LABORATORY RISK ASSESSMENT TOOL (LAB R.A.T.)

The Laboratory Risk Assessment Tool (Lab RAT) provides a framework for risk assessment complimenting the process researchers already use to answer scientific questions.

This tool provides a format for researchers to systematically identify and control hazards to reduce risk of injuries and incidents. Conduct a risk assessment prior to conducting an experiment for the first time and review the **Lab R.A.T. Guidelines** document for further details.

The risk assessment process involves rating the risk of the experiment from "low" to "unacceptable" risk. Consult with your PI/supervisor and EH&S if your risk rating is "high" or "unacceptable" to redesign the experiment and/or implement additional controls to reduce risk.

Procedure:

PI / Lab Group:

Department: **Building / Location**:

Form Completed By: **Start Date:**

PHASE 1: EXPLORE

Identify your research question and approach. What question are you trying to answer? What are you trying to measure or learn? What is your hypothesis? What approach or method will you use to answer your question? Are there alternative approaches?

RESEARCH QUESTION(S)
We are trying to compare coral innate immune gene repertoires against microbiome diversity
APPROACHES OR METHOD
Kit-based DNA extraction of coral genomic DNA, either performed locally, by collaborators, or outsourced. Although we are not currently using phenol-choloform extraction, we completed the exercise as if we were for purposes of familiarizing ourselves with the process (lab is currently mostly bioinformatic, so not lots of molecular work to explore).

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 (SDSs), and safety information for hazardous chemicals, agents, or processes. Review accident histories within your laboratory/department.

HAZARDOUS AGENT(S)

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 or toxic gases

Health Hazards of Chemicals
X Acute toxicity
X Carcinogens
X Eye damage/ irritation
☐ Germ cell mutagens
☐ Nanomaterials
☐ Reproductive toxins
☐ Respiratory or skin sensitization
☐ Simple asphyxiant
X Skin corrosion/ irritation
X Specific target organ toxicity
☐ Hazards not otherwise classified

Ionizing Radiation
☐ Irradiator
☐ Radionuclide
☐ Radionuclide sealed source
☐ X-ray machine

Non-Ionizing Radiation
☐ Lasers, Class 3 or 4
☐ Lasers, Class 2
☐ 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
☐ High risk animals (RC1)
☐ Other (list):

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

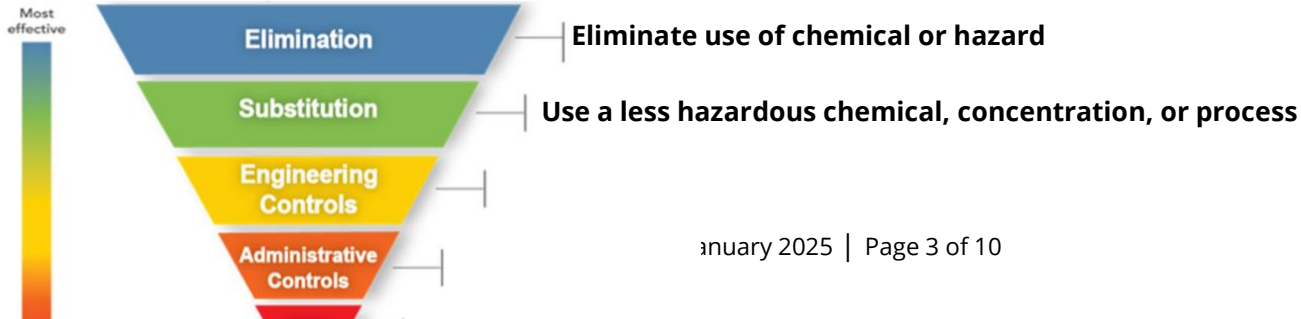
Other Hazards
☐ Hand/power tools
☐ Moving equipment/parts
☐ Electrical
☐ Noise > 80 dBA
☐ Heat/hot surfaces
☐ Ergonomic hazards
☐ Needles/sharps
☐ Other (list):

PHASE 2: PLAN

Outline the Procedure. List the steps or tasks for your procedure and the hazard/potential consequences of each. Include set-up and clean-up steps or tasks. Define the hazard controls to minimize the risk of each step using the hierarchy of controls starting with the most effective (i.e., elimination, substitution, engineering controls, administrative controls, and personal protective equipment). List the hazard control measure you would use for each step or task (e.g., run at a micro scale, work in a fume hood, wear face shield and goggles).

