**Risk Assessment Tool**

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| Date of Development | Click or tap to enter a date. |
| Procedure | Click or tap here to enter text. |
| Lab Group | Click or tap here to enter text. |
| Completed by | Click or tap here to enter text. |

Risk assessments are vital tools that are used extensively in the chemical process field but are rarely used in academic settings. There are several steps to a risk assessment: hazard identification, risk evaluation, risk mitigation, and finally performing a trial run (if possible) and assessing how well your controls have worked.

**Hazard Identification**

Hazard identification is the first step in a risk assessment because to understand the risk involved in a certain reaction or procedure, you need to understand what hazards exist. A hazard is any source of **potential** damage, harm or adverse health effects on something or someone[[1]](#footnote-1). While this sounds straightforward, the more time spent identifying the hazards of a process the better the overall understanding of the risk.

Hazard identification starts with understanding what you are researching and how you intend to approach the research subject. The general hazards of the research you intend to pursue should be thought about before the research begins. It is much easier to plan for hazards before research begins than to try to change the procedures during the research in response to a hazard.

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| Research Question, Hypothesis, What are you trying to learn or measure? |
| Click or tap here to enter text. |
| What methods do you plan to use? Are there alternative approaches? |
| Click or tap here to enter text. |

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| **Identify the general hazards (check all that apply).** Perform background research to identify known risks of the reagents, reactions, or processes. Review protocols, [Safety Data Sheets](http://ccinfoweb.ccohs.ca/msds/search.html) (SDSs), and safety information for hazardous chemicals, agents, or processes. Review accident histories within your laboratory/department and [Lessons Learned](https://dchas.org/technical-information/laboratory-lessons-learned/) from incidents at other universities. **Hazardous Agents**  |
| **Physical Hazards of Chemicals** [ ]  Compressed Gases [ ]  Cryogens [ ]  Explosives [ ]  Flammables [ ]  Organic Peroxides [ ]  Oxidizers [ ]  Peroxide Formers [ ]  Pyrophorics [ ]  Self-heating substances [ ]  Self-reactive substances [ ]  Substances which, in contact with water, emit flammable gases | **Health Hazards of Chemicals** [ ]  Acute toxicity [ ]  Carcinogens [ ]  Eye damage/irritation [ ]  Germ cell mutagens [ ]  Nanomaterials [ ]  Reproductive toxins [ ]  Respiratory or skin sensitization [ ]  Simple asphyxiant [ ]  Skin corrosion/irritation [ ]  Specific target organ toxicity [ ]  Substances which, in contact with water, emit toxic gases[ ]  Hazards not otherwise classified  | **Ionizing Radiation** [ ]  Irradiator [ ]  Radionuclide Type[ ]  Radionuclide sealed source [ ]  X-ray machine **Non-Ionizing Radiation** [ ]  Lasers, Class 3B or 4 [ ]  Lasers, Class 2 or 3R[ ]  Magnetic fields (e.g., NMR, MRI) [ ]  RF/microwaves [ ]  UV lamps  | **Biohazards** [ ]  BSL-2 Biological agents [ ]  BSL-3 Biological agents [ ]  Human cells, blood, BBP [ ]  NHPs/cells/blood [ ]  Non-exempt rDNA [ ]  Animal work [ ]  Other (list): Click or tap here to enter text. |
| **Hazardous Conditions or Processes**  |
| **Reaction Hazards** [ ]  Explosive [ ]  Exothermic, with potential for fire, excessive heat, or runaway reaction [ ]  Endothermic, with potential for freezing solvents decreased solubility or heterogeneous mixtures [ ]  Gases produced [ ]  Hazardous reaction intermediates/products [ ]  Hazardous side reactions  | **Hazardous Processes** [ ]  Generation of air contaminants (gases, aerosols, or particulates) [ ]  Heating chemicals [ ]  Large mass or volume [ ]  Pressure > atmospheric [ ]  Pressure < atmospheric [ ]  Scale-up of reaction  | **Other Hazards** [ ]  Hand/power tools [ ]  Moving equipment/parts [ ]  Electrical [ ]  Non-standard power (Not 120V 15A)[ ]  Noise > 80 dBA [ ]  Heat/hot surfaces [ ]  Cold/cold surfaces[ ]  Ergonomic hazards [ ]  Extended work in hot or cold environments[ ]  Needles/Sharps [ ]  Other (list): Click or tap here to enter text. |
| **Field Hazards (**[**more information here**](https://www.safety.duke.edu/laboratory-safety/fieldwork)**)** |
| **Environmental Hazards** [ ]  Foul weather [ ]  Temperature extremes [ ]  Intense sunlight [ ]  Darkness/low light [ ]  Altitude [ ]  Smoke/dust [ ]  Fire [ ]  Animals/insects [ ]  Plants/allergens [ ]  Hygiene/water-borne and food-borne illness [ ]  Vector-borne or other endemic diseases (list):  | **Site Hazards** [ ]  Uneven/slippery surfaces [ ]  Heights/drop-offs [ ]  Falling objects [ ]  Tight spaces/overhangs [ ]  Boating/swimming/water hazards (waves, tides, current, depth) [ ]  Navigation challenges [ ]  Limited communication [ ]  Remote area/limited medical services [ ]  Personal security issues, risk of harassment or violence, US State Department active travel alert  | **Task/Equipment Hazards** [ ]  Driving/vehicle operation/traffic [ ]  Operating vehicles other than cars (boats, planes, etc.)[ ]  Use of firearms[ ]  Lifting/carrying [ ]  Digging/trenching [ ]  Hand tools/power tools [ ]  Sharp objects [ ]  Strenuous physical activity [ ]  Mental demands (e.g. long days, high-stress environment, language barriers) [ ]  Other (list): Click or tap here to enter text. |

**Hazard Control**

After determining the research questions you intend to answer, how you plan to answer those questions, and looking at the general hazards of the research you intend to pursue, the next step is to evaluate the potential consequences of each of the hazards you have identified and where you will encounter those hazards in the research process.

Start by writing out the steps of the process or tasks you need to complete. For each step, think through what hazards might exist in that step. Some questions[[2]](#footnote-2) to ask yourself are:

* What can go wrong?
* What are the consequences?
* How could it arise?
* What are other contributing factors?
* How likely is it that the hazard will occur?

A good way of identifying hazards is to look at the general hazards and see if any of those types of hazards might exist in the particular step you are writing about. There may be more than one potential hazard for a particular step. Deal with each hazard separately, including controls for each hazard. In most processes, you will find several hazards can be controlled using one type of control.

For each hazard in the process that you identify, how do you plan to control that hazard? Use the hierarchy of controls (below) starting with the most effective first: elimination, substitution, engineering, administrative, and personal protective equipment.

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| Steps or Task | Hazard | Hazard Controls |
| Click or tap here to enter text. | Click or tap here to enter text. | Click or tap here to enter text. |
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A hierarchy of controls should be applied starting with the most effective controls (i.e., elimination and substitution) at the top of the graphic and moving down. While personal protective equipment (PPE) should always be used, it should be considered the last line of defense from potential hazards.

Use the following [PPE Hazard Assessment](https://www.safety.duke.edu/sites/default/files/PPE-Hazard-Assessment-Form.pdf) to help select appropriate PPE for the hazards in your process. For gloves, see the following resources for [chemical applications](https://www.safety.duke.edu/occupational-hygiene-safety/personal-protective-equipment/gloves-chemical-applications).

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| **Select the appropriate PPE and safety supplies for the procedure (check all that apply).** **Laboratory PPE/Safety Supplies**  |
| [ ]  Appropriate street clothing (long pants, closed-toed shoes) [ ]  Gloves; indicate type: Click or tap here to enter text. [ ]  Safety glasses [ ]  Safety goggles [ ]  Face shield and googles [ ]  Lab coat [ ]  Flame-resistant lab coat [ ]  Other (list): Click or tap here to enter text. | [ ]  Fire extinguisher [ ]  Class ABC or [ ]  Class D[ ]  Eyewash/safety shower [ ]  First aid kit [ ]  Spill kit [ ]  Specialized medical supplies (e.g. calcium gluconate for hydrofluoric acid and amyl nitrite for cyanides) Click or tap here to enter text. |
| **Field PPE/Safety Supplies**  |
| [ ]  Proper clothing (list): Click or tap here to enter text.[ ]  Proper footwear (list): Click or tap here to enter text.[ ]  Communication device(s) (list): Click or tap here to enter text.[ ]  Eye protection (safety glasses and/or sunglasses) [ ]  Work gloves [ ]  Hardhat [ ]  Hearing protection [ ]  First aid kit [ ]  Map (and GPS)  | [ ]  Sunscreen [ ]  Anti-animal devices (e.g. bear bell, whistle, bear canister) [ ]  Personal floatation device[ ]  Fall protection[ ]  Road flares[ ]  Safety Vests[ ]  Extra food, water/water treatment method[ ]  Personal medications[ ]  Other (list all): Click or tap here to enter text. |
| **Identify the appropriate training (check all that apply).** Identify the general safety and procedure based/specific training appropriate for your procedure.  |
| **General Safety Training** |
| **General/Chemical Safety**[ ]  Laboratory Safety - General[ ]  Fire/Life Safety[ ]  Lab Chemical Waste Management Practices[ ]  Hazard Communication for Laboratory Personnel[ ]  Ergonomics - Laboratory | **Radiation Safety** ☐ Radiation Safety Orientation for Laboratory Workers) and Annual Update☐ Laser Safety - Non-Clinical Use**Biosafety** [ ]  Biosafety Level 2 and BBP for Lab Workers[ ]  Shipping Biological Materials | **Field Safety** [ ]  CPR [ ]  Wilderness First Aid [ ]  SCUBA certification/diving safety [ ]  Vehicle safety [ ]  Other (list): Click or tap here to enter text. |
| **Job Specific Training**  |
| [ ]  Lab/job-specific training [ ]  Lab SOP(s) to review (list): Click or tap here to enter text. | [ ]  Emergency plans or field evacuation plans [ ]  Equipment SOP(s) to review (list): Click or tap here to enter text. | [ ]  Other (list): Click or tap here to enter text. |

**Risk Evaluation**

Risk is defined by OSHA as the product of hazard and exposure. Hazards exist everywhere, but it is the exposure to that hazard that causes harm. A simple method for assessing risks is to use a What If Analysis. To complete the analysis you simply ask what if questions about the different steps. The questions should challenge your assumptions about what happens. Just because you have never had a problem before, doesn’t mean you won’t have that problem in the future. Look through the different steps of the process you have identified hazards and ask What If something happened. Some examples are below:

After developing the what-if questions, determine what would happen due to those scenarios.

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| **What if…?** Examples: there is a loss of cooling? …valves/stopcocks are left open/closed? …there is unexpected over-pressurization? …a spill occurs? …the laser is misaligned? …weather conditions change? |
| **Then…** …there may be a runaway reaction. …there may be an unexpected splash potential. …the reaction vessel may fail. …there may be a dermal exposure. …there may be an eye injury. …routes may be inaccessible.  |
| **What if…?** Click or tap here to enter text. |
| **Then…** Click or tap here to enter text. |
| **What if…?** Click or tap here to enter text. |
| **Then…** Click or tap here to enter text. |
| **What if…?** Click or tap here to enter text. |
| **Then…** Click or tap here to enter text. |

Review your what-if scenarios. Does anything give you cause for concern? Are any of the outcomes unacceptable? Consider changing your controls to address any of these new concerns. Another option is to give the procedure and risk assessment tool to a colleague to review. Many times a second person will find issues you hadn’t thought of. Incorporate any changes you feel are needed and then review the what-if questions and scenarios again. This process should be iterative and help to evolve your procedure to be safer and more controlled.

**Trial Run and Evaluation**

**Perform a trial run.** How you can test your experimental design? Can you do a dry run of the procedure without hazardous chemicals/reagents/gases to familiarize yourself with equipment and demonstrate your ability to manipulate the experimental apparatus? Can you run the procedure with a less hazardous material? Can you test your experimental design at a smaller scale? If your procedure requires multiple people, would a tabletop exercise be useful?

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| **Trial Run**  |
| Trial Run Procedure: Click or tap here to enter text. |
| Did the trial go as expected? Yes [ ]  No [ ]   |
| Experimental design changes needed (if any): Click or tap here to enter text. |

**Perform and evaluate.** Run your procedure using the appropriate controls you’ve identified. Evaluate controls and hazards as you work. Critique the controls and process you used by answering the following questions. If changes to controls are needed, update your risk assessment tool and re-evaluate any time you revise your process (e.g. changes in scale, reagent, equipment, or conditions that might increase the hazard/risk). Share your assessment with your PI/colleagues for the next iteration of the experiment.

**ASSESS**

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| **Evaluate Your Procedure**  |
| What went well?  |
| Click or tap here to enter text. |
| Did the controls perform as expected?  |
| Click or tap here to enter text. |
| Did anything unexpected occur?  |
| Click or tap here to enter text. |
| Did a hazard manifest itself that was not previously identified?  |
| Click or tap here to enter text. |
| Were there any close-calls or near misses that indicate areas of needed improvement?  |
| Click or tap here to enter text. |
| Did something go exceptionally well that others could learn from?  |
| Click or tap here to enter text. |
| I plan to evolve my procedure by...  |
| Click or tap here to enter text. |

[[3]](#endnote-1)

1. <https://www.ccohs.ca/oshanswers/hsprograms/hazard_risk.html> [↑](#footnote-ref-1)
2. <https://www.osha.gov/Publications/osha3071.pdf> [↑](#footnote-ref-2)
3. This risk assessment tool is adapted from the [Stanford Laboratory Risk Assessment Tool](https://ehs.stanford.edu/wp-content/uploads/Laboratory-Risk-Assessment-Tool.pdf) [↑](#endnote-ref-1)