

**GRADING AT PRINCETON:  
PHILOSOPHY, STRATEGY, PRACTICE**

**The Faculty Committee on Grading  
November 2005**

## **GRADING AT PRINCETON: PHILOSOPHY, STRATEGY, PRACTICE**

Earlier this fall, the Faculty Committee on Grading asked department chairs to tell us how their departments were approaching the implementation of the University's new grading expectations. We asked for information about strategies and practices that had proven to be successful as well as challenges that needed to be addressed. We promised to disseminate a compilation of best practices and to share ideas to assist departments in making further progress.

This report begins to make good on that promise. The practices described here are not intended to be prescriptive; rather, they reflect some of the diverse strategies employed across the University, strategies that may be appropriate in some contexts and inappropriate in others. The Grading Committee's intent in disseminating them is to lay out the broadest array of possibilities as a starting point for department-wide conversations about collective behaviors and practices that may be applicable in each local context.

We first review the basic philosophy that guides our efforts. We turn next to strategies for grading undergraduate courses, and we conclude with strategies for grading independent work. We also attach several appendices: suggestions from undergraduates, conveyed to us through the Student Committee on Examinations and Standing and the Undergraduate Student Government's Task Force on Grade Inflation; advice from the McGraw Center for Teaching and Learning; and specific examples of strategy and practice from two departments, Economics and Molecular Biology. The Dean of the College is familiar with strategy and practice in other departments and can offer guidance about whom to consult for additional information.

The Grading Committee welcomes further advice from the departments as well as from individual members of the faculty. As additional strategies and practices are conveyed to the committee, they will be shared broadly with the faculty.

### **WHAT ARE WE TRYING TO ACCOMPLISH?**

The purpose of the new institutional grading expectations is clear: responsible grading is a key ingredient of good pedagogy. By grading in a discriminating fashion, we give clearer signals about the quality of student work. By making plain the differences among inadequate work, ordinary work, good work, and excellent work, we give students information that contributes importantly to their learning, and we encourage them to strive to do the best work of which they are capable. More nuanced grading helps us to do a better job in our teaching and enhances the learning experience of our students.

More nuanced grading also corresponds to students' own understanding of the variations in the quality of their work. Students know when they have done their best and when they have not. Providing grades that make those distinctions clear serves to reinforce students' own basic instincts.

An important element of more nuanced grading is a clear, shared understanding of what is being graded. In general, we recommend grading product, not effort. As we explain in more detail when we take up strategies for grading independent work, the simplest and fairest way to recalibrate grades is to grade the final product regardless of our assessment of the effort the student put into achieving that product.

Recalibrating the grading standards that we all carry in our heads is at the heart of meeting the new institutional grading expectations. Recalibration means taking the opportunity to be honest with ourselves and with our students about what A's and B's and C's really mean. The new grading expectations give the faculty reason and opportunity to engage in that recalibration. As one chair told her colleagues, the grading policy can be used "as a tool to help us call grades as we see them and to resist the impulse to award high and higher grades for work we know is undeserving." The implementation of the new policy affords the opportunity (again in the words of some chairs) to find one's "inner grader"; to redress slipping standards; and to find the cover to be more honest about appraising student work.

This recalibration is far more important than hitting a particular grade distribution. In the words of another chair, "I have constantly insisted that instructors should not focus on the 35% percentage, but should instead use the new grading system to set the highest standards in our classes, and let the chips fall where they may." If we seize this opportunity to do the intellectual work of recalibrating our standards for evaluating student work, the percentages should fall into place over time. As you take on the project of recalibration, try thinking about the meaning of the grade distribution for your course. Make use of the whole range of grades that can reflect the reality of a group's performance. As you collect your data for performance evaluation, you may find that the group is doing well, but that the quality of the work done by some students exceeds (or is lower than) the quality of the work produced by most of the students. Recognizing the "middle of the pack" performance appropriately will facilitate your assignment of appropriate grades to exceptional and not so exceptional performances.

### **WHAT TOOLS ARE AVAILABLE TO HELP US IN THIS ENTERPRISE?**

Below are ideas we have gathered from department chairs. We re-emphasize the point we made at the outset: some of them may be applicable to your department, while others may not be. We hope that you will consider those that may be worth adopting.

#### **Undergraduate Courses: Strategies for Course Heads**

##### **The more kinds of graded work, the better**

- The more data points, the easier it is to differentiate among your students. Assign different kinds of written work throughout the semester, not just a midterm and a final exercise. Multiple types of assignments have real pedagogical value. As an added benefit, they may also help to achieve a broader distribution of grades.

- Exams tend to provide more differentiation than papers.
- In-class exams can often provide more differentiation than take-homes.

### **Establish a shared understanding of evaluative standards**

- Recognize excellence. Reserve grades in the A range for students who do outstanding work.
- Be consistent in grading. To begin with, agree on what constitutes outstanding or not so outstanding work. For example, have each preceptor rank his or her papers or answers to exam questions from best to worst; have all preceptors read examples of the best and decide together what letter grades to assign.
- Define the grade boundaries. Have each preceptor bring forward what appear to be A-/B+ and B-/C+ papers and answers to exam questions; cross-read those papers and exams and decide together where to draw the line between A- and B+ as well as between B- and C+.
- Recognize what being at a grade boundary means. Doubt suggests that the work probably falls short of the higher level of quality. Therefore, when in doubt about where to draw the line between A- and B+, tilt downward. Assume that grades of A-/B+ are most likely to be B+'s. Similarly, assume that grades of B-/C+ are most likely to be C+'s.

### **Give yourself maximum flexibility to decide where to draw the line between grades**

- Where possible, establish numerical values for the various components of course work; after tallying up all the numbers, the course head can then decide where to draw the lines between letter grades.

### **To the extent possible, dissociate grading from the identity of the individual student**

- Where possible, assign numbers to students so that names do not appear on work to be graded.
- Where names must appear, fold back the cover sheet of the exam or paper and grade without considering the student's identity.
- On exams, have preceptors grade by question, not by precept.
- The course head can then assign grades (exam grades, final course grades) based on components graded by (or, in the case of precept participation, submitted by) various preceptors.

### **Once you assign grades, stick to your guns**

- Resist the frequent importuning of students to reconsider their grades. (But be open to acknowledging genuine mistakes in grading when those occur.)
- Where appropriate, establish a departmental policy for the circumstances under which grades can be changed (e.g., mathematical error); faculty members can then invoke the policy when students ask for re-grading.

- Be brave; resist telling students that you would have graded them differently had it not been for the new expectations.
- Provide detailed written comments along with grades when you return papers and exams; students will understand better the grounds for your evaluation and should therefore be better able to accept their grades.

### **Undergraduate Courses: Strategies for Chairs**

#### **Ensure that the department reaches agreement about the meaning of letter grades**

- Establish a shared understanding of the specific characteristics of A work, B work, C work, D work, and failing work in departmental courses; be as explicit as possible in spelling out those characteristics; make those characteristics and standards widely known among faculty; make them known to students; remind faculty of the departmental agreement about those characteristics and standards at the beginning of each grading period. It helps to put the standards in writing.
- Agree especially on standards (high standards) for A grades – e.g. the grade of A+ is reserved for work that is good enough to merit publication in a scholarly journal; the grade of A means that the work is good enough to be read aloud in class.

#### **Engage in exhortation**

- Consistent attention and encouragement from the chair makes a real difference. Keep institutional grading expectations on everyone’s radar screen. Insist that excellence be properly recognized. Emphasize the importance of recalibration; encourage colleagues to seize the opportunity to recalibrate collectively.
- Start the semester by disseminating the University’s grading policy, reiterating the department’s responsibility to meet the expectations, and talking about grading expectations and practices with new faculty and AIs.
- Remind faculty and AIs of the grading policy just before exams.
- As appropriate, venture beyond moral suasion – e.g., have private conversations with faculty who have a history of unusually lenient grading; send what one chair calls “gentle reminders” to faculty whose grades continue to be more lenient than the expectations suggest; ask faculty whose grades deviate significantly from expectations to explain why in a memo to the chair.
- Remind the faculty that the percentage targets are meant to be three-year averages. That may mean that an exceptionally strong class one year will receive an unusually large number of A grades. If the class appears to be exceptionally strong every year, however, the instructor should consider reevaluating his/her grading standards and/or making the course more challenging.

#### **Enable frank and open discussion in faculty meetings**

- In every department: Review grading standards regularly; open every year with a discussion of what differentiates outstanding work from good work.

- In departments where such discussion could be helpful instead of counterproductive: Review the grading histories of individual courses. Discuss options and strategies for recalibration openly and collectively.

### **Undergraduate Courses: Selected Departmental Approaches**

These are alternative approaches that are being employed by one or more of the departments. Some of them may be applicable to your department.

#### **A compact among the faculty**

Members of the department agree explicitly on their shared responsibility to recalibrate, grade in a more discriminating fashion, and thereby meet institutional grading standards. Individuals commit to keeping the expectations in mind and each doing their part to meet them.

#### **35% across the board**

Members of the department agree that everyone will try to hold to 35% A's in the suite of courses he/she is teaching.

#### **Different targets for different kinds of courses**

Departments review grading patterns in courses of different sizes and different levels and decide on appropriate targets for the percentage of A's in different groups of courses. (See the Economics model in Appendix III.)

#### **Adherence to a long-established grading standard**

Some departments – e.g. Math and Physics – have used the same grading standard for undergraduate courses for many years, even decades. Sticking to longstanding expectations about what constitutes A work, B work, etc., makes it less likely that grades will inflate. Departments may wish to consider returning to and then sustaining earlier grading patterns that seem more reflective of the inevitable variety of student performance. Once the appropriate standard has been established, use it as the point of departure every year.

#### **A word of caution: introductory courses should not carry the whole burden**

Introductory courses often enroll students of varying abilities who perform at varying levels of quality. Where that is the case, a greater spread of grades is to be expected, and the percentage of A grades is appropriately lower than in more advanced courses in the department. But artificially depressing grades in introductory courses to enable high grades in advanced courses is likely to have inimical effects: penalizing freshmen; discouraging generalist exploration; depressing enrollment; encouraging under-prepared students to jump immediately to higher-level courses where the A's will be more

abundant. Recalibration of grading standards is likely to be a more effective approach than artificial suppression of A's in introductory courses.

### **Independent Work: Useful Strategies**

Again, these are alternative approaches employed by different departments. One or more of them may be applicable to your department.

### **Make grading a product of collective assessment and deliberation**

#### **For senior theses**

- Diminish the role of the adviser in evaluating student work. Add at least second readers, even third readers to the evaluative process; make their proposed grades count equally, or even more heavily, than the grade proposed by the adviser.
- Establish a departmental committee to participate in the process of evaluation. Such a committee might compile evaluations and decide final grades. It might read every thesis, rank them, assign grades to them, and have those grades comprise a portion of the assessment that produces a final grade (in this model, the committee functions as a third or even fourth reader.) Adding the distance that comes from evaluation by a committee should allow more objective assessment.
- Establish small subcommittees to assess theses in particular areas of specialty; each committee sends its proposed grades and comments to the departmental representative or the Undergraduate Committee, who determine final grades.
- Alternatively, a department could appoint a committee to read a subset of theses and identify theses that fall in different grade categories. Those theses would illustrate the criteria for different grades and serve as models against which to judge other theses.
- Bring all readers' comments and proposed grades to a department meeting; advisers and readers describe each thesis and make the case for their proposed grades; the department decides collectively how the theses are to be graded.

#### **For junior papers**

- Diminish the evaluative role of advisers by adding second readers.
- As the size and structure of the department permits, distribute copies of JPs to all advisers after they have recommended grades; convene a meeting of all advisers to discuss grades and agree on adjustments to ensure consistency of standards.
- As the size and structure of the department permits, establish a committee to participate in the process of evaluation (see suggestions above for senior theses).

### **Take great care in assessment**

- Develop detailed rubrics for evaluation; ask advisers and readers to score the thesis on each of many different criteria. Generate a numerical score for each

- student. In a small department, convene a meeting of the faculty to review the ranked list and assign the letter grades. In a large department, the departmental representative tallies the scores and decides where to establish the numerical cutoffs for each letter grade. (See the Molecular Biology model in Appendix IV.)
- Establish a shared understanding of the characteristics of A work, B work, C work, D work, and failing work in JPs and senior theses; be as explicit as possible in spelling out those characteristics; make those characteristics and standards widely known among faculty; make them known to students; remind faculty of the departmental agreement about those characteristics and standards at the beginning of each period when independent work is graded.
  - Agree especially on standards (high standards) for A grades – e.g. the grade of A+ is reserved for work that is good enough to merit publication in a scholarly journal; the grade of A means that the work is good enough to be used as a scholarly source by other students engaged in independent work.
  - Make the distinction between the product and the effort that went into it, and grade accordingly. Evaluating the effort a student puts forward involves considerable subjectivity (effort compared to what? the student's ability? the adviser's expectations?). Evaluating the product -- that is, the written work the student produces -- can be accomplished much more objectively. The simplest and fairest way to recalibrate grades in independent work is to remove effort from the equation and grade the final product. Effort can be evaluated and commended in ways other than the final letter grade. If a department takes the view that level of effort should be one component of the final grade, there should be a shared, clearly articulated agreement on how effort should be evaluated and what weight it should carry. In general, the quality of what the student produces should be the metric of achievement.

### **Be sure to provide detailed written commentary**

Take the time to explain precisely to students not only the features of their work that are especially strong but also the features that need improvement. A lower grade will be accepted more easily when it is accompanied by detailed written comments. A higher grade will be more meaningful when it is accompanied by a detailed statement about the ways in which the work stands out. Understanding the characteristics of one's best work will have the added benefit of making it clearer to students why they get lower grades for work that falls short.

**THE FACULTY COMMITTEE ON GRADING  
2005-06**

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## **SUGGESTIONS FROM UNDERGRADUATES**

These suggestions come from the Student Committee on Examinations and Standing and the Undergraduate Student Government's Task Force on Grade Inflation.

### **Provide detailed critical feedback**

No grade stands on its own without explanation; even an A grade should be accompanied by detailed critical feedback. Students want and deserve to know what they did that worked well, what they did that worked less well, and what they need to do to improve the next time around. Grades are shorthand for effectiveness of accomplishment; detailed critical feedback is an essential ingredient of learning.

### **Spell out departmental grading guidelines and make them available to students**

Reach agreement on the characteristics of A work, B work, C work, D work, and failing work in departmental courses and independent work. Write those characteristics down in as much detail as possible. Make them widely available to students in departmental courses as well as departmental concentrators. That will help students understand why they receive the grades they are given.

### **Be careful how you speak about the effect of institutional grading expectations on your course**

Student anxieties about the new grading expectations are heightened when faculty members and AIs speak about grading in some unnuanced, possibly even ungraceful, ways. Here are close paraphrases of statements that trouble students:

- “Two years ago, half of you would have gotten A's, but under the new grading expectations, I can only give 35 percent of you A's.”
- “No matter what happens, only four of you will get A's in this course.”
- “You should know up front that only 35 percent of you can get A grades.”

We have tried to tell students that we don't have grading quotas, and that student work will be graded according to its quality. We have tried to tell them that students who do A work will be graded accordingly. We have also told them that the new grading expectations presume that faculty members will grade in a more rigorous, more discriminating fashion, and that if that happens, it will turn out to be the case, on balance, over a three-year period, that about 35 percent of the grades in undergraduate courses and 55 percent of the grades in independent work in each department will be in the A range. That last set of statements is considerably more nuanced than the bullets above; to the extent possible, it would be helpful to try to convey grading expectations in that more nuanced fashion.

## **Making Informed Grading Decisions: Advice from the McGraw Center**

Meeting the spirit of the new grading policy when grading students' work can be challenging. Although we all recognize exceptional student work when we see it, we may find it difficult to differentiate among other levels of accomplishment. Delineating your goals for a specific assignment and articulating your grading criteria can help assure that the grades you assign reflect the quality of work you value. Giving these criteria to students can help them produce more sophisticated work and minimize any frustration about their grades after the fact.

Your grading decisions may seem clearer if you take time to reflect on the purpose of your assignments within the broader context of the class. For each assignment, first identify your educational aims for your students and then use these aims to construct a grading template or rubric. Examples of questions that might guide you in the process include:

- What do you want students to learn from completing this assignment? That is, what are your goals for their learning?
- What qualities of an assignment would demonstrate that a student had achieved—or even exceeded—that level of learning? These qualities may differ somewhat depending on the nature of the assignment, but articulating them specifically can help you make important distinctions for evaluating student work. For example, characteristics might include clearly stating an original hypothesis or thesis, organizing ideas coherently and progressively, analyzing data thoughtfully, addressing alternate interpretations, demonstrating clarity and conceptual understanding in problem solving, and so on.
- Given the number of learning goals that you would ideally like students to achieve, which ones are of first importance? Of secondary value? Clarifying the relative value of each objective can help you allocate proportionate grade or point assignments for a grading rubric.
- In light of the objectives that you've identified for your students, how would you describe an "A" piece of work? A "B" lab report? A "C" exam? Using this description as you comment on student work makes your expectations clearer for them, helps them improve future work, and makes the process more efficient for you.

Developing a grading template can help you evaluate students' work consistently and with a level of discrimination that coordinates with the department's grading policy. The exact model of the template will depend upon your discipline and the type of assignment that you are grading, and can range from the simple to the elaborate.

When possible, providing your students with your grading criteria prior to the assignment can clarify your goals for their learning for them and guide them in understanding the process of producing a quality piece of work. Although these goals may seem transparent to instructors who are experts in a field, they may not seem so to your

students. You may also wish to provide exemplars of prior students' work that fit certain criteria. These exemplars can provide concrete examples of what may otherwise appear to students to be rather abstract descriptions of expectations.

Given students' concerns over the grading policy, you may be tempted to provide either too much or too little feedback on assignments. Both over-commenting and under-commenting on student work are counterproductive. Marking every error is not only time-consuming, but it also may not be that helpful for students. They may find it difficult to distinguish between minor mistakes in grammar or calculation and major flaws in reasoning, and may be generally demoralized. On the other hand, students need a clear idea of areas requiring improvement. Keeping your focus on engaging students' ideas in your feedback, rather than editing or simply correcting their work, may help them direct their focus more on their work's intellectual merit. One tactic is to compose a paragraph about each student's work that addresses areas of strength and weakness based on the grading criteria. These remarks may be structured much as a professional reviewer's comments on a manuscript or as a colleague's comments on a proof. By typing these comments in a word processing file, you can save them as part of your record of students' work and use them to follow and document their progress.

### **Reference and Resource**

Walvoord, B. E. and Anderson, V. J. *Effective Grading: A Tool for Learning and Assessment*. San Francisco: Jossey-Bass, 1998.

**Princeton University**  
Department of Economics

*Memorandum*

To: Faculty teaching UG Economics courses in Spring 2005  
 From: Gene Grossman, Chair *ggg*  
 Date: February 2, 2005  
 Subject: Departmental Grading Practices for Spring 2005

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As many of you know, the University faculty took action last spring to control grade inflation in undergraduate courses. The University left it to each department to implement practices to meet the requirements of the new policy.

The Economics Department met to discuss how it would respond to the new policy, which places a maximum on the percentage of A grades (A+, A, A-) that may be granted by each department across all undergraduate courses. The limit is 35%, to be maintained on a 3-year rolling-average basis.

We decided to respect the 35% limit on an annual basis. We agreed to the following.

1. Those teaching undergraduate courses **ordinarily** should not award more than the following percentage of A grades, depending on the type of course:

ECO 100, 101	30%
ECO 200	40%
ECO 202	30%
ECO 300, 301, 302	30%
ECO 310, 311, 312	40%
300 Level Electives	35%
400 Level Electives	50%

2. Any instructor who feels that there is a special reason to exceed the ordinary maximum may do so, but his or her grade sheet must be accompanied by a memo addressed to the Chair explaining the circumstances. Appropriate circumstances might include: extraordinary performance by a large fraction of students in a small class; close bunching of students near the boundary between A- and B+, etc.

3. The percentages listed here are **maxima**, not targets. If the performance of the class and the natural grade distribution do not warrant, for example, 50% A grades in a 400-level course, the instructor should not elevate grades to achieve the percentage.

Princeton University  
Department of Economics

*Memorandum*

To: Graders of Senior Thesis in Spring 2005  
From: Gene Grossman *ggg*  
Date: April 7, 2005  
Subject: Departmental Grading Practices for Spring 2005

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Dear Colleagues,

As you may know, the University faculty took action last spring to control grade inflation in undergraduate courses and independent work. The University left it to each department to implement practices to meet the requirements of the new policy.

The Economics Department faculty met to discuss how it would respond to the new policy, which places a maximum on the percentage of A grades (A+, A, A-) that may be granted by each department across all junior and senior independent work. The limit is 55%, to be maintained on a 3-year rolling-average basis.

Our record in the past few years does **not** meet this standard. In AY 2002-2003, for example, we awarded more than 65% A grades to independent work.

There is no obvious way to impose the limit when a large number of individuals will grade a few theses apiece. In any case, I am asking all of you to help us respect the new policy. This means that, in the aggregate, we should not award more than 55% A grades to independent work. Please keep this in mind when awarding grades to the senior theses.

We will try this year to meet the limit via voluntary, decentralized compliance. If this procedure does not work, we will have to try something else for next year.

Thanks for your help.

**Princeton University**  
Department of Economics

*Memorandum*

To: Faculty teaching UG Economics courses in Fall 2005  
From: Bo Honoré, Chair *BH*  
Date: September 20, 2005  
Subject: Departmental Grading Practices

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As you may know, the University has taken action to control grade inflation in undergraduate courses and independent work. One aspect of the policy is to place a maximum on the percentage of A grades (A+, A, A-) that may be granted by each department across all undergraduate courses. The limit is 35%, to be maintained on a 3-year rolling-average basis.

The Department of Economics decided to respect the 35% limit on an annual basis. We agreed to the following.

1. Those teaching undergraduate courses ordinarily should not award more than the following percentage of A grades, depending on the type of course:

ECO 100, 101	30%
ECO 200	40%
ECO 202	30%
ECO 300, 301, 302	30%
ECO 310, 311, 312	40%
300 Level Electives	35%
400 Level Electives	50%

2. Any instructor who feels that there is a special reason to exceed the ordinary maximum may do so, but his or her grade sheet must be accompanied by a memo addressed to the Chair explaining the circumstances. Appropriate circumstances might include: extraordinary performance by a large fraction of students in a small class; close bunching of students near the boundary between A- and B+, etc.

3. The percentages listed here are **maxima**, not targets. If the performance of the class and the natural grade distribution do not warrant, for example, 50% A grades in a 400-level course, the instructor should not elevate grades to achieve the percentage.

If you have any questions, please feel free to contact me.

**Princeton University**  
Department of Economics

*Memorandum*

To: Advisors of JIW in Fall 2005  
From: Bo Honoré, Chair *BEH*  
Date: September 20, 2005  
Subject: Departmental Grading Practices

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As you may know, the University has taken action to control grade inflation in undergraduate courses and independent work. One aspect of the policy is to place a maximum on the percentage A grades (A+, A, A-) that may be granted by each department across all junior and senior independent work. The limit is 55%, to be maintained on a 3-year rolling-average basis.

Our record in the past few years is mixed. In AY 2002-2003, for example, we awarded more than 72% A grades to junior independent work. In other years, we have been closer to the target.

There is no obvious way to impose the limit when a large number of individuals advise a few independent projects each. But a number of you will be advising reasonably large numbers of junior independent work projects this year; so the law of large-ish numbers might work for you.

In any case, I am asking all of you to help us respect the new policy. This means that, in the aggregate, we should not award more than 55% A grades to independent work. Please keep this in mind when awarding grades in January.

It is much easier for everybody if we can meet the limit via voluntary, decentralized compliance. This procedure worked reasonably well last year. Hopefully, it will again this year. If not, we will have to try something else for next year.

Thanks for your help.

## **Grading Practices in the Department Molecular Biology**

Mark Rose

Thursday, September 22, 2005

### **Course Grades**

For a variety of reasons, The Department of Molecular Biology has had to make only a very minor effort to fulfill the new University Grading Guidelines. First, most of the faculty were already grading in a manner that met or exceeded the standards. The largest effect comes from several relatively large introductory and intermediate level courses (MOL214, MOL342, 345, 348). All give significantly fewer than 35% A grades and they strongly buffer the tendency of smaller and upper level courses to give an excess number of A grades. Second, in all of these courses grades are based on examinations and problem sets. Because these methods of evaluation provide raw numbers reflecting achievement, which are not explicitly tied to grades, meeting the target is simply a matter of adjusting “the curve”. Perhaps our sense of the appropriate number of A’s awarded in these courses is rooted in our own student experiences, but the professors teaching these courses have granted approximately 25%-30% A’s for many years.

The upper level courses have been more problematic. There are fewer bases of evaluation and much less objective standards. Two approaches have been successful. First, in at least one case, merely circulating a list of all the grades awarded for each class, lead to embarrassment and self-correction. In this regard, the issue is that previously we did not have clear guidelines for grading or a consensus as to what constituted appropriate grades. To that extent, the grading guidelines have been very helpful, particularly for new faculty. Second, I have gone around to the faculty who give too many A's and persuaded them to change their practices. The most often used excuse is that the students all did so well that they all deserved A’s. My best counter argument is that if all the students are getting A's then their courses are not challenging enough. This seems to have been effective in at least two cases.

### **Independent Work**

In contrast, standardizing the grading of independent work has been a significant challenge. In the past, each faculty member saw only a small number of theses each year, each thesis was read by two readers (including the advisor) and grades were assigned for a variety of subjective, even emotional, reasons. Serious efforts to reform our practices predate the Grading guidelines and were in reaction to one year in which 25% of the senior theses were awarded an A+ grade.

**Senior Thesis** Our current grading system was developed to minimize the problems listed above. Each thesis is read by three readers, numerically evaluated according to a detailed rubric (appendix A), and the grades are ultimately awarded by the undergraduate committee, not by the individual faculty member. The keys to making this work are: (1) having a set of very detailed criteria to use for evaluation (and not simply some overall

subjective impression of whether it is "A" work), (2) the balance provided by multiple readers, (3) the oversight provided by the Undergraduate committee (which also examines the basis of large variations between the readers), (4) the ability to grade to a curve because we consider the entire class, (5) the feedback provided to each faculty when they see how their grading compared to that of other faculty (we have become more normalized over time). Because the grades are controlled by the Undergraduate committee, we can (and do) ensure that the number of A grades fulfill our target goal. In fact, the guidelines are more liberal than we were and we have awarded more A's this past year than previously. Faculty who feel that their student did not receive the appropriate grade may appeal to the undergraduate committee. One or two do so each year – most, if not all requests have been honored. Finally the rubrics are available to the students beforehand so that they can see the basis of the grade. Each student's detailed score is available upon request.

The same system is used for the general exam, which is based on an oral defense of the thesis. The two readers (without the advisor) spend approximately 30 minutes discussing the thesis with the student and then evaluate their ability to defend it, extend the ideas, etc. Scores are based on a rubric and grades assigned by the undergraduate committee.

**Junior Independent Work** Following the general success of the Senior thesis grading scheme, we applied a similar system to the Junior independent work. Again, there are detailed rubrics for evaluation (see appendix B) and the grade is ultimately assigned by a centralized authority rather than by the reader. In the fall, juniors work with Post-doctoral instructors in small reading groups, critically evaluating papers from the primary literature. They write two papers which are read by the Post-doc instructors. Professor Gammie, who oversees the Fall semester JP, works very hard to insure that each instructor uses similar criteria in scoring the rubric. If there are large variations between the instructors (e.g. one may be very lenient and another very harsh), she has them go back and reconsider their scores. Although each paper is read by only one reader, each instructor reads multiple papers, making it easier to normalize. In exceptional cases a second reader may be assigned. Beginning this year, the papers are being submitted to the readers in a blind manner, to avoid bias based on class-room performance.

Ultimately, Professor Gammie assigns the grade, based on the rubric scores, making sure that the number of A's meets our target. In fact, she typically awards fewer A's than the overall target, which has allowed us to have more leeway in grading the Spring JPS.

Normalizing the Spring JP grading has been the most difficult to accomplish. The only person who reads the Spring JP is the advisor and there are usually only one or two JP's per advisor per year. In addition, we tend to assign grades for many reasons, not all of which are reflective of the quality of the work. A typical comment is that the advisor wants to give a reasonably good grade to encourage the student, but not so good as to make them complacent.

To help with the normalization, we first asked all the students to use a single format for the JP, writing a detailed grant proposal for their senior research. Those students who have already begun laboratory work incorporate their preliminary results as part of the background material. Several faculty members have reported that the forward looking paper format is useful for getting the students to focus on their goals and develop

a realistic expectation of what they might be able to accomplish within the following year.

Once again, grading is accomplished through use of a detailed rubric, which is made easier because of the common paper format. The rubric was revised this past year, with the goal of encouraging people to use the full range of scores available for each criterion. The undergraduate committee then assigns the grades based on the scores. Given the comments above about encouraging the students, our faculty seem to be most comfortable when the mean Spring JP grade is an A-, and this is acceptable within the overall guidelines because the Fall JP is curved to a B+. The challenge here has been that a few faculty members have not been fully cooperative and routinely assign very high rubric scores to their own students. Because the grades are awarded on a curve this practice is unfair to other students. Nevertheless, feedback and peer pressure is gradually inducing the outliers to move towards the middle.

## Appendix A: Senior Thesis and Oral Exam Grading

Below are a set of parameters that will be judged by both the thesis readers and advisors. Because there is some information that is only known to the advisor and not the readers, there are two separate grading sheets. Finally, some of the criteria have been modified for those students who have undertaken non-laboratory theses. The grading criteria for the oral exam are given as well. Raw rubric scores are collected via a secure on-line voting system. (1 is highest, 5 is lowest) for all of the criteria listed below. NOTE: Most students should get a 3 for each criterion.

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### Laboratory Thesis – Advisor’s evaluation form

#### *Evaluation of the thesis work and the written document*

##### **Originality** – This student’s thesis:

- 1 – Originated the thesis project (Wish I had thought of it!).
- 2 – Developed a project from a vague suggestion of the advisor.
- 3 – Elaborated a project mostly suggested by advisor.
- 4 – Carried out a project entirely laid out by the advisor.
- 5 – Couldn’t follow the plan for the project.

##### **Work Ethic** – This student:

- 1 – Worked as much as a good graduate student.
- 2 – Worked significantly more than 20 hours a week.
- 3 – Worked about 15-20 hours a week, a few hours every day.
- 4 – Worked sporadically, a few hours a few days a week, or went long stretches without appearing.
- 5 – Worked rarely or not at all.

##### **Independence** – This student:

- 1 – Worked almost completely on his/her own in the lab.
- 2 – Worked with occasional (weekly?) guidance from a post-doc or graduate student.
- 3 – Worked with daily consultation from mentors, but planned many of the experiments.
- 4 – Needed frequent help with the planning and/or execution of most experiments.
- 5 – Needed extensive help with the planning and execution of all experiments.

##### **Completion** – This thesis:

- 1 – Is a complete story and essentially publishable in its own right.
- 2 – Needs just one or two additional experiments or controls to get it ready for publication.
- 3 – Contains most of the elements of a nice result that someone will follow up.
- 4 – Is not complete enough to decide whether there is a result or not.
- 5 – Is obviously incomplete.

##### **Perseverance** – This student:

- 1 – Worked through and solved difficult technical problems on his/her own.
- 2 – Did not get discouraged and solved technical problems with some advice.
- 3 – Needed some encouragement to keep going in spite of technical problems.
- 4 – Seemed averse to solving technical problems.
- 5 – Folded up at the first problem.

**Quality** – The experimental work by this student:

- 1 – Was beautiful, clear-cut, and well-controlled, equivalent to an excellent graduate student's.
- 2 – Was clearly superior, perhaps equivalent to most graduate students.
- 3 – Was average, several nice experiments but with occasional problems in consistency, or reproducibility.
- 4 – Was frequently sloppy and uncontrolled.
- 5 – Was essentially without merit, no believable or controlled experiments.

**Thesis Experimental Description:**

- 1 – Outstanding. All experiments were clearly described and their rationales explained. Understandable by a general science reader. Description conveyed more than sufficient information to repeat the experiments.
- 2 – An excellent summary of the experimental procedures. A knowledgeable reader could repeat the experiment with little difficulty.
- 3 – A very good description of the experimental procedures. A knowledgeable reader could understand and repeat the experiments with some effort. The rationale was not always clear. There were some instances where the author assumed knowledge on the part of the reader, or used lab jargon.
- 4 – A good summary of the experiments. Occasionally, relevant experimental details were either inappropriate or missing. The experiment would be difficult to repeat. The author used a lot of lab jargon without explanation.
- 5 – A poor description of the experiments. It would be impossible for a knowledgeable reader to reconstruct the experiments.

**Thesis Results:**

- 1 – Outstanding. Results were presented in a logical, effective and creative manner. Data were presented accurately and clearly and could be easily understood by a general reader. Controls and their significance clearly and thoroughly described. Conclusions were valid, insightful and not over-interpreted.
- 2 – Excellent. The data are described accurately and completely. Conclusions about data and controls were appropriate and not over-interpreted, but not particularly insightful or thoughtful.
- 3 – Very good. Data were presented in an effective manner. Most of the conclusions about the data and controls were solid, but in rare occasions may lack accuracy. A general reader might have minor difficulty following the conclusions.
- 4 – The results section is a collection of data with little information to explain the significance. Some portions were unclear or missing. Data were presented in a confusing or incomplete fashion. The author may have misunderstood some of the results, or failed to include or communicate them in an effective manner. Some conclusions may not have fit the data or were absent (under-interpreted).
- 5 – Little attention beyond a quick statement of the results. Missing context or controls. The author did not understand data or failed to draw conclusions.

**Thesis Discussion:**

- 1 – The author provided an in-depth analysis of the results and demonstrated exceptional insight into the broader implications. The student was thinking about experiments, results and future directions at the level of a professional in the field.
- 2 – The author provided an excellent critical analysis of the data. Interpretation went significantly beyond the simplest interpretation. Contained several good ideas for future work.
- 3 – The author provided a very good discussion of the results but stayed mostly within the bounds of current thinking. Provided one or two good ideas for future work.
- 4 – The author provided a limited analysis of the data; however, the author mostly reiterated the results without further expansion. Made a limited attempt to suggest future experiments or directions.
- 5 – The author failed to provide a thorough critique of the experiments and results. Made an unsuccessful attempt or failed to explain future directions.

**Thesis Scholarship** – This thesis:

- 1 – Is a model of impeccable scholarship, very carefully and thoroughly researched and referenced. It is an authoritative survey of the primary literature. The author has mastered all the issues and integrated them to make an original and complete intellectual contribution.
- 2 – Shows superior scholarship and frequently cited the primary literature. The author has mastered most of the material and has integrated it to make an original contribution. However, some subtleties, references or issues were missed.
- 3 – Shows average scholarship. The author has made a competent review of the literature, but relied mainly on reviews and secondary sources. The thesis does not go much beyond the source material, or has left out important issues or references.
- 4 – Shows below average scholarship. The author has mastered only a part of the relevant literature. Significant parts of the thesis are not supported by cited material. References are almost exclusively reviews and secondary sources. Important material has been neglected.
- 5 – Shows seriously poor scholarship. The author knows or understands little of the relevant literature or has made major errors in interpretation and/or citation.

**Thesis Writing** – This thesis:

- 1 – Is a pleasure to read. It is crisp, clear and concise. Needs no editing to be an excellent review. I would give it to colleagues who want to be caught up with the field.
- 2 – Is easy to read, needs only minor editing to be a good review. I would give it to my students but maybe not to a colleague.
- 3 – Is well written, but would still need a fair amount of revision to be a good review. Usually clear, but some sections need to be re-read to get at the meaning.
- 4 – Is poorly written. Significant portions are sloppy or unclear. There are many misspellings and ambiguities.
- 5 – Is very difficult to read. Most sections are unclear, ungrammatical and convoluted.

**Overall Evaluation:**

- 1 – This student was one of the best I have seen, within the top 5%.
- 2 – This student was really excellent, within the top 15%.

- 3– This student was good but not exceptional, within the top 80%.
- 4– This student was fairly weak student, within the bottom 20%.
- 5– This student was one of the weakest I have seen, within the bottom 5%.

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## Laboratory Thesis – Reader’s evaluation form

### *Evaluation of the thesis work and the written document*

#### **Originality** – This student’s thesis:

- 1– Demonstrated exceptional originality.
- 2– Clearly went beyond the literature in several areas.
- 3– Contained one or more good ideas that extended the current thinking.
- 4– Stayed within the bounds of current thinking from the literature.
- 5– Was basically a repeat of other ideas or discussion without modification.

#### **Completion** – This thesis:

- 1– Is a complete story and essentially publishable in its own right.
- 2– Needs just one or two additional experiments or controls to get it ready.
- 3– Contains most of the elements of a nice result that someone should follow up.
- 4– Is not complete enough to decide whether there is a result or not.
- 5– Is obviously incomplete.

#### **Quality** – The experimental work by this student:

- 1– Was beautiful, clear-cut, and well-controlled, equivalent to an excellent graduate student’s.
- 2– Was clearly superior, perhaps equivalent to most graduate students.
- 3– Was average, several nice experiments but with occasional problems in consistency, or reproducibility.
- 4– Was more often than not sloppy and uncontrolled.
- 5– Was essentially without merit, no believable or controlled experiments.

#### **Thesis Experimental Description:**

- 1– Outstanding. All experiments were clearly described and their rationales explained. Understandable by a general science reader. Description conveyed more than sufficient information to repeat the experiments.
- 2– An excellent summary of the experimental procedures. A knowledgeable reader could repeat the experiment with little difficulty.
- 3– A very good description of the experimental procedures. A knowledgeable reader could understand and repeat the experiments with some effort. The rationale was not always clear. There were some instances where the author assumed knowledge on the part of the reader, or used lab jargon.
- 4– A good summary of the experiments. Occasionally, relevant experimental details were either inappropriate or missing. The experiment would be difficult to repeat. The author used a lot of lab jargon without explanation.
- 5– A poor description of the experiments. It would be impossible for a knowledgeable reader to reconstruct the experiments.

