

Lab Expectations - Engineering (a generic template)

Please note: this document is just a template that will need to be customized by each PI and research group to address the topics that are relevant for their specific research projects/portfolio (not meant as a one size fits all!). The template includes several important lab expectations topics and each PI and research group is invited to review, use, add or discard topics, as needed.

Core values of this lab

Welcome to our lab! This document outlines the expectations for all members of our research group. We value honesty, trust, integrity, transparency, truthfulness, mutual respect, fairness, responsibility, inclusiveness, and hard work. As we build upon these foundational values we will maintain and improve our research productivity, reproducibility and replicability, rigor and integrity, and earn the public trust in our research.

Our research group - Who we are

Our research group is led by Prof. XXXX, who is a faculty member at Purdue. We have a Lab Manager who works directly with the PI to ensure coordination of research personnel and smooth operation of lab equipment. All group members are vital to the operation of our research lab and the generation of novel ideas through discovery. Mutual respect is the standard in this research group. For more information about our group and our research portfolio, visit our Lab website: <https://>

Code of Ethics for Engineers

Engineering research, like any other scientific endeavor, is subject to a set of ethical principles that guide the conduct of research and ensure its responsible application. These principles are crucial for safeguarding the well-being of individuals and society, maintaining public trust in the profession, and upholding the integrity of engineering research. This lab and its members strive to uphold high standards of professional ethics and research integrity. As a guideline, this lab follows the Code of Ethics for Engineers from the National Society of Professional Engineers (NSPE). This code of ethics is based on the idea that members of the engineering profession should exhibit honesty and integrity through the ways in which they work and the decisions that they make.

“Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession” (NSPE, 2019).

Lab members are invited to consult the [Compendium of Ethical Guidelines by Discipline](#) and review other field specific guidelines.

Lab Expectations

General Expectations

➤ **Professionalism and Conduct:**

- All lab members are expected to conduct themselves professionally, ethically, and respectfully at all times.
- Be fair and respectful of all members of our research group and our colleagues.

➤ **Safety:**

- Complete required safety training and adhere to all safety protocols.
- Report to the PI or Lab Manager any issues that may place people, subjects, surrounding labs, or the campus community at risk. Use equipment and materials only as they are intended and following all safety instructions.
- Wear the appropriate attire for the equipment you will be working with. This can include wearing close-toed shoes, long pants, removing jewelry, tying back long hair, not wearing clothing with dangling strings, and wearing lab coats.
- Wear safety glasses or goggles when needed.
- Take appropriate trainings for equipment usage if required (e.g., for machine shop tools, lasers, microscopes, radiation training, etc.).

In addition, this lab follows Purdue guidelines for safety:

- Biological safety for proper use and handling procedures for biohazards
- Laser safety for the use of Class 3B or Class 4 lasers
- Chemical Hygiene Plan and Hazardous Materials Safety Manual
- Standard Operating Procedures (SOPs) for common chemicals and processes

➤ **Communication and Collaboration:**

Clear and open communication is essential for effective collaboration. Lab members are expected to:

- Attend lab meetings and actively participate in discussions.
- Communicate effectively with lab colleagues, advisors, and collaborators.
- Keep the PI informed about their research progress and any relevant updates.

➤ **Time Management and Work Ethic:**

Lab members are expected to manage their time effectively and demonstrate a strong work ethic. Please maintain a clear record of the hours spent working and participating in lab activities (especially when participation in research activities that require tracking for research credit or payment purposes).

Research-Specific Expectations

- **Project Participation:**
 - Understand and actively participate in the assigned research project or tasks.
- **Training and Development:**
 - Attend relevant seminars, workshops, and conferences to broaden your knowledge and skills.
 - Pursue relevant training and development options for your research project and career.
 - Complete Responsible Conduct of Research and other Researcher Trainings as required by University policy and sponsor.
- **Scientific Integrity:**
 - Conduct research with honesty and objectivity, adhering to principles of scientific integrity.
 - Report findings truthfully and accurately without fabrication, falsification, or plagiarism.
 - Acknowledge the contributions of others involved in the research, including funding agencies.

