Procedures on Working with Chlorpyrifos and Chlorpyrifos-Treated Animals	
Uses:	Chlorpyrifos is an organophosphate insecticide used to control foliage and soil-borne insect pests on a variety of food and feed crops.
Mechanism of Action:	The toxicity of chlorpyrifos is probably the result of metabolic conversion to its oxygen analog, chlorpyrifos-oxon, and its subsequent inhibition of various enzymes (eg, cholinesterases, carboxylases, acetylcholinesterases, and mitochondrial oxidative phosphorylases resulting in widespread effects such as 1) Potentiation of postganglionic parasympathetic activity. (2) Persistent depolarization of skeletal muscle (3) Initial stimulation following depression of cells of central nervous system (4) Variable ganglionic stimulation or blockade. [USEPA; Ambient Water Quality Criteria Doc: Chlorpyrifos p.2 (1986) EPA 440/5-86-005] [Dreisbach, R.H. Handbook of Poisoning. 12th ed. Norwalk, CT: Appleton and Lange, 1987., p. 113]
Routes of Exposure:	Occupational exposure to chlorpyrifos may occur through inhalation and dermal contact with this compound at workplaces where chlorpyrifos is produced or used. Unintentional ingestion or accidental injection can occur while working with chlorpyrifos.
Toxicity Values:	8 hr Time Weighted Avg (TWA): 0.1 mg/cm3, inhalable fraction and vapor, SKIN notation. Rat oral LD50: 82-350mg/kg, Rabbit oral LD50: 1000mg/kg, Mouse oral LD50: 60-152mg/kg, Rat dermal LD50: 202->2000mg/kg, Rabbit dermal LD50: 1233->5000mg/kg, Rat inhalation LC50: >36-560mg/cu m/4hr
Adverse Health Effects:	Exposure produces a broad spectrum of clinical effects that are indicative of massive overstimulation of the cholinergic system, including muscarinic effects (parasympathetic), nicotinic effects (sympathetic and motor), and CNS effects. These effects present clinically as feelings of headache, weakness, dizziness, blurred vision, psychosis, respiratory difficulty, paralysis, convulsions, and coma. Typical findings are given by the mnemonic SLUD (salivation, lacrimation, urination, and defecation). A small percentage of patients may fail to demonstrate miosis, a classic diagnostic hallmark. The onset of the clinical manifestation of organophosphate poisoning usually occurs within 12 hr of exposure. [Klaassen, C.D., M.O. Amdur, Doull J. (eds.). Casarett and Doull's Toxicology. The Basic Science of Poisons. 5th ed. New York, NY: McGraw-Hill, 1995., p. 979]
Irritant:	Some evidence of irritation in animal studies. In rabbit study, slight skin irritation resolved within 7 days. Slight erythema (score 1) was noted on three of six test sites at 1 hr, and this effect persisted until 72 hr at one site and until day 5 in another animal. No skin irritation was seen on day 6. [FAO/WHO; Pesticide Residues in Food, Toxicological Evaluations, Chlorpyrifos (1999). Available from, as of September 17, 2007: http://www.inchem.org/documents/jmpr/jmpmono/v99pr03.htm]
Sensitizer:	Not known as sensitizer
Carcinogen:	A4; Not classifiable as a human carcinogen
Mutagen:	Not known as mutagen
Teratogen:	Some evidence of teratogenicity in animal studies. In utero exposure to chlorpyrifos, produced significant sensorimotor deficits in male and female offspring, differential increase in brain AChE activity, a decrease in the surviving neurons and an increased expression of GFAP in cerebellum in adult offspring rats at a corresponding human adult age. [Abou-Donia MB et al; Arch Toxicol 80(9): 620-31 (2006)] is suggested that chlorpyrifos is teratogenic and embryotoxic in mice at doses below those that cause significant maternal toxicity. [Tian Y et al; Reprod Toxicol 20(2): 267-70 (2005)]
Physical Properties:	Colourless to white crystalline solid with a mild mercaptan odour
Elimination:	The concentration of two urinary metabolites of chlorpyrifos--diethylphosphate and diethyl-thiophosphate--was determined for each urine sample. ... The apparent elimination half life of urinary dialkylphosphates after the oral dose was 15.5 hours and after the dermal dose it was 30 hours. Most of the oral dose (mean (range) 93% (55-115%)) and 1% of the applied dermal dose was recovered as urinary metabolites. About half (53%) of the dermal dose was recovered from the skin surface.
Note:	Chlorpyrifos must be stored to avoid contact with strong bases, or acids, or acid fumes since violent reaction can occur. Store in tightly closed containers in a cool, well ventilated area away from sources of heat. Patients on anticholinesterases (even topical, such as eye drops) should be cautious about exposure Chlorpyrifos due to synergistic effects. [Martin, E. W. (ed.). Hazards of Medication. 2nd ed. Philadelphia: J.B. Lippincott Co., l978., p. 422]. Young persons under 18 yr, expectant or nursing mothers, alcoholics, or persons for whom work with toxic chemicals is contraindicated on account of their state of health /are at elevated risk from the toxic effects of organophosphorus pesticides. Those individuals with organic diseases of the CNS, mental disorders & epilepsy, pronounced endocrine & vegetative disorders, pulmonary tuberculosis, bronchial asthma, chronic respiratory diseases, cardiovascular diseases and circulatory disorders, gastrointestinal diseases (peptic ulcer), gastroenterocolitis, diseases of the liver & kidneys, eye diseases (chronic conjunctivitis and keratitis) are at elevated risk from exposure.

	Prior to Working with Chlorpyrifos or Chlorpyrifos-Treated Animals, the Principal Investigator (PI) and Area Manager must ensure all employees who intend to work with Chlorpyrifos or Chlorpyrifos-treated animals: a. Have been trained and are familiar with the contents of this procedure b. If female, complete a Pregnancy - Workplace Screening Tool for Pregnant Workers form (can be downloaded from www.ehs.utoronto.ca) and submit the form to Office of Environmental Health & Safety (Fax number 416-971-1361) for evaluation and to determine if any follow-up by medical provider or accommodation is required.
Chlorpyrifos PREPARATION	
Engineering Controls:	Chlorpyrifos solutions must be prepared in a certified chemical fume hood. Personal protective equipment (PPE) must be worn. All work surfaces must be covered with absorbent, plastic-backed, disposable bench paper. If it is not possible to weigh chlorpyrifos in a certified chemical fume hood, then: - Tare an empty container with its cap; - In a certified chemical fume hood, transfer an approximate quantity of chlorpyrifos into the container; - Cap and weigh the container; - In a certified chemical fume hood, add an appropriate amount of solvent to achieve the desired concentration.
Administrative Controls:	Chlorpyrifos and chlorpyrifos-solutions must be stored in labeled, tightly capped containers. The container must be properly labeled with the identity of the hazardous contents (i.e., chlorpyrifos) and the appropriate hazard warning (i.e., Toxic). .
Personal Protective Equipment:	Two pairs of chemical-resistant gloves (e.g., nitrile), lab coat, and mucous membrane protection (e.g. safety glasses and face shield) must be worn before commencing this step.
Waste Disposal:	If non-disposable glassware is used, it must be single rinsed in a detergent solution prior to washing. The rinsate must be collected and disposed of as chemical waste. chlorpyrifos solutions must be collected and disposed of as chemical waste. Refer to the Laboratory Hazardous Waste Management and Disposal Manual for specific instructions or contact EHS Environmental Protection Services for further information. When all work with chlorpyrifos is complete, carefully remove all bench paper and dispose of as chemical waste. Wipe all surfaces after usage.
Chlorpyrifos ADMINISTRATION	
Engineering Controls:	Administration of chlorpyrifos to rodents must be conducted in a certified chemical fume hood, certified class II type A2 biological safety cabinet at a minimum or at a certified down draft table.
