

## Genetics Research Paper Requirements for GENE 4960R/4970R/4980R

Every student completing a research course for Genetics credit must submit a paper to fulfill the requirements for the course and receive a final grade.

The content of the final paper will largely be determined by the faculty research mentor. The standard expectation for the final paper follows the format of a standard primary literature scientific paper, with an Introduction to the background of the research problem, a Materials and Methods section detailing the experimental approach taken, a Results section, a Discussion of the results with some connection to the introduction and Literature Cited of the primary scientific literature used in preparation of the paper.

The Department recognizes that each research experience is unique and that not all students will be able to complete a research experience with substantial data collection. However, the primary expected learning outcome of all research courses is that the student learns how to apply the process of science to research questions in genetics. Even without data, each student should be able to write a report that details (1) an understanding of the broader context of the research attempted, properly researched and cited, and why the research question was worth pursuing; (2) the hypotheses being explored in the research; (3) a description of the experimental approaches attempted to address the research, with special attention paid to the nature of controls and replication; and (4) a description of any results obtained, or if no results were obtained, a description of how and why the research was not successful and steps to be taken in the next phase of research.

A draft of the final paper should first be submitted to the faculty research mentor, who should provide feedback on the draft and provide an opportunity to make revisions before a final paper grade is assigned. The deadlines for submission of a draft and final version of the final paper are to be set by the faculty research mentor.

After the final version of the paper is submitted to the faculty research mentor, the paper must also be filed with the Department of Genetics. For fall and spring, the final paper is due to the Undergraduate Coordinator's Office no later than 5 pm on the last day of finals of the semester enrolled, and on the last day of classes for the Thru Session in summer. Please email your paper to both mauricio@uga.edu and blnorman@uga.edu.

### Paper Guidelines

- The requirement requires a substantive written report, not simply an abstract or a brief research progress update. The paper must include, at minimum, (see below) a title page, an introduction, a discussion and literature cited. There are no page limits set by the Department; the length of the paper should be determined in consultation with the faculty mentor.
- Typeface should be Times New Roman, 12-point.
- Paragraphs should be single-spaced with 1-inch margins.
- Submit your paper with the file name in the following format: Last name, first name\_ GENE 4960R/4970R/4980R
- The paper must consist of a single .pdf or .docx with all figures incorporated into the text of the document (not grouped at the end). If your paper requires an Appendix, include this section following the References.

Papers should include the following elements:

#### 1. A Title Page, which should include:

- Research Paper Title
- Faculty Mentor Information: Name, Department, Email, and Phone Number
- Student Information: Name, Address, Email, and Phone Number
- Semester/year research was completed
- Course Number (*i.e.*, GENE 4960R/4970R/4980R)

#### 2. Abstract (1 paragraph, maximum of 200 words)

- State your purpose and the significance of your paper.
- Summarize your methodology.
- Summarize your results by stating your major findings.
- State major conclusions and implications.

#### 3. Introduction\*

- Present tense: Write the Introduction in present tense.
- Key terms: Define key terms so that readers in other disciplines will understand them.
- Explicit language: Use explicit language (e.g. “we hypothesize”) as it helps the reader to find the key parts of your study, such as your statement of purpose.
- 2-5 paragraphs: The Introduction is often in the range of two to five paragraphs long

Broad to narrow: Focus the Introduction around the hypothesis, specific questions, or aim of your study. Start with what is known: provide context and background information about what is known on your topic. Then move to what is NOT known. Pinpoint the gaps and limitations of previous studies. Include several citations in the Introduction, not just one or two. What were the limitations of those studies that make the results uncertain? Hypothesis: Your Introduction should end with your hypothesis or specific question and explain your approach to the research problem.

#### 4. Methods\*

- Past tense: Write your Methods section in past tense (e.g. “We measured...”), as you’ve already completed the research.
- Voice: The Methods section is the one place in your paper where you may opt to use passive voice. (Remember: passive voice emphasizes the action and object: “The sample was placed under the microscope.” Active voice emphasizes the subject: “We placed the sample under the microscope.”)
- Recipe for replication: The Methods section should give a clear overview of how the research study was conducted: it is the recipe for the study. It gives sufficient information so that someone else could replicate the study.
- Narrative structure: This section should be written as a narrative, not as directives. For example, instead of writing “Place the sample under the microscope,” say either “The sample was placed under the microscope,” or “We placed the sample under the microscope.”
- Subsections: The Methods section should be written in paragraph form. You can break your methods into smaller sections with subheadings (discuss related methods together) to help with organization.
- Details: The Methods section should contain information about the materials used to conduct the study, experimental conditions, and study subjects.
- Rationale: As you describe your actions during the experiment, explain your rationale for the any protocol you developed. If you capped a test tube immediately after adding a solute to a solvent, why did you do that? (That prompts two questions: why did you cap it, and why did you cap it immediately?) Provide rationale as a way to explain your thinking to potential critics.

