

Environmental Toxicology Laboratory (ETL)

The Environmental Toxicology Laboratory (ETL) is part of the ca. 38,600 sq-ft [Toxicology Centre](#) at the University of Saskatchewan (U of S) in Saskatoon, SK, Canada. The 15,600 sq-ft ETL consists of a 2,260 sq-ft biochemistry/molecular biology lab, a 2,720 sq-ft wet chemistry and analytical lab (a separate 320 sq-ft high resolution (HR) GC-MS for dioxin analysis), and 3,560 sq-ft office and lounge spaces to accommodate room for up to 50 graduate students, post-docs, visiting scientists and professors. ETL also manages a 7,100 sq-ft laboratory for the maintenance, culture, and exposure of aquatic organisms, which is a facility for the use of all investigators in the Toxicology Centre. The facility allows U of S researchers to conduct long-term studies of the accumulation, metabolism, and effects of toxic substances and therapeutic agents on aquatic organisms under controlled laboratory conditions. Aquaculture drug studies can also be conducted. The facility was built to assist researchers from academic institutions, state and federal agencies and businesses and industries as well as non-government institutions in conducting research into the fates and effects of trace substances in aquatic environments. The facility is specifically designed to assist the aquaculture, commercial and sport-commercial fishing and chemical industries by providing a safe and efficient facility in which to conduct studies without danger to researchers or releases to the ambient environment. The containment laboratories also minimize contamination from normal urban and agricultural environments so that controlled studies can be conducted. In addition to the culturing and rearing capabilities and exposure capabilities, the facility contains the following specialized areas: storage areas rearing and exposure tanks and coolers, food, chemicals, solvents and drugs. There are also freezers and walk-in chambers that allow for experiments to be run at in a controlled constant environment. The ETL laboratories were designed to allow researchers to conduct all of the steps in a study from rearing organisms, preparing chemicals, diet preparation, exposure, sample collection and both biochemical and instrumental residue analyses of compounds and their metabolites in a single completely contained and regulated facility. The specific types of studies that can be conducted include setting water quality standards for the protection of aquatic life and determining the kinetics of accumulation of trace contaminants from water, food and sediments by aquatic biota. This information can then be used to assist regulators in setting safe environmental concentrations of these compounds or determining the degree of remediation required at contaminated sites. The flexible facility can also be used to determine the accumulation, metabolism, and safety of veterinary pharmaceuticals used in fish culture and of industrial chemicals. In addition to the applied aspects, the facility can also be used to study the basic mechanisms of effects of contaminants such as mutagens and carcinogens, in animal models.

Occupational and Environmental Safety

The ETL was designed so that all aspects of research into toxic substances can be conducted under one roof without the need to transport toxic or radio-active materials from one building to another. The building has special treatment facilities for air and water entering and leaving the building to guard against releases and to maintain the integrity of experiments.

Culture Facilities

The 4600 sq-ft rearing laboratory is divided by moveable plastic curtains so that research areas can be configured in a variety of ways to accommodate and separate various experiments. The area can be set up as one large area or divided into several separate research areas. Lighting in each region of the laboratory is controlled by individual timers so that the duration of lighting can be regulated in each area separately. The room is equipped with a range of containers for rearing aquatic organisms including aquariums, large round and rectangular fiberglass tanks speciality rearing systems for small tropical fish. The facilities are designed and equipped to allow both static- and continuous flow through exposures with organisms ranging from phytoplankton, and zooplankton to benthic invertebrates, including insects and clams, fish and amphibians. Adult salmon as large as 10 kg can be accommodated.

Influent water treatment

The source of water for the facility is Saskatoon city water with a maximum potential flow rate of 100,000 L per day. The incoming city water is treated with activated carbon and biological filtration before it is stored in 2 100,000 L cement storage tanks. The treated fresh water (FW) then is passed through ultraviolet light banks to kill any possible pathogens, including spores. Portions of the FE can be diverted to a reverse osmosis system to decrease hardness and to a chiller/heater system to provide temperatures ranging from 30 °C to 4 °C. Each tank or research area is plumbed with three water lines that deliver normal FW, heated/cooled FW and RO water. In addition to these three types of water, there are several additional larger capacity lines carrying treated freshwater. The water can be mixed at the tank to make any combination of hardness from 0 to 235 mg CaCO₃/L and temperature from 6 to 45 °C. The rearing and containment rooms each contain a 108 sq-ft stainless steel controlled temperature room that researchers can use to maintain temperatures from 6 to 30 °C within 0.2 °C.

