate and interact to maintain short-term homeostasis of the individual and long term survival of the species		MC, Q, L, I					M/C Exam	L
a) Knowledge of animal and plant physiological systems, their interactions and control	M/C, Q, L, I	MC, Q, L,I			M/C	M/C	M/C Exam	
b) Acclimation and adaptation of these systems to different physiological conditions, e.g. heat stress vs. cold stress, iso-osmotic vs. hypo-osmotic/hyper-osmotic environment	M/C, Q, L, I				E	E	M/C Exam	
4) ***Ecology:*** how organisms interact with each other and their physical environment		MC, Q			E	E		
a) The growth of populations and the mathematical models which describe that behavior								
b) The organization of species population into communities and levels of emergent characteristics		MC, Q,			M/C	M/C		
c) Ecosystems dynamics and the evolutionary future of the biosphere					E	E		
5) ***Evolution*****:** how the incredible diversity of life on earth has evolved over the course of several billion years		MC, Q			E	E		
a) Origin of organic molecules and the evolution of life	M/c	MC, Q			M/C	M/C		
b) Mechanisms of natural selection and their effect on gene frequencies		MC, Q			E	E		
c) Evolution of cellular organization		MC, Q	M/C; P ,T/F, F		M/C	M/C	M/C Exam	

	K101 Biology I Marrs	**K103 Biology II Yost**	**K322 Genetics Bard**	**K323 Genetics Lab Frey**	**341 Ecology Wang**	**342 Ecology lab Clark**	**K324 Cell Biology Watson**	**K325 Cell Lab Frey**
d) Evolution of functionally specific biomolecules for carrying out processes of heredity, growth and development, and homeostasis					E	E	M/C Exam	
e) Microevolution: organism survival and diversification as a function of adaptation		MC, Q						
f) Variability of evolutionary rates								
II. Applied skills					M/C	M/C		
1) *Application of scientific method*					E	E		
Biology graduates will understand the theory of, and be able to apply, the scientific method in a Biology setting. For this purpose, the scientific method is defined as:								
(a) Making an observation about a poorly understood phenomenon and researching available related information from textbooks, journals, databases	L, q, I,							
(b) Forming an hypothesis (a testable statement explaining the observation	L, q			L, W	M/C	M/C	M/C Exam	
(c) Designing an experiment to test the hypothesis	L, q				E	E	M/C Exam	
(d) Analyzing and interpreting experimental data, and forming conclusions about accepting or rejecting the hypothesis	M/c			E, W, L			M/C Exam	L, E
(e) Retesting the hypothesis, if necessary, so as to reinforce the conclusions								

	K101 Biology I Marrs	K103 Biology II Yost	K322 Genetics Bard	K323 Genetics Lab Frey	341 Ecology Wang	342 Ecology lab Clark	K324 Cell Biology Watson	K325 Cell Lab Frey
(f) Publication of results and/or oral presentation of the results and ideas through appropriate vehicles of communication				W				
2) *Biotechnology*								
Biology graduates will be competent in selected techniques and equipment commonly used in field and laboratory studies.The following are examples, but the list may change with the advent of new technologies								
(a) Microscopy	L, m/c, q	MC, Q, L		L			M/C Exam	L, E
(b) Culture growth of selected organisms, e.g. bacteria, fruit flies	L. m/c q			L			M/C Exam	
(c) Dissection		MC, Q, L		L			M/C Exam	L
(d) Enzyme assays	L, m/c, q			L			M/C Exam	L, E, M/C
(e) Biological staining techniques	L			L			M/C Exam	L, E. M/C
(f) Separation procedures for biological molecules, e.g. gel electrophoresis of protein or DNA, ultracentrifugation	L, m/c, q			L, E			M/C Exam	L, E, M/C
(7) Aseptic technique	L			L			M/C Exam	

	K331 Chernoff Embryology	K333 Chernoff EmbryoLab	K356/K357 Micro Lees Marrs	493 Randall	548 Randal	697 Randall
1) ***Molecular Biology***: how biomolecules carry out functions, control processes, and dictate inheritance	M/C, E		M/C, E	L,P,W (thesis)		P,E
a) Structure of nucleic acids, proteins, lipids, and carbohydrates			M/C, E		E,W,L	P,E
b) Synthesis and metabolism of biomolecules, e.g. DNA replication, mRNA transcription, proteins			M/C, E		E,L,W	P,E
c) Functions of biomolecules, e.g. DNA replication and recombination in the inheritance of genetic traits, roles of cholesterol and phospholipids in biomembrane	M/C, E		M/C, E	L,P,W (thesis		P,E
2) ***Cell and Developmental Biology***: cell structure and function; mechanisms regulating the development of multicellular	M/C, E					P,E
a) Cell membranes and receptors	M/C, E	L, M/C,W				
b) Cytoplasmic structure and	M/C	L, M/C, W	M/C, E			
c) Nuclear structure and function						
d Extracellular matrix synthesis, structure, and function	M/C, E	L, M/C, W				
e) Cell responses to external signals, e.g. hormones, antigens, or growth	M/C, E	L, M/C, W		L,P,W (thesis		
f) Intracellular signaling pathways	M/C			L,P,W (thesis		
g) Metabolic pathways	M/C		E			
h) Gamete formation and fertilization	M/C, E					
i) Cell division: mitosis and meiosis	M/C					
j) Cell differentiation, pattern formation, and morphogenesis	M/C, E	L, M/C, W				

	K331 Chernoff Embryology	K333 Chernoff EmbryoLab	K356/K357 Micro Lees Marrs	493 Randall	548 Randal	697 Randall
3) ***Physiology*****:** how systems within an organism operate and interact to maintain short-term homeostasis of the individual and long term survival of the species						
a) Knowledge of animal and plant physiological systems, their interactions and control						E,P
b) Acclimation and adaptation of these systems to different physiological conditions, e.g. heat stress vs. cold stress, iso-osmotic vs. hypo-osmotic/hyper-osmotic				L,P,W (thesis		E,P
4) ***Ecology:*** how organisms interact with each other and their physical environment				L,P,W (thesis		E,P
a) The growth of populations and the mathematical models which describe that behavior						
b) The organization of species population into communities and levels of emergent characteristics						
c) Ecosystems dynamics and the evolutionary future of the biosphere						
5) ***Evolution*****:** how the incredible diversity of life on earth has evolved over the course of several billion						
a) Origin of organic molecules and the evolution of life						
b) Mechanisms of natural selection and their effect on gene frequencies			M/C, E			
c) Evolution of cellular organization						

	K331 Chernoff Embryology	K333 Chernoff EmbryoLab	K356/K357 Micro Lees Marrs	493 Randall	548 Randal	697 Randall
d) Evolution of functionally specific biomolecules for carrying out processes of heredity, growth and development, and homeostasis	M/C					E,P
e) Microevolution: organism survival and diversification as a function of adaptation						
f) Variability of evolutionary rates						
II. Applied skills						
1) *Application of scientific method*						
Biology graduates will understand the theory of, and be able to apply, the scientific method in a Biology setting. For this purpose, the scientific method is defined as:						
(a) Making an observation about a poorly understood phenomenon and researching available related information from textbooks, journals, databases		L, M/C, W		L,P,W, (thesis)		
(b) Forming an hypothesis (a testable statement explaining the observation	E	L,M/C, W		L,P,W, (thesis)		
(c) Designing an experiment to test the hypothesis			M/C, E	L,P,W, (thesis)		
(d) Analyzing and interpreting experimental data, and forming conclusions about accepting or rejecting the hypothesis	M/C, E	L,M/C, W	M/C, E	L,P,W, (thesis)		
(e) Retesting the hypothesis, if necessary, so as to reinforce the conclusions				L,P,W, (thesis)		

	K331 Chernoff Embryology	K333 Chernoff EmbryoLab	K356/K357 Micro Lees Marrs	493 Randall	548 Randal	697 Randall
(f) Publication of results and/or oral presentation of the results and ideas through appropriate vehicles of communication				L,P,W, (thesis)		
2) *Biotechnology*						
Biology graduates will be competent in selected techniques and equipment commonly used in field and laboratory studies.The following are examples, but the list may change with the advent of new technologies						
(a) Microscopy			L. E		E,L,W	
(b) Culture growth of selected organisms, e.g. bacteria, fruit flies			L. E		E,L,W	
(c) Dissection						
(d) Enzyme assays		L	L. E	L,P,W, (thesis)	E,L,W	
(e) Biological staining techniques		L	L. E	L,P,W, (thesis)	E,L,W	
(f) Separation procedures for biological molecules, e.g. gel electrophoresis of protein or DNA, ultracentrifugation				L,P,W, (thesis)	E,L,W	
(7) Aseptic technique		L	L. E	L,P,W, (thesis)	E,L,W	

Tuesday, April 03, 2007

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1. Demographics

1. What is your class status?

	Response Percent	Response Total
freshman	19.5%	24
sophomore	17.9%	22
junior	26%	32
senior	**35%**	**43**
don't know	0.8%	1
View Other (please specify)	4.1%	5
Total Respondents		**123**
(skipped this question)		**2**

2. If you are a senior, when do you graduate?

	Response Percent	Response Total
A. May	**68.4%**	**26**
B. August	31.6%	12
Total Respondents		**38**
(skipped this question)		**87**

3. What is our goal upon completion of your undergraduate studies?

	Response Percent	Response Total
medical school	**44.7%**	**55**
dental school	10.6%	13
pharmacy school	7.3%	9
graduate school	21.1%	26

	Response Percent	Response Total
work	9.8%	12
don't know	7.3%	9
View Other (please specify)	12.2%	15
Total Respondents		**123**
(skipped this question)		**2**

4. What made you choose your career path?

	Response Percent	Response Total
A. runs in the family	6.6%	8
B. childhood experience	13.9%	17
C. truly passionate about the field	**70.5%**	**86**
D. previous work experience	20.5%	25
E. other	24.6%	30
Total Respondents		**122**
(skipped this question)		**3**

2. Education

5. Rate the following study habits as they correlate with how well you perform.

	very effective	fairly effective	neutral	not always effective	prefer another method	Response Average
read the text before the lecture	26% (28)	**36% (38)**	19% (20)	9% (10)	9% (10)	**2.40**
read the text afterwards	38% (40)	**45% (48)**	12% (13)	4% (4)	1% (1)	**1.85**
read the text before and after lecture	**45% (48)**	14% (15)	24% (25)	5% (5)	12% (13)	**2.25**
go over the powerpoints alone	28% (29)	**37% (39)**	18% (19)	16% (17)	1% (1)	**2.26**
read the text and lecture powerpoints	**44% (47)**	42% (45)	10% (11)	2% (2)	1% (1)	**1.73**
istream alone	2% (2)	21% (22)	**32% (34)**	25% (26)	20% (21)	**3.40**
istream in concert with reading the text and powerpoints	31% (32)	14% (15)	**36% (37)**	3% (3)	16% (17)	**2.60**
attending the lecture	**70% (74)**	25% (26)	4% (4)	2% (2)	0% (0)	**1.38**
making use of the professor's office hours	11% (12)	27% (28)	**42% (44)**	8% (8)	12% (13)	**2.83**
					Total Respondents	**105**
					(skipped this question)	**20**

6. While going to school, do you work? If so, how many hours per week?

	Response Percent	Response Total
A. I do not work	22.9%	24
B. I work 5-10 hours/week	12.4%	13
C. I work 10-20 hours/week	**27.6%**	**29**
D. I work 20-30 hours/week	21.9%	23

	Response Percent	Response Total
E. I work more than 30 hours/week	16.2%	17
Total Respondents		**105**
(skipped this question)		**20**

7. Are you a part-time or full time student?

	Response Percent	Response Total
A. Part-time	6.7%	7
B. Full-time	**94.3**%	**99**
Total Respondents		**105**
(skipped this question)		**20**

8. What kind of learner are you?

	Response Percent	Response Total
A. Visual	**76.2**%	**80**
B. Auditory	28.6%	30
C. Hands-on activity, such as those classes that have a laboratory component	47.6%	50
Total Respondents		**105**
(skipped this question)		**20**

9. Rate your IUPUI experience. For the following questions, rate your level of confidence on understanding the concepts listed below.

	very confident	**fairly confident**	**neutral**	**need to brush up on some concepts**	**never heard of it**	**Response Average**
Structure of nucleic acids, proteins, lipids, and carbohydrates	33% (34)	**46% (48)**	6% (6)	15% (16)	0% (0)	**2.04**
Synthesis and metabolism of biomolecules, e.g. DNA replication, mRNA transcription, proteins	36% (37)	**39% (41)**	5% (5)	20% (21)	0% (0)	**2.10**
Functions of biomolecules, e.g. DNA replication and recombination in the inheritance of genetic traits, roles of cholesterol and phospholipids in biomembranes	28% (29)	**41% (43)**	17% (18)	13% (14)	0% (0)	**2.16**
Cell membranes and receptors	35% (36)	**48% (50)**	9% (9)	9% (9)	0% (0)	**1.91**
Cytoplasmic structure and function	38% (39)	**43% (44)**	10% (10)	10% (10)	0% (0)	**1.91**
Nuclears structure and function	33% (34)	**40% (41)**	13% (13)	13% (13)	2% (2)	**2.11**
Extracellular matrix synthesis, structure, and function	19% (20)	**43% (44)**	15% (15)	21% (22)	2% (2)	**2.44**
Cell responses to external signals, e.g. hormones, antigens, or growth factors	26% (27)	**47% (49)**	15% (16)	11% (11)	1% (1)	**2.13**
Intracellular signaling pathways	17% (17)	**44% (45)**	17% (18)	20% (21)	2% (2)	**2.48**
Metabolic pathways	21% (22)	**38% (39)**	18% (19)	19% (20)	3% (3)	**2.45**
Gamete formation and fertilization	34% (34)	**46% (46)**	14% (14)	7% (7)	0% (0)	**1.94**
Cell division: mitosis and meiosis	**51% (53)**	38% (39)	8% (8)	4% (4)	0% (0)	**1.64**
Cell differentiation, pattern formation, and morphogenesis	17% (17)	**44% (45)**	18% (19)	15% (15)	7% (7)	**2.51**

Physiology: how systems within an organism operate and interact to maintain short-term homeostasis of the individual and long term survival of the species	20% (21)	**44% (45)**	17% (18)	17% (17)	2% (2)	**2.36**
Knowledge of animal and plant physiological systems, their interactions and control	14% (15)	**44% (46)**	17% (18)	24% (25)	1% (1)	**2.53**
Acclimation and adaptation of these systems to different physiological conditions (heat stress vs. cold stress, iso-osmotic vs. hypo-osmotic/hyper-osmotic environments	17% (18)	**39% (41)**	24% (25)	19% (20)	1% (1)	**2.48**
The growth of populations and the mathematical models which describe that behavior	21% (22)	**33% (34)**	18% (19)	19% (20)	9% (9)	**2.62**
The organization of species population into communities and levels of emergent characteristics	17% (18)	**41% (43)**	18% (19)	20% (21)	3% (3)	**2.50**
Ecosystems dynamics and the evolutionary future of the biosphere	15% (16)	**38% (39)**	19% (20)	20% (21)	8% (8)	**2.67**
Origin of organic molecules and the evolution of life	26% (27)	**41% (42)**	15% (15)	17% (18)	1% (1)	**2.26**
Mechanisms of natural selection and their effect on gene frequencies	34% (35)	**43% (44)**	13% (13)	10% (10)	1% (1)	**2.01**
Evolution of cellular frequencies	21% (22)	**23% (24)**	22% (23)	**23% (24)**	10% (10)	**2.77**
Evolution of functionally specific biomolecules for carrying out processes of heredity, growth and development, and homeostasis	17% (17)	**33% (34)**	26% (27)	18% (19)	6% (6)	**2.64**
Microevolution: organism survival and diversification as a function of adaptation	20% (21)	**37% (39)**	25% (26)	15% (16)	3% (3)	**2.44**
Variability of evolutionary rates	16% (17)	**30% (31)**	25% (26)	23% (24)	7% (7)	**2.74**
Microscopy	31% (32)	**39% (41)**	11% (11)	16% (17)	3% (3)	**2.21**
Culture growth of selected organisms, such as bacteria, fruit flies	**35% (37)**	30% (31)	14% (15)	19% (20)	2% (2)	**2.23**
Dissection	**39% (41)**	37% (39)	12% (13)	10% (11)	1% (1)	**1.97**
Enzyme assays	17% (17)	**34% (35)**	19% (19)	18% (18)	13% (13)	**2.75**
Biological staining techniques	**35% (36)**	34% (35)	10% (10)	17% (17)	5% (5)	**2.22**
Separation procedures for biological molecules, such as gel electrophoresis of protein or DNA, ultracentrifugation	29% (30)	**42% (43)**	15% (15)	12% (12)	3% (3)	**2.17**
Aseptic technique	**49% (50)**	20% (21)	10% (10)	6% (6)	16% (16)	**2.19**
					Total Respondents	**104**
					(skipped this question)	**21**

10. Rate your IUPUI experience. For the following questions, rate your level experience on how often you have done the following.

	5 or more times	**4 or more times**	**3 or more times**	**not much experience, but would have liked to have done it**	**never heard of it**	**Response Average**
Making an observation about a poorly understood phenomenon and researching available related information from textbooks, journals, databases	16% (17)	10% (10)	26% (27)	**38% (40)**	10% (11)	**3.17**
Forming an hypothesis, a testable statement explaining the observation	**33% (35)**	20% (21)	28% (29)	16% (17)	3% (3)	**2.35**
Designing an experiment to test the hypothesis	15% (16)	13% (14)	34% (35)	**35% (36)**	3% (3)	**2.96**

Analyzing and interpreting experimental data, and forming conclusions about accepting or rejecting the hypothesis	**46% (48)**	15% (16)	23% (24)	16% (17)	0% (0)	**2.10**
Retesting the hypothesis, if necessary, so as to reinforce the conclusions	24% (25)	19% (20)	**33% (34)**	24% (25)	0% (0)	**2.57**
Publication of results and/or oral presentation of the results and ideas through appropriate vehicles of communication	12% (13)	9% (9)	21% (22)	**50% (53)**	8% (8)	**3.32**
					Total Respondents	**104**
					(skipped this question)	**21**

Assessment of Student Learning
Department of Chemistry and Chemical Biology
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report for the Six-Stage Assessment Strategy

Submitted by Jay A. Siegel, Ph.D.
(Edited by Joseph L. Thompson)
June 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

Stage 1 → Identify the program's student learning outcomes (SLOs).
Stage 2 → Link these SLOs to specific components of the program's curriculum.
Stage 3 → Identify or create methods to measure these SLOs.
Stage 4 → Collect data to determine if the SLOs are being accomplished successfully.
Stage 5 → Use the data collected in Stage 4 to make curricular changes.
Stage 6 → Repeat Stage 4 to determine if the curricular changes were effective.

These stages are comparable to the following stages in the Planning for Learning and Assessment table that has been approved and distributed by IUPUI's Program Review and Assessment Committee,

1. What general outcome are you seeking?
2. How would you know it (the outcome) if you saw it? (What will the student know or be able to do?)
3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Chemistry Undergraduate Program in Regard to These Stages

The Department of Chemistry and Chemical Biology is currently at Stage 1 in the six-stage process.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

In AY 2005-2006 the Department of Chemistry began the process of developing student outcomes for its Gateway and other lower-level, high enrollment classes. Lecturers Gavrin Kirton and Jayanthi Jacob along with David Malik, Professor, accomplished this work in large part. Since that time, the Department has lost two faculty members and both lecturers. Dr. Frank Schultz, the Chairman, is retiring and the Department is preparing for a nationwide search for a new chair and to fill the vacant faculty positions. In 2005-06, the Department had an external review that called for a study of the undergraduate curriculum. In addition, the American Chemical Society (ACS) is significantly changing the standards for certified Bachelor of Science (B.S.) degrees. These changes are nearing final form. When adopted, the new standards will cause the Department to make further changes in the courses and curriculum offered at the undergraduate level.

All of the above changes necessitated the Department faculty to suspend its efforts to comply with the School of Science Assessment Committee six-stage assessment strategy. It is hoped that filling the open faculty slots and adopting the new ACS rules for certification of B.S. degrees will enable the Department to achieve a stable environment for continuing work on this assessment strategy.

Assessment of Student Learning
Department of Computer and Information Science
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted by Xukai Zou, Ph.D.
(Edited by Joseph L. Thompson)
June 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

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4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Computer Science Undergraduate Program in Regard to These Stages

The Department of Computer and Information Science has accomplished the first stage, basically finished the second stage, and is in the process of accomplishing the third stage. The following sections describe this progress.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

The Department of Computer and Information Science synthesized the IUPUI's Principles of Undergraduate Learning and the curriculum guidelines from Association of Computing Machinery / Institute of Electrical and Electronics Engineers (ACM/IEEE) to create the following six student learning outcomes (SLOs) for the Department.

1. **Basic understanding of computing**: Computer science majors will have a basic understanding of the theoretical foundations of computer science. These foundations and models of computing include principles of data structures (organizations of data so as to achieve the maximum performance), algorithms (precise techniques for solving problems), computer organization (functionalities and relationships of various components such as processor, memory, secondary storage, operating system and their interrelations), and theory of programming languages (different execution models of higher-level languages).
2. **Ability to analyze different data structures**: Selecting an appropriate data structure is extremely critical for performance. Performance can be measured in terms of execution speed and/or computational resource requirements. Different problem characteristics benefit from the use of different data structures. Hence, it is of the utmost necessity to analyze the problem domain and select a suitable data structure from the set of well-known data structures, such as linked lists, arrays, stacks, trees, hash tables, etc. All these data structures and operations on them are mathematically analyzable. Students will be familiar with various data structures and be able to select the most appropriate one for a given problem.
3. **Knowledge of a diverse array of computational algorithms**: The precise technique, an algorithm, to solve any problem not only guarantees the correct solution, but also achieves it in an optimal fashion. Just like data structures, students will have an in-depth knowledge of a diverse array of computational algorithms and their mathematical analysis. Algorithms, which students will have learned, include searching, sorting, graph, and floating point computations.
4. **Basic understanding of computer architecture and systems**: The interrelations among structure and functionality of hardware (CPU, I/O, Memory, etc.) and software components (operating system, compilers, interpreters, etc.) will be known to computer science students. This understanding is of the utmost necessity for exploiting the capabilities offered by modern computer systems.
5. **Ability to develop and design small-scale software projects**: Mapping a problem into a specific architecture includes implementing the solution in a particular higher-level language. Advances in programming have facilitated the creation of large software systems, often needed for solving fairly complex real-world problems. Students will be able to apply the principles of Software Engineering to the entire software life cycle, i.e., problem specification, analysis, design, implementation, testing, verification and maintenance, and develop large software systems in at least one currently used high-level programming language.
6. **Knowledge of advanced and recent computing trends:** Computer science, being a relatively young branch of science, is constantly changing. Students will possess

knowledge of the advanced computing trends (in all different aspects) and will have an ability to extrapolate this knowledge to quickly adapt to future advances.

