



UNDERGRADUATE RESEARCH

You have the opportunity to follow your own investigational instincts through undergraduate research. This experience gives you the opportunity to specialize in a specific area of interest, connect with faculty, and prepare for graduate school or a career in research and development. This packet covers information that can assist you in finding opportunities in undergraduate research, as well as the possibility of writing a thesis and earning distinction. Please read through this thoroughly and if you still have questions, contact the College of Engineering office to speak with an advisor.

DEFINITION OF RESEARCH

Why are frogs dying at such a high rate? If we just googled this, we would come up with about 26,900,000 hits. We could click on a few of them, read the information on the webpages, and we would know more about this topic. We could even write a report to summarize the information that we read. Although we probably learned something interesting, what we did is not research.

However, it could be the beginning of research, if we took the process further.

This section describes what it means to do research. A research project consists of several stages, as described below. **At the undergraduate level**, you might only be able to get involved in one or two stages of an ongoing research project. Nonetheless, you should understand the entire generic research process, and for the specific research project in which the student is engaged, you should be able to demonstrate knowledge of the topic area and should make a meaningful contribution to the research, in order for the involvement to receive research credit.

The research process. Gathering information on the current understanding of a problem/question is the first step in doing research. It is referred to as a review of the literature (a review of the knowledge others have discovered about the topic). In other words, this is simply coming “up to speed” on the topic of interest.

The essential aspect of research is the creation of new knowledge. This can occur in many ways, including observation, planned investigation, design and analysis.

Some purposes of research include:

- Developing or testing a theory
 - This is research that tries to establish why or how something occurs (consistently, apple falls downward from tree to ground – why?)
- Predicting an outcome
 - For example: based on statistical analysis of climate data, a new computational model predicts that the world’s oceans will rise X cm by the year 2050.
- Developing or testing a new method or device
 - Is there a better way? For example: using a standard screwdriver was compared to using a new prototype tool; using the prototype tool required less time and less arm muscle activity, but resulted in more defects than using the standard screwdriver
- Systematic review
 - Collectively, what do all these separate research studies on topic Z say about the topic? A systematic review goes well beyond reading the existing literature on a topic; it involves planning and critical analysis.

Individuals who conduct research must identify **something new to study**, review what is already known about the topic, and develop a plan for gathering and analyzing data that will provide information to address the question in an objective way. Then conduct the study, analyze the data, draw conclusions, and examine the limitations of the study. Research requires critical self-examination. What are the limitations of the planned investigation? Could the results be due, in part, to the way the study was conducted? The final step is disseminating the results, to an internal or external audience, through a report, presentation, peer-reviewed journal paper, patent, product, or other means of communication.

Something new to study does not have to be something entirely new. It can include using new technology to study a question that has been studied before, if the new technology is likely to provide new insights, or studying a question in a new population (how does this apply to older adults, to veterans, to first generation college students, etc.), or applying new modeling techniques, etc. **The key is that the information that the research produces is new.** It is also highly desirable that the question being studied is interesting, meaning what you learn through your research will be useful, or at least interesting, to someone else.

To reiterate, at the undergraduate level, you are not expected to conduct an entire research project. You must, however, make a meaningful contribution to the research in which you engage and demonstrate knowledge of the topic area in order for the involvement to receive research credit.

GETTING STARTED

One of the most challenging parts of undergraduate research can be finding a project. This process should occur during your first three years as an undergraduate engineering student. Here are a few ways to find a project:

- Reach out to an influential instructor with whom you've had a course. Before doing so, gather information on your own regarding the research this faculty member is currently working on to ensure that it aligns with your interests and prepare for your initial discussion about opportunities or formal email listed below.
- Search departmental and faculty websites to see what current projects exist in that department or with that faculty member. Innovative projects are usually highlighted here. These websites also usually contain detailed information about areas of research and/or labs available within that specific department.
- Connect with our Undergraduate Research Office (URO) by checking their website regularly, signing up to be on their email listserv, and/or contacting one of their peer researchers.
- Talk to upper class students already working on research projects by attending research forums (e.g. Denman Forum). You can also reach out to your departmental academic advisor and/or your departmental Undergraduate Honors Representative. You should also check with your advisors about information sessions held in the department about undergraduate research.

Your next step should be to contact the faculty members who are conducting research in areas of interest you, in order to identify a faculty member who would be willing to serve as your research advisor. Keep in mind, you can do research outside of your major department, within a different engineering department or even within a different college at Ohio State. Here are a few strategies for contacting faculty:

- Be formal. When contacting them through email, make sure you are clear in your request and also formal in your writing. Be ready to email them a current resume and Advising Report. Make sure to email from your Ohio State email account.
- Be patient. Faculty members are busy people. Not only do they have teaching responsibilities for multiple classes, but they have research and service responsibilities as well. It may take them up to a week to respond, so plan ahead.
- Understand that some faculty members may not have room in their lab or may not be willing to advise undergraduate students. Try not to take this personally and keep looking for an advisor.

If you are looking to earn course credit for your research, you are able to take 4998 while you are getting started. If you decide to pursue research distinction or honors research distinction, you will take 4999 or 4999H at a later time. More information can be found in the following sections.

RESEARCH DISTINCTION

Research that culminates in the production of an undergraduate research thesis allows you to receive the designation of “**Graduation with Research Distinction**” or “**Graduation with Honors Research Distinction**” on your diploma upon graduation from Ohio State. The requirements for earning either research distinction or honors research distinction can be found below. Keep in mind, you can earn this as an honors student or as a non-honors student. Students may also choose to participate in undergraduate research in the absence of earning distinction. Either option will provide you with a valuable experience. If you are looking to earn “**Graduation with Honors in Engineering**,” please work with an honors advisor in the College of Engineering to submit an Honors Contract.

RESEARCH DISTINCTION GPA REQUIREMENT

If you are planning to earn research distinction, you need to have the following cumulative point hour ratio (CPHR) at Ohio State at the end of the term in which you apply for distinction and also at the end of the term in which you graduate:

- Honors Students = **3.400** Minimum
- Non-Honors Students = **3.000** Minimum

The reason for a CPHR requirement is to make sure classes are your first priority. There are no exceptions to this requirement.

RESEARCH DISTINCTION APPLICATION

In order to be eligible for research distinction or honors research distinction upon graduation, you must submit an application, which includes both a proposal and letter of recommendation from your research advisor. **We recommend that you submit this at least three terms prior to your graduation term to ensure that you have enough time to complete your project and the distinction requirements, while having a worthwhile and beneficial experience.** If you are unable to meet this deadline and you are an honors student, you will likely lose your honors status temporarily, but you can regain honors status when you do receive approval to pursue distinction through this application. Please note that you cannot seek approval of an application during your graduation term.

Application approval will enable you to enroll in research distinction coursework (4999 or 4999H) and to earn distinction upon graduation, if all other requirements are met. Your application will also be reviewed for potential funding from the **Undergraduate Research Scholarship (URS)**. This is not a separate application process; see section “Research Distinction Application: Undergraduate Research Scholarship” for the details of this scholarship opportunity. The application is online only and accessible between the first day of the term and 5 p.m. on the deadline through this website: <https://engineering.osu.edu/scholarships/undergraduate-research>. **The deadline for this application is 5:00 p.m. on the 6th Friday of autumn or spring term, or 5:00 p.m. on the 3rd Friday of summer term.**

Your application will be reviewed by a committee of faculty members during the entirety of the term in which you submit your application. The faculty will review both your proposal and your research advisor’s letter of recommendation. You will be notified of the results of your application in regards to both approval and the scholarship by the last day of final exams during the term in which you applied. Because you need application

approval to enroll in 4999 or 4999H, please wait until receiving this response to enroll in the appropriate research course for the following term.

When filling out this application, you will need to determine the area in which you plan to receive distinction if your project is interdisciplinary in nature. You and your advisor should determine this at the beginning of the project. For example, you may be a student pursuing a Chemical Engineering BS degree, but your distinction area and co-advisor are within the department of Chemistry. You can earn "Graduation with Honors Research Distinction in Chemistry." It is important to plan this in advance to ensure that you are meeting the correct requirements which align with your project. If you are doing research outside of engineering, you need to have a co-advisor in engineering with graduate advising status. See the following sections regarding guidelines for the proposal, letter of recommendation, and scholarship.

RESEARCH DISTINCTION APPLICATION: PROPOSAL

Begin working on your proposal during your third year or sooner, after determining your project topic and research advisor, as you start the initial steps of your research project. The proposal should be a maximum of six typewritten page, including figures. Your figures can be all on a single page at the end of the body of the proposal or embedded throughout the text – either way, they will be included in the page count. The title page (which includes your abstract) must all be on one single page at the beginning of the document, and does not count towards your six page maximum. Your bibliography should include all of your references (which should also be cited throughout the body of your proposal) and should appear at the end of the document – the bibliography also does not count towards the six page maximum. **A penalty of -3 points out of 30 points will be assessed for exceeding this page limit.** All pages should have a 1" margin all around; font should be Arial or Times New Roman in size 12; proposal should be double-spaced. **Failure to follow these guidelines will result in penalties during the application review process, which may reduce the amount of scholarship money awarded and/or lead to the application not being approved.**

The proposal should include the following content areas (multiple sections can appear on a page):

- **Title Page (includes abstract – 1 page maximum)**
 - Project Topic, Name, Date, Department, Advisor
 - Abstract (summary of the problem statement, objectives, and methodology) – **penalty of -3 points out of 30 total points for not including an abstract**
- **Body (6 page maximum – figures can be on a single page at the end or embedded in text)**
 - Background and Motivation
 - Define problem statement and general area in which you are working
 - Assess the shortcoming(s) with existing knowledge and/or existing approach
 - Discuss previous related research in this area
 - Include specific key facts about the problem at-hand
 - Highlight the importance of answering the problem
 - Significance
 - Discuss importance of research project
 - Research Goals
 - Discuss hypothesis of project and/or overall objectives
 - Include what you hope to resolve after performing this research
 - If working in a research group with multiple investigators, indicate your individual contribution to the project
 - Methodology
 - Provide specific details in your proposed approach

- Timeline – **penalty of -2 points out of 30 total points for not including a timeline**
 - Provide a table or chart outlining your full timeline for completing this project, including all tasks involved (e.g. taking 4999, writing thesis, etc.)
 - Include any work you have already completed for this research project
- Brief Personal Statement
 - Include information regarding your background in the field and how the project prepares you for your future career
 - Include a statement concerning any arrangements that have been made to obtain or use special equipment or other resources required for the project
- **Bibliography (does not count towards 6 page maximum of body)**
 - List all references (they should also be cited throughout the body)

Proposals are reviewed and scored by a faculty committee which very likely will not include a specialist in your field. The faculty members who review your proposal will be from Engineering departments outside of your major and department of research, so be sure you write your proposal for a non-expert audience (but they will still be familiar with common scientific and general engineering principles). Attempt to state your proposal and its significance as clearly as possible. Make sure to avoid jargon and define acronyms. Clearly define the part of your project on which you are focusing if there is a group involved with this research. Your proposal will be reviewed based on the following criteria:

- Technical Feasibility (timeframe, facilities, and student background)
- Clarity of Presentation (appropriate language and grammar, precise and logical presentation of ideas)
- Research Contribution (well-formed questions and an explanation of how this project will address those)

Submission of a research proposal does not guarantee that it will be approved by the committee, and an approved proposal is a pre-requisite for the pursuit of research distinction. Because the project is to be carried out in close cooperation with your research advisor, the proposal should be written in consultation with the faculty member who will serve as your research advisor.

Sample proposals are available for viewing in Hitchcock Hall (2070 Neil Avenue) Room 025 (basement) during normal business hours (Monday - Friday from 8:30 AM through 4:30 PM).

RESEARCH DISTINCTION APPLICATION: LETTER OF RECOMMENDATION

Applications and proposals must be accompanied by a letter of support from your research advisor. Upon completion of the electronic application, your research advisor will be notified via email and instructed to upload a letter of recommendation in support of your proposal. The research advisor recommendation must be received by **5 p.m. on the seventh Friday** of the term in which you applied (**or 4th Friday if you applied during summer term**). The importance of the recommendation letter cannot be overemphasized. Approval and scholarship award determination will be based on the potential value of the project for the student. The interest and concern of the research advisor and his/her assessment of the student and the project often will be influential in the approval process. Recommendation letters should include the following:

- Context for the research project and a discussion of why the research is significant;
- Description of how the research work will be supervised (e.g., weekly meetings or by a graduate/postdoctoral student);
- Description of how the proposed project fits within other related research projects in your lab;
- A discussion of the proposed time schedule and whether the project can be completed in the given time;
- A description of progress made up to the current time, if the student has already started the proposed research project;

- A description of previous research, if the student has worked on other research projects under your supervision;
- If student is working in a research group with multiple investigators, indicate his or her individual contribution to the project.
- A discussion of the ability of the student to successfully carry out the project

RESEARCH DISTINCTION APPLICATION: COLLEGE OF ENGINEERING UNDERGRADUATE RESEARCH SCHOLARSHIP (URS)

The faculty committee will also review your application for consideration of receiving the College of Engineering Undergraduate Research Scholarship based on the criteria mentioned in the previous section during the term in which you apply. All engineering students pursuing distinction and with at least a 3.000 CPHR at the end of the term in which they apply will be considered for this scholarship.

The number of scholarships awarded will be determined by the amount of funds available. The amount of the awards range from \$500 to full in-state tuition and are determined by the score on your research proposal, with higher scoring proposals leading to larger dollar amounts. The scholarships are applied toward any University fees at the rate of half the amount of the scholarship over the subsequent two semesters. Students who are awarded funds as part of the autumn application will receive funding during the subsequent spring and autumn semesters; students who are awarded funds as part of the spring or summer application will receive funding during the subsequent autumn and spring semesters. Should the project require a different pattern of support, special arrangements must be made with and approved by the College of Engineering Scholarship Coordinator and Associate Dean of Undergraduate Education and Student Services. Submission of an application does not guarantee award. Students who do not receive awards are eligible to re-apply for the College of Engineering Undergraduate Research Scholarship in a future autumn, spring, or summer term.

Please note that this scholarship will merely substitute other forms of aid with no net gain to the recipient. First, if you are receiving need-based aid, the College of Engineering Undergraduate Research Scholarship can only bring total awards to the amount allowable under the Title IV federal regulations which establish need. Second, if you are receiving University scholarship funds at the maximum currently allowable, you are ineligible for additional funding. **Students who have been awarded funds from a previous College of Engineering Undergraduate Research Competition are not eligible to re-apply.** Students may receive funding for a maximum of two semesters. All awards will be divided into two equal disbursements. Students graduating in the term following their application submission may receive only a portion of their award. Continued disbursement of funding is contingent upon satisfactory progress as determined by the faculty research advisor. The College of Engineering will require satisfactory progress reports each semester. Students must also maintain a CPHR of 3.000 or higher to continue receiving funds. Any violation of these terms is subject to immediate suspension of funding.

Recipients generally must be enrolled as full-time students (12 credit hours) during the semesters in which they receive funding (except summer term). Exceptions for less than 12 credit hours must be approved by the College of Engineering Associate Dean of Undergraduate Education and Student Services. Students must enroll in and complete a minimum of 6 credit hours of 4999 (non-honors) or 4999H (honors) within the department in which the research is being completed. This is also a requirement for distinction as outlined in the next section. Recipients are also required to participate in the College of Engineering Research Forum occurring in the spring term: www.engineering.osu.edu/urf. Students are also encouraged to participate in the Denman Research Forum in the spring: www.engineering.osu.edu/undergraduate/research/forum. Keep in mind, both of these events can count towards your Enhanced Honors Experience (more details provided in "Research Distinction: Enhanced Honors Experience" section). Recipients are required to complete all requirements of Honors Research Distinction or Research Distinction, as outlined in the following sections. Failure to do so may result in suspension of funding.

RESEARCH DISTINCTION COURSEWORK

After being approved for distinction through the previously mentioned application process, you are eligible to enroll in research coursework. A minimum of 6 semester credit hours is required; a maximum of 9 hours is allowed. These must be taken over multiple (2 or more) terms. Students usually enroll in this course during their last two terms at Ohio State as an undergraduate student.

In most departments, this course is not an actual class, but a placeholder to give you credit for the amount of work put into your research project. The exact number of credits will be determined by the student and project advisor, in accordance with any department policies. You should work with your research advisor to determine the requirements for successful completion of this course. This course should be taken in the department in which you are receiving distinction and also with your research advisor listed as the instructor of record. Therefore, your advisor needs to be a faculty member in that department. Honors students pursuing a research thesis to graduate "With Honors Research Distinction" should enroll in 4999H and students pursuing a research thesis to graduate "With Research Distinction" should enroll in 4999.

In most departments, at least some of these hours can count towards your Technical Elective requirements. **Please talk to your academic advisor ahead of time to plan your projected curriculum considering this option.**

If you have not received approval through your distinction application or if you are not looking to pursue distinction but still want to conduct undergraduate research, you should enroll in 4998. Keep in mind, this course does not count towards the 6 required distinction hours.

RESEARCH DISTINCTION ENHANCED HONORS EXPERIENCE

This only applies to Honors students admitted to Ohio State in Autumn 2012 and beyond.

To earn **Honors** Research Distinction, you must complete option (A) or (B) below. Verification of completion of these activities should be emailed to the Undergraduate Research Coordinator, Mike Knisley, at Knisley.33@osu.edu. **Verifications are due four Fridays prior to the Commencement date of your graduation term.**

- Honors Contract in Engineering OR successful completion of the IBE Program OR
- Complete at least **3** of the following activities (with up to one repeated use of the same category)
 - Presentation of research at an OSU sponsored event (e.g. the Denman Undergraduate Research Forum)
 - Presentation of research at a meeting or conference external to OSU (e.g. meeting of a professional society)
 - Submission of a manuscript to a peer-reviewed research journal or conference proceedings (student may be a co-author)
 - Submission of a manuscript to an undergraduate research journal or non-peer-reviewed journal or proceedings (student must be lead author)
 - Submission of a graduate fellowship application to NSF, NIH, or NDSEG
 - Completion and submission of a patent disclosure application
 - 3 semester hours of Honors designated or graduate coursework (excluding 4998(H), 4999(H) courses)
 - Other appropriate activity by petition to and approval of the College of Engineering Undergraduate Honors Committee.