### **Thesis Results:**

- 1 – Outstanding. Results were presented in a logical, effective and creative manner. Data were presented accurately and clearly and could be easily understood by a general reader. Controls and their significance clearly and thoroughly described. Conclusions were valid, insightful and not over-interpreted.
- 2 – Excellent. The data are described accurately and completely. Conclusions about data and controls were appropriate and not over-interpreted, but not particularly insightful or thoughtful.
- 3 – Very good. Data were presented in an effective manner. Most of the conclusions about the data and controls were solid, but in rare occasions may lack accuracy. A general reader might have minor difficulty following the conclusions.
- 4 – The results section is a collection of data with little information to explain the significance. Some portions were unclear or missing. Data were presented in a confusing or incomplete fashion. The author may have misunderstood some of the results, or failed to include or communicate them in an effective manner. Some conclusions may not have fit the data or were absent (under-interpreted).
- 5 – Little attention beyond a quick statement of the results. Missing context or controls. The author did not understand data or failed to draw conclusions.

### **Thesis Discussion:**

- 1 – The author provided an in-depth analysis of the results and demonstrated exceptional insight into the broader implications. The student was thinking about experiments, results and future directions at the level of a professional in the field.
- 2 – The author provided an excellent critical analysis of the data. Interpretation went significantly beyond the simplest interpretation. Contained several good ideas for future work.
- 3 – The author provided a very good discussion of the results but stayed mostly within the bounds of current thinking. Provided one or two good ideas for future work.
- 4 – The author provided a limited analysis of the data; however, the author mostly reiterated the results without further expansion. Made a limited attempt to suggest future experiments or directions.
- 5 – The author failed to provide a thorough critique of the experiments and results. Made an unsuccessful attempt or failed to explain future directions.

### **Thesis Scholarship** – This thesis:

- 1 – Is a model of impeccable scholarship, very carefully and thoroughly researched and referenced. It is an authoritative survey of the primary literature. The author has mastered all the issues and integrated them to make an original and complete intellectual contribution.
- 2 – Shows superior scholarship and frequently cited the primary literature. The author has mastered most of the material and has integrated it to make an original contribution. However, some subtleties, references or issues were missed.
- 3 – Shows average scholarship. The author has made a competent review of the literature, but relied mainly on reviews and secondary sources. The thesis does not go much beyond the source material, or has left out important issues or references.

- 4 – Shows below average scholarship. The author has mastered only a part of the relevant literature. Significant parts of the thesis are not supported by cited material. References are almost exclusively reviews and secondary sources. Important material has been neglected.
- 5 – Shows seriously poor scholarship. The author knows or understands little of the relevant literature or has made major errors in interpretation and/or citation.

**Thesis Writing** – This thesis:

- 1 – Is a pleasure to read. It is crisp, clear and concise. Needs no editing to be an excellent review. I would give it to colleagues who want to be caught up with the field.
- 2 – Is easy to read, needs only minor editing to be a good review. I would give it to my students but maybe not to a colleague.
- 3 – Is well written, but would still need a fair amount of revision to be a good review. Usually clear, but some sections need to be re-read to get at the meaning.
- 4 – Is poorly written. Significant portions are sloppy or unclear. There are many misspellings and ambiguities.
- 5 – Is very difficult to read. Most sections are unclear, ungrammatical, and convoluted.

**Overall Evaluation:**

- 1 – This student was one of the best I have seen, within the top 5%.
- 2 – This student was really excellent, within the top 15%.
- 3 – This student was good but not exceptional, within the top 80%.
- 4 – This student was fairly weak student, within the bottom 20%.
- 5 – This student was one of the weakest I have seen, within the bottom 5%.

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## **Non-Laboratory Thesis – Advisor’s evaluation form**

*Evaluation of the thesis work and the written document*

**Originality** – This student’s thesis:

- 1 – Originated the thesis project (Wish I had thought of it!).
- 2 – Developed a project from a vague suggestion of the advisor.
- 3 – Elaborated a project mostly suggested by advisor.
- 4 – Carried out a project entirely laid out by the advisor.
- 5 – Couldn’t follow the plan for the project.

**Work Ethic** - This student:

- 1 – Worked unusually hard researching the thesis, spent an enormous amount of time finding material, was always prepared for discussions.
- 2 – Worked very hard researching the thesis, going beyond the expected level of effort.
- 3 – Worked hard on the thesis, was usually well prepared for discussions.
- 4 – Worked sporadically, or went long stretches without appearing.
- 5 – Worked rarely or not at all.

**Independence** - This student:

- 1 – Found, understood, and analyzed the source material completely on his/her own. Needed minimal guidance to complete the thesis.
- 2 – Needed very occasional guidance in the identification, comprehension, or analysis of source material.
- 3 – Needed regular (weekly or biweekly) guidance to stay on track. Student was able to identify, comprehend and analyze most of the source material on own.
- 4 – Much of the research needed direct supervision from the advisor.
- 5 – Got nothing done without the direct involvement of the advisor.

**Completeness** - This thesis:

- 1 – Is complete and could be publishable in its own right.
- 2 – Needs just one or two additional areas to be complete.
- 3 – Contains most of the elements of an interesting idea/review but would need significant additional material to be complete.
- 4 – Contains the bare minimum of an idea for a thesis. Would need extensive fleshing out to be complete.
- 5 – Is obviously incomplete.

**Resourcefulness/Perseverance** - This student:

- 1 – Was unusually brave/adept at hunting down/developing unusual sources (e.g. attended conferences or interviewed people) or identifying original material.
- 2 – Found some really great original material in some unusual places.
- 3 – Used the standard sources.
- 4 – Missed some relevant sources.
- 5 – Missed important, relevant and obvious sources.

**Research Description:**

- 1 – Outstanding. A brilliant exposition of the questions and hypotheses, showing deep insight into the problem. Very clear and logical development and resolution. Easily understandable by a general science reader.
- 2 – An excellent summary of the research question. Hypotheses were clearly described, logical and the approaches to their resolution were adequately explained. A knowledgeable reader could easily understand the research.
- 3 – A very good description of the research question/hypothesis. A knowledgeable reader could understand with some effort. The rationale was mostly clear and logically presented. A few instances where the author assumed knowledge on the part of the reader, or used jargon.
- 4 – A good summary of the research. Occasional sections were inappropriate, illogical or missing. The author used a lot of jargon without explanation.
- 5 – A poor description of the research. It would be impossible even for a knowledgeable reader to understand the approach.

**Thesis Results/Findings:**

- 1 – Outstanding. Research findings presented in a logical, effective and creative manner. Findings presented accurately and clearly, easily understandable by a general reader. Significance clearly and thoroughly described. Conclusions valid, insightful and not over-interpreted.

- 2 – Excellent. Results/findings described accurately and completely. Conclusions were appropriate and not over-interpreted, but not particularly insightful or thoughtful.
- 3 – Very good. Results/findings presented in an effective manner. Solid conclusions, but in rare occasions may lack accuracy. A general reader might have minor difficulty following some of the conclusions.
- 4 – Good. Results/findings presented in a somewhat random or illogical manner. Little information to explain the significance. Some portions unclear or missing. The author may have misunderstood some of the findings, or failed to include or communicate them. Some conclusions may not have fit or were absent (under-interpreted).
- 5 – Poor. Little beyond a quick statement of the findings. Missing context or significance. The author did not understand significant sections of the findings or failed to draw conclusions.

**Thesis Discussion:**

- 1 – An in-depth analysis of the findings/results, demonstrating exceptional insight into the broader implications. The student was thinking about experiments, results or future directions at the level of a professional in the field.
- 2 – An excellent critical analysis of the findings. Interpretation went significantly beyond the simplest interpretation. Contained several good ideas for future work.
- 3 – A very good discussion of the findings, staying mostly within the bounds of current thinking. Provided one or two good ideas for future work.
- 4 – A limited analysis of the findings. The author mostly reiterated them without further expansion or made only a limited attempt to suggest future directions.
- 5 – The author failed to provide a thorough critique of their findings. Made an unsuccessful attempt or failed to explain future directions.

**Thesis Scholarship** – This thesis:

- 1 – Is a model of impeccable scholarship, very carefully and thoroughly researched and referenced. It is an authoritative survey of the primary literature. The author has mastered all the issues and integrated them to make an original and complete intellectual contribution.
- 2 – Shows superior scholarship and frequently cited the primary literature. The author has mastered most of the material and has integrated it to make an original contribution. However, some subtleties, references or issues were missed.
- 3 – Shows average scholarship. The author has made a competent review of the literature, but relied mainly on reviews and secondary sources. The thesis does not go much beyond the source material, or has left out important issues or references.
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- 5 – Shows seriously poor scholarship. The author knows or understands little of the relevant literature or has made major errors in interpretation and/or citation.

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- 2 – Is easy to read, needs only minor editing to be a good review. I would give it to my students but maybe not to a colleague.
- 3 – Is well written, but would still need a fair amount of revision to be a good review. Usually clear, but some sections need to be re-read to get at the meaning.
- 4 – Is poorly written. Significant portions are sloppy or unclear. There are many misspellings and ambiguities.
- 5 – Is very difficult to read. Most sections are unclear, ungrammatical and convoluted.

**Overall Evaluation:**

- 1 – This student was one of the best I have seen, within the top 5%.
  - 2 – This student was really excellent, within the top 15%.
  - 3 – This student was good but not exceptional, within the top 80%.
  - 4 – This student was fairly weak student, within the bottom 20%.
  - 5 – This student was one of the weakest I have seen, within the bottom 5%.
- 

## **Non-Laboratory Thesis – Reader’s evaluation form**

*Evaluation of the thesis work and the written document*

**Originality** – This student’s thesis:

- 1 – Demonstrated exceptional originality.
- 2 – Clearly went beyond the literature in several areas.
- 3 – Contained one or more good ideas that extended the current thinking.
- 4 – Stayed within the bounds of current thinking from the literature.
- 5 – Was basically a repeat of other ideas or discussion without modification.

**Completeness** – This thesis:

- 1 – Is complete and could be publishable in its own right.
- 2 – Needs just one or two additional areas to be discussed to be complete.
- 3 – Contains most of the elements of an interesting idea/review but would need significant additional material to be complete.
- 4 – Contains the bare minimum of an idea for a thesis. Would need extensive fleshing out to be complete.
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**Research Description:**

- 1 – Outstanding. A brilliant exposition of the questions and hypotheses, showing deep insight into the problem. Very clear and logical development and resolution. Easily understandable by a general science reader.
- 2 – An excellent summary of the research question. Hypotheses were clearly described, logical and the approaches to their resolution were adequately explained. A knowledgeable reader could easily understand the research.

- 3 – A very good description of the research question/hypothesis. A knowledgeable reader could understand with some effort. The rationale was mostly clear and logically presented. A few instances where the author assumed knowledge on the part of the reader, or used jargon.
- 4 – A good summary of the research. Occasional sections were inappropriate, illogical or missing. The author used a lot of jargon without explanation.
- 5 – A poor description of the research. It would be impossible even for a knowledgeable reader to understand the approach.

**Thesis Results/Findings:**

- 1 – Outstanding. Research findings presented in a logical, effective and creative manner. Findings presented accurately and clearly, easily understandable by a general reader. Significance clearly and thoroughly described. Conclusions valid, insightful and not over-interpreted.
- 2 – Excellent. Results/findings described accurately and completely. Conclusions were appropriate and not over-interpreted, but not particularly insightful or thoughtful.
- 3 – Very good. Results/findings presented in an effective manner. Solid conclusions, but in rare occasions may lack accuracy. A general reader might have minor difficulty following some of the conclusions.
- 4 – Good. Results/findings presented in a somewhat random or illogical manner. Little information to explain the significance. Some portions unclear or missing. The author may have misunderstood some of the findings, or failed to include or communicate them. Some conclusions may not have fit or were absent (under-interpreted).
- 5 – Poor. Little beyond a quick statement of the findings. Missing context or significance. The author did not understand significant sections of the findings or failed to draw conclusions.

**Thesis Discussion:**

- 1 – An in-depth analysis of the findings/results, demonstrating exceptional insight into the broader implications. The student was thinking about experiments, results or future directions at the level of a professional in the field.
- 2 – An excellent critical analysis of the findings. Interpretation went significantly beyond the simplest interpretation. Contained several good ideas for future work.
- 3 – A very good discussion of the findings, staying mostly within the bounds of current thinking. Provided one or two good ideas for future work.
- 4 – A limited analysis of the findings. The author mostly reiterated them without further expansion or made only a limited attempt to suggest future directions.
- 5 – The author failed to provide a thorough critique of their findings. Made an unsuccessful attempt or failed to explain future directions.

**Thesis Scholarship** – This thesis:

- 1 – Is a model of impeccable scholarship, very carefully and thoroughly researched and referenced. It is an authoritative survey of the primary literature. The author has

mastered all the issues and integrated them to make an original and complete intellectual contribution.

- 2 – Shows superior scholarship and frequently cited the primary literature. The author has mastered most of the material and has integrated it to make an original contribution. However, some subtleties, references or issues were missed.
- 3 – Shows average scholarship. The author has made a competent review of the literature, but relied mainly on reviews and secondary sources. The thesis does not go much beyond the source material, or has left out important issues or references.
- 4 – Shows below average scholarship. The author has mastered only a part of the relevant literature. Significant parts of the thesis are not supported by cited material. References are almost exclusively reviews and secondary sources. Important material has been neglected.
- 5 – Shows seriously poor scholarship. The author knows or understands little of the relevant literature or has made major errors in interpretation and/or citation.

**Thesis Writing** – This thesis:

- 1 – Is a pleasure to read. It is crisp, clear and concise. Needs no editing to be an excellent review. I would give it to colleagues who want to be caught up with the field.
- 2 – Is easy to read, needs only minor editing to be a good review. I would give it to my students but maybe not to a colleague.
- 3 – Is well written, but would still need a fair amount of revision to be a good review. Usually clear, but some sections need to be re-read to get at the meaning.
- 4 – Is poorly written. Significant portions are sloppy or unclear. There are many misspellings and ambiguities.
- 5 – Is very difficult to read. Most sections are unclear, ungrammatical and convoluted.

**Overall Evaluation:**

- 1 – This student was one of the best I have seen, within the top 5%.
- 2 – This student was really excellent, within the top 15%.
- 3 – This student was good but not exceptional, within the top 80%.
- 4 – This student was fairly weak student, within the bottom 20%.
- 5 – This student was one of the weakest I have seen, within the bottom 5%.

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## ***Evaluation of the oral exam***

**Factual/Conceptual Knowledge:**

- 1 – Outstanding. This student demonstrated mastery of the larger area of their thesis topic. The student would do well on a graduate level general exam.
- 2 – Above average. The student mastered both the basis of the thesis as well as areas directly related to the thesis. The student would be on the borderline for a graduate general exam.
- 3 – Average. The student has mastered the basic facts and concepts for the thesis. The student knows some of the facts or concepts that are direct extensions of the thesis.

- 4 – Below average. The student did not know or understand some of the basic material for their thesis.
- 5 – Poor. The student exhibited serious deficits in understanding/knowledge of the basis of their thesis.

**Ability to Integrate Knowledge/Formulate Hypotheses:**

- 1 – Outstanding. The student was remarkably adept at formulating specific hypotheses as well as suggesting well-controlled tests of their ideas. The student could easily integrate material to formulate a fundamental mechanistic model to explain observations.
- 2 – Above average. The student could independently formulate several hypotheses, or integrate disparate concepts. The student could suggest experiments to test the hypothesis.
- 3 – Average. With help, the student could be lead to formulate a specific hypothesis to explain a set of observations. The hypotheses were narrow or simple extensions of given paradigms, or required little integration of additional concepts. The student could be lead to suggest a test of their hypothesis.
- 4 – Below average. The student was able to understand hypotheses provided to explain observations and provided either a test or an extension of the hypothesis.
- 5 – Poor. The student was unable to understand provided hypotheses or to suggest either tests or extensions of the hypotheses.

**Ability to Propose Future Directions/Experiments:**

- 1 – Outstanding. The student had great/novel ideas about the new/best directions to pursue in areas related to their research.
- 2 – Above average. The student had a good grasp of the gaps in our understanding related to their thesis and was able to suggest ways to approach its study.
- 3 – Average. The student was able to suggest the obvious next steps in the thesis. These would be incremental in nature.
- 4 – Below average. The student could be aided to propose the next step.
- 5 – Poor. The student had serious difficulty in identifying directions for future research.

## **Appendix B: Grading Guidelines for Junior Independent Work Spring Semester**

Department of Molecular Biology (Revised April, 2005)

**Student:**

**Advisor:**

PLEASE CIRCLE THE ENTRY THAT MOST ACCURATELY REPRESENTS THE STUDENT'S WORK. Return completed forms to Laura Gallagher-Katz or Elena Chiarchiaro (LTL 119) by May 17<sup>th</sup>

**Abstract -**

- 1 The abstract is either missing some of the major points, or does not explain them adequately. The abstract requires major revisions.
- 2 The abstract mentions the major points, but would need additional information or would need significant revisions before serving as a good abstract.
- 3 The abstract contains all of the required information, would need only minor revisions before serving as a good abstract.
- 4 The abstract contains all of the required information, would need only minor revisions before serving as an excellent abstract.
- 5 The abstract is concise and thorough. Does not give extraneous information. Stands alone as an effective summary for the proposal. One of the best I have seen.

**Specific Aims-**

- 1 This section is either missing some of the major aims, or does not explain them adequately. The section requires major revisions.
- 2 The specific aims mentions the major points, but would need additional information or would need significant revisions before serving as a good specific aims section.
- 3 The specific aims contain all of the required information and accurately summarize the research plan, serving as a good specific aims section.
- 4 The specific aims contain all of the required information and accurately summarize the research plan, serving as an excellent specific aims section.
- 5 The specific aims are concise, thorough, explicit and well written. The aims summarize a reasonable and well thought out research plan. I could use these specific aims in a grant proposal.

**Background & Significance -**

- 5 The author describes very little of the relevant literature, or significant errors were made in reporting previous findings.
- 10 The author has mastered some of the relevant literature, but important material has been omitted or was not presented clearly.
- 15 The author has made an accurate review of the relevant literature. However, the report does not go much beyond the material suggested by the advisor.

- 20 The author has mastered the background material and has integrated it to make an accurate survey. The student included relevant material not suggested by the advisor.
- 25 This section is a model of impeccable scholarship. The author has mastered the salient issues and integrated them to make an original, complete, and concise introduction. I would submit this as a mini-review without revision.

**Progress / Preliminary Results**

- 1 The description of the preliminary data was hard to understand or key experiments were missing.
- 3 The description of the preliminary data was complete, but required knowledge of the system to fully comprehend.
- 5 The preliminary data was complete and understandable.
- 6 The preliminary data were presented in a detailed and effective manner and could be easily understood by a reader not familiar with the system. The feasibility of the experimental research was evident.
- 8 The preliminary data were presented in a professional manner and effectively established the feasibility of the research proposal. The description of the data could be submitted with a grant proposal.

**Research Proposal - Description of Experimental Rationale and Methods.**

- 5 The student supplied a minimal explanation of the rationale and methods.
- 10 The rationale was explained adequately, but this section lacks a complete summary of the experimental methods. In some cases the relevant details were inaccurate or missing.
- 10 The methods were explained adequately, but this section lacks a compelling rationale.
- 15 This section is an acceptable summary of the experimental rationale and methods.
- 20 Each section contains a good summary of the experimental rationale and methods. Other readers could easily understand the experimental methods and rationale.
- 25 This section is an exceptional description of the experimental rationale and methods. I would base a grant proposal on this section.

**Research Proposal - Originality.**

- 3 The student presented a research plan that was detailed by the advisor or instructor.
- 4 The student integrated and presented a research plan that was based on suggestions by the advisor or instructor.
- 6 The proposals for future work went beyond what was suggested during consultations. The student proposed experiments that were reasonable.
- 8 The proposals for future work went clearly beyond what was suggested during consultations. The student was proposing experiments that were reasonable and feasible.
- 10 The proposals for future work clearly went beyond what was suggested during consultations. The student was proposing interesting experiments that were clever, feasible and well thought out.

## References -

- 0 The citations were lacking; **three** of the following were true (a) a few key facts were not properly referenced, (b) references were missing from the list, (c) references were in the list, but not cited, (d) the references were not listed in an accepted scientific format, (e) the student relied almost exclusively on non-peer reviewed Internet sources
- 1 The citations and references were acceptable; however **two** of the following were true (a) a few key facts were not properly referenced, (b) references were missing from the list, (c) references were in the list, but not cited, (d) the references were not listed in an accepted scientific format, (e) the student relied almost exclusively on non-peer reviewed Internet sources
- 1.5 Most citations were accurate; however **one** of the following was true (a) a few key facts were not properly referenced, (b) references were missing from the list, (c) references were in the list, but not cited, (d) the references were not listed in an accepted scientific format, (e) the student relied almost exclusively on non-peer reviewed Internet sources
- 2 The citations were completely accurate and in a format found in a published journal. Each factual statement was referenced to the appropriate primary source. The reference list contained only the articles mentioned in the student's paper. Each reference was listed completely in the Literature Cited section.

PLEASE FILL ANSWER ONE OF THE FOLLOWING, DEPENDING ON WHETHER THE JUNIOR INDEPENDENT WORK WAS LABORATORY OR NON-LABORATORY (NEXT PAGE) BASED

### Work Ethic - **Laboratory-Based**

- 5 The student worked in the laboratory, but did not put in much time. Consequently, the student has little to report.
- 10 The student worked intermittently in the laboratory and gained experience with the basic techniques needed for the senior thesis project; however, the student did not work independently.
- 15 The student worked in the laboratory and gained experience with the basic techniques needed for the senior thesis project; the student worked independently with regular consultations.
- 17 The student worked on average 6 to 10 hours per week in the laboratory and became proficient with the basic techniques needed for the senior thesis project. The student worked independently with occasional consultations and was starting to produce interpretable results.
- 20 The student worked on average 6 to 10 hours per week in the laboratory and mastered the basic techniques needed for the senior thesis project. The student functioned independently and produced publishable results.

### Work Ethic - **Non-Laboratory-Based**

- 5 The student put in some effort, but accomplished little beyond writing up the proposal

- without the direct involvement of the advisor.
- 10** The student worked intermittently. Much of the research and analyses needed direct supervision from the advisor.
  - 15** The student worked consistently on the junior independent work and was prepared for discussions. Student was able to identify, comprehend and analyze most of the source material with regular consultations.
  - 17** The student worked very hard researching the topic, going beyond the expected level of effort. The student needed occasional guidance in the identification, comprehension, or analysis of source material.
  - 20** The student worked unusually hard researching the topic The student found, understood, and analyzed the source material completely on his/her own. The student needed minimal guidance to complete the research proposal.

### **Spring JP Format**

<b>Abstract (200 words)</b>	5
<b>Specific Aims (half page outline of project)</b>	5
<b>Background and Significance (2-3 pages)</b>	25
<b>Progress / Preliminary Results (2-3 pages)</b>	8
<b>Research Proposal (5 -8 pages)</b>	
<b>Experimental rationale and procedures</b>	25
<b>Originality</b>	10
<b>References (at least 10 primary sources)</b>	2
<b>Work Ethic</b>	20
<b>total</b>	100