Exposure Facilities

The exposure area is similar in most respects to the culture area. The exposure rooms are equipped with HEPA filters in the influent and effluent air to maintain clean air in the laboratory while minimizing the chance that any toxicants would escape the containment room. In addition, the biochemistry/microbiology and chemistry labs contain laminar flow hoods and fume hoods so that studies can be conducted with toxic chemicals, radioisotopes and genetically engineered organisms.

Effluent water treatment

The effluent water can be sent directly to the sanitary sewer if it does not require any special treatment. Inorganic and organic contaminants can be removed from water before it is released to the sewer. The treatment system is a series of closed cartridge filters that can be filled with different materials, depending on what contaminant needs to be removed from the system. These

are closed systems so that workers are never exposed to the contaminants. In addition to the sanitary line, there are two separate lines to receive effluent water so that two different types of treatment can be used simultaneously. All of the effluents are removed from the tanks by gravity flow through piping enclosed in trenches in the floor. In the case of a spill or complete system failure wastes can be diverted to two 112,000 L storage tanks until the system can be shut down. Wastes can also be treated by UV sterilization before discharge to prevent the possible escape of hazardous microorganisms to the environment

Analytical Facilities

The facility is designed so that all phases of studies can be conducted under one roof, without the need to transport samples among buildings. These specialty areas include the following rooms:

- Cell culture
- Molecular biology
- Biochemistry
- Wet chemistry
- Organic chemistry
- High Resolution GC-MS Room
- Analytical Instrumentation

Cell Culture Facilities

The cell culture facility contains two large Microzone biosafety cabinets used in the safe cell culturing of many environmentally relevant cell lines (H295R, MVLN, H4IIE, MDA). The lab has two water jacketed CO₂ incubators and 2 other Hotpack incubators for more than one cell line can be in culture at any one time. The cell culture facilities are attached to the biochemistry main room for easy analysis of all the cell samples. Also attached to the cell culture lab is a microscope room equipped with an Olympus fluorescence microscope and many stereo and light microscopes.

Biochemistry and Molecular Facilities

This brand new facility is capable of doing just about any type of biochemistry and molecular work used on the toxicology field. New equipment includes Polarstar Optima which can read fluorescence intensity, fluorescence polarization, time resolved fluorescence, luminescence and absorbance. The 7300 Real time PCR system, which runs 96 well plates, for the analysis of gene expression. Also, a new micro injector, Injectman NI 2, that can micro inject small specimens including fish eggs, cells, and bird eggs. These facilities have the equipment (centrifuges, water baths, incubators, etc.) and capacity to run anything from gel electrophoresis and western blotting to ELISA's and enzyme activity (EROD, MROD and Aromatase). Three rooms adjacent to this facility are a dish washing room with an autoclave and nanopure system for washing and sterilizing dishware. ETL also includes a chemical storage room for all the

chemicals used in the facilities and a separate room for micro and analytical balances. Within the biochemical and molecular rooms are a -80 degree freezer, liquid nitrogen dewars and many -20 and 4 degree freezers and fridges for preserving all samples and reagents. Safety is also a big concern and will be the number one priority for these labs. Eye wash and shower stations are throughout the facilities for anyone exposed to any toxic chemicals and two fume hoods are available for use with the more volatile chemicals.

Chemistry Facilities

Wet lab

The chemistry lab at the ETL is designed to handle all aspects of sample processing from extraction to cleanup. The lab has a glassware washing station with nano-pure water, 4 chemical hoods, 6 lab benches, and a gas cylinder rack for safe and convenient storage of gas cylinders. The lab is set up so that everything from glassware washing to sample cleanup can take place in one room to maximize efficiency and minimize possible contamination to other parts of the facility.

Analytical lab

The analytical lab is connected to the wet chemistry lab to maximize efficiency and communication between all aspects of the research. The Analytical lab contains instruments including a Agilent 5975 GS-MSD including G1942N 6890 GC and 5973N MSD, an Applied Biosystems/SCIEX API 3000 Triple Quadrupole Mass Spectrometer, a Micromass Q-Tof II/Ultima (housed at Environment Canada), 2 Agilent 5975 GC/MSD systems, 2 Micromass Platform II LC/MS systems, a Mitsubishi AQF-100 for combustion ion chromatography, and two Dionex DX-500 Ion Chromatography system. There is also a separate room which houses a Micromass AutoSpec-S High Resolution Mass spectrometer used for the analysis of dioxins and similar semi-volatile organic contaminants.

Support Facilities

- Autoclave and dishwasher room
- Equipment and tank storage
- Field equipment storage and staging area
- Food storage
- Drug storage
- Chemical storage (special explosion proof room)
- Chemical storage
- Controlled Environment Chambers (4-30 °C)
- Walk-in freezer (-20 °C)
- Lunch and Conference Room
- Auxiliary power generator to supply 65% of peak power for critical areas