Steps or Tasks	Hazard	Hazard Control Measure(s)
Cell Lysis and Homogenization	Liquid Nitrogen	Training, Cryoprotective gloves Practically, outsourcing DNA extraction or substuting with less hazardous kit-based extractions.
Extraction	Phenol, chloroform, isoamyl alcohol mixture (corrosion, cancer risk, irritant)	PPE, fume hood, training. In practice: outsource to dedicated facility.
Phase Separation	Centrifugation	Proper training (e.g. proper balance of centriguge, ensure maintenance, report problems)
Aqueous phase collection	Pipetting	Splash risk. Minimize quantities, work in fume hood and with face protection.
Ethanol precipitation	Ethanol stock may be flammable	Take minimum quantity needed for work then return stock to flammables cabinet. Avoid exposure to heat/sparks.
Washing and Resuspension	Ethanol stock may be flammable	Take minimum quantity needed for work then return stock to flammables cabinet. Avoid exposure to heat/sparks.

HIERARCHY OF CONTROLS



Isolate people from hazard (e.g. ventilation, barriers)

Change the way people work (e.g. training, work policies, SOPs)

Personal protective equipment
(e.g. lab coat, appropriate gloves, goggles)

1 For guidance on selection of personal protective equipment (PPE), use EH&S Laboratory PPE Hazard Assessment Guide.
2 For guidance on selection of chemical-resistant gloves, visit the EH&S website.

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.

Select the appropriate PPE and safety supplies for the procedure (check all that apply).

LABORATORY PPE/SAFETY SUPPLIES

☒ Appropriate street clothing
(long pants, closed shoes)
X Gloves; indicate type: butyl rubber, change immediately if exposed.
Safety glasses
Safety goggles
X Face shield and googles
X Lab coat
☐ Flame-resistant lab coat
X Fire extinguisher
X Eyewash/safety shower
X First aid kit
X Spill kit
☐ Specialized medical supplies (e.g. calcium gluconate for hydrofluoric acid and amyl nitrite for cyanides
X Other (list):

Switch protocol or oursource.

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
X Lab Safety Compliance & Practices
☒ Managing Lab Chemicals
☐ Compressed Gas Safety
X Fume Hood Training
☐ Hydrofluoric Acid Safety
☐ Formaldehyde Safety

Biosafety
☐ Biosafety Training
☐ Bloodborne Pathogens

Radiation Safety
☐ Radiation Safety
☐ Laser Safety

Field Safety
☐ First Aid & CPR
☐ SCUBA certification/diving safety
☐ Driving safety
☐ Other (list):

JOB-SPECIFIC TRAINING

☒ Lab/job-specific training
☐ Lab SOP(s) to review (list):

☐ Emergency plans or field evacuation plans
☐ Equipment SOP(s) to review (list):

☐ Other (list):

PHASE 3: CHALLENGE

Question your methods. What have you missed and who can advise you? Challenge your hazard control measures by asking "What if…?" questions. "What if" questions should challenge you to find the gaps in your knowledge or logic. Include possible accident scenarios. Factors to consider are human error, equipment failures, and deviations from the planned/expected parameters (e.g., temperature, pressure, time, flow rate, and scale/concentration). Update your plan to include any new controls required to address these possibilities.

What If Analysis

What if…?	Then…
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?*	 *…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 there was a spill of phenol or chloroform	There could be an exposure hazard.
Ethanol stock was ignited (e.g. by other ongoing labwork from other labs)	Fire hazard

Assign a risk rating to the experiment. Based on your procedure outline and the what if analysis, determine the risk rating for the experiment or procedure.

