Environmental Health & Safety
Functional Risk Observation Guidance (F.R.O.G.) Tool

The TCU Functional Risk Observation Guidance (F.R.O.G.) Tool provides a framework for risk assessment complimenting the processes researchers already use to answer scientific questions.

This tool provides a format to systematically identify and control hazards to reduce risk of injuries and incidents. Prior to conducting a new procedure, it is recommended to perform a risk assessment. Please review the **F.R.O.G. Tool Guidelines** for additional details.

The risk assessment process involves rating the risk of a procedure from "low" to "unacceptable." Consult with your PI/Supervisor and EHS if your risk rating is "high" or "unacceptable" to redesign and/or implement additional controls.

Procedure:			
PI / Lab Group:			
Department:		**Building / Location:**	
Completed By:		**Date:**	

Step 1: EXPLORE

Identify your research question(s) and approach. What question(s) 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(s)? Are there alternative approaches?

RESEARCH QUESTION(S)

APPROACH OR METHOD

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 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 or toxic 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
- ☐ 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 (NMR, MRI, etc.)
- ☐ RF / Microwaves
- ☐ UV lamps

Biohazards
- ☐ BSL-1 Biological agents
- ☐ BSL-2 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 (potential for fire, excessive heat, runaway reaction, etc.)
- ☐ Endothermic (potential for freezing solvents, decreased solubility, heterogeneous mixtures, etc.)
- ☐ Gases produced
- ☐ Hazardous reaction intermediates / products
- ☐ Hazardous side reactions

Hazardous Processes
- ☐ Generation of air contaminants (gases, aerosols, 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):

GENERAL HAZARDS

Equipment Hazards
- ☐ Unguarded moving parts
- ☐ Cranes / Lifts / Hoists
- ☐ Ladders
- ☐ Energized equipment
- ☐ De-energized equipment
- ☐ High voltage (>50 volts)
- ☐ DC Equipment (>800 amp)
- ☐ Lithium batteries
- ☐ Robotics
- ☐ Welding / Soldering
- ☐ Pressure or vacuum vessels
- ☐ Catwalks / Rigging / Lighting systems

Ergonomic Hazards
- ☐ Repetitive motion
- ☐ Contact Stress
- ☐ Cold environment
- ☐ Awkward postures
- ☐ Lifting >30 lbs.
- ☐ Awkward lifts (poor grip, long distance, uneven weight distribution, etc.)
- ☐ Vibration
- ☐ Personal risk factors
- ☐ Strenuous physical activity

Site Hazards
- ☐ Confined spaces
- ☐ Slippery surfaces
- ☐ Oxygen deficiency potential
- ☐ Slip / Trip / Fall
- ☐ Working at elevated locations

Other Hazards
- ☐ Mental demands (high stress, language barriers, long days, etc.)
- ☐ Experience level
- ☐ Other (list):

FIELD HAZARDS
***May also use sections above, as needed, for specific tasks / processes**

Environmental Hazards
- ☐ Inclement weather
- ☐ Temperature extremes
- ☐ Sun exposure
- ☐ 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
- ☐ Snow / Ice
- ☐ Slide hazards (mudslide / avalanche)
- ☐ 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

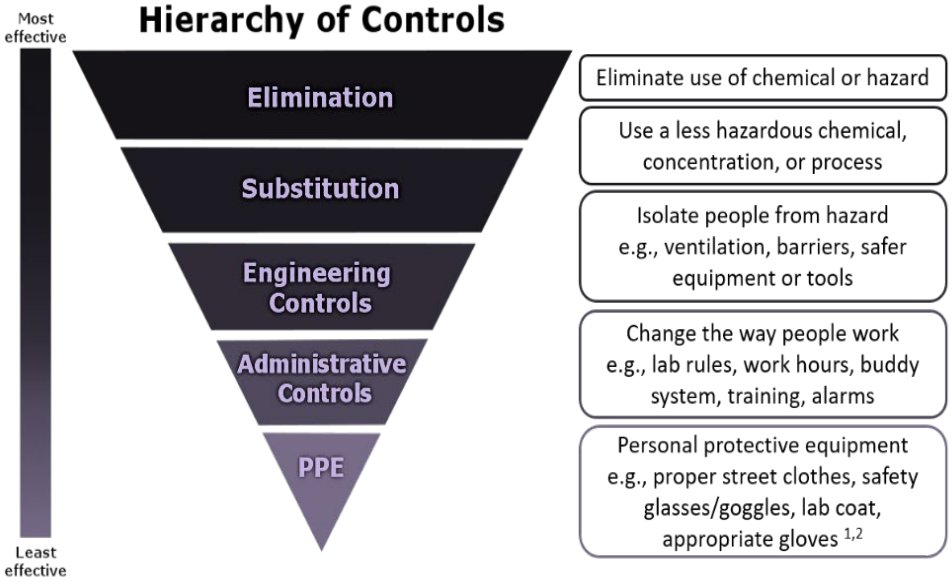
Personal Security
- ☐ Crime / Theft
- ☐ Risk of harassment / Violence
- ☐ US State Department active travel alert
- ☐ Traveling alone
- ☐ Entering personal residences
- ☐ Unfamiliar with area (roads, terrain, neighborhoods, etc.)
- ☐ Unfamiliar with local customs / Cultural norms

Task/Equipment Hazards
- ☐ Driving / Vehicle operation / Traffic
- ☐ Drone use
- ☐ Lifting / Carrying
- ☐ Digging / Trenching
- ☐ Hand tools / Power tools
- ☐ Sharp objects
- ☐ Loud noises
- ☐ Strenuous physical activity
- ☐ Mental demands (high stress, language barriers, long days, etc.)
- ☐ Other (list):

Step 2: PLAN

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

Steps or Tasks	Hazard	Hazard Control Measure(s)



A hierarchy of controls should be applied starting with the most effective controls (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.

1 For guidance on selection of Personal Protective Equipment (PPE), use TCU's PPE Hazard Assessment SOP.
2 For guidance on selection of chemical-resistant gloves, see EHS Website.

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: _____
- ☐ Safety glasses
- ☐ Safety goggles
- ☐ Face shield and googles
- ☐ Lab coat
- ☐ Flame-resistant lab coat
- ☐ Fire extinguisher
- ☐ Eyewash/safety shower
- ☐ First aid kit / EpiPen
- ☐ Spill kit
- ☐ Specialized medical supplies (calcium gluconate for hydrofluoric acid, amyl nitrite for cyanides, etc.)
- ☐ Other (list):

GENERAL SAFETY SUPPLIES

- ☐ Proper clothing (long pants, long sleeve shirt, warm layers, rain / wind protection, hat etc.)
- ☐ Proper footwear (list): _____
- ☐ Communication device
- ☐ Map (and GPS)
- ☐ First aid kit / EpiPen
- ☐ Sunscreen
- ☐ Eye protection (safety goggles, glasses and/or sunglasses)
- ☐ Hearing protection
- ☐ Work gloves
- ☐ Hardhat
- ☐ Anti-animal devices (strobe light, distress call, reflective tape, etc.)
- ☐ Personal floatation device
- ☐ Fall protection
- ☐ Road flares
- ☐ Safety vests
- ☐ Extra food, water / water treatment method
- ☐ Personal medications
- ☐ Other (list all):

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 Safety

- ☐ Hand & Power Tool Safety
- ☐ Ladder Safety
- ☐ Scissor Lift Safety
- ☐ Portable Fire Extinguishers
- ☐ Heat Stress in the Workplace
- ☐ Hot Work / Arc Welding
- ☐ OSHA – Confined Spaces
- ☐ Electrical Safety / NFPA 70E in Research & Education
- ☐ Other (list):

Radiation Safety

- ☐ Radiation Safety Awareness
- ☐ Laser Safety
- ☐ Working with Lasers in Research & Education

Chemical Safety

- ☐ Lab Safety in Research & Education
- ☐ Chemical Storage in Lab & Research Facilities
- ☐ HAZCOM: Chemical Labels & SDSs
- ☐ RCRA: Lab Chemical Waste Management
- ☐ Compressed Gas Safety
- ☐ Art Safety for Education – Chemical Hazards

Field Safety

- ☐ Basic First Aid
- ☐ *CPR
- ☐ *SCUBA certification
- ☐ Other (list):

Biosafety

- ☐ Laboratory Safety – Biological Hazards
- ☐ BBP: Basics of Bloodborne Pathogens
- ☐ BBP: Bloodborne Pathogens for Research & Campus Activities
- ☐ Scalpel & Needle Safety in Laboratories
- ☐ Biosafety Level 2
- ☐ Autoclave Safety
- ☐ Working with Animals in Research

**In person courses or additional instruction required outside of web-based training content.*

PROCEDURE BASED / JOB SPECIFIC TRAINING

☐ Lab / Job specific training
☐ Emergency or field evacuation plans
☐ Other (list):
☐ Lab SOP(s) to review (list):
☐ Equipment SOP(s) to review (list):

Step 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

Examples:

What if…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…? **Then…**	
What if…? **Then…**	
What if…? **Then…**	

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.

Risk Rating: <Select One>

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.

	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 *

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.

Hazard Risk Level	Action
Unacceptable **	**STOP!** Additional controls needed 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 required for **High** risk ratings. If needed, contact EHS (safety@tcu.edu) for recommendations.

NOTE: **Unacceptable risk-rated experiments **should not proceed**. Introduce further controls to reduce risk. Contact EHS (safety@tcu.edu) for recommendations and best practices.

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

Date:	**Did the trial go as expected?** Yes ☐ No ☐
Trial Run Procedure:	
Experimental design changes needed (if any):	

Step 4: ASSESS

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 (changes in scale, reagent, equipment, or conditions that might increase the hazard/risk, etc.). Share your assessment with your PI / Colleagues for the next iteration of the experiment.

EVALUATE YOUR PROCEDURE
What went well?
Did the controls perform as expected?
Did anything unexpected occur?
Did a hazard manifest itself that was not previously identified?
Were there any close-calls or near misses that indicate areas of needed improvement?
Did something go exceptionally well that others could learn from?
I plan to evolve my procedure by...

Procedure risk assessment is complete

Form Completed By:	**Date:**
Signature:	
PI / Supervisor Signature:	