Lab Responsibilities

- **Maintain a clean and organized lab space:**
 - Clean up your work area after each use and dispose of waste materials appropriately.
 - Report any spills, equipment malfunctions, or safety hazards immediately.
- **Share resources responsibly:**
 - Use lab equipment and resources efficiently and according to established protocols.
 - Conserve resources and avoid unnecessary waste.
 - Respect the research materials and equipment used by others.

Additional Notes

This Lab Expectations manual is a living document and agreement between lab members that lays out the expectations for all members of the research group. The manual is meant to evolve across time to meet the needs and scope of our research portfolio. Lab members are encouraged to discuss any questions or concerns with the PI.

General Lab Guidance, Considerations, and Procedures

Research Study Design

Prior to beginning a research project in this lab, it is essential to lay out a comprehensive study design plan. Here's some guidance to help you navigate the process:

- *Define your research question/s.*
- *Conduct a comprehensive literature review:*
 - This helps identify gaps and opportunities in the field and ensures your study builds upon previous research. Identify relevant theories, methodologies, and findings that can inform your study design and analysis.
- *Choose an appropriate study design:*
 - Select a study design that effectively addresses your research question (e.g., laboratory experiments, observational studies, feasibility studies etc.).
- *Specify your methodology:*
 - Clearly outline the specific methods you will use to conduct your research, including materials and equipment needed, data collection procedures, data analysis methods, and quality control measures to maintain data integrity and reliability. Plan for a pilot study if needed.
- *Collaboration:*
 - Collaborate with other researchers in your field or related disciplines. This can offer diverse perspectives, enhance your research expertise, and enrich your study design.
- *Statistical power analysis:*
 - Conduct a power analysis to determine the minimum sample size needed to achieve statistically significant results.
- *Reference relevant resources:*
 - Consult relevant research guides, textbooks, and academic publications in your specific field for detailed guidance on study design and methodologies.
- *Ethical considerations:*
 - Be transparent. Clearly document your research design and methods to ensure scientific integrity and replicability. Adhere to ethical principles in your research, such as obtaining informed consent from participants, protecting participant data, and maintaining anonymity as necessary. If using animals, ensure they are treated ethically and in accordance with relevant regulations. Any study associated conflicts of interest (real or apparent), scientific or financial, must be disclosed to Purdue, colleagues and collaborators, and human research participants (if any).

Maintaining Lab Notebooks

Maintaining a well-labeled and annotated lab notebook acts as a permanent record, capturing observations, procedures, data, and analyses. It serves as an essential tool, documenting the entire research journey, preserving the integrity of your work, and providing a valuable

resource for both yourself and others. It also demonstrates transparency in your research conduct and ensures ethical and responsible research practices. As technology is advancing, lab notebooks may come in paper and electronic forms. Here are some ideas to help with lab notebook keeping:

- *Use a bound, permanent notebook:*
 - Avoid loose-leaf sheets or spiral notebooks to prevent information from being lost or tampered with. Develop a clear and consistent format for recording information, making it easier to navigate the notebook.
- *Date and number all pages:*
 - Consistently number pages and record the date on each page for easy reference and traceability. Date and initial each entry for ease of identification.
- *Record information in permanent ink:*
 - Use a pen with permanent ink to avoid smudging or fading.
- *Write legibly:*
 - Maintain neat and clear handwriting to ensure future readability for you and others.
- *Record chronologically:*
 - Document your work in the order it was performed.
- *Record raw data:*
 - Include all experimental data, observations, and measurements, even unexpected or negative results.
- *Include relevant details:*
 - Document details like research objectives, materials used, protocols followed, and equipment settings.
- *Label figures and tables:*
 - Clearly label figures, tables, and graphs with titles and legends for proper interpretation.
- *Sign and document changes:*
 - If any errors occur, draw a single line through the mistake, write the correct information beside it, and initial and date the change. Do not erase or rewrite information.
- *Adhere to lab-specific requirements:*
 - Consult your advisor or lab for specific guidelines or policies regarding lab notebook maintenance.

Biological Sample Management

Biological samples are the backbone of many scientific studies, and proper management is crucial for achieving reliable and reproducible results and enhance research integrity. Develop Standard Operating Procedures (SOPs) and establishing clear instructions will ensure the integrity and quality of your biological samples throughout the research process.

- *Pre-Sample Collection Plan:*
 - Specify the type of sample to be collected (e.g., blood, tissue, DNA).

- Detail the process to minimize errors, ensure consistency in sample collection and safe handling. List the materials and equipment needed.
 - Define clear labeling guidelines with essential information.
 - Determine the appropriate storage conditions based on the sample type such as temperature, light etc.
 - Create a plan for disposing the materials after the study.
- *Sample Collection:*
 - *Informed Consent (if applicable):* Obtain informed consent from participants before collecting human samples.
 - *Training:* Ensure personnel collecting samples are adequately trained depending on the animal model and sample type.
 - This could include learning aseptic techniques to minimize contamination risks or hands-on training workshops offered at Purdue to learn basic techniques for handling and biological sample collection from laboratory rat and mouse.
 - *Documentation:* Record relevant details of sample collection, including:
 - Date and time of collection
 - Collection method
 - Sample Type
 - Subject ID (anonymized, if applicable)
 - Any relevant observations during collection
 - Collector's initials
- *Processing and Aliquoting:*
 - Follow established SOPs for processing and aliquoting to maintain sample integrity if required.
 - Maintain a sterile environment to minimize contamination risks.
- *Sample Labeling:*
 - Use a consistent and clear labeling system on each sample container.
 - Include all information specified in your SOPs to ensure easy identification and tracking.
- *Sample Storage:*
 - Depending on sample type Store samples under appropriate conditions following your established SOPs (e.g.: in freezers, cryogenic freezers, and biobanks,).
 - Implement a secure storage system to prevent unauthorized access or loss.
- *Master Log:*
 - Maintain a master log for each study, recording details of all samples collected with sample and study information etc.).

- *Data Management:*
 - Describe sample specific data management procedures.

Additional Considerations:

- *Ethical considerations:* Ensure ethical collection, storage, and disposal of samples, adhering to relevant guidelines.
- *Biosafety procedures:* Follow biosafety procedures when collecting, storing, and handling biospecimens.
- *Quality Control:* Regularly monitor storage conditions and sample integrity to ensure quality.
- *Inventory Management:* Maintain an inventory of all samples to track their location and usage.

Lab Solution Preparation, Usage, Storage, and Disposal

The research projects conducted in our lab may require many types of solutions to elicit the data needed to answer specific research questions. These solutions may be prepared in the lab or purchased pre-made. Regardless, proper protocols are required to make and handle them safely. Here are some things to consider in our protocol/decision-making regarding solutions and chemicals:

- Safety first. Prior to opening any container with chemical or biological samples, refer to the Material Safety Data Sheets to learn the classification of the material, proper handling, exposure risk, storage, steps to handle spills, inhalation, or ingestion, and disposal process of the material.
- Before using a solution, understand its purpose in your experiment. What is the purpose of the solution you are about to use? What role does each chemical or ingredient have in this solution?
- Prior to making a solution, ensure there are enough of each ingredient to make the desired solution. Determine the appropriate mixing method (swirling, stirring) and if heating is necessary for proper dissolution.
- Store solutions at the appropriate temperature (refrigeration, room temperature) to maintain their effectiveness. Consider light sensitivity and its impact on degradation.
- Clearly label each container with the solution name, date prepared, initials of the person who made it, and shelf life.
- Record the entire recipe and preparation process in your lab notebook. This detailed record allows for future replication of the exact same solution by others.
- Document proper disposal procedures for expired solutions in your lab notebook/file for future reference, ensuring safe waste management even after personnel changes.

Estimating Sample Size and Statistics

Research data is collected, recorded, created, and analyzed with the aim to discover new knowledge and produce original research results. It is a good idea to think about the data-

related aspects of your research before you begin. How much data will you need to collect and what should be your sample size? If the sample size is large enough, every additional observation increases the power marginally and collecting additional data will increase the associated costs of your research study while providing little additional benefit. Similarly, low-powered studies result in overestimation of effect size and outcomes that are difficult to replicate. Use power analysis to determine the minimum sample size required for your experiment, given a desired significance level, effect size, and statistical power. Here are some things to keep in mind when planning your research.

- Identify appropriate statistical tests for the study. Let the PI know if you need training to use or help selecting appropriate statistical methods.
- Once you run your power calculations, perform your study, run statistical analyses and obtain your output, think about normalizing your data.
- Reconcile statistical outliers, if any; an outlier, usually three standard deviations beyond the mean (three sigma rule), may be eligible for removal from datasets. Consider the effect or removal on data integrity.

Resources for learning and understanding best practices for statistical analysis and avoiding common pitfalls can be found at: [Practices for Statistical Analysis](#).

Data Management

Thoughtful data management is a good research practice that saves time and effort and contributes towards research reproducibility.

Please consider the following checklist when planning for research data management:

- *Project Goals and Team Information:*
 - What are the research objectives and overall aim of the project?
 - Who are the investigators and collaborators of the project?
 - What is the funding source? What are the funding requirements?
 - Identify data needs.
- *Data Collection and Organization:*
 - What types of data will be created/collected during the course of the project?
 - What equipment and methods will be used to capture and process data?
 - How will the data files be labelled and organized?
 - Is there any metadata associated with this data set?
If yes, what will be the metadata format and content? Follow metadata standards to describe the data fields, labels, values, components and parameters, nature of the data files produced in terms of bytes, format, software used to create the file, version, and who created it.
- *Data Storage and Backup:*

- How and where the data will be stored (locally, cloud-based, etc.) and how often backups will be performed?
 - Do you need any server space?
It is recommended to store the raw and normalized data in three separate storage places to prevent data loss. Encrypted data may be required if your project involves human subjects research, and this may need specific storage methods.
 - Specify the file formats used for data storage. Consider using open-source, long-term accessible formats for better sharing.
 - Establish a plan for where and how long the data (including backups) will be stored. Where will data be stored during and after the project?
 - Decide which data will be retained for future use, shared with collaborators, or preserved for the long term.
 - Who is responsible for managing the data storage?
- *Data Access, Security and Retention:*
 - If your research involves sensitive data, define access control measures and security protocols to protect it.
 - Determine if data needs to be retained (achieved, anonymized) or destroyed based on policy or regulatory obligations.
 - *Data Sharing:*
 - Who will own the data? Who all will have access to, and be responsible for managing these data?
 - Specify who will have access to the data and outline the methods for sharing it (repositories, data portals, etc.).
 - Confidentiality: It is important to maintain the confidentiality of data when applicable (e.g., human research subjects) for ethical reasons. It protects their privacy and builds trust, encouraging continued participation in valuable research.

Funded research often comes with data sharing requirements. However, some data, particularly involving sensitive personal information, may be difficult or impossible to share due to regulations. For example: The Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule, restricts the sharing of protected health information (PHI) without participant authorization.

Data handling Upon Researcher's Departure:

(Adapted from ORI:

https://ori.hhs.gov/education/products/rcradmin/topics/data/tutorial_11.shtml)

When a researcher departs the institution, a clear agreement between the researcher and the institution is crucial to ensure smooth data access and retention. Here are key considerations:

- For the data access and retention, the departing researcher and the institution should determine if the researcher can take a copy of the data. If so, it's crucial to ensure:

- A complete copy of the original data must be retained by the institution for the required data retention period.
- The departing researcher should agree to provide reasonable access to the original data held by them to the institution and authorized individuals.
- If the original data is transferred to the departing researcher, they are obligated to:
 - Maintain a copy of the original data for the required retention period as determined by the institution or funding agency.
 - Provide reasonable access to the original data upon request from the institution or authorized individuals (as outlined above).

Please refer to Purdue's [data handling policy](#) for additional guidance.

Authorship Policies

Authorship of publications resulting from the work in this lab is important to discuss among the research team. As noted by the [Office of Research Integrity \(ORI\)](#), proper authorship attributions promote credibility and hold researchers accountable for their work, while also providing recognition for researchers' contributions to their field.

This lab follows Purdue's standard for the Authorship of Scholarly Works ([S-24](#)) regarding acceptable authorship practices. General practices for authorship according to this standard include accurately listing all authors, avoiding unacceptable authorship practices (e.g., listing gift, guest, or ghost authors), and properly crediting individuals for their contribution through authorship or acknowledgements.

The order in which authors appear on a published manuscript is important to discuss among the research team and should be agreed upon as early as possible, either prior to conducting the study or before beginning new publications based on the work. In this lab, we will establish an authorship agreement prior to beginning any new publication. The agreement will be signed by all parties and will be revisited as the study progresses to update the lists of authors and contributors and address any authorship issues that may arise.

In order to receive credit as an author on a manuscript, Purdue's S-24 standard indicates that the individual must have contributed both materially and intellectually to the work. This includes activities such as writing and editing the manuscript, designing the study, collecting and analyzing data, and approving the final version of the manuscript. Reading and providing comments or suggestions on the paper (without contributing to the writing/drafting) does not typically warrant authorship. In addition, providing administrative and technical support for a project (e.g., providing monetary resources, participants, or supplies; routine experimental work; mentoring; training) does not generally constitute authorship. Individuals who provide this type of support may be recognized in the acknowledgements section.

Norms about authorship order vary between disciplines. In engineering, those who contributed the most intellectual effort are typically listed first, with subsequent authors listed in order of

their level of contribution. Supervisors, mentors, PIs, and other senior authors may be listed last per the Institute of Electrical and Electronic Engineers (IEEE) [guidelines](#). If there is equal involvement among the authors, Purdue's S-24 standard recommends listing the names alphabetically by last name. Many journals and professional organizations have their own authorship policies (e.g., [IEEE, 2023](#); [Resnik et al., 2016](#)) and our lab will ensure that we follow the respective policies when submitting an article for publication.

This lab does not support or take part in gift or ghost authorship as these are detrimental research practices. Gift authorship includes placing a prominent person on the publication or grant to improve opportunities to publish, or to pay back a collaborator who permitted this lab to perform work but made no significant contribution to the study. An individual must fulfill the requirements for authorship established by the lab in order to be an author on a publication; people who contribute to research but do not meet the authorship requirements may be recognized in the acknowledgements section.

Mentor & Mentee Relationships

The Mentor/Mentee and Advisor/Advisee relationships are some of the foundational elements of researcher training and an important factor in the cohesiveness of a research team. The relationships are two-way streets and require careful nurturing. The PI will design a plan for the development of each mentee and may employ Advisor/Advisee or Mentor/Mentee agreements (e.g., [here is a sample of an agreement](#) developed by the University of Alabama Graduate School) to keep the development moving forward.

The Advisee/Mentee is strongly encouraged to engage with the Mentor/Advisor and not just wait for the senior member to drive the relationship. Both the Mentor/Advisor and Mentee/Advisee are developing together throughout this process, and it will take work of both parties. Guidance on how to build successful Advisor/Advisee relationships has been developed and is available from various resources, including Purdue's Graduate School (e.g., [Resources for Grad Students](#), [Guidelines for Graduate Student Mentoring and Advising](#) and "Advisor Issues" section of the [Helpful Information](#) page), professional associations (e.g., the [American Psychological Association](#), [Dingfelder, 2012]), and [guidance](#) from the Jacobs School of Engineering at UC San Diego on successful mentoring relationships.

Responsible Conduct of Research and other Researcher Trainings

All researchers in this lab are expected to complete the Responsible Conduct of Research (RCR) training as required by Purdue's [RCR Standard \(S-20\)](#) and funding agencies.

[RCR training](#) has an online component and a field/discipline-specific component. The online RCR training is meant to create a baseline RCR education and researchers are required to complete this training at their appropriate career level (e.g., Faculty, Postdoctoral, Graduate or Undergraduate) within 30 days of joining the lab.

Researchers are also required to complete field/discipline-specific RCR training through interactive RCR discussions within our group, with PI-led and peer-to-peer training in lab/group meetings, and discussions at the departmental and college levels. Field-specific RCR training must be completed within the first 12 months of joining our research group and then refreshed as new members join our group and research projects are added to our portfolio.

According to the updated RCR Training guidance issued by PHS agencies ([NIH](#), [AHRO](#), [HRSA](#)) on Feb. 17, 2022, Updated Guidance: Requirement for Instruction in the Responsible Conduct of Research (NOT-OD-22-055), the following general topics merit inclusion in instruction and discussions on the responsible conduct of research:

- Conflict of interest (personal, professional, and financial) and conflict of commitment, in allocating time, effort, or other research resources
- Policies regarding human and animal subjects in research, and safe laboratory practices
- Mentor/mentee responsibilities and relationships
- Safe research environments (e.g., those that promote inclusion and are free of sexual, racial, ethnic, disability and other forms of discriminatory harassment)
- Collaborative research, including collaborations with industry and investigators and institutions in other countries
- Peer review, including the responsibility for maintaining confidentiality and security in peer review
- Data acquisition and analysis; laboratory tools (e.g., tools for analyzing data and creating or working with digital images); recordkeeping practices, including methods such as electronic laboratory notebooks
- Secure and ethical data use; data confidentiality, management, sharing, and ownership
- Research misconduct and policies for handling misconduct
- Responsible authorship and publication
- The scientist as a responsible member of society, contemporary ethical issues in biomedical research, and the environmental and societal impacts of scientific research.

Consult [Purdue's RCR training website](#) for additional information and resources.

Other types of research training are required to conduct research with integrity and to ensure safe and secure conditions for all engaged in the research process. Please refer to the [Researcher Training decision tree](#) to identify all research training applicable to you and check with the Lab Manager and the PI if you have any questions.

Research Lab Transitions & Departures

When leaving the lab, research personnel should clean up their desk, bench, and all other areas of the facility. Graduation and the end of a laboratory term can be busy. Below are some ideas that may help to navigate the exit process smoothly and ensure the continuity and integrity of lab operations.

- Review the labels and content of lab notebook/s (electronic or physical) to ensure the ease of data identification by other researchers and hand/transfer the notebooks/files to the PI/Lab manager.
- Survey the shared storage units such as refrigerators, freezers, cold rooms, stock rooms, etc. to locate and appropriately designate/dispose remaining chemicals and biological materials.
- Ensure all chemical containers are properly closed and labeled.
- Follow the biosafety guidelines for the disposal of any unknown chemicals in your bench space.
- Clean and decontaminate the equipment that you used. Ensure that the manuals/software/maintenance records are retained with the equipment.
- Return borrowed equipment and/or chemicals if any.
- Speak to your supervisor about the transfer/custody of computer passwords.
- Forward any unfinished work/incomplete data to the people who will take over the experiments.
- Clean your office and bench space.
- Have a discussion with your supervisor on your ownership and access to the data that was generated by you.
 - As a rule, Purdue owns the data generated on research projects conducted at Purdue or using Purdue resources.
 - The PI is the custodian of the data and may have a right to have a copy of the data upon departure from Purdue.
 - The departing researchers may have rights to some data, depending on the PI and university needs for data protection (e.g., when applying for an IP patent).
- Before departure, researchers are required to disclose intellectual property and copyrightable materials to Purdue/OTC as required by Purdue's policy on intellectual property.
- Discuss what research data you may take with you to begin your next career stage. This may depend upon several issues to clarify before departure:
 - What is the funding source of the research project and what kind of agreements are in place for data and IP ownership?
 - Does the PI have rights to a departing researcher's ideas?
 - Does the departing researcher have rights to ongoing research from the lab the researcher is departing?
- Plan out the manuscripts, clarify your role/authorship and journal destinations for each manuscript and list of other authors on each manuscript. With changes of career stage, it is not uncommon for pressure to be placed upon a departing researcher (such as gift authorship and other detrimental/questionable research practices).

Additional guidance developed for faculty/Pis who are leaving Purdue/offboarding (moving to other institutions or retiring) may be valuable when drafting your Lab Expectations document: https://www.purdue.edu/business/sps/postaward/faculty/faculty_offboarding.html

Note: Please send your comments or suggestions on how to improve this Lab Expectations Template – Engineering to RCRTraining@purdue.edu.

Resources and Useful Links

- Purdue University Code of Conduct
 - https://www.purdue.edu/purdue/about/integrity_statement.php
- Purdue University Responsible Conduct of Research Standard (S-20)
 - <https://www.purdue.edu/policies/academic-research-affairs/s20.html>
- Purdue University Authorship of Scholarly Works Standard (S-24)
 - <https://www.purdue.edu/policies/academic-research-affairs/s24.html>
- National Institute of Health Laboratory Notebook guidelines
 - [https://www.training.nih.gov/assets/Lab_Notebook_508_\(new\).pdf](https://www.training.nih.gov/assets/Lab_Notebook_508_(new).pdf)
- National Library of Medicine guideline for working with chemicals
 - <https://www.ncbi.nlm.nih.gov/books/NBK55872/>
- Safety data sheets for chemical information and handling
 - <https://chemicalsafety.com/sds-search/>
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