Severity of Consequences - Personnel Safety

Likelihood of Incident Occurrence	No injuries	Minor injury	Significant injury	Life threatening
Very likely	**Low**	**High***	**Unacceptable****	**Unacceptable****
Likely	**Low**	**Medium**	**High***	**Unacceptable****
Possible	**Low**	**Medium**	**High***	**High***
Rare	**Low**	**Low**	**Medium**	**High***

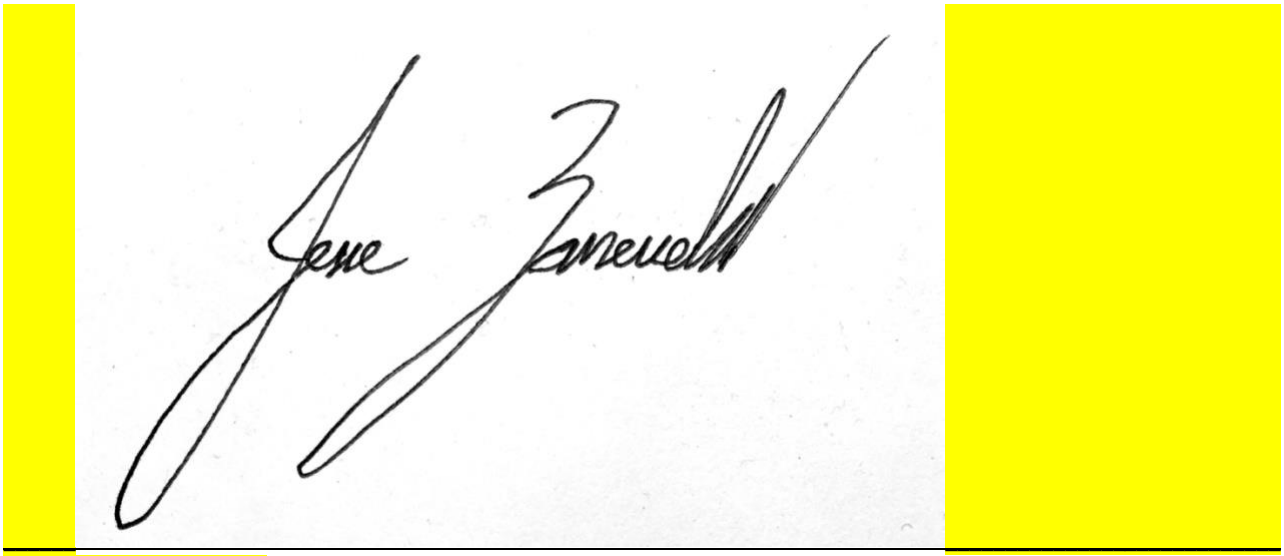
Risk Rating: ___Medium_____

The Risk Rating is subjective. The primary goal is for researchers to think about risk, and differentiate unacceptable and high-level risk steps from those with a lower level risk. This will help drive additional consultation and control measures where needed.

Revise plan if the risk rating is too high. Are these risks acceptable? Use this table to determine the action to take based on the risk rating. What are the highest risk steps? What more can you do to control the risks? Return to planning and use the hierarchy of controls to design a safer experiment.

Risk Rating	Action
Unacceptable**	**STOP**! Additional controls need to reduce risk. **Consult with PI.**
High*	Additional controls recommended to reduce risk. **Consult with PI.**
Medium	Ensure you are following best practices. Consult with peers, PI, and EH&S as needed.
Low	Perform work within controls.

PI/Supervisor Approval:



*****Signature for **High** risk ratings. If needed, contact EH&S (206.221.2339) for recommendations.

NOTE: **Unacceptable risk-rated experiments **should not proceed**. Introduce further controls to reduce risk. Contact EH&S (206.221.2339) for recommendations and best practices.

PHASE 4: ASSESS

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?

TRIAL RUN

Trial Run Procedure / Date: Tested our alternative of outsourcing extractions to a company.

Did the trial go as expected? Yes ☐ No X

Experimental design changes needed (if any):

Unfortunately the company we used was not able to successfully extract high molecular weight DNA from corals.

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.

EVALUATE YOUR PROCEDURE

What went well?

Communications

Did the controls perform as expected?

NA

Did anything unexpected occur?

Failure to extract DNA

Did a hazard manifest itself that was not previously identified?

No

Were there any close-calls or near misses that indicate areas of needed improvement?

No

Did something go exceptionally well that others could learn from?

No

I plan to evolve my procedure by...

Potentially using collaborators or lower-hazard Qiagen kits to extract coral genomic DNA.

Procedure risk assessment is complete.

Form Completed By: Jesse Zaneveld

Signature: **Date:** 1/15/2026

PI / Supervisor Signature: