

Laboratory Thesis

Evaluation of the thesis work and the written document (1 is highest, 5 is lowest) for all of the criteria listed below. Most students should get a 3 for each criterion.

Originality – This student:

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

Work Ethic (Adviser Only) – This student:

- 1 – Worked as much as a good graduate student.
- 2 – Worked significantly more than 20 hours a week.
- 3 – Worked consistently, about 15-20 hours a week.
- 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 (Adviser Only) – This student:

- 1 – Attained a high level of independence and became self-sufficient in the lab.
- 2 – Became largely independent, requiring occasional guidance from the faculty, post-doc, or graduate student mentor.
- 3 – Continued to require frequent consultation from mentors, but planned many of the experiments.
- 4 – Continued to need frequent help with the planning and/or execution of most experiments.
- 5 – Never worked without extensive help in 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 a few additional experiments to be a publishable story.
- 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 (Adviser Only) – 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.

Experimental Quality – The experimental work by this student:

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

Thesis Experimental Description (including Methods):

- 1 – Outstanding. All experiments are 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 is not always clear. There are 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 are 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.

Experimental Design:

- 1 – Experiments are incisive, rigorous and powerful. They allowed the student to rigorously test the hypothesis and distinguish between all reasonable models. Both positive and negative results are interpretable.
- 2 – Experiments as designed provide strong support for (or falsify) the hypothesis. Most outcomes are interpretable.
- 3 – Experiments provide clear support for a hypothesis, but do not distinguish between all possible models. Several possible outcomes are not interpretable.
- 4 – Experiments have little power to distinguish among multiple possible models. They provide some support for a hypothesis, but multiple models are consistent with outcomes.
- 5 – Experiments do not test the hypothesis. Experiments have insufficient power to distinguish different models.

Thesis Results:

- 1 – Outstanding. Results are presented in a logical, effective and creative manner. Data are presented accurately and clearly and could be easily understood by a general reader. Controls and their significance are clearly and thoroughly described. Conclusions are valid, insightful and not over-interpreted. Figures are publication quality, appropriately labeled, with comprehensive legends.
- 2 – Excellent. The data are described accurately and completely. Conclusions about data and controls are appropriate and not over-interpreted, but not particularly insightful or thoughtful. Figures are high quality, appropriately labeled, with comprehensive legends.
- 3 – Very good. Data are presented in an effective manner. Most of the conclusions about the data and controls are solid, but in rare occasions may lack accuracy. A general reader might have minor difficulty following the conclusions. Some figures are lacking in quality and/or labeling; legends are adequate.
- 4 – The results section is a collection of data with little information to explain the significance. Some portions are unclear or missing. Data are 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 fit the data or are absent (under-interpreted). Some figures are missing or low quality, poorly labeled, with minimal legends.
- 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. Figures are missing, poor quality, lack labels, with minimal legends.

Discussion (Analysis):

- 1 – The author provided an in-depth analysis of the results and demonstrated exceptional insight into the broader implications.
- 2 – The author provided an excellent critical analysis of the data, including ideas that went significantly beyond the simplest interpretation.
- 3 – The author provided a very good discussion of the results but stayed mostly within the bounds of current thinking.
- 4 – The author provided a limited analysis of the data; however, the author mostly reiterated the results without further expansion.
- 5 – The author failed to provide a critique and simply reiterated the results.

Discussion (Future Research):

- 1 – The student was thinking about experiments, results and future directions at the level of a professional in the field.

- 2 – The thesis contained several good ideas for future work. The ideas build upon the student’s findings, incorporate additional scholarship and are worthwhile suggestions for future research.
- 3 – The thesis provided one or two good ideas for future work. These are relevant to the field but may be only incremental in nature.
- 4 – The student made a very limited attempt to suggest future experiments or directions.
- 5 – The student made an unsuccessful attempt or failed to explain future directions.