#### 5. Results (if you have any)\*

- Past tense: Write your Results section in past tense (e.g. “We analyzed...”), as the events have already occurred.
- Summarize: In the Results section, data, observations, and findings should be summarized, without being interpreted.
- Tables, equations, charts, and figures: Include tables and figures (images or graphs) to present findings clearly and concisely.
- Contextualize: Do not begin the Results section with tables and figures. Present some context in paragraph form before you incorporate your exhibits.
- Tables and figures must include a title, a number, and a brief description (Table 1, 2, 3...).
- Most often, tables and figures appear in the text just after they are mentioned.
- A table is identified by a heading, which should go above the table.
- A figure is identified by a caption, which should go below the figure.
- The title should be a brief phrase stating the type of analysis or a sentence summarizing the major result seen in the figure.
- All figures and tables should be referred to in the body of the paper (i.e. “see Table 1”) and need to be numbered in the order they are discussed in the paper.
- Describe trends that emerge: The reader can go to a table or figure to get data themselves: the Results section should give a higher-level summary. Which significant data do you want your readers notice? What are the overall results that a table shows? Remember: do not interpret what your data means in the Results section: save your interpretation for the Discussion section.

## 6. Discussion (whether you have results or not)\*

- Present tense: Write the Discussion section in present tense.
- Interpretation: The Discussion section should interpret your results and convey why they are important.
- Reverse Introduction: The Discussion section can be represented by inverting the cone of your Introduction. Answer the question you asked at the end of the Introduction. Support your conclusion. Defend your conclusion. Give the big picture.
- Address hypothesis: The Discussion section starts by answering the question asked at the end of the Introduction. Explain whether or not your data support your hypothesis. Remember, data do not prove or disprove a hypothesis; rather they add support for or do not provide support for a hypothesis.
- Anomalous data: Acknowledge any anomalous data or deviations from what you expected.
- Claims: Refer to evidence to derive conclusions about the process you're studying.
- Avoid overreaching: Avoid overstating your findings in the Discussion section. Focus on the interpretations you can support with evidence, and avoid coming to conclusions that are not supported.
- Previous work: Discuss your findings in relation to other research: say how your results fit into the context of the literature.
- Limitations: State limitations of your research. Anticipate the criticisms that readers may have and defend your conclusions against those criticisms.
- Implications: At the end, give the big-picture implications of your research. What is the relevance of your findings beyond the experiment? Also, consider where future research might further develop your findings.

## 7. Literature Cited\*

- Start the Literature Cited section on a new page.
- All literature sources that were cited in your paper must appear in the reference section. Only cite materials that were referenced in your paper.
- Journals often have their own citation styles. You may follow the citation format of a scientific journal in your research field for your paper. Alternatively, you may use the Scientific Style and Format Name-Year format, as specified in the Council of Science Editors (CSE) :

Last-name, First-initial. Year. Paper title. Journal title. Volume: page numbers.

- For the Literature Cited page in the CSE Name-Year format, list all references alphabetically by first author's last name. If there is more than one study by the same author, list them in date order (oldest to newest). Use hanging indent for the second line of each reference:

### In-text Citations

- In the body of your paper, use reference citations to give credit to the people who have written the articles you use.
- When you refer to someone else's work, paraphrase or summarize rather than quoting.
- If you are following the style guide and citation format from a scientific journal in your research field, then follow their guidelines for in-text citations.
- If you are following the CSE Name-Year format for your references, then your in-text citations should be in the following format: (Author Year).

#### *Example:*

...the adult brain can have multiple cilia, and cells in the bronchial epithelium can have hundreds of cilia (Afzelius 2004).

#### *Example of citation appearing as part of a sentence:*

Kartagener (1933) defined an inherited human syndrome that showed the unusual combination of bronchiectasis.

When a work has one or two authors, cite both surnames and the date of publication.

#### *Example:*

It has also been suggested that cilia, which protrude into the extracellular space, act as antennae to receive extracellular signals (Singla and Reiter 2006).

*Example of citation appearing as part of a sentence:*

Singla and Reiter (2006) suggested that cilia act as antennae to receive extracellular signals.

For co-author groups of three or more authors, cite only the surname of the first author followed by *et al.* and the date.

*Example:*

...alleles showed that the gene was required for the movement of IFT particles (Kozminski *et al.* 1995).

*Example of citation appearing as part of a sentence:*

Kozminski *et al.* (1993) observed particles that moved from the base to the tip of the *Chlamydomonas* flagellum

Use multiple citations if several articles have the same findings. Cite sources as close as practicable to the information they support. This might mean citing a source at the end of a sentence or in the middle of a sentence. When several in-text references occur at the same point, give them in chronologic sequence from earliest to latest, separated by semicolons. For multiple citations from the same author, include the surname only once and list the years of publication chronologically, separated by commas.

*Example:*

Genetic studies have confirmed that IFT proteins are essential for the construction of cilia in *C. elegans* (Cole *et al.* 1998), zebrafish (Sun *et al.* 2004; Tsujikawa and Malicki 2004), and mice (Pazour *et al.* 2000; Huangfu *et al.* 2003).

#### Final Tips\*

- Write simply: Avoid lengthy and complex sentences. Instead of “The initial hypotheses of the results of this series of experiments are as follows,” write “My hypothesis is...”
- Latin (scientific names and abbreviations like *i.e.*, *e.g.*, *et al.*, *etc.*) must be italicized.
- Writing process: Though the order of sections in your final draft should be Introduction, Methods, Results, Discussion, it’s often easier to develop a research paper by working on the sections of it in the following order: (1) Tables and figures, (2) Results, (3) Methods, (4) Discussion, (5) Introduction, (6) Abstract.

**\* These sections were almost entirely based on material provided by the Division of Biological Sciences to Biology majors completing research courses.**