RESEARCH DISTINCTION THESIS

You should be working on your thesis while you are enrolled in the 4999 or 4999H course. Your research advisor can provide direction regarding the content and format of your thesis. Here are some recommendations in terms of the content of your thesis:

- Title Page
- Abstract
- Acknowledgements
- Table of Contents
- List of Figures
- List of Tables
- Introduction, including Literature Review, research significance, overview of thesis
- Methodology
- Results
- Conclusion, including contributions, additional applications, future work, summary
- Appendices
- References
- Figures
- Table

You should submit a draft of your thesis to your defense committee prior to defending. Once your research advisor has approved your thesis (typically after the defense), you should submit your final thesis to the [Knowledge Bank](#) **no later than four Fridays prior to the Commencement date of your graduation term.** Please see this site for instructions on submitting your thesis: <http://library.osu.edu/projects-initiatives/knowledge-bank/tools/submission-instructions-for-knowledge-bank-collections/knowledge-bank-submission-instructions-honors-theses/>. This can take a few days to be approved, so please submit 2-3 days prior to the noted deadline. As an additional resource for writing your final thesis, please reference the Graduate School handbook guidelines: <http://www.gradsch.osu.edu/Depo/PDF/Guidelines.pdf>.

If you are looking to **DELAY DISSEMINATION** of your thesis due to the following reasons, please contact Anne Krabacher at krabacher.4@osu.edu directly to request an embargo for your thesis: your research contains intellectual property, your donor or advisor has requested the dissemination of your thesis be delayed, you are publishing work elsewhere, or similar reason approved by Anne Krabacher. Please note, this is not a request to extend the thesis/defense deadline; it is to delay the public dissemination of your thesis and research findings for the previously mentioned reasons.

RESEARCH DISTINCTION ORAL DEFENSE

You must complete a satisfactory oral defense (presentation) of your research project and thesis before a 2-3 member faculty committee. The committee must consist of the research advisor, and at least one other faculty member with graduate advising status. It is your responsibility to ask faculty members to be a part of your committee and to ensure that they have graduate advising status (also known as M or P-status), to set up the day/time of your defense, and to reserve a space in which you will do this. You should plan for a one hour defense, including a 30 minute presentation and 30 minutes of Q&A. However, the format of the defense is determined by your research advisor.

Upon successful completion of your defense, the committee members will sign the Oral Defense Form, which must then be submitted to the Undergraduate Research Coordinator no later than **four Fridays prior to the Commencement date of your graduation term.**

RESEARCH DISTINCTION GRADUATION CERTIFICATION

Once you have completed all of these requirements, you will be certified to graduate with either Research Distinction or Honors Research Distinction during the term in which you are graduating. **Make sure to indicate this on your application to graduate.** In general, these are the checks we do for certification:

1. Earned the required CPHR (GPA)
2. Received approval via the Distinction Application/ Proposal
3. Completed and passed at least 6 hours of 4999 or 4999H in department of distinction over multiple terms
4. Completed and submitted verification of Enhanced Honors Experience (*only required for Honors students*) by deadline
5. Completed and submitted Oral Defense Form by deadline
6. Completed and submitted Final Thesis to Knowledge Bank by deadline

You will be notified via email by the Undergraduate Research Coordinator of your distinction certification two Fridays prior to the Commencement date of your graduation term. If you do not meet these requirements or deadlines, you will not receive this distinction on your diploma.

THE OHIO STATE UNIVERSITY

College of Engineering
Engineering Honors Committee
**Graduation With Research Distinction
Record of Oral Defense**

This is to certify that _____ has undergone the required examination* for Graduation With Research Distinction and that the quality of both the written and oral work is such that he/she should be graduated With Research Distinction in

(Research Program Name)

Sincerely,

Faculty Examiners

Name Printed Department Signature Date

Name Printed Department Signature Date

(Optional) Name Printed Department Signature Date

* The final examination may include a written component but must include a one-hour oral examination before **two** members of the faculty with graduate advising status, one of whom is the thesis advisor. Both must sign the report form above. The signed report form is due to the college (Undergraduate Research/Honors Advisor) in Hitchcock Hall (2070 Neil Avenue) Room 025 (basement) no later than **four Fridays prior to the Commencement date** of your graduation term.

* The final thesis must be filed electronically with the Knowledge Bank at <https://kb.osu.edu/dspace/> no later than **four Fridays prior to the Commencement date** of your graduation term.

Please print the link to your uploaded thesis here:
