The assessment plan for the Graduate Program in the Biological Sciences Department consists of four parts:

1. Student Learning Outcomes – outcomes adopted by the Graduate Committee to reflect the expectations of students with respect to learning in the Graduate Program;
2. Assessment of Student Learning Outcomes – when and by whom the assessment of student performance relative to the outcomes will be assessed;
3. Measurement of the Assessment Process – an evaluation of the information provided by the assessment, presented in a format that facilitates critical evaluation of the program;
4. Process for Using Assessment Results to Increase Student Learning – how the results of the assessment and its measure will be communicated to those with responsibility for student learning at the graduate level, so that changes to the program can be implemented.

The plan is designed to critically examine learning in the Graduate Program using a mechanism that is manageable, and does not place undo burdens on the faculty or administration.

Student Learning Outcomes

1. Demonstrate knowledge in areas of biology relevant to selected research interests.
2. Identify research questions on a contemporary issue in biology, and critically analyze the relevant literature.
3. Develop specific hypotheses pertaining to a research problem.
4. Devise and conduct experiments to test hypotheses.
5. Demonstrate mastery of the methodology and techniques specific to the field of study.
6. Statistically analyze and interpret research data.
7. Discuss, both orally and in writing, the relevance of their research data to the original hypotheses and to the general field of interest.

Assessment of Student Learning Outcomes

Assessment of Student Learning Outcomes is conducted by the major professor (chair of the Thesis Committee), the Thesis Committee, and instructors of courses taken by the student. Assessment consists of:

1. Students complete written examinations, research projects, and lab practical exams. Primary assessment of this outcome is conducted in the program courses, and is conducted by examination and other assignments. Additional assessment is conducted at the oral defense of the thesis.
2. Preparation and presentation of an oral thesis research proposal, and approval of the proposal by the Thesis Committee. These activities take place in fulfillment of the required Thesis Proposal (BIO 693).

3. Preparation and oral defense of a written thesis. The hypotheses are assessed at the thesis proposal (BIO 693), as well as during review of the written thesis by the Thesis Committee. Final assessment of hypotheses is conducted at the oral defense.
4. Preparation and oral defense of a written thesis. Experimental design and experiments are assessed at the thesis proposal (BIO 693), as well as during review of the written thesis by the Thesis Committee. Final assessment is conducted at the oral defense.
5. Preparation and oral defense of a written thesis. Mastery of methodology and techniques are assessed by reviewing the written thesis and during the oral defense.
6. Preparation and oral defense of a written thesis. Statistical analysis and interpretation is assessed by review of the written thesis and during the oral defense.
7. Preparation and oral defense of a written thesis. Synthesis of the research in the context of the original hypotheses and the relevant literature in the field is assessed by review of the written thesis and during the oral defense.

Measurement of the Assessment Process

Measurement of the assessment process will be conducted by Primary Trait Analysis (PTA) and evaluation of process effectiveness. Following the oral defense, both the thesis committee and the student will complete forms which in part provide data on assessment of each of the Student Learning Outcomes. In addition, information will be gathered on the effectiveness of the thesis and thesis defense process.

The faculty form (PTA - Faculty) and student form (PTA - Student) are appended to this plan.

All student and faculty PTA forms will be placed in the student's departmental file.

Using Assessment Results to Increase Student Learning

The Graduate Coordinator will collect forms from students and faculty. PTA scores and Process Effectiveness ordinals will be entered into Excel templates. Information from students on their future plans will be entered into the Graduate Program database.

For PTA data, grades (means across the SLOs) for each student wll be calculated. Outcome coefficients (mean of scores for SLOs across the students as a percentage of the maximum score of 4) will be calculated. Separate analyses will be conducted for data provided by faculty and data provided by students. For Process Effectiveness data, frequency of each ordinal response will be calculated. Separate analyses will be conducted for data provided by faculty and data provided by students. The Excel templates will provide summaries and graphs of the results, as well as basic analyses. Examples of these are attached.

These analyses will be added to the annual Status of the Graduate Program report prepared by the Graduate Coordinator. All analyses will be anonymous with respect to the individuals reporting the scores and ordinals.

The Status of the Graduate Program is provided to the faculty, the Department Chair, and the Dean of the College. Analyses will be examined to determine outcomes that are not being met, as well as differences in the perspectives of students and faculty. It is important to stress that the raw data will be included in the Status Report along with the analyses. Therefore, evaluation and assessment are not restricted to those provided; rather there is the opportunity for additional exploration or analysis by any one evaluating the program. Discussion of problems and suggestions for change can be initiated and planned by all levels concerned with the Graduate Program.

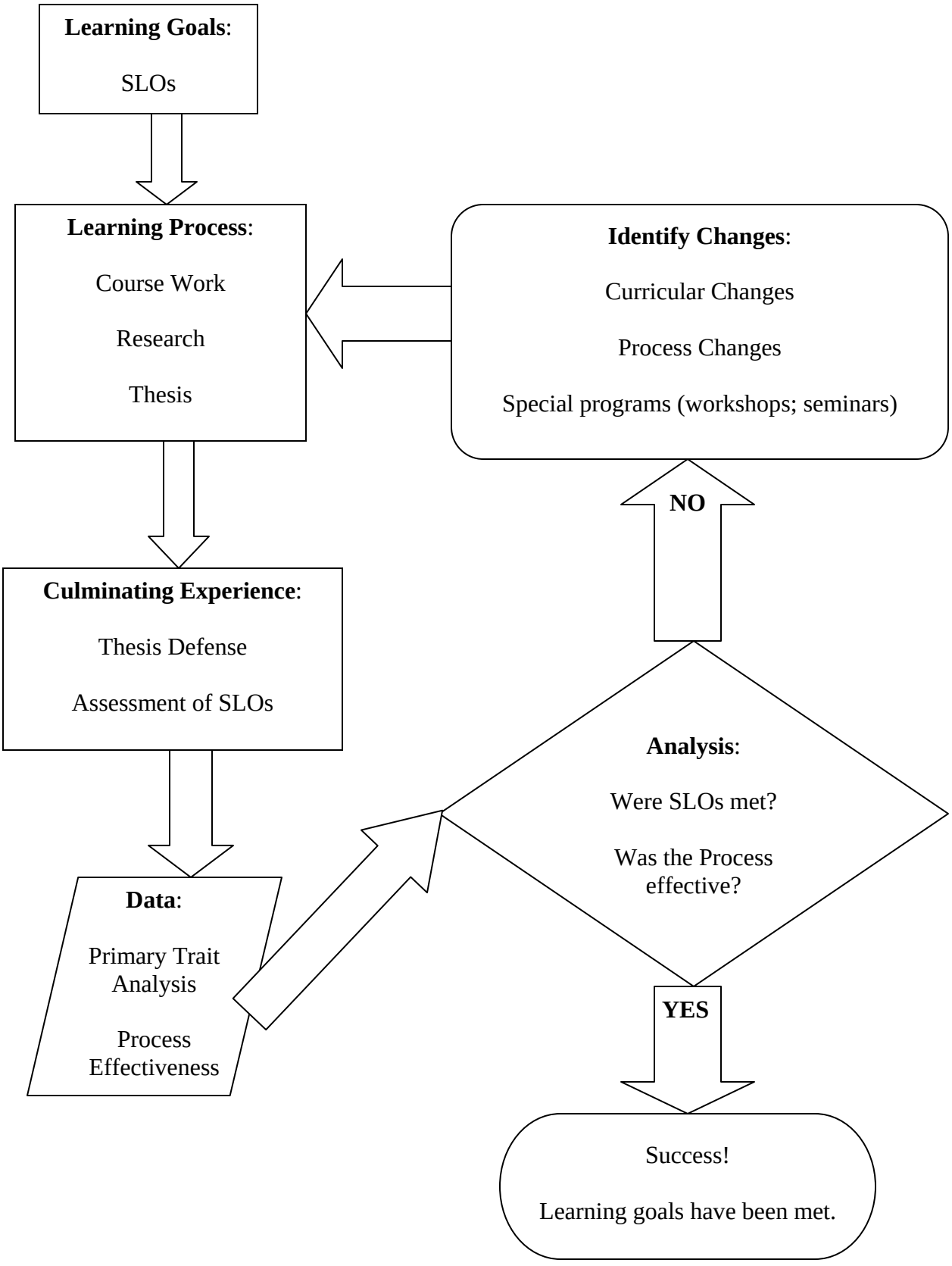
Changes initiated by the faculty, the Graduate Committee, the Department Chair, or the Dean may include the curriculum. For example, if the outcome coefficient for SLO #4 (Devise and conduct experiments to test hypotheses) is found to be low, courses in experimental design and/or laboratory techniques could be proposed and added to the graduate program. Other changes may not require new courses, but may impact many courses as well as more informal learning situations, such as discussions among students and faculty. For example, if the agreement with the Process Effectiveness item involving integrating across the levels (The student showed the ability to vertically integrate "from the molecule to the ecosystem") is low, this would be brought to the attention of all faculty teaching graduate courses. Faculty would be urged to emphasize the importance of multi-level integration in their courses. Workshops could be developed where faculty members working at different levels (cell/molecular; organ system; organismal) demonstrate to students the necessity to understand the impact of the biological processes at all the levels. There are no constraints on how the assessment results might be utilized. Whatever actions best increase student learning are those that will be implemented.

Examples of the types of summaries and analyses provided are appended to this plan. All examples use hypothetical data, simply for the purpose of demonstration.

Visual Summary of the Plan

A visual summary of the assessment plan and the interaction with the learning process is provided on the following page.

Flowchart of the Graduate Learning and Assessment Process



Graduate Assessment - Biological Sciences Department [FORM PTA - FACULTY]

RETURN DIRECTLY TO GRADUATE COORDINATOR
DO NOT GIVE TO STUDENT

Form to be completed by each Faculty member of the Thesis Committee
This form to be used for Program Assessment only; not to be used to determine pass or fail of the exam

Student Name:_____ Date:_____

Evaluator Name:_____

Your role: ____Major Professor ____Committee Member

Primary Trait Analysis – to be completed by each Thesis Committee Member following the oral defense of thesis.

Please evaluate how well the student met each learning outcome using the following rubric:

0 = Outcome not met; unsatisfactory performance.
1 = Minimal competency in outcome demonstrated; performance low.
2 = Competency demonstrated; performance at expected level.
3 = Above average competency demonstrated; performance above expectations.
4 = Outstanding competency demonstrated; performance greatly exceeds expectations.
N/A = Not applicable; not assessed

Please circle the appropriate value

Student Learning Outcome	**Evaluation**
Demonstrate knowledge in areas of biology relevant to selected research interests.	0 1 2 3 4 N/A
Identify research questions on a contemporary issue in biology, and critically analyze the relevant literature.	0 1 2 3 4 N/A
Develop specific hypotheses pertaining to a research problem.	0 1 2 3 4 N/A
Devise and conduct experiments to test hypotheses.	0 1 2 3 4 N/A
Demonstrate mastery of the methodology and techniques specific to the field of study.	0 1 2 3 4 N/A
Statistically analyze and interpret research data.	0 1 2 3 4 N/A
Discuss, both orally and in writing, the relevance of their research data to the original hypotheses and to the general field of interest.	0 1 2 3 4 N/A

Did the student pass or fail the exam, as determined by the committee? ____pass ____fail

Do you agree or disagree with the committee's decision? _____agree _____disagree

Please complete the second page of this form (Process Effectiveness)

Graduate Assessment - Biological Sciences Department [FORM PTA - FACULTY]

Process Effectiveness – please respond to the following questions to provide an evaluation of the graduate education process, including development and defense of the thesis.

Please indicate (by circling the appropriate number) your extent of agreement to each of the following from 1 = completely agree to 5 = completely disagree. N/A = Not applicable.

	Completely Agree ⇔ Completely Disagree					
The proceedings were handled in a fair, professional, and impartial manner.	1	2	3	4	5	N/A
Each of the committee members was given a reasonable chance to ask questions, including follow-up questions.	1	2	3	4	5	N/A
The questions by the committee were appropriate.	1	2	3	4	5	N/A
The student was allowed/required to answer questions without undue interference/help from the Major Professor or other committee members.	1	2	3	4	5	N/A
The exam was rigorous.	1	2	3	4	5	N/A
The student showed solid knowledge of the area of specialization.	1	2	3	4	5	N/A
The student demonstrated a thorough working knowledge of his/her specific field of biology.	1	2	3	4	5	N/A
The student showed a solid understanding of the scientific method.	1	2	3	4	5	N/A
The student demonstrated good communication skills; he/she was able to communicate as a scientist and potential colleague.	1	2	3	4	5	N/A
The Major Professor was NOT overbearing in the discussion of the student's exam, after the student left the room.	1	2	3	4	5	N/A
The student is making adequate progress towards attaining the working knowledge required to contribute to his/her chosen field upon graduation.	1	2	3	4	5	N/A
The student showed the ability to vertically integrate "from the molecule to the ecosystem."	1	2	3	4	5	N/A

Please provide any comments or suggestions that you feel would contribute toward improving the graduate education process:

Return form directly to Graduate Coordinator
Do not give to student

RETURN DIRECTLY TO GRADUATE COORDINATOR
DO NOT GIVE TO MAJOR PROFESSOR OR COMMITTEE MEMBERS

Your Name:_____ Date:_____

Major Professor:_____

Members of Thesis Committee:_____

_____

Primary Trait Analysis – Please evaluate how well you feel you met each learning outcome using the following rubric:

0 = Outcome not met
1 = Minimal competency in outcome demonstrated
2 = Competency demonstrated
3 = Above average competency demonstrated
4 = Outstanding competency demonstrated
N/A = Not applicable; not assessed

Please circle the appropriate value

Student Learning Outcome	**Evaluation**
Demonstrate knowledge in areas of biology relevant to selected research interests.	0 1 2 3 4 N/A
Identify research questions on a contemporary issue in biology, and critically analyze the relevant literature.	0 1 2 3 4 N/A
Develop specific hypotheses pertaining to a research problem.	0 1 2 3 4 N/A
Devise and conduct experiments to test hypotheses.	0 1 2 3 4 N/A
Demonstrate mastery of the methodology and techniques specific to the field of study.	0 1 2 3 4 N/A
Statistically analyze and interpret research data.	0 1 2 3 4 N/A
Discuss, both orally and in writing, the relevance of their research data to the original hypotheses and to the general field of interest.	0 1 2 3 4 N/A

What are your plans after graduation?

_____Employment. Where?_____

_____Ph.D. Where?_____

_____Teaching. Where?_____

_____Professional School. What degree?_____Where?_____

_____Other Explain_____

Please complete the second page of this form (Process Effectiveness)

Process Effectiveness – please respond to the following questions to provide an evaluation of the graduate education process, including development and defense of the thesis.

Please indicate (by circling the appropriate number) your extent of agreement to each of the following from 1 = completely agree to 5 = completely disagree. N/A = Not applicable.

	Completely Agree ⇔ Completely Disagree					
The proceedings were handled in a fair, professional, and impartial manner.	1	2	3	4	5	N/A
Each of the committee members was given a reasonable chance to ask questions, including follow-up questions.	1	2	3	4	5	N/A
The questions by the committee were appropriate.	1	2	3	4	5	N/A
You were allowed/required to answer questions without undue interference/help from the Major Professor or other committee members.	1	2	3	4	5	N/A
The exam was rigorous.	1	2	3	4	5	N/A
You showed solid knowledge of the area of specialization.	1	2	3	4	5	N/A
You demonstrated a thorough working knowledge of your specific field of biology.	1	2	3	4	5	N/A
You showed a solid understanding of the scientific method.	1	2	3	4	5	N/A
You demonstrated good communication skills; you were able to communicate as a scientist and potential colleague.	1	2	3	4	5	N/A
You are making adequate progress towards attaining the working knowledge required to contribute to your chosen field upon graduation.	1	2	3	4	5	N/A
You showed the ability to vertically integrate "from the molecule to the ecosystem."	1	2	3	4	5	N/A

Please provide any comments or suggestions that you feel would contribute toward improving the graduate education process:

Return form directly to Graduate Coordinator
Do not give to the major professor or thesis committee

EXAMPLE

Primary Trait Analysis as provided in annual report on Status of the Graduate Program.

Attached are examples of the types of materials to be distributed with the annual Status Report of the Graduate Program. Please note that the data are all hypothetical.

The first sheet ("Primary Trait Analysis – Data Source: Faculty) represents the Excel template for entry of data from the PTA-FACULTY forms. The scores are entered and the template calculates all summary descriptives.

The second sheet ("Primary Trait Analysis – Data Source: Student) represents the template for data from the PTA-STUDENT forms.

The third sheet is a graphical representation of the Outcome Coefficient for each SLO. Examination of the graph can suggest areas to be targeted to increase learning. For example:

> The Outcome Coefficients for the SLO "Identify research questions on a contemporary issue in biology, and critically analyze the relevant literature" are low as scored by both faculty and students. This objective might be identified for increased effort in the learning process.
>
> The Outcome Coefficients for the SLO "Statistically analyze and interpret research data" are rated higher by faculty than by students. Effort may be directed to giving students perspective on their analysis abilities, and making sure they are aware of their learning.
>
> The Outcome Coefficients for the SLO "Develop specific hypotheses pertaining to a research problem" are rated higher by students than by faculty. Additional effort may be necessary to increase learning with respect to generating hypotheses, and to giving students a better perspective on this area.

The fourth sheet provides mean/mode comparisons for faculty data on all SLOs. Mean/mode contrasts indicate the nature of outliers in the data. Of interest here is that all means are lower than the modes, indicating some negative (below the mean) outliers. It appears that some faculty are rating the outcome substantially lower than average. This topic can be pursued to see if it's merely a scoring anomaly, or if some faculty detected problems in student learning. Follow-ups with faculty may identify actions to increase learning.

Again, these are not real data and the examples are hypothetical. They are presented to demonstrate how the learning process can be affected by analysis of the assessment data.

Primary Trait Analysis - Data Source: Faculty

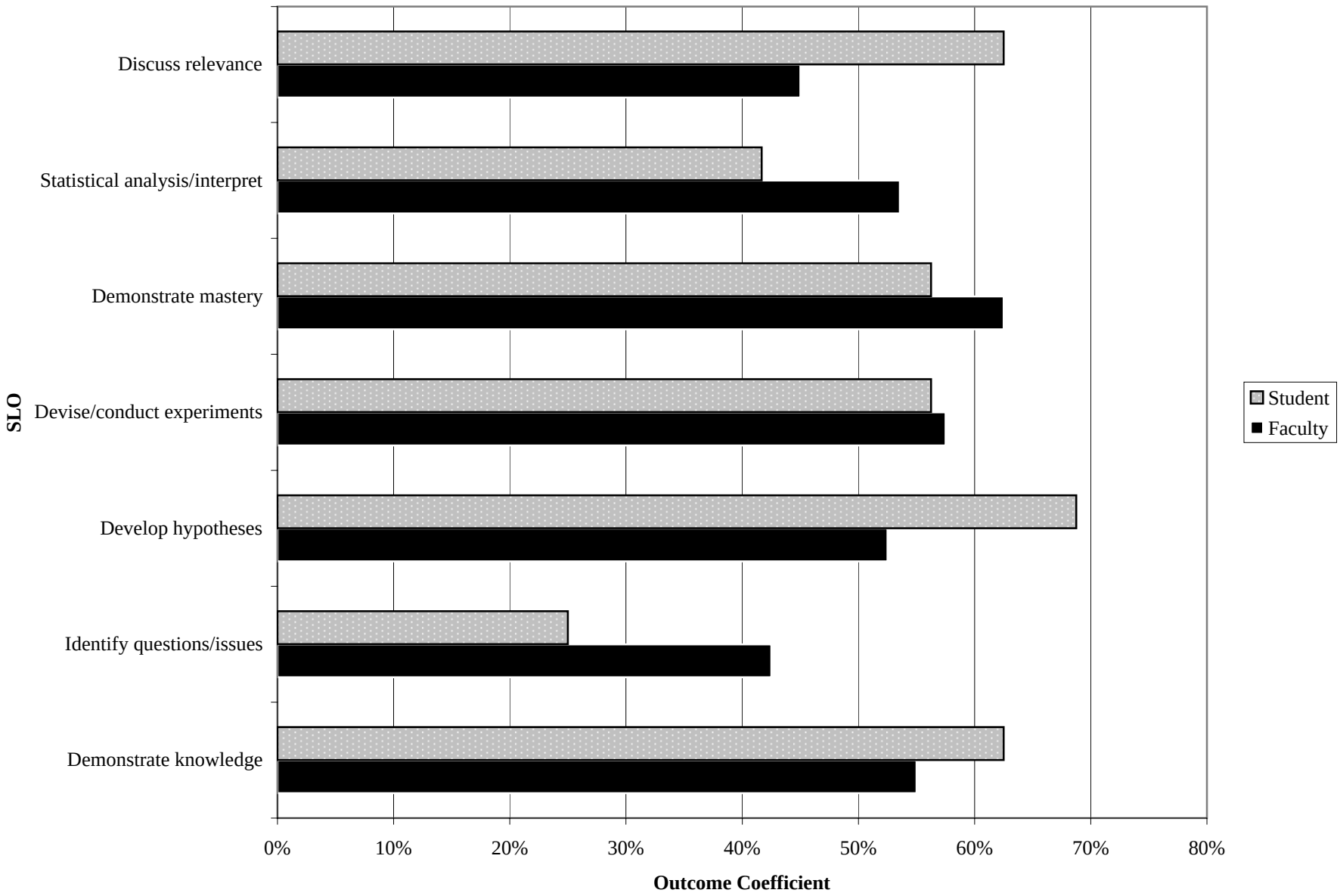
Biological Sciences Department Graduate Program Assessment

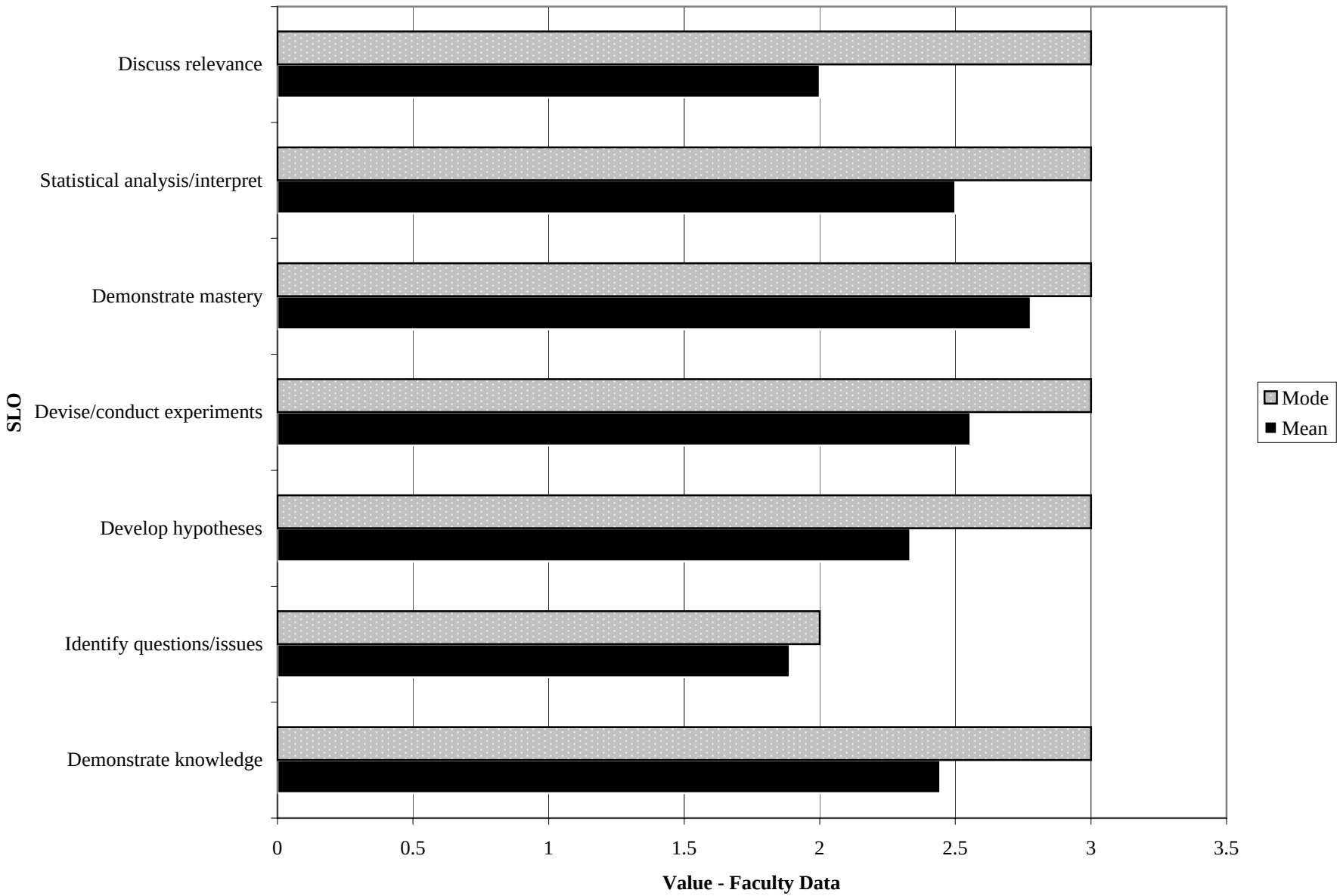
		Student Learning Outcomes							
Faculty Member	Student	**Demonstrate knowledge in areas of biology relevant to selected research interests.**	**Identify research questions on a contemporary issue in biology, and critically analyze the relevant literature.**	**Develop specific hypotheses pertaining to a research problem.**	**Devise and conduct experiments to test hypotheses.**	**Demonstrate mastery of the methodology and techniques specific to the field of study.**	**Statistically analyze and interpret research data.**	**Discuss, both orally and in writing, the relevance of their research data to the original hypotheses and to the general field of interest.**	**Grade**
A	S1	3	1	3	2	1	3	3	2.3
B	S1	2	3	2	3	2	2	1	2.1
C	S1	1	1	2	1	3	3	1	1.7
D	S2	3	2	3	3	4	2	3	2.9
E	S2	3	1	3	4	3	3	2	2.7
F	S2	4	3	2	3	4	2	2	2.9
G	S3	1	2	1	3	2		1	1.7
H	S3	2	2	3	3	3		2	2.5
I	S3	3	2	2	1	3		3	2.3
	Sum	22	17	21	23	25	15	18	
	Outcome Coefficient	55%	43%	53%	58%	63%	54%	45%	
	Mean	2.4	1.9	2.3	2.6	2.8	2.5	2.0	
	Standard Deviation	1.0	0.8	0.7	1.0	1.0	0.5	0.9	
	Coefficient of Variation	41.5%	41.4%	30.3%	39.7%	35.0%	21.9%	43.3%	
	Mode	3	2	3	3	3	3	3	

Primary Trait Analysis - Data Source: Student

Biological Sciences Department Graduate Program Assessment

	Student Learning Outcomes							
Student	**Demonstrate knowledge in areas of biology relevant to selected research interests.**	**Identify research questions on a contemporary issue in biology, and critically analyze the relevant literature.**	**Develop specific hypotheses pertaining to a research problem.**	**Devise and conduct experiments to test hypotheses.**	**Demonstrate mastery of the methodology and techniques specific to the field of study.**	**Statistically analyze and interpret research data.**	**Discuss, both orally and in writing, the relevance of their research data to the original hypotheses and to the general field of interest.**	**Grade**
S1	4	1	4	3	3	3	4	3.1
S2	3	2	4	3	4	2	3	3.0
S3	3	1	3	3	2		3	2.5
Sum	10	4	11	9	9	5	10	
Outcome Coefficient	63%	25%	69%	56%	56%	42%	63%	
Mean	3.3	1.3	3.7	3.0	3.0	2.5	3.3	
Standard Deviation	0.6	0.6	0.6	0.0	1.0	0.7	0.6	
Coefficient of Variation	17.3%	43.3%	15.7%	0.0%	33.3%	28.3%	17.3%	
Mode	3	1	4	3	#N/A	#N/A	3	


Discuss relevance
Statistical analysis/interpret
Demonstrate mastery
Devise/conduct experiments
Develop hypotheses
Identify questions/issues
Demonstrate knowledge
SLO
Student
Faculty
0%
10%
20%
30%
40%
50%
60%
70%
80%
Outcome Coefficient


Discuss relevance
Statistical analysis/interpret
Demonstrate mastery
Devise/conduct experiments
Develop hypotheses
Identify questions/issues
Demonstrate knowledge
SLO
Mode
Mean
0
0.5
1
1.5
2
2.5
3
3.5
Value - Faculty Data

EXAMPLE

Process Effectiveness as provided in annual report on Status of the Graduate Program.

Attached are examples of the types of materials to be distributed with the annual Status Report of the Graduate Program. Please note that the data are all hypothetical.

The first sheet ("Process Effectiveness – Faculty Data) represents the Excel template for entry of data from the PTA-FACULTY forms. The scores are entered and the template calculates all summary frequencies of each response.

The second sheet ("Process Effectiveness – Student Data) represents the template for data from the PTA-STUDENT forms.

The third sheet ("Process Effectiveness – Data Summary") presents a summary of the first two sheets, with both frequencies and the percentage of each response displayed.

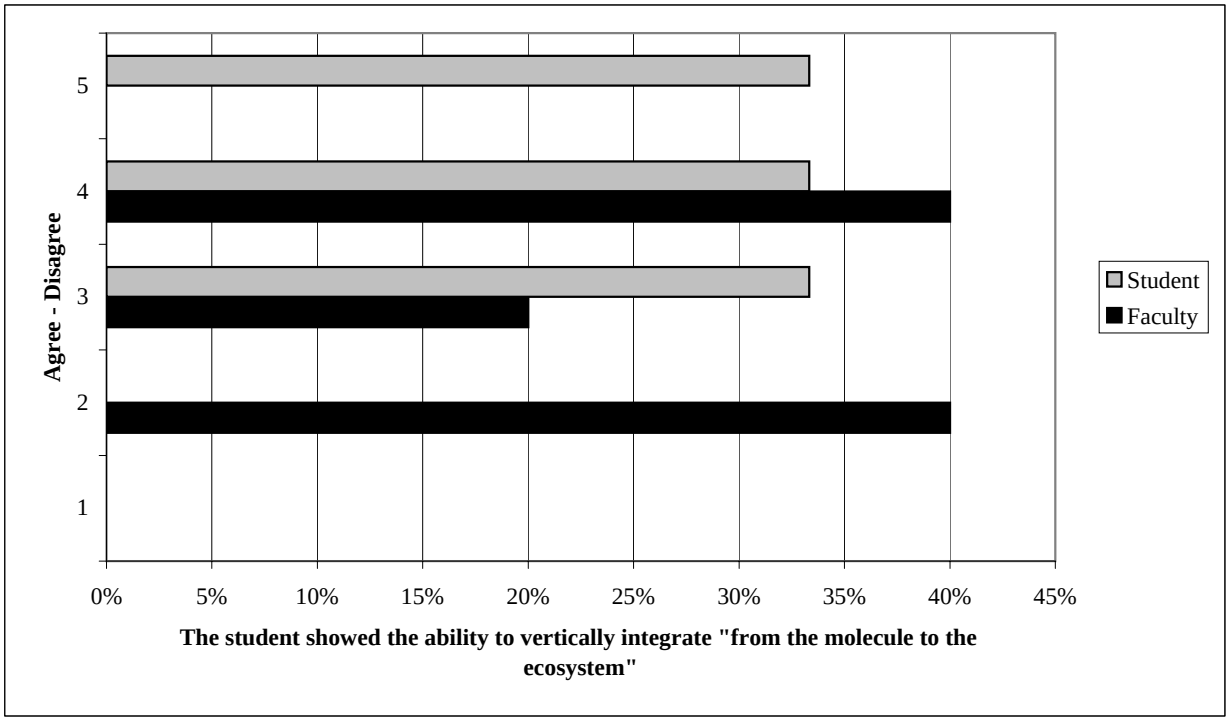
The fourth sheet is a graphical representation of the percentage responses for two of the Process Effectiveness items. Examination of the graph can suggest areas to be targeted to increase learning. For example:

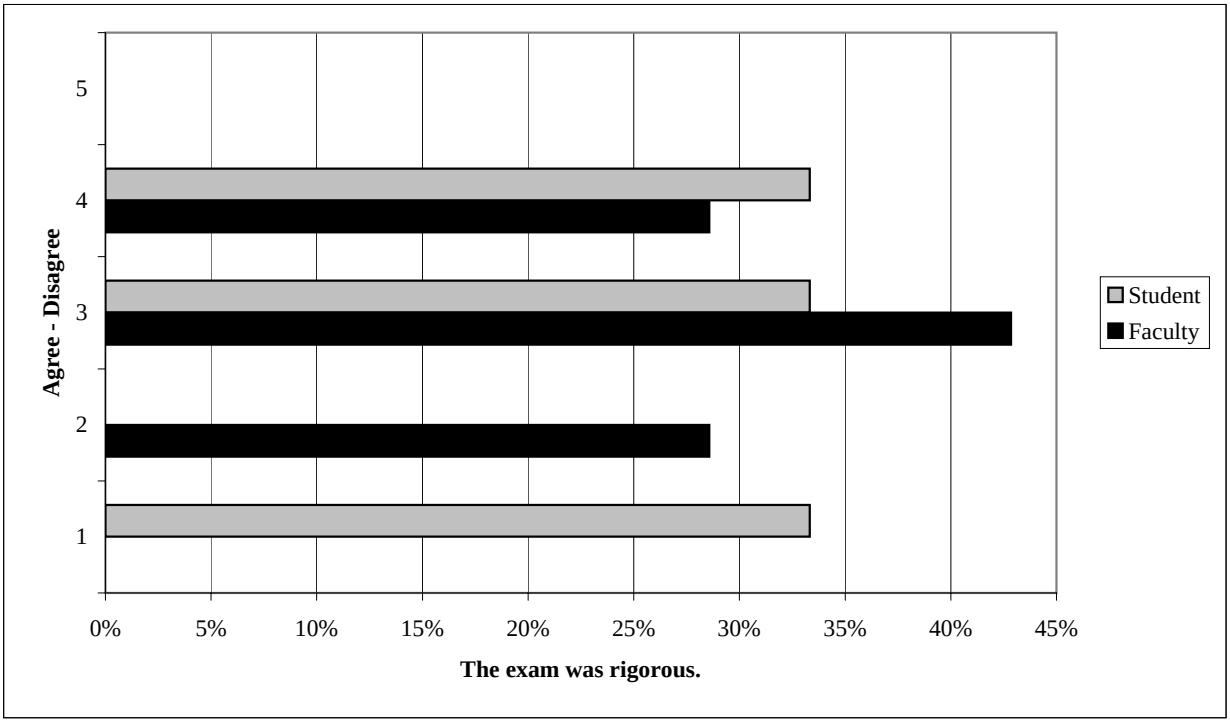
> The top graph (for the item: The student showed the ability to vertically integrate "from the molecule to the ecosystem") shows that over 30% of the students disagreed strongly with this statement, and none agreed. However, no faculty strongly disagreed, and 40% agreed with this statement. The disparity identifies this integration ability as a target for increased effort in the learning process. Perhaps workshops or seminars would help students better understand the connections they are apparently making.
>
> The bottom graph (for the item The exam was rigorous) also indicates a disparity between student and faculty perceptions. Here the faculty did not think the exam was as rigorous as the students. This would indicate that the process of the oral exam needs to be examined, to insure that it is a valuable learning process for the students, and that students understand the expectations of the faculty. Workshops or seminars might also facilitate this process.

Again, these are not real data and the examples are hypothetical. They are presented to demonstrate how the learning process can be affected by analysis of the assessment data.

Process Effectiveness - Faculty Data															
											Response Frequencies				
Student:	S1	S1	S1	S2	S2	S2	S3	S3	S3		1	2	3	4	5
The proceedings were handled in a fair, professional, and impartial manner.	4	3	2	2	5	5	2	2	3		0	4	2	0	2
Each of the committee members was given a reasonable chance to ask questions, including follow-up questions.	3	5	5	5	2	5	3	2	4		0	2	1	1	2
The questions by the committee were appropriate.	2	4	5	4	4	4	5	3	2		0	1	1	4	1
The student was allowed/required to answer questions without undue interference/help from the Major Professor or other committee members.	2	3	3	2	4	5	4	2	5		0	2	2	2	0
The exam was rigorous.	5	4	3	3	2	5	3	2	4		0	2	3	2	0
The student showed solid knowledge of the area of specialization.	2	2	4	3	4	2	2	5	2		0	4	1	2	0
The student demonstrated a thorough working knowledge of his/her specific field of biology.	3	3	2	5	4	3	4	4	4		0	1	2	4	0
The student showed a solid understanding of the scientific method.	3	3	3	2	3	3	2	5	5		0	2	4	0	0
The student demonstrated good communication skills; he/she was able to communicate as a scientist and potential colleague.	5	2	3	2	4	3	4	5	3		0	2	3	2	0
The Major Professor was NOT overbearing in the discussion of the student's exam, after the student left the room.	3	4	5	2	2	4	2	4	2		0	4	0	3	0
The student is making adequate progress towards attaining the working knowledge required to contribute to his/her chosen field upon graduation.	5	2	3	2	4	5	5	2	4		0	3	1	2	0
The student showed the ability to vertically integrate "from the molecule to the ecosystem."	3	5	4	4	3	5	2	5	2		0	2	1	2	0

Process Effectiveness - Student Data																	
													Response Frequencies				
Student:	S1	S2	S3									1	2	3	4	5
The proceedings were handled in a fair, professional, and impartial manner.	3	2	3									0	1	2	0	0
Each of the committee members was given a reasonable chance to ask questions, including follow-up questions.	2	2	3									0	2	1	0	0
The questions by the committee were appropriate.	4	4	2									0	1	0	2	0
You were allowed/required to answer questions without undue interference/help from the Major Professor or other committee members.	3	2	1									1	1	1	0	0
The exam was rigorous.	1	4	3									1	0	1	1	0
You showed solid knowledge of the area of specialization.	2	3	4									0	1	1	1	0
You demonstrated a thorough working knowledge of your specific field of biology.	3	1	3									1	0	2	0	0
You showed a solid understanding of the scientific method.	3	4	2									0	1	1	1	0
You demonstrated good communication skills; you were able to communicate as a scientist and potential colleague.	4	4	3									0	0	1	2	0
The Major Professor was NOT overbearing in the discussion of the student's exam, after the student left the room.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
You are making adequate progress towards attaining the working knowledge required to contribute to your chosen field upon graduation.	5	2	3									0	1	1	0	1
You showed the ability to vertically integrate "from the molecule to the ecosystem."	3	5	4									0	0	1	1	1


Agree - Disagree
5
4
3
2
1
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
Student
Faculty
The student showed the ability to vertically integrate "from the molecule to the ecosystem"


Agree - Disagree
5
4
3
2
1
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
Student
Faculty
The exam was rigorous.