These six SLOs plus the six Principles of Undergraduate Learning form the basis for the Department's student learning outcomes with which it measures student progress in its courses. Additionally, in view of the fact that some engineering students are present in these courses, the Department incorporated the Accreditation Board for Engineering and Technology (ABET) guidelines for computer engineering and ACM guidelines for computer science curricula into these SLOs. This change eased the movement to Stage 2, linking the SLOs to specific curricular components.

Stage 2 → Link These SLOs to Specific Components of the Department's Curriculum

The Department of Computer and Information Science performed detailed and concrete analysis between the six SLOs and its curriculum and connected them together as follows:

1. Basic understanding of computing: CSCI 230 Computing I (4 cr.) and CSCI 240 Computing II (4 cr.).
2. Ability to analyze different data structures: CSCI 340 Discrete Computational Structure (3 cr.) and CSCI 362 Data Structures (3 cr.).
3. Knowledge of a diverse array of computational algorithms: CSCI 230, CSCI 240, and CSCI 362, and CSCI 463 Analysis of Algorithms (3 cr.).
4. Basic understanding of computer architecture and systems: CSCI 402 Architecture of Computers (3 cr.) and CSCI 403 Introduction to Operating Systems (3 cr.).
5. Ability to develop and design small-scale software projects: CSCI 450 Principles of Software Engineering (3 cr.).
6. Knowledge of advanced and recent computing trends: take at lease four computer science elective courses from among over twenty available courses (see the end of Appendix A).

The details of specific student outcomes for each course are given in Appendix A.

Stage 3 → Identify or Create Methods to Measure These SLOs

The Department of Computer and Information Science has been using the following mechanisms assessing SLOs.

a. The Department uses a grading system as the fine-grained component of its approach to assessing learning outcomes. For certain courses, on selected exams, homework and programming assignments, a student's performance relative to each of the student learning outcomes are evaluated. The evaluations in each course are combined to form a measure of the student's performance relative to the SLOs. The primary purpose in performing this assessment is not to assign grades to individual students. Rather, it is to determine in what ways the Department can improve its instruction to better support its students' achievement of the goals embodied in the learning outcomes. (See the following Table showing the concrete mechanisms, such as, examinations, quizzes, assignments, labs, projects, for main courses.)

b. Three of the other vehicles that the Department employs to assess the quality of the delivery of its services are described below. These are coarse-grained measures.
   i. Enrollment Data: The Department monitors, documents, and analyzes DWF rates and enrollment data throughout the registration cycle. It uses these latter data particularly for determining course offerings for services courses. Monitoring the data tells of student demands for learning in areas such as Web design and popular programming languages, such as Java and C#. The Department continuously adjusts Certificate Program course offerings based on student demand. For our major's courses, enrollment and DWF data are analyzed particularly for determining retention percentages. Low retention can be an indicator of a possible problem that needs further investigation. This information has influenced faculty hiring and assignment decisions as well as course delivery systems.
   ii. Student Evaluations of Teaching: The Department extensively uses the information from these student questionnaires not only to assess the quality of instruction, but also the quality of specific course content.
   iii. Faculty Reviews: As the need arises for specific courses, the responsible faculty committee (Graduate, Undergraduate, Service Course) examines their content, delivery, objectives and student performance in order to maximize the achievement of the program's objectives.
c. The Department is planning to design and adopt summative mechanisms to assess the overall SLOs for senior students. One important option is to let our senior students take ETS Major Field Tests to which Computer Science belongs.

Assessment of SLOs in Core Required Courses

General Computer Science Student Learning Outcome	**CSCI 230**	**CSCI 240**	**CSCI 340**	**CSCI 362**	**CSCI 402**	**CSCI 403**	**CSCI 495**
1. Basic understanding of computing: Computer science majors will have a basic understanding of the theoretical foundations of computer science. These foundations and models of computing include principles of data structures (organizations of data so as to achieve the maximum performance), algorithms (precise techniques for solving problems), computer organization (functionalities and relationships of various components such as processor, memory, secondary storage, operating system and their interrelations), and theory of programming languages (different execution models of higher-level languages).	M/C, E, Q, and W	M/C, E, Q, and W					
2. Ability to analyze different data structures: Selecting an appropriate data structure is extremely critical for performance. Performance can be measured in terms of execution speed and/or computational resource requirements. Different problem characteristics benefit from the use of different data structures. Hence, it is of the utmost necessity to analyze the problem domain and select a suitable data structure from the set of well-known data structures such as linked lists, arrays, stacks, trees, hash tables, etc. All these data structures and operations on them are mathematically analyzable. Students will be familiar with various data structures and be able to select the most appropriate one for a given problem.			M/C, E, Q, and W	M/C, E, Q, and W			
3. Knowledge of a diverse array of computational algorithms: The precise technique, an algorithm, to solve any problem not only guarantees the correct solution, but also achieves it in an optimal fashion. Just like data structures, students will have an in-depth knowledge of a diverse array of computational algorithms and their mathematical analysis. Algorithms, which students will have learned, include searching, sorting, graph, and floating point computations.					M/C, E, Q, and W	M/C, E, Q, and W	
4. Basic understanding of computer architecture: The interrelations among structure and functionality of hardware (CPU, I/O, Memory, etc.) and software components (operating system, compilers, interpreters, etc.) will be known to computer science students. This understanding is of the utmost necessity for exploiting the capabilities offered by modern computer systems.					M/C, E, Q, and W	M/C, E, Q, and W	
5. Ability to develop and design small-scale software projects: Mapping a problem into a specific architecture includes implementing the solution in a particular higher-level language. Advances in programming have facilitated the creation of large software systems, often needed for solving fairly complex real-world problems. Students will be able to apply the principles of Software Engineering to the entire software life cycle, i.e., problem specification, analysis, design, implementation, testing, verification and maintenance, and develop large software systems in at least one currently used high-level programming language.							
6. Knowledge of advanced and recent computing trends: Computer science, being a relatively young branch of science, is constantly changing. Students will possess knowledge of the advanced computing trends (in all different aspects) and will have an ability to extrapolate this knowledge to quickly adapt to future advances.							M/C, E, Q, and W

M/C: Multiple choice exam
E: Essay/short answer exam
Q: Quizzes
W: Writing assignment
L: Lab Exercise
P: Presentation to class
I: In class (group or individual activity)
O: Other (please explain)

Appendix A

Stage 2 in detail: Link These SLOs to Specific Components of the Department's Curriculum

1. The Department's first SLO, "Basic Understanding of Computing," is addressed in depth in our gateway courses, CSCI 230 and CSCI 240.
    a. **CSCI 230 Computing I (4 cr.)** The context of computing in history and society; information representation in digital computers; introduction to programming in a modern high-level language; introduction to algorithm and data structures; their implementation as programs. Specific student outcomes for this course are:
        - Handle problem-solving techniques using computers.
        - Program proficiently in a high-level programming language (C, Java, etc.).
        - Translate algorithms into programs, compile, execute, and debug.
        - Know concepts about Data Types and Memory.
        - Use appropriate Data Structures and their use for data manipulation in memory.
        - Design efficient algorithms design and algorithm complexities.

    b. **CSCI 240 Computing II (4 cr.)** P: CSCI 230. Continues the introduction of programming began in CSCI 230, with particular focus on the ideas of data abstraction and object oriented programming. Topics include programming paradigms, principle of language design, object oriented programming, programming and debugging tools, documentation, recursion, linked data structures, and introduction to language translation. Specific student outcomes for this course are:
        - Write Shell-programming scripts in Unix O/S.
        - Implement and test various operating system concepts in Unix.
        - Design and implement simple Database systems using SQL.
        - Write Functional and Logic Programming-based solutions as opposed to procedural programs.
        - Design and simulate logic circuits.
        - Design and simulate micro- and macro-level programs.
        - Design various file handling techniques using a high-level language.

2. The Department's second SLO, "Ability to Analyze Different Data Structures," is addressed in depth our core component courses, CSCI 340 and CSCI 362.
    a. **CSCI 340 Discrete Computational Structure (3 cr.)** Theory and application of discrete mathematics structures and their relationship to computer science. Topics include mathematical logic, sets, relations, functions, permutations, combinatorics, graphs, Boolean algebra, digital logic, recurrence relations, and finite-state automata. Specific student outcomes for this course are:
        - "*Mathematical reasoning*: Students must understand mathematical reasoning in order to read, comprehend, and construct mathematical arguments. Mathematical logic, serves as foundation for the subsequent discussions of methods of proofs. The technique of mathematical induction is conveyed through many different types of examples. Extensive explanation is provided to show why mathematical induction is a valid proof technique.

- *Combinatorial Analysis*: An important problem solving skill is the ability to count or enumerate objects. The discussion of enumeration begins with the basic technique of counting. The stress is on performing combinatorial analysis to solve counting problems, not on applying formulae.
- *Discrete Structures*: Students will be taught how to deal with discrete structures, which are abstract mathematical structures used to represent discrete objects and relations between these objects. These discrete structures include sets, permutations, relations, graphs, trees, and finite state machines.
- *Algorithmic Thinking*: In computer science, problem solving is done via the specification of an algorithm. After an algorithm has been described, a computer program can be constructed to implement it. The mathematical portion of this activity includes the specification of the algorithm, the verification that it works properly, and the analysis of the computer memory and time required to perform it.
- *Applications and Modeling*: Discrete mathematics has applications to almost every conceivable area of study. There are many application to computer science and data networking, as well as applications to such diverse areas as chemistry, botany, zoology, linguistics, geography, business, and the Internet. Modeling with discrete mathematics is an extremely important problem-solving skill, which students must acquire by constructing their own models in some of the exercises."

b. **CSCI 362 Data Structures (3 cr.)** A study of the design and analysis of data structures and algorithms. Abstract data types: arrays, stacks, queues, lists, trees, graphs. Algorithms: sorting, searching, hashing. File structures: organization and access methods. Specific student outcomes for this course are:
   - Knowing concepts of various data structures.
   - Knowing merits and demerits of different data structures.
   - Knowing algorithms to manipulate data structures.
   - Being able to perform complexity evaluation for different algorithms.
   - Having knowledge of using C++ Standard Template Library to compose algorithms.
   - Understanding file structures in dealing with information saved in the secondary devices.

3. The Department's third SLO, "Knowledge of a diverse array of computational algorithms," is introduced to computer science students in multiple freshmen/sophomore courses including CSCI 230, CSCI 240, and CSCI 362. Algorithm design is an integral part of all computing courses. However, students wishing an in depth course can choose CSCI 463 as an elective:
   a. **CSCI 463 Analysis of Algorithms (3 cr.)** Techniques for analyzing and comparing algorithms. Average case analysis in sorting and searching; dynamic programming: greedy algorithms, amortized analysis, and applications; matrix algorithms: polynomials, discrete Fourier transforms, and fast Fourier transforms; parallel algorithms: examples in sorting, searching, graphs, and matrices; computational complexity, polynomial complexity classes. Specific student outcomes for this course are:
      - Discuss the importance of algorithms in the problem-solving process.

- Identify the necessary properties of good algorithms.
- Create algorithms for solving simple problems.
- Use pseudo-code or a programming language to implement, test, and debug algorithms for solving simple problems.
- Describe strategies that are useful in debugging.
- Implement the most common quadratic and *O*(N log N) sorting algorithms.
- Design and implement an appropriate hashing function for an application.
- Design and implement a collision-resolution algorithm for a hash table.
- Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.
- Discuss factors other than computational efficiency that influence the choice of algorithms, such as programming time, maintainability, and the use of application specific patterns in the input data.
- Solve problems using the fundamental graph algorithms, including depth-first and breadth-first search, single-source and all-pairs shortest paths, transitive closure, topological sort, and at least one minimum spanning tree algorithm.
- Demonstrate the following capabilities: to evaluate algorithms, to select from a range of possible options, to provide justification for that selection, and to implement the algorithm in programming context.

4. The Department's fourth SLO, "Basic Understanding of Computer Architecture and Systems" is addressed in core-required course CSCI 402 and CSCI 403.
   a. **CSCI 402 Architecture of Computers (3 cr.)** Basic logic design. Storage systems. Processor organization: instruction formats, addressing modes, subroutines, hardware and microprogramming implementation. Computer arithmetic, fixed and floating point operations. Properties of I/O devices and their controllers. Interrupt structure. Virtual memory structure, cache memory. Examination of architectures such as microcomputers, minicomputers, vector and array processors. Specific Student outcomes for this course are:
      - Demonstrate the understanding of the major building blocks and their role in the historical development of computer architecture.
      - Use mathematical expressions to describe the functions of simple combinational and sequential circuits.
      - Design a simple circuit using the fundamental building blocks.
      - Understand the representation of the data.
      - Know the principles of memory management and the role of cache and virtual memory.
      - Understand the concepts behind Parallel Computer Systems.
   b. **CSCI 403 Introduction to Operating Systems (3 cr.)** Operating system concepts; history, evolution and philosophy of operating systems. Concurrent processes, process coordination and synchronization, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage and file management, device management, security and protection, networking, distributed and real-time systems.
      - Demonstrate the understanding of the major building blocks and their role in the historical development of operating systems.

- Understand the relation and interaction among computer hardware and operating systems.
- Understand the relation among operating system components and how these components coordinate systematically to support users, other software systems and applications.
- Apply typical operating system techniques to other systems and applications.

5. The Department's fifth SLO, "Ability to develop and design small-scale software projects" is addressed in depth in CSCI 450.
   a. **CSCI 450 Principles of Software Engineering (3 cr.)** Tools and techniques used in software development. Lifecycle concepts applied to program specification, development, and maintenance. Topics include overall design principles in software development; the use of structured programming techniques in writing large programs; formal methods of program verification; techniques and software tools for program testing, maintenance, and documentation. A primary goal of this course is to provide experience in team development of software. Specific student outcomes for this course are:
      - Evaluate the quality of multiple software design based on key design principles and concepts.
      - Select and apply appropriate design patterns in the construction of a software application.
      - Analyze and evaluate a set of tools in a given area of software development.
      - Create, evaluate and implement a test plan for a medium size code segment.
      - Discuss the advantages and disadvantages of software reuse.
      - Compare and Contrast the different methods and techniques used to assure the quality of a software product.

6. Students are given an opportunity to explore numerous applied computing concepts in a series of computing elective courses allowing exploration on the final learning outcome, "Knowledge of advanced and recent computing trends."

   a. The curriculum encourages students to explore recent computing trends as early as their sophomore year, advising students to take at lease four computer science elative courses from among the following:

      CSCI-N311 Advanced Database Programming, Oracle (3 cr.) Focus on the concepts and skills required for database programming and client server development. Concepts will apply to any modern distributed database management system. Emphasis on developing Oracle SQLPlus scripts, PL/SQL server side programming, and Oracle database architecture. Students with programming experience in ODBC compliant languages will be able to practice connecting such languages to an Oracle database. Lecture and laboratory.

      CSCI-N321 System and Network Administration (3 cr.) Fundamental concepts of system administration. Design and administration of network servers and workstations. Focus on basic network concepts such as user account administration, resource allocation, security issues, and Internet service management. Lecture and laboratory.

CSCI-N335 Advanced Programming, Visual Basic (3 cr.) Databases and VB, object-oriented design and practice, the component object model, inter-object communication, related RAD environments such as VB for Applications and ActiveX using the Windows API, and generating online help. Lecture and laboratory.

CSCI-N342 Server-Side Programming for the Web (3 cr.) Designing and building applications on a Web server. Focuses on the issues of programming applied to Web servers. Emphasis on relational database concepts, data design, languages used on the server, transaction handling, and integration of data into Web applications.

CSCI-N343 Object-Oriented Programming for the Web (3 cr.) Algorithm design and development within the object-oriented paradigm. Students will utilize Java to create Web-based application software with strong user interaction and graphics. In addition, students will utilize Oracle and SQL to learn introductory database design principles, coupling backend database operation to application software. Lecture and laboratory.

CSCI-N345 Advanced Programming, Java (3 cr.) A Java language course designed for students familiar with programming and the World Wide Web. Focus on the unique aspects of Java, Applet, and GUI design, object-oriented programming, event-handling, multi-threaded applications, animation, and network programming. Lecture and laboratory.

CSCI-N351 Introduction to Multimedia Programming (3 cr.) An integration of computing concepts and multimedia development tools. An introduction to the science behind multimedia (compression algorithms and digital/audio conversion). Use of authoring tools to create compositions of images, sounds, and video. Special emphasis given to using the Web as a multimedia presentation environment. Lecture and laboratory.

CSCI-N431 E-Commerce with ASP.NET (3 cr.) Topics include basic Web controls, form validation, connecting to an Enterprise-level database, SSL, and sending email within an ASP.NET Web page. A significant software development final project creating a functional web store is featured. Lecture and laboratory.

CSCI-N435 Data Management Best Practices with ADO.NET (3 cr.) A study of managing data in the .NET environment. Focus on strategies to efficiently manage data for large-scale projects. Topics include XML, DataSets, SQL, and error management. Lecture and laboratory.

CSCI-N443 XML Programming Fundamentals of XML programming language. After mastering fundamental XML scripting syntax, the course focuses on narrative-centric and data-centric XML applications. Narrative content includes CSS, DTD and XSLT, and X-path, -link, and -pointer tools; data-centric content includes the DOM, Schemas and ADO/ASP. A required masterpiece project summarizes course competencies. Lecture and laboratory.

CSCI-N451 Web Game Development (3 cr.) Study of basic game development principles with a focus on client-side Web delivers. Topics to include creation of sprite objects, user interaction concepts, basic intelligence concepts, game data structures, and basic game physics. Lecture and laboratory.

CSCI-N461 Software Engineering for Applied Computer Science (3 cr.) This is a survey course covering software engineering concepts, tools, techniques and methodologies. The topics covered include software engineering, software process and its difficulties, software lifecycle models, project planning including cost estimation, design methodologies including structured design, data structure oriented design, object-oriented design, and software testing. This course is intended for non-majors and credit will not be awarded to Computer Science majors.

b. In the junior and senior year, students choose six more computer science elective courses at a more advanced level. Students choose from among the following:

CSCI 432 Security in Computers (3 cr.) P: CSCI 403. An introduction to computing security to include Cryptography; identity and authentication; software security; operating system security; trusted operating system design and evaluation; network threats and defenses; security management; legal aspects of security; privacy and ethics.

CSCI 435 Multimedia Information Systems (3 cr.) P or C: CSCI 362, MATH 351/511. Multimedia information systems concepts, evolution of multimedia information systems, media and supporting device commonly associated, image databases, techniques for presenting visual information, video databases, multi-models, audio databases, text databases, multimedia information systems architecture.

CSCI 436 Principles of Computer Networking (3 cr.) P: CSCI 362. Survey of underlying principles, fundamental problems, and their solutions in designing computer networks. Laboratory projects include using network systems and network simulation environments. Topics include: motivations, networking topologies, layered open systems protocols, transmission capacity, circuit and packet switching, packet framing and error correction, routing, flow and congestion control, and inter-networking.

CSCI 437 Introduction to Computer Graphics (3 cr.) P: CSCI 362, and MATH 351/511. An introduction to 3D programming with emphasis on game engine development using 3D graphics techniques and the standard and platform independent OpenGL library. Topics include: lighting, shading, texture mapping, coordinate systems and transformations, collision detection, 3D geometric and physically-based modeling and animation.

CSCI 438 Advanced Game Development (3 cr.) P: CSCI 437. Advanced game design and development principles and technologies. Students will gain practical experience through extensive game development project. Topics include: character animation, special effects, user interface design, networking for computer games, game engine components and variations, game performance considerations, artificial intelligence, and ethics in computer games.

CSCI 441 Client-Server Database Systems (3 cr.) P or C: CSCI 362. Database system concepts, data models database design, CASE tools, SQL, query processing and query optimization, transaction processing, reliability and security issues, database interactions on the world wide web.

CSCI 443 Database Systems (3 cr.) P: CSCI 362. Fall. Relational database systems: architecture, theory, and application. Relational data structure, integrity rules, mathematical description, data manipulation. Standard SQL and its data manipulation language, engineering aspects of database design in industry, introduction to non-relational database systems.

CSCI 448 Biometric Computing (3 cr.) P: CSCI 362 and STAT 416 or STAT 511. Biometrics is capturing and using physiological and behavioral characteristics for personal identification. It is set to become the successor to the PIN. This course will introduce computational methods for the implementation of various biometric technologies including face and voice recognition, fingerprint and iris identification, and DNA matching.

CSCI 452 Object-Oriented Analysis and Design (3 cr.) P: CSCI 362. Spring. Introduction to the object-oriented paradigm in software development. Basic concepts: objects, classes, messaging, inheritance, methodologies. Analysis: defining objects, structures, attributes, services. Design: transforming the analytic model into the design model. Implementation: comparison of the support features provided by languages such as Smalltalk, C++, Eiffel, and CLOS. A significant design project is required.

CSCI 481 Data Mining (3cr.) P or C: CSCI 240, MATH 351/511, STAT 511/416. An introduction to data warehousing and OLAP technology for data mining, data processing, languages and systems, descriptive data mining: characterization and comparison, association analysis classification and predication, cluster analysis mining complex types of data, application and trends in data mining.

CSCI 487 Artificial Intelligence (3 cr.) P: CSCI 362. Study of key concepts and applications of artificial intelligence. Problem-solving methods, state space search, heuristic search, knowledge representation: predicate logic, resolution, natural deduction, nonmonotonic reasoning, semantic networks, conceptual dependency, frames, scripts, and statistical reasoning; advanced AI topics in game playing, planning, learning, and connectionist models.

Assessment of Student Learning
Department of Earth Sciences
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted by Chris W. Thomas, M.S.
(Edited by Joseph L. Thompson)
June 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

Stage 1 → Identify the program's student learning outcomes (SLOs).
Stage 2 → Link these SLOs to specific components of the program's curriculum.
Stage 3 → Identify or create methods to measure these SLOs.
Stage 4 → Collect data to determine if the SLOs are being accomplished successfully.
Stage 5 → Use the data collected in Stage 4 to make curricular changes.
Stage 6 → Repeat Stage 4 to determine if the curricular changes were effective.

These stages are comparable to the following stages in the Planning for Learning and Assessment table that has been approved and distributed by IUPUI's Program Review and Assessment Committee,

1. What general outcome are you seeking?
2. How would you know it (the outcome) if you saw it? (What will the student know or be able to do?)
3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Earth Sciences Undergraduate Program in Regard to These Stages

The Department of Earth Sciences has accomplished the first two stages and is in the process of accomplishing the third stage. The following sections describe this progress.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

The Department of Earth Sciences synthesized IUPUI's Principles of Undergraduate Learning with new Student Learning Outcomes (SLOs). In spring 2007, the Department faculty agreed that the current learning objectives were out of date and not reflective of the outcomes expected of students. As part of this process, the required curriculum for students earning a Bachelor of Science (B.S.) or Bachelor of Arts (B.A.) in Geology was revised. This new curriculum will be aligned with these new learning objectives. The faculty agreed on ten new outcomes, which also incorporated some old outcomes. These ten outcomes, listed below, are broken down into further detail in Appendix A.

1. Appraise the significance of fossil material and interpret the ancient environments in which the organisms lived.
2. Relate and understand geologic timescales and Earth history.
3. Explain fundamental processes of tectonics and deformation and relate them to surficial processes and features.
4. Identify common earth materials and describe how crystal chemistry predicts their behavior.
5. Evaluate surficial and near-surface processes as a function of geochemical cycles and systematic processes.
6. Relate and interpret processes of the Rock Cycle to modern and historical environments.
7. Solve earth science problems using the scientific method and advanced technologies of earth science.
8. Spatially describe earth processes through modeling, mapping, observation, and measurement.
9. Demonstrate competence in communicating earth science problems to a broad audience.
10. Compile and demonstrate competence in advanced disciplines of earth sciences.

To revise our curriculum, the Department has decided to change the status of some required courses to elective courses, and to eliminate some required courses completely. To replace the dropped required courses, three new courses are being created (tentatively titled *Earth Evolution and History*, *Earth Materials*, and *Earth Processes*). These courses will provide students with appropriate depth and focus on all the key concepts of earth sciences and will prepare students to follow a tract or choose *ala carte* a set of advanced courses that will prepare them for graduate school or the job market.

Stage 2 → Link These SLOs to Specific Components of the Department's Curriculum

The Department of Earth Sciences is currently performing an audit of its required courses and new required courses to determine in which courses and at what developmental levels its SLOs are being taught and assessed. Currently, the faculty are agreeing on which courses accomplish the stated learning objectives from Stage 1. Additionally, they are debating how these objectives will translate into course-specific learning objectives and assignments in our new courses. The next stage is to examine the syllabus and assignments in each course and categorize by the critical thinking skill(s) required to successfully complete the course.

Stage 3 → Identify or Create Methods to Measure These SLOs

The Department of Earth Sciences has not yet reached this stage. However, as curriculum revision is finalized, the Department will move into Stage 3 in 2007-08.

Appendix A

2007 Draft for Curriculum Revision

IUPUI Department of Earth Sciences Learning Objectives

These objectives were drafted for a B.S. in Geology starting in 2007-08 School Year

Course Related to this Objective

1. **Appraise the significance of fossil material and interpret the ancient environments in which the organisms lived.**
   a. Describe and illustrate fundamentals of biological evolution as revealed by the fossil record.
   b. Recognize the range, quality, and quantity of information preserved in the fossil record, particularly the fundamental similarities of all living things through geologic history, as well as the systematic differences that distinguish major groups.
   c. Explain basic genetics and evolutionary theory, including the Darwin/Wallace concept of natural selection as well as neo-Darwinian reformulations and the impact of molecular biology.
   d. Describe the concepts of microevolution and macroevolution, and comparisons (timing, patterns, & possible causes) between normal, background, and mass extinction events that have punctuated the history of life.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (Sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

2. **Relate and understand geologic timescales and Earth history.**
   a. Describe the nature of the temporal and spatial variations in transfers of mass and energy at Earth's surface as they relate to Earth's history.
   b. Relate geologic features to the geologic time scale and the true length of geologic time, including methods of relative and absolute dating.
   c. Appraise the fossil record for relative age dating of the rocks in which they occur, hence for corroborating the succession of events comprising the physical evolution of our planet.
   d. Evaluate changes to both the physical and biological structure of the earth within a geologic framework in order to demonstrate the rate of change of earth processes, patterns of change of the physical world, relationships of developing life forms, and patterns of sedimentation through time.
   e. Summarize the theoretical foundations of material behavior as it pertains to the short- and long-term deformation processes occurring in the Earth.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

3. **Explain fundamental processes of tectonics and deformation and relate them to surficial processes and features.**
    a. Identify the earth processes that sustain plate tectonics and differentiate the surficial processes and features that result.
    b. Apply the concept of stress (how the internal state of stress is related to external loadings).
    c. Apply the concept of strain (the physical and chemical phenomena related to deformation).
    d. Explain the mechanics of fracture (from small-scale crack growth to large-scale development of joints and faults).
    e. Explain the mechanics of folding (the physical and chemical changes related to buckling of layered media).

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

4. **Identify common earth materials and describe how crystal chemistry predicts their behavior.**
    a. Apply principles of inorganic chemistry to describe the formation and behavior of mineral crystals.
    b. Use crystal chemistry to predict how a mineral will form or evolve in different contexts (crystallization, weathering, soil development, metamorphism) to create rocks, sediment, and soils.
    c. Identify and describe the most abundant minerals in Earth's crust, including the mineralogy of common igneous, sedimentary, and metamorphic rocks.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

5. **Evaluate surficial and near-surface processes as a function of geochemical cycles and systematic processes.**
    a. Define the transfers of mass and energy at or near the Earth's surface.
    b. Differentiate the erosion and deposition of sediments by mass movements, glaciers, rivers, and wind.
    c. Explain the physical interactions between the atmosphere, hydrosphere and lithosphere, and chemical fractionation associated with incongruent weathering reactions leading to the diversity of sediments.
    d. Diagram and interpret the cycling of major and trace elements in the particulate and aqueous phases.
    e. Use the hydrologic cycle to describe the movement of water over short- and long-term time scales.
    f. Relate the fundamental ways that life impacts modern geochemical cycles and systems, and describe how ancient life influenced Earth's geochemical environment (origin of the oxidizing atmosphere, biogeochemical cycles, sedimentary cycles of erosion and deposition).

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

6. **Relate and interpret processes of the Rock Cycle to modern and historical environments.**
    a. Apply basic chemical thermodynamics and actualistic principles to interpret environments of rock formation.
    b. Diagram and interpret the physical processes of material transfer and chemical fractionation involved in the Earth's formation and differentiation, as illustrated by the rock cycle.
    c. Describe the mechanical and chemical weathering of rocks and minerals into sediment and soils.
    d. Explain the processes of partial melting and fractionation leading to the formation of igneous rocks.
    e. Apply actualistic analogy to interpret environments of deposition of sedimentary rocks.
    f. Associate the dynamics of the rock cycle with orogenesis and lithospheric plate kinematics.
    g. Use solid-state chemical reactions to describe environments of isochemical metamorphism.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

7. **Solve earth science problems using the scientific method and advanced technologies of earth science.**
    a. Demonstrate competence at applying each step of the scientific method through a major project or several minor projects.
    b. Operate or apply modern geologic field and laboratory instrumentation, such as high precision mapping with GPS and total stations, remote imagery, physical and geochemical analytic instrumentation.
    c. Operate and apply fundamental computational technologies for data collection, processing, analysis, and presentation (e.g., GIS or CAD, data-sheet and statistical manipulations, construction of graphical representations of data and analytic results).
    d. Search, evaluate, and compile geologic literature using information technologies and databases.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

8. **Spatially describe Earth processes through modeling, mapping, observation, and measurement.**
   a. Measure, describe, and interpret earth materials in context, meaning the ability to analyze rock and sediment in the field and laboratory, and to relate those observations to natural processes and environments of formation.
   b. Conceptualize geologic relationships and processes in three-dimensions and through time, meaning the ability to visualize geologic phenomena (e.g., crystallography, geomorphology, earth structure, sedimentology) at many spatial and temporal scales, and to manipulate data in three-dimensions.
   c. Create and interpret geologic problems by constructing maps and cross sections.
   d. Analyze remotely sensed data and describe how geologic phenomena can be remotely measured and mapped.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

9. **Demonstrate competence in communicating earth science problems to a broad audience**.
   a. Create graphs, diagrams, and maps that reduce complex geologic concepts into simplified and clear visual representations.
   b. Summarize geologic problems in professional abstract, poster, and/or oral presentation format.
   c. Describe geologic problems using professional writing skills.

G110 (physical)
G120 (phys lab)
G205 (writing)
G221 (earth materials)
G222 (petrology)
G323 (structure)
G334 (sedimentology)
G3xx (Earth history)
G406 (Geochemistry)
G451 (Hydrogeology)
Capstone/ Research/ Field Camp/ G445

10. **Compile and demonstrate competence in advanced disciplines of earth sciences.**
    a. Develop a knowledge base of advanced disciplines of earth sciences and evaluate interrelationships between disciplines.
    b. Demonstrate competence to create, evaluate, and apply earth sciences to discipline specific problems in graduate school or industry.

Approved 400-level courses in Earth Sciences.
Approved 400-level courses in related disciplines
Capstone/ Research/ Field Camp/ G445

Appendix B

Results of the Department of Earth Science's Syllabus Audit to Determine the Developmental Coherence of Its Curriculum

	Basic	Developmental	Advanced
Objective 1 (Fossil Material)	G110 (physical); G334 (sedimentology), Approved 400-level course in Earth Sciences.		G3## Earth history
Objective 2 (Earth history and timescales)	Approved 400-level course in Earth Sciences. G221 (earth materials/mineralogy), G222 (petrology), G323 (structure), G334 (sedimentology)	G110 (physical geology); G120 (physical lab);	G3## Earth history
Objective 3 (Tectonics and deformation)		G3xx Earth history; G110 physical geology	G323 (structure)
Objective 4 (Earth materials and crystal chemistry)	G110 physical geology	G334 (sedimentology) G222 (petrology) G406 (geochemistry)	G221 (earth materials/mineralogy) Approved 400-level course in Earth Sciences.
Objective 5 (surface processes and geochemical cycles)	G3## Earth history, G221 Earth materials/mineralogy, G110 Physical Geology		G334 (sedimentology); G406 (Geochemistry); G451 Hydrogeology; Approved 400-level course in Earth Sciences. Approved 400-level courses in related disciplines Capstone/ Research/ Field Camp/ G445
Objective 6 (Rock cycle)	G110 Physical Geology; G222 Petrology	G120 (physical lab)	G221 Earth materials/mineralogy; Earth history; G222 (petrology); G334 (sedimentology); Approved 400-level course in Earth Sciences.
Objective 7 (Scientific Method and technologies)		G205 (writing); G221 (earth materials/mineralogy); G222 (petrology); Earth materials; Earth history	Approved 400-level course in Earth Sciences. Approved 400-level courses in related disciplines Capstone/ Research/ Field Camp/ G445
Objective 8 (Spatial observations and descriptions)		G120 (physical lab); G3## Earth history	G323 (structure); G451 Hydrogeology
Objective 9 (Communication)		Approved 400-level course in Earth Sciences. Approved 400-level courses in related disciplines	G205 Geowriting; Capstone/ Research/ Field Camp/ G445
Objective 10 (Advanced Disciplines)			Approved 400-level course in Earth Sciences. Approved 400-level courses in related disciplines Capstone/ Research/ Field Camp/ G445

**Earth Materials* and *Mineralogy* are different 200-level courses with overlapping content, and both can be substituted for each other in the new curriculum. *Mineralogy* emphasizes Objective 4, while *Earth Materials* emphasizes Objective 5.

Assessment of Student Learning
Forensic and Investigative Sciences Program
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted by Jay A. Siegel, Ph.D.
(Edited by Joseph L. Thompson)
June 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

Stage 1 → Identify the program's student learning outcomes (SLOs).
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Stage 4 → Collect data to determine if the SLOs are being accomplished successfully.
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Stage 6 → Repeat Stage 4 to determine if the curricular changes were effective.

These stages are comparable to the following stages in the Planning for Learning and Assessment table that has been approved and distributed by IUPUI's Program Review and Assessment Committee,

1. What general outcome are you seeking?
2. How would you know it (the outcome) if you saw it? (What will the student know or be able to do?)
3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Forensic Science Undergraduate Program in Regard to These Stages

The Forensic and Investigative Sciences Program began operation in the fall of 2004 offering a Bachelor of Science degree in Forensic and Investigative Sciences (FIS). In December of 2004, Kristi Shea was hired as advisor and program coordinator. She has developed considerable competence in the development of student learning outcomes and assessments. She will be the lead person in developing these for the FIS program.

During the fall of 2007 Mrs. Shea will coordinate the Program's work on stages 1 and 2. She will meet with the faculty of the Program and together they will identify the major student learning outcomes of the Bachelor of Science program and link the SLOs to specific components of the Program's curriculum. During the spring of 2008, stage 3 will be completed.

During the fall of 2008 and spring of 2009, the Program will prepare for accreditation of the FIS undergraduate degree by the Forensic Science Education Program Accreditation Commission (FEPAC). One segment of the self-study for accreditation requires a description of major SLOs and how these will be assessed. This will require the FIS program faculty and staff to complete stage 3 of the six-stage assessment strategy. The self-study for the accreditation must be complete by September 2008, and the on-site evaluation will take place during September or October of that year.

After the accreditation process is completed in late 2008, the Program will work on stage 4, with the hope of completion by the end of AY 2008-09.

Assessment of Student Learning
Department of Mathematical Sciences
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted by Jeffrey X. Watt, Ph.D.
(Edited by Joseph L. Thompson)
June 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

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3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Mathematics Undergraduate Program in Regard to These Stages

The Department of Mathematical Sciences has accomplished the first two stages and is in the process of beginning the third stage. The following sections describe this progress.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

The Department of Mathematical Sciences synthesized IUPUI's Principles of Undergraduate Learning, the National Council of Teachers of Mathematics Standards, and the Mathematics Association of America's competencies for undergraduate mathematics majors to create the following ten Student Learning Outcomes (SLOs) for the Department.

1. Understand and critically analyze mathematical arguments.
2. Understand, appreciate, and identify connections between different areas of mathematics.
3. Understand, appreciate, and solve some applications of mathematics to other subjects.
4. Develop a deeper knowledge and competence of at least one area of mathematics.
5. Develop and demonstrate abstract reasoning in a mathematical context.
6. Develop and demonstrate the principle modes of discovery in mathematics.
7. Develop and demonstrate careful and ethical analysis of data.
8. Develop and demonstrate problem-solving skills.
9. Demonstrate effective communication skills of mathematical ideas precisely and clearly, both orally and in writing.
10. Utilize a variety of technological tools (CAS, statistical packages, programming languages, etc.) in analyzing and solving mathematical problems.

In pursuit of the above SLOs, students should be exposed to courses in several of the following areas:

Analysis (not including differential equations)
Differential Equations
Discrete Math (other than algebra and geometry)
Modern or Abstract Algebra
Geometry
Probability and Statistics
Deterministic Modeling
Stochastic Modeling

Ideally, areas studied by a student should include a number of contrasting, but complementary, points of view:

Continuous and Discrete
Algebraic and Geometric
Deterministic and Stochastic
Theoretical and Applied

All majors should work on a senior-level project that requires them to analyze and create mathematical arguments and leads to a written or oral report (capstone).

Stage 2 → Link These SLOs to Specific Components of the Department's Curriculum

The Department of Mathematical Sciences performed an audit of its course syllabi to determine in what courses and at what developmental levels its SLOs are being taught and assessed. Each assignment that provided data for these assessments was categorized by the critical thinking skill(s) required to successfully complete it. Assignments requiring retention and comprehension were labeled "Basic," those requiring application and analysis were labeled as "Intermediate," and those requiring evaluating and creating were labeled as "Advanced." This audit enabled the Department to determine if (1) where its SLOs are being taught and assessed and (2) if its curriculum is "developmentally appropriate" so that students who progress through it are required to experience its SLOs in a developmentally coherent manner. The model that was used to define this developmental coherence is given in Appendix A. The results of this curriculum audit are given in Appendix B.

Stage 3 → Identify or Create Methods to Measure These SLOs

The Department of Mathematical Sciences is beginning to identify and consider creating instruments to measure the SLOs.

Appendix A

Three Levels of the Developmentally Coherent Curriculum

A. Basic Level → Retaining and Understanding

1. the ability to <u>retain</u> specific information in the way it was originally presented
   a. being asked to recognize the definition of a bold-faced term in a textbook
   b. questions it can be used to answer: Who, what, where, and when?
   c. Bloom calls this "knowledge"
2. the ability to <u>understand</u> information when it is presented in a different manner than it has been originally presented
   a. being asked to recognize a principle, concept, or method when presented with an example that has not been previously encountered
   b. questions it can be used to answer: How and why?
   c. Bloom calls this "comprehension"

B. Intermediate Level → Analyzing and Applying

1. the ability to <u>analyze</u> (i.e., reduce) a complex whole into its constituent parts and their functional relationships
   a. being able to recognize the parts of a complex whole and how they interact or are related to one another
   b. questions it can be used to answer: Of what is this complex whole composed, and how are its parts related to one another?
   c. Bloom calls this "analysis"
2. the ability to produce and <u>apply</u> original and useful solutions to solvable problems
   a. being able to recognize how the products of retention, comprehension, and analysis can be used to solve real world problems
   b. questions it can be used to answer: How can this problem be solved?
   c. Bloom calls this "application"

C. Advanced Level → Evaluating and Creating

   a. the ability to <u>evaluate</u> the effectiveness and/or merit of the products of application
   b. being able to recognize how established criteria can be used to judge the success of problem-solving methods (e.g., the scientific method and psychotherapy)
   c. questions it can be used to answer: What is the validity or value of a particular principle, theory, or method?
   d. Bloom calls this "evaluation"
2. the ability to <u>create</u> (i.e., synthesize) new wholes from previously unrelated parts
   a. being able to recognize how elements that have been previously unassociated can be combined into new and meaningful/useful wholes
   b. questions it can be used to answer: What new conclusions can you reach on the basis of what you have learned?
   c. Bloom calls this "synthesis"

Reference

Bloom, B.S., Englehart, M.D., Furst, E.J., & Krathwohl, D.R. (1956). *Taxonomy of educational objectives: Cognitive domain*. New York: McKay.

Appendix B

Results of the Department of Mathematical Sciences Syllabus Audit to Determine the Developmental Coherence of Its Curriculum

	Basic	Developmental	Advanced
1. Content Analysis	163, 276, 375, 426, 561, S350, S472, S473	164, 261, 262, 510, 511, 520, 522	300, 351, 333, 414, 417, 441, 442, 453, 456, 462, 463, 505, 525, S511
2. Math Connections	163, 164, 261, 375, 561	262, 276, 462, S350, S472, S473	300, 351, 414, 417, 426, 441, 442, 453, 456, 463, 505, 510, 511, 520, 522, 525. S416, S417, S511
3. Math Applications	163, 164, 300	261, 262, 351, 453, 462, 505, S416, S417, S472, S473	276, 333, 375, 414, 417, 426, 510, 511, 520, 522, 561, S350, S511
4. Depth of Knowledge	163, 276, 300, S472, S473	164, 261, 262, 333, 375, 414, 417, 426, 510, 511, 520, 522, S350, S416, S417	351, 441, 442, 453, 456, 462, 463, 505, 525, 561, S511
5. Abstract Reasoning	163, 164, 261, 262, 375	276, 300	351, 441, 442, 453, 456, 462, 463, 505, 525
6. Modes of Discovery	163, 164, 262, 375, 510	261, 276, 333, 414, 417, 456, 463, S350, S416, S417, S472, S473, S511	300, 351, 426, 441, 442, 453, 505
7. Data Analysis	276	300, 426, 561, S472, S473	375, 414, S350, S416, S417, S511
8. Problem Solving	163, 262, S472, S473	164, 261, 375, 414, 417, 510, 511, 520, 522, 561, S350	276, 333, 351, 426, 441, 442, 453, 456, 462, 463, 505, 525, S416, S417, S511
9. Communication Skills	163, 164, 262, 426, S472, S473	261, 276, 453, 505, S350	300, 351, 456, 462, S416, S417
10. Tech Competence	163	164, 300, 375, 417, S350	261, 414, 462, 561, S416, S417, S511

Appendix C

Mathematical Areas Covered in Courses

DI = Discrete Math
DQ = Differential Equations

AL = Algebraic
GE = Geometric

AP = Applied
TH = Theoretical

AN = Analysis
ST = Probability and Statistics

DM = Deterministic Modeling
SM = Stochastic Modeling

Course	Title	DI	DQ	AL	GE	AP	TH	AN	ST	DM	SM
163	Calculus I		X			X					
164	Calculus II					X					
261	Multi-Var Calc					X					
262	Diffy-Q		X			X					
276	Discrete	X				X					
300	Logic + Proof						X				
333	Dynamical Sys									X	
351	Linear Algebra						X				
375	Thry of Interest	X									X
414	Numerical Mthd	X				X					
417	Discrete Model	X				X					X
426	Math Model		X			X				X	
441	Analysis I						X	X			
442	Analysis II						X	X			
453	Abstract Algebra			X			X				
456	Number Thry	X					X				
462	Diff Geom				X		X	X			
463	Euclid Geom				X		X				
504	Real Analysis						X	X			
505	Abstract Algebra			X			X				
510	Vector Calculus							X			
511	Linear Algebra					X					
520	BVP Diffy-Q		X								
522	Diffy-Q		X								
525	Complex Analys							X			
561	Projective Geom				X						
S350	Intro Stats								X		X
S416	Probability								X		X
S417	Statistical Thry								X		X
S472	Actuarial Mod I								X		X
S473	Actuarial Mod II								X		X
S511	Stat Methods I								X		X

Assessment of Student Learning
Department of Physics
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted by Brian A. Woodahl, Ph.D.
(Edited by Joseph L. Thompson)
June 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

Stage 1 → Identify the program's student learning outcomes (SLOs).
Stage 2 → Link these SLOs to specific components of the program's curriculum.
Stage 3 → Identify or create methods to measure these SLOs.
Stage 4 → Collect data to determine if the SLOs are being accomplished successfully.
Stage 5 → Use the data collected in Stage 4 to make curricular changes.
Stage 6 → Repeat Stage 4 to determine if the curricular changes were effective.

These stages are comparable to the following stages in the Planning for Learning and Assessment table that has been approved and distributed by IUPUI's Program Review and Assessment Committee,

1. What general outcome are you seeking?
2. How would you know it (the outcome) if you saw it? (What will the student know or be able to do?)
3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Physics Undergraduate Program in Regard to These Stages

The Physics Department has very recently completed Stage 1 and is currently addressing the second stage of the plan.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

The Department of Physics synthesized IUPUI's Principles of Undergraduate Learning to create the following eight Student Learning Outcomes (SLOs).

1. Understand the basic and advanced concepts of classical and modern physics.
2. Master the mathematical skills relevant to the study of physics.
3. Apply knowledge of physics and mathematics to solve physical problems.
4. Design and perform laboratory experiments in physics.
5. Use computers and software to solve physics problems and to obtain and analyze experimental data.
6. Successfully collaborate with peers, attain the necessary skills, and develop the work ethic to perform and complete physics research.
7. Prepare a written technical document and deliver an oral presentation relevant to physics.
8. Apply skills to other areas or problems.

Assessment of Student Learning
Department of Psychology
Indiana University-Purdue University Indianapolis

2006-2007 Progress Report
for the Six-Stage Assessment Strategy

Submitted by Drew Appleby, Ph.D.
Director of Undergraduate Studies in Psychology
(Edited by Joseph L. Thompson)
June 15, 2007

Introduction

The IUPUI School of Science Assessment Committee endorsed the following six-stage plan in 2005 to assess the academic programs of its eight undergraduate programs (Biology, Chemistry, Computer Science, Earth Science, Forensic Science, Mathematics, Physics, and Psychology).

Stage 1 → Identify the program's student learning outcomes (SLOs).
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3. How will you help students learn it? (in class or out of class)
4. How could you measure each of the desired behaviors listed in #2?
5. What are the assessment findings?
6. What improvements have been made based on assessment findings?

Current State of Assessment in the IUPUI Psychology Undergraduate Program in Regard to These Stages

The Psychology Department has accomplished the first three stages of the School of Science's strategies and is in the process of accomplishing the fourth and fifth stages. The following sections of this report describe this progress.

Stage 1 → Identify the Department's Student Learning Outcomes (SLOs)

The Psychology Department synthesized IUPUI's Principles of Undergraduate Learning and the American Psychological Association's Competencies for Undergraduate Psychology Majors to create the following 16 SLOs for the Department.

1. Understand the major concepts, theoretical perspectives, empirical findings and historical trends in psychology.
2. Understand and use basic research methods in psychology, including design, data analysis, and interpretation.
3. Understand and generate applications of psychology to individual, social, and organizational issues.
4. Understand and abide by the ethical principles of psychology.
5. Recognize, understand, and respect the complexity of socio-cultural and international diversity.
6. Develop self-awareness by identifying your own personal strengths, weaknesses, values, goals, etc.
7. Understand the behavior and mental processes of others.
8. Work effectively as a member of a group to accomplish a task.
9. Identify and prepare for a career in psychology or a related field.
10. Demonstrate effective speaking skills.
11. Demonstrate effective writing skills.
12. Demonstrate information competence by identifying, locating, and retrieving written and electronic information sources.
13. Utilize technology for many purposes.
14. Demonstrate creative thinking skills.
15. Demonstrate problem-solving skills.
16. Demonstrate the critical thinking skills of retention, comprehension, application, analysis, synthesis, and evaluation.

Stage 2 → Link These SLOs to Specific Components of the Department's Curriculum

An extensive audit of the Department's course syllabi was undertaken by the students of Drew Appleby's PSY B454 *Capstone Seminar in Psychology* (in collaboration with the faculty who produced these syllabi) to determine in what courses and at what developmental levels the Department's SLOs are being taught and assessed. Each assignment that provided data for these assessments was categorized by the critical thinking skill(s) required to successfully complete it.

- Assignments requiring retention and comprehension were labeled Basic.
- Assignments requiring application and analysis were labeled Intermediate.
- Assignments requiring evaluating and creating were labeled Advanced.

This audit enabled the Department to determine (1) where its SLOs are being taught and assessed and (2) if its curriculum is "developmentally appropriate" so that students who progress through it are required to experience its SLOs in a manner that requires ever-increasing levels of critical thinking. The model that was used to define this developmental coherence is contained in Appendix A. The full results of this curriculum audit appear in Appendix B, a summary table of these results is presented in Appendix C, and a discussion of these results appears in Appendix D.

Stage 3 → Identify or Create Methods to Measure These SLOs

Method 1

The Psychology Department offers the following three types of capstone experiences.

- An empirical research project, which can be conducted (a) in a laboratory class dedicated to the study of a particular sub-discipline of psychology (e.g., social or developmental) or in an honors research class in which students choose their own research topics. The classes that will currently satisfy the research capstone requirement are B461 *Capstone Laboratory in Developmental Psychology*, B471 *Capstone Laboratory in Social Psychology*, B481 *Capstone Laboratory in Clinical Rehabilitation Psychology*, and B499 *Honors Capstone Research*.
- An on-the-job practicum, which allows students to apply what they have learned about a particular sub-disciple of psychology (e.g., industrial/organizational or clinical rehabilitation psychology) in the workplace. The classes that will satisfy the practicum capstone requirement are B462 *Capstone Practicum in Industrial/Organizational Psychology* and B482 *Capstone Practicum in Clinical Rehabilitation Psychology*.
- A scholarly seminar, which provides students with the opportunities to (a) perform an in-depth examination of a sub-discipline of psychology in which they have an occupational interest, (b) engage in a collaborative research project with their classmates, and (c) create a professional planning portfolio designed to facilitate their transition to life after college (i.e., employment or graduate school). The class that will satisfy the seminar capstone requirement is B454 *Capstone Seminar in Psychology*.

While it is important to use subjective, self-report data from our students to assess our SLOs (e.g., Method 2), it is also important to involve faculty evaluations of student performance because these measures are assumed to be more objective. To do this, a matrix has been created (see Appendix C) that will be completed by each capstone instructor for each student in her/his class after the class has been completed. The data from this matrix for all capstone classes will be aggregated and used to identify the degree to which capstone faculty believe that senior psychology majors have accomplished the department's SLOs.

Method 2

All students enrolled in psychology capstone classes were surveyed to determine the "grade" they would give themselves in regard to their accomplishment of each of the Department's SLOs. The instrument used to collect this data appears in Appendix E, the data collected appears in the right column of the table presented in Appendix C, and a discussion of these data is included in Appendix D.

Method 3

The School of Science has been using a paper-and-pencil senior exit survey for many years. One component of this survey requires students to write one or two paragraphs about how they have experienced the University's six Principles of Undergraduate Learning (PULs) during their undergraduate education at IUPUI. While this has produced an abundance of data, it has never been fully utilized because of the time-intensive nature of the qualitative research methods necessary to analyze these data. The Psychology Department collaborated with the School of Science office to create an electronic version of this survey. This survey will enable the Psychology Department to incorporate its unique set of SLOs into this survey by asking its seniors to use a Likert scale to indicate how successfully they have accomplished each of these SLOs. Students will then be asked to identify the experiences that helped them to accomplish the SLOs they indicated that they had successfully accomplished and to provide suggestions to the Department that would help future psychology majors to accomplish the PULs and SLOs that they indicated they had not successfully accomplished. These data will provide our Department with information to answer the following questions.

1. How do psychology majors perceive their ability to accomplish the department's SLOs?
2. Which of the SLOs do our students perceive they have accomplished successfully, and what aspects of their undergraduate educations enabled them to do so?
3. Which of the SLOs do our students perceive they have not accomplished successfully, and how can we use their suggestions to enable future students to accomplish them more successfully?

We can use the answers to these questions to make data-driven changes to our curriculum. It will be interesting to compare the results of this method to results of Method 1 to determine the similarities and differences between how students and their faculty assess the accomplishment of the department's SLOs.

Method 4

Students enrolled in B311 *Introductory Laboratory in Psychology* and B454 *Capstone Seminar in Psychology* were surveyed to determine their experience with the transition from B305 *Statistics* to B311. B305 is a prerequisite for B311, and certain statistical skills are assumed to exist in students who enter B311 after successfully completing B305. One of these skills is the ability to use SPSS to analyze statistical data. The purpose of this method was to determine the validity of the assumption that students entering B311 possess this skill.

Method 5 (Planned for Fall 2007)

Using information from the course syllabus audit presented in Appendix B, members of Drew Appleby's Fall 2007 B454 *Capstone Seminar in Psychology* will work with psychology faculty to identify one assignment in each of their courses that can provide data to be used to assess one of the SLOs at a particular level of critical thinking (as presented in Appendix C).

Stage 4 → Collect Data to Determine if the SLOs Are Being Accomplished Successfully

Data Collected with Method 1

Only 28 capstone templates were completed and returned by June 15, 2007. The data from these templates are presented in Appendix G.

Data Collected with Method 2

Data collected from the senior self-grading project are presented in the far right column of Appendix C.

Data Collected with Method 3

Data from the electronic senior exit survey will not be available until after this report has been submitted so they cannot be included in this report.

Data Collected with Method 4

Data collected from students entering B311 Introductory Laboratory in Psychology indicated a very wide range of competency in the ability to use SPSS to analyze data. B305 Statistics is a prerequisite for B311 and is the course in which data analysis is learned.

Data Collected with Method 5
These data will be collected during Fall 2007.

Stage 5 → Use the Data Collected in Stage 4 to Make Curricular Changes

Curricular Changes Made on the Basis of Data Collected with Method 4
A set of standardized SPSS modules was created and required in all sections of B305 during the 2006-07 school year to insure that all students who enroll in B311 in the future will enter the course with a fundamental competence in SPSS.

Appendix A

Three Levels of the Developmentally Coherent Curriculum

(based on the work of Anderson & Krathwohl, 2001)

A. Basic Level → Retaining and Understanding

1. the ability to retain specific information in the way it was originally presented
   a. being asked to recognize the definition of a bold-faced term in a textbook
   b. questions it can be used to answer: Who, what, where, and when?
2. the ability to understand information when it is presented in a different manner than it has been originally presented
   a. being asked to recognize a principle, concept, or method when presented with an example that has not been previously encountered
   b. questions it can be used to answer: How and why?

B. Intermediate Level → Analyzing and Applying

1. the ability to analyze (i.e., reduce) a complex whole into its constituent parts and their functional relationships
   a. being able to recognize the parts of a complex whole and how they interact or are related to one another
   b. questions it can be used to answer: Of what is this complex whole composed, and how are its parts related to one another?
2. the ability to produce and apply original and useful solutions to solvable problems
   a. being able to recognize how the products of retention, comprehension, and analysis can be used to solve real world problems
   b. questions it can be used to answer: How can this problem be solved?

C. Advanced Level → Evaluating and Creating

1. the ability to evaluate the effectiveness and/or merit of the products of application
   a. being able to recognize how established criteria can be used to judge the success of problem-solving methods (e.g., the scientific method and psychotherapy)
   b. questions it can be used to answer: What is the validity or value of a particular principle, theory, or method?
2. the ability to create (i.e., synthesize) new wholes from previously unrelated parts
   a. being able to recognize how elements that have been previously unassociated can be combined into new, creative, meaningful, and/or useful wholes
   b. questions it can be used to answer: What new conclusions can you reach on the basis of what you have learned?

Appendix B

Results of the Psychology Department's Syllabus Audit to Determine the Developmental Coherence of Its Curriculum

	Basic	Intermediate	Advanced
Content	B105a; B105b*; B311a; B344a; B344b*; B356*; B358a; B380c; B360a *; B360b; B368; B396; B422 *; B252a; B252c	B104; B105c; B305b*; B310a; B340; B358b; B370a; B380a*; B380b; B322*; B365 *; B366; B376; B386; B420; B472; B252b	B305a; B311b; B307*; B310b; B320; B370b; B424; B375; B394; B454; B461; B481*; B499*
Research	B105b*; B305a; B310b; B340; B344a; B358b; B370a; B360b; B365 *; B366; B375; B376; B422 *	B311a; B310a; B320; B344b*; B370b; B380a*; B322*; B360a *; B396	B305b*; B311b; B307*; B472; B461; B462*; B482; B499*; B252a
Application	B103a; B105c; B310b; B340; B380c; B365 *; B482	B103b*; B105a; B105b*; B305a; B311a; B320; B344b*; B356*; B358a; B358b; B370a; B370b; B380b; B424; B360a *; B368; B375; B376; B386; B396; B422*; B472; B481*; B252b; B252c	B305b*; B311b; B307*; B310a; B344a; B380a*; B322*; B360b; B366; B394; B454; B461; B462*; B499*; B252a
Ethics	B103a ; B105b*; B305a; B310b; B340; B344b*; B356*; B358b; B370a; B370b; B380b; B360a *; B360b; B365 *; B366; B375; B376; B386; B482; B252b; B252c	B103b*; B305b*; B311b; B307*; B310a; B320; B344a; B380a*; B322*; B461; B462*; B499*	B394; B472; B252a
Diversity	B103b*; B305a; B310a; B310b; B340; B358b; B370b; B360a *; B396; B252b	B320; B380a*; B375; B422 *; B472; B454; B481*; B499*	B365 *; B386
Self-Awareness	B305a; B340; B370b; B360a *; B365 *; B376	B104; B310b; B344b*; B358b; B370a; B380a*; B375; B396; B422 *; B472; B454; B481*	B103a ; B103b*; B380b; B322*; B360b; B366; B368; B386; B394; B461; B482; B499*; B252b; B252c
Understanding Others	B103a ; B103b*; B305a; B340; B380b; B380c; B424; B360a *; B365 *; B366; B368; B482; B252b	B310b; B320; B370b; B380a*; B375; B386; B396; B422 *; B472; B454; B462*; B481*; B252c	B344a; B322*; B394; B461; B499*
Collaboration Skills	B105a; B307*; B370a; B360b; B365 *; B462*; B482	B104; B305b*; B310b; B320; B344a; B358b; B380a*; B375; B394; B396; B422 *; B454; B481*; B499*	B103b*; B310a; B322*; B386; B472; B461; B252a
Career Exploration	B305a; B370a; B380a*; B368; B375; B376; B394; B252c	B360a *; B481*	B103b*; B104; B358b; B461; B499*
Writing Skills	B105a; B105b*; B305a; B356*; B360b; B365*; B481*; B482	B103a ; B305b*; B310b; B320; B340; B344a; B344b*; B358a; B358b; B370b; B380b; B360a *; B366; B368; B375; B386; B394; B396; B420; B252b; B252c	B103b*; B104; B311b; B307*; B370a; B380a*; B322*; B376; B422 *; B472; B454; B461; B462*; B499*; B252a
Speaking Skills	B103b*; B104; B310b; B360b; B376; B422*; B482	B344a; B358b; B370a; B322*; B360a *; B375; B386; B394; B472; B454; B461; B462*; B481*	B499*; B252a
Information Competence	B103a ; B311b; B310b; B356*; B358b; B370b; B365 *; B366; B376; B454; B481*	B104; B105b*; B305b*; B320; B340; B380b; B322*; B360a *; B360b; B368; B375; B396; B420; B422 *; B472; B482; B252b; B252c	B103b*; B307*; B310a; B380a*; B386; B461; B462*; B252a
Technological Competence	B105a; B105b*; B305a; B310b; B360b; B365*; B366; B376; B394; B422 *; B454	B103a ; B103b*; B104; B305b*; B311a; B311b; B320; B344a; B344b*; B356*; B358b; B370b; B380a*; B380b; B380c; B360a *; B375; B386; B396; B472; B462*; B482; B499*; B252b; B252c	B307*; B322*; B461; B252a
Creative Thinking	B105a; B105b*; B305a; B358b; B365*	B103a ; B104; B344b*; B370b; B380a*; B380b; B322*; B360a *; B360b; B375; B420; B481*; B482; B252b; B252c	B103b*; B311b; B307*; B310b; B366; B386; B394; B422 *; B472; B454; B461; B462*; B499*; B252a
Problem Solving	B105a; B310b; B370a; B376	B104; B311a; B320; B344b*; B358b; B380a*; B360a *; B360b; B375; B386; B394; B396; B422 *; B454; B481*; B482	B103a ; B103b*; B305b*; B311b; B307*; B310a; B380b; B322*; B366; B472; B461; B462*; B499*; B252a; B252b; B252c

* Indicates courses whose instructors could not be reached to discuss the students' syllabus audits.

Appendix C

Summary Table of Curriculum Audit and Self-Reported GPA

Learning Outcome	**Number of Total Assignments**	**Beginning Level**	**Intermediate Level**	**Advanced Level**	**Mean Self-Reported GPA**
Application	47	7	25	15	3.41
Career Exploration	15	8	2	5	3.32
Collaboration Skills	28	7	14	7	3.37
Content	45	15	17	13	3.10
Creative Thinking	34	5	15	14	3.20
Diversity	20	10	8	2	3.10
Ethics	36	21	12	3	3.54
Information Competence	37	11	18	8	3.41
Problem Solving	36	4	16	16	3.24
Research	31	13	9	9	2.98
Self-Awareness	32	6	12	14	3.56
Speaking Skills	22	7	13	2	3.07
Technological Competence	40	11	25	4	3.20
Understand Others	31	13	13	5	3.39
Writing Skills	44	8	21	15	3.34
	Total = 498	Total = 146	Total = 220	Total = 132	Mean = 3.28

Appendix D

Discussion of the Results of the Syllabus Audit and Self-Grading Data Presented in Appendices B and C

Data Gathered During the Syllabus Audit

It appears that the department's SLOs are being addressed in many classes and at all three cognitive levels. Each SLO was taught an average of 33 times across all audited psychology classes and levels. The SLOs were taught at the Beginning level an average of 9.7 times, 14.6 times at the Intermediate level, and 8.8 times at the Advanced level. The three SLOs addressed the least number of times were Career Exploration (15 times**),** Diversity (20 times), and Speaking Skills (22 times). All the other SLOs were addressed 28 times or more. The three most often targeted SLOs were Application (47 times), Content (45 times), and Technological Competence (40 times). Some potential concerns about the cognitive level at which the SLOs are targeted emerged when it was discovered that Speaking Skills, Diversity, Ethics, Understanding Others, and Career Exploration were all targeted fewer than six times at the Advanced level. These results have not yet been addressed by the Department, so no curriculum changes have been recommended at this time.

Data Gathered When Capstone Students "Graded" Themselves

The average grades students gave themselves for the extent to which they had successfully accomplished each of the SLOs were high. All were above a 3.0 (B, which indicated above average attainment) with the exception of Research, which was a 2.98. Although this data reflect that our students are confident in their attainment of our SLOs, they may not necessarily reflect their actual level of attainment of our SLOs. As Kruger and Dunning (1999, p. 1121) found in research on the relationship between competence and confidence, "People tend to hold overly favorable views of their abilities in many social and intellectual domains." It will be necessary to compare these subjective, self-report data with more objective data gathered from faculty observations of student performance.

Appendix E

Please grade yourself on your attainment of each of the following 15 student learning outcomes of the IUPUI Psychology Department. Use the grading scale of A-F as described below.

A = Outstanding
B = Above Average
C = Average
D = Below Average
F = Unacceptable

Please perform this task as honestly as possible. The grade you give yourself in this situation should reflect both the Department's ability to provide opportunities for you to develop these sets of knowledge and skills and your willingness to take advantage of these opportunities.

Essential Skills	**Grade** (A-F)
Understand the major concepts, theoretical perspectives, empirical findings and historical trends in psychology.	
Understand and use basic research methods in psychology, including design, data analysis, and interpretation.	
Understand and generate applications of psychology to individual, social, and organizational issues.	
Understand and abide by the ethics of psychology.	
Recognize, understand, and respect the complexity of socio-cultural and international diversity.	
Develop self-awareness by identifying your own personal strengths, weaknesses, values, goals, etc.	
Understand the behavior and mental processes of others.	
Work effectively as a member of a group to accomplish a task.	
Identify and prepare for a career in psychology or a related field.	
Demonstrate effective writing skills.	
Demonstrate effective speaking skills.	
Demonstrate information competence by identifying, locating, and retrieving written and electronic information sources.	
Utilize technology for many purposes.	
Demonstrate creative thinking skills.	
Demonstrate problem-solving skills.	

Appendix F

IUPUI Psychology Department Capstone Assessment Template

<u>Instructions to the Capstone Instructor:</u>

Please make a copy of this double-side document for each student who completed your capstone class. Fill in each of the four lines below and complete the Capstone Assessment Template that appears on the other side of this page for each of your students. Please return your completed templates to Drew Appleby at your earliest convenience.

Class Number and Title:

____

Instructor's Name:

____

Semester and Year:

____

Student's Name:

____

Place an X in the box below the descriptor that most accurately describes the extent to which this student accomplished each of the Psychology Department's 16 SLOs in your capstone course.

Student Learning Outcome (SLO)	Did Not Accomplish this SLO	Accomplished this SLO at an Acceptable Level	Accomplished this SLO at an Exemplary Level	This SLO was not addressed in this class
Content of Psychology → Student shows familiarity with the major concepts, theoretical perspectives, empirical findings, and historical trends in psychology.				
Research in Psychology → The student understands and uses basic research methods in psychology, including design, data analysis, and interpretation.				
Application of Psychology → The student understands and generates applications of psychology to personal, social, and organizational issues.				
Ethics in Psychology → The student understands and abides by the ethics of psychology.				
Diversity → The student recognizes, understands, and respects the complexity of socio-cultural and international diversity.				
Self-Awareness → The student has developed self-awareness by identifying her/his personal strengths, weaknesses, values, and goals.				
Understanding Others → The student understands the behavior and mental processes of others.				
Collaboration → The student can work effectively as a member of a group to accomplish a task.				
Career Planning → The student has developed realistic ideas about how to pursue careers in psychology and related fields.				
Writing Skills → The student demonstrates effective writing skills.				
Speaking Skills → The student demonstrates effective speaking skills.				
Information Competence → The student demonstrates information competence by identifying, locating, and retrieving written and electronic information sources.				
Technological Proficiency → The student can utilize technology for many purposes.				
Creative Thinking → The student can demonstrates the ability to combine existing information into new, creative, and useful ideas and hypotheses.				
Problem Solving → The student can use the scientific method to solve problems.				
Critical Thinking → The student can retain, comprehend, apply, analyze, synthesize, and evaluate information.				

Appendix G

Data Collected with the Capstone Templates

Completed templates were collected from 28 students (24 enrolled in B461 *Capstone Lab in Developmental Psychology* and 4 enrolled in B499 *Honors Research*. Two of the SLOs were generally ranked as "not addressed in these classes" by the instructors. (Self-Awareness was ranked as "not addressed" for 24 students and Career Planning was ranked as "not addressed" for 26 students.) A mean accomplishment rating was computed for the remaining 14 SLOs by assigning a 0 to "Did Not Accomplish this SLO," a 1 to "Accomplished this SLO at an Acceptable Level," and a 3 to "Accomplished this SLO at an Exemplary Level. These mean ratings appear in descending order of magnitude below.

1.71 = Information Competence
1.68 = Technological Proficiency
1.44 = Collaboration
1.32 = Writing Skills
1.32 = Problem Solving
1.25 = Application of Psychology
1.21 = Research in Psychology
1.15 = Diversity
1.14 = Understanding Others
1.07 = Content of Psychology
0.98 = Critical Thinking
0.96 = Speaking Skills
0.93 = Ethics in Psychology
0.86 = Creative Thinking

Another way to analyze these data is to use modal scores. When the SLOs are arranged in order of the magnitude of their modes, the results are as follows.

3 = Technological Proficiency
3 = Information Competence
3 = Collaboration
2 = Writing Skills
2 = Understanding Others
2 = Research in Psychology
2 = Problem Solving
2 = Ethics in Psychology
2 = Diversity
2 = Critical Thinking
2 = Creative Thinking
2 = Content of Psychology
2 = Application of Psychology
0 = Speaking Skills

The results of this modal analysis indicate that the plurality of senior psychology majors enrolled in capstone classes are able to demonstrate to their faculty that they have accomplished the following SLOs in an exemplary manner.

- Information Competence
- Technological Proficiency
- Collaboration

These results indicate that the plurality of senior psychology majors enrolled in capstone classes are able to demonstrate to their faculty that they have accomplished the following SLOs in an acceptable manner.

- Writing Skills
- Understanding Others
- Research in Psychology
- Problem Solving
- Ethics in Psychology
- Diversity
- Critical Thinking
- Creative Thinking
- Content of Psychology
- Application of Psychology

These results indicate that the plurality of senior psychology majors enrolled in capstone classes are unable to demonstrate to their faculty that they have accomplished the following SLO in an adequate manner.

- Speaking Skills

These results will be presented to the Psychology Undergraduate Committee next fall for discussion.

References

Anderson, L.W., & Krathwohl, D.R. (Eds.) (2001). *A taxonomy of learning, teaching, and assessment: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

Kruger, J, & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77*(6), 1127-1134.