Thesis Scholarship – This thesis:

- 1 – Is a model of impeccable scholarship. The background material has been thoroughly researched and properly referenced. It is an authoritative assessment of the relevant primary literature. The author has mastered the issues and integrated them to make an original and complete intellectual contribution. The author has provided the reader with the relevant information to understand the significance of the problem at hand.
- 2 – Shows careful scholarship and frequently cited the primary literature. The author has mastered most of the relevant material and has integrated it well to set up the thesis research.
- 3 – Shows average scholarship. The author accurately presented findings from the literature, but relied heavily on reviews rather than primary sources. The significance of the thesis research may not be immediately clear to an outside reader or may be difficult to extract because of excessive detail.
- 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. Not enough information has been provided to understand the thesis research question.
- 5 – Shows 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 clear and concise. Needs no editing and reads as though it was written by a professional in the field.
- 2 – Is easy to read, needs only minor editing. Represents excellence in student writing and appears to be the end product of multiple drafts.
- 3 – Is well written, but requires revisions and editing. Usually clear, but some sections need to be re-read to get at the meaning. Reads like a good, proof-read draft.
- 4 – Is poorly written. Significant portions are sloppy or unclear. There are many grammatical errors and ambiguities. Reads like a rough draft.
- 5 – Is difficult to read. Most sections are unclear, ungrammatical and convoluted. Unquestionably a rushed draft that has not been proof-read.

Non-Laboratory Thesis

Evaluation of the thesis work and the written document (1 is highest, 5 is lowest) for all of the criteria listed below. Most students should get a 3 for each criterion.

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 adviser.
- 3 – Elaborated a project mostly suggested by adviser.
- 4 – Carried out a project entirely laid out by the adviser.
- 5 – Couldn’t follow the plan for the project.

Work Ethic (Adviser Only) - 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 (Adviser Only) - 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 adviser.
- 5 – Got nothing done without the direct involvement of the adviser.

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.
- 5 – Is obviously incomplete.

Resourcefulness/Perseverance (Adviser Only) - 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 Design:

- 1 – Studies are incisive, rigorous and powerful. They allowed the student to rigorously test the hypothesis and distinguish among all reasonable models. Both positive and negative results are interpretable.
- 2 – Studies as designed provide strong support for (or falsify) the hypothesis. Most outcomes are interpretable.
- 3 – Studies provide clear support for a hypothesis, but do not distinguish between all possible models. Several possible outcomes are not interpretable.
- 4 – Studies have little power to distinguish among multiple possible models. They provide some support for a hypothesis, but multiple models are consistent with outcomes.

5 – Studies do not test the hypothesis or have insufficient power to distinguish different models.

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 are clearly described, logical and the approaches to their resolution are adequately explained. A knowledgeable reader can easily understand the research.
- 3 – A very good description of the research question/hypothesis. A knowledgeable reader can understand with some effort. The rationale is 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 are inappropriate, illogical or missing. The author used a lot of jargon without explanation.
- 5 – A poor description of the research. It is 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 are 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 fit or are 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.

Discussion (Analysis):

- 1 – The author provided an in-depth analysis of the results and demonstrated exceptional insight into the broader implications.
- 2 – The author provided an excellent critical analysis of the data. Interpretation goes significantly beyond the simplest interpretation.
- 3 – The author provided a very good discussion of the results but stayed mostly within the bounds of current thinking.
- 4 – The author provided a limited analysis of the data; however, the author mostly reiterated the results without further expansion.
- 5 – The author failed to provide a thorough critique of the experiments and results.

Discussion (Future Research):

- 1 – The student was thinking about experiments, results and future directions at the level of a professional in the field.
- 2 – The thesis contains several good ideas for future work. The ideas build upon the student's findings, incorporate additional scholarship and are worthwhile suggestions for future research.
- 3 – The thesis provides one or two good ideas for future work. These are relevant to the field but may be only incremental in nature.
- 4 – The student made a very limited attempt to suggest future experiments or directions.
- 5 – The student made an unsuccessful attempt or failed to explain future directions.

Thesis Scholarship – This thesis:

- 1 – Is a model of impeccable scholarship. The background material has been thoroughly researched and properly referenced. It is an authoritative assessment of the relevant primary literature. The author has mastered the

issues and integrated them to make an original and complete intellectual contribution. The author has provided the reader with the relevant information to understand the significance of the problem at hand.

- 2 – Shows careful scholarship and frequently cites the primary literature. The author has mastered most of the relevant material and has integrated it well to set up the thesis research.
- 3 – Shows average scholarship. The author accurately presented findings from the literature, but relied heavily on reviews rather than primary sources. The significance of the thesis research may not be immediately clear to an outside reader or may be difficult to extract because of excessive detail.
- 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. Not enough information has been provided to understand the thesis research question.
- 5 – Shows 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 clear and concise. Needs no editing and reads as though it was written by a professional in the field.
- 2 – Is easy to read, needs only minor editing. Represents excellence in student writing and appears to be the end product of multiple drafts.
- 3 – Is well written, but requires revisions and editing. Usually clear, but some sections need to be re-read to get at the meaning. Reads like a good, proof-read draft.
- 4 – Is poorly written. Significant portions are sloppy or unclear. There are many grammatical errors and ambiguities. Reads like a rough draft.
- 5 – Is difficult to read. Most sections are unclear, ungrammatical and convoluted. Unquestionably a rushed draft that has not been proof-read.

Computational Thesis

Evaluation of the thesis work and the written document (1 is highest, 5 is lowest) for all of the criteria listed below. Most students should get a 3 for each criterion.

Originality – This student:

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

Work Ethic (Adviser Only) – This student:

- 1 – Worked as much as a good graduate student.
- 2 – Worked significantly more than 20 hours a week.
- 3 – Worked consistently, about 15-20 hours a week.
- 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 (Adviser Only) – This student:

- 1 – Attained a high level of independence and became self-sufficient in performing analyses/computations.
- 2 – Became largely independent, requiring occasional guidance from the faculty, post-doc, or graduate student mentor.
- 3 – Continued to require frequent consultation from mentors, but originated many of the analyses/computations.
- 4 – Continued to need frequent help with the planning and/or execution of most analyses/computations.
- 5 – Never worked without extensive help in the planning and execution of all analyses/computations.

Completion – This thesis:

- 1 – Is a complete story and essentially publishable in its own right.
- 2 – Needs just a few additional experiments to be a publishable story.
- 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 (Adviser Only) – 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.

Analysis/Computation Quality – The analysis/computational work by this student:

- 1 – Is beautiful, creative, and error-free, equivalent to an excellent graduate student's.
- 2 – Is clearly superior, perhaps equivalent to most graduate students.
- 3 – Is average, largely correct, but with occasional errors.
- 4 – Is error-prone and without important contributions.
- 5 – Is essentially without merit, no useful contributions or believable results.

Thesis Technical Description (including Methods):

- 1 – Outstanding. All analyses/computations are clearly described and their rationales explained. Understandable by a general science reader. Description conveyed more than sufficient information to repeat the work.
- 2 – An excellent summary of the analytical/computational procedures. A knowledgeable reader could repeat with little difficulty.

- 3 – A very good description of the analyses/computations. A knowledgeable reader could understand and repeat with some effort. The rationale is not always clear. There are some instances where the author assumed knowledge on the part of the reader, or used jargon.
- 4 – A good summary of the analyses/computations. Occasionally, relevant details are either incorrect or missing. The work would be difficult to repeat. The author used a lot of jargon without explanation.
- 5 – A poor description of the analyses/computations. It would be impossible for a knowledgeable reader to repeat the work.

Approach:

- 1 – Chosen approaches are incisive, rigorous and powerful. They allowed the student to rigorously test hypotheses and distinguish between all reasonable models. Both positive and negative results are interpretable.
- 2 – Approaches as designed provide strong support for (or falsify) hypotheses. Most outcomes are interpretable.
- 3 – Approaches provide clear support for hypotheses, but do not distinguish between all possible models. Several possible outcomes are not interpretable.
- 4 – Approaches have little power to distinguish among multiple possible models. They provide some support for hypotheses, but multiple models are consistent with outcomes.
- 5 – Approaches do not test hypotheses. Experiments have insufficient power to distinguish different models.

Thesis Results:

- 1 – Outstanding. Results are presented in a logical, effective and creative manner. Data are presented accurately and clearly and could be easily understood by a general reader. Where appropriate, controls and their significance are clearly and thoroughly described. Conclusions are valid, insightful and not over-interpreted. Figures are publication quality, appropriately labeled, with comprehensive legends.
- 2 – Excellent. The analytical/computational results are described accurately and completely. Conclusions about these results are appropriate and not over-interpreted, but not particularly insightful or thoughtful. Figures are high quality, appropriately labeled, with comprehensive legends.
- 3 – Very good. Analytical/computational results are presented in an effective manner. Most of the conclusions about these results are solid, but in rare occasions may lack accuracy. A general reader might have minor difficulty following the conclusions. Some figures are lacking in quality and/or labeling; legends are adequate.
- 4 – The results section is a collection of data with little information to explain the significance. Some portions are unclear or missing. Analytical/computational results are 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 are absent (under-interpreted). Some figures are missing or low quality, poorly labeled, with minimal legends.
- 5 – Little attention beyond a quick statement of the results. Missing context or controls where appropriate. The author did not understand analytical/computational results or failed to draw conclusions. Figures are missing, poor quality, lack labels, with minimal legends.

Discussion (Analysis):

- 1 – The author provided an in-depth analysis of the results and demonstrated exceptional insight into the broader implications.
- 2 – The author provided an excellent critical analysis of the analytical/computational results, including ideas that went significantly beyond the simplest interpretation.
- 3 – The author provided a very good discussion of the results but stayed mostly within the bounds of current thinking.
- 4 – The author provided a limited analysis of the analytical/computational results; however, the author mostly reiterated the results without further expansion.
- 5 – The author failed to provide a critique and simply reiterated the results.

Discussion (Future Research):

- 1 – The student was thinking about analysis, results and future directions at the level of a professional in the field.
- 2 – The thesis contained several good ideas for future work. The ideas build upon the student's findings, incorporate additional scholarship and are worthwhile suggestions for future research.

- 3 – The thesis provided one or two good ideas for future work. These are relevant to the field but may be only incremental in nature.
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Thesis Scholarship – This thesis:

- 1 – Is a model of impeccable scholarship. The background material has been thoroughly researched and properly referenced. It is an authoritative assessment of the relevant primary literature. The author has mastered the issues and integrated them to make an original and complete intellectual contribution. The author has provided the reader with the relevant information to understand the significance of the problem at hand.
- 2 – Shows careful scholarship and frequently cited the primary literature. The author has mastered most of the relevant material and has integrated it well to set up the thesis research.
- 3 – Shows average scholarship. The author accurately presented findings from the literature, but relied heavily on reviews rather than primary sources. The significance of the thesis research may not be immediately clear to an outside reader or may be difficult to extract because of excessive detail.
- 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. Not enough information has been provided to understand the thesis research question.
- 5 – Shows 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 clear and concise. Needs no editing and reads as though it was written by a professional in the field.
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- 5 – Is difficult to read. Most sections are unclear, ungrammatical and convoluted. Unquestionably a rushed draft that has not been proof-read.

Evaluation of the Oral Exam

The oral exam is designed to evaluate the student in three ways. First, the faculty will examine the student's mastery of the specific topic of the thesis, as well as the larger field of molecular biology related to the research topic. The student should be able to describe both the details of his/her research as well as its meaning and context; s/he should be able to answer the questions "What did you do, and what did you learn?" Second, the faculty will investigate how well the student is able to synthesize his/her understanding by suggesting new hypothesis and/or experimental tests to resolve ambiguities, gaps in their research or alternate interpretations of their results. This part is: "What is missing and what more would you like to have done?" The third part concerns the bigger context of the research topic and asks the student to propose future research that would substantially move the field forward. This part is: "What don't we know that is important and how would you study it?"

Evaluation of the oral exam (1 is highest, 5 is lowest) for the criteria listed below. Most students should get a 3 for each criterion.

Factual/Conceptual Knowledge:

- 1 – Outstanding. This student demonstrated mastery of the larger area of his/her 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 his/her 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 led 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 led to suggest a test of their hypothesis.
- 4 – Below average. The student was able to understand hypotheses provided to explain observations and provide 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 the 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.
- 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.