Administrative Controls:	Animals must be chemically or physically restrained prior to starting the procedure. All work surfaces, except the down-draft table, must be covered with absorbent, plastic-backed, disposable bench paper.
Personal Protective Equipment:	Both the personnel administering the chlorpyrifos, and those in the immediate vicinity of the procedure must wear appropriate PPE. Two pairs of chemical-resistant gloves (e.g., nitrile), disposable lab coat or gown, and mucous membrane protection (e.g., chemical goggles, face shield and surgical mask) must be worn before commencing this task.
Waste Disposal:	After the completion of each injection, immediately place the syringe-needle unit in a sharps disposal container.
Note:	Use only needle-locking syringes or disposable syringe-needle units (i.e., needle is integral to the syringe). Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated before disposal.
ANIMAL HOUSING	**Before the first cage change or if cage change before 150 hours after administration:**
Engineering Controls:	For rodents; cover the cages with filter bonnets if possible If cages are not filtered, they can be ventilated (i.e. via certified chemical fume hood, certified class II type A2 biological safety cabinet at a minimum or ventilated rack)
Administrative Controls:	Unless for specific research purpose, the first cage change should be conducted at least 150 hours after administration. The door(s) to a room containing chlorpyrifos-treated animals must be posted in such a manner that it is clear that the room contains chlorpyrifos-treated animals. The animal cages must also be properly labeled. For large animals (Non-Human Primates and Dogs): a. To minimize the creation of aerosols, line the cage drop pans with disposable, plastic-backed, absorbent pads. Adequately wet excreta with water.
Personal Protective Equipment:	If handling/working with chlorpyrifos-treated animals, changing cages, disposing cages or disposing cage waste: Wear disposable gown covering on top of gown, wrist-guards or gloves taped to sleeves, head and foot covering, two pair chemical-resistant gloves (e.g., nitrile), N-95 disposable respirator, and chemical goggles must be worn handling chlorpyrifos-treated animals.

Waste Disposal:	Carefully remove the pads and place in a hazardous waste container for disposal. If pan liners are not used, adequately wet the bedding with water to keep the dust down. Place bedding in a hazardous waste container, using care not to aerosolize dust from the bedding.
Note:	If entering room with chlorpyrifos-treated animals without handling chlorpyrifos-treated animals (cage closed): Wear gown, foot covering and chemical-resistant gloves (e.g., nitrile) must be worn before entering room.
ANIMAL HOUSING	**After the first cage change:**
Engineering Controls:	Cage change/dumping should be performed using certified local exhaust ventilation (e.g., certified class II type A2 biosafety cabinet at a minimum or chemical fume hood). This local exhaust ventilation should be wiped down with detergent and water after use.
Administrative Controls:	The animals may be transferred to clean, standard caging and the chlorpyrifos door signs and cage tags may be removed.
Personal Protective Equipment:	During handling animals, changing cages and disposing cage waste: Wear a disposable gown covering on top of gown, foot covering, wrist-guards or gloves taped to sleeves, double chemical resistant gloves (e.g., nitrile), safety glasses and mucous membrane protection (e.g. surgical mask).
Waste Disposal:	Disposable rodent cages must be carefully placed into hazardous waste containers, taking care to avoid creation of dusts. Dirty cages and racks should be covered with a full drape and moved to the cage wash for immediate cleaning.
Note:	If entering room with chlorpyrifos-treated animals without handling chlorpyrifos-treated animals (cage closed): Lab coat/gown and foot covering must be worn before entering room.
EMERGENCY RESPONSE	**In the event of an exposure:**
	1. Flush body area for a minimum of 15 minutes: a. Contaminated skin should be washed with copious amounts of soap and water b. Contaminated eyes and mucous membranes should be irrigated using normal saline or water 2. Notify the supervisor, if immediately available. Supervisor to fill out an incident/accident/occupational disease form and return the complete form to Health & Well-Being (Fax number: 416-971-3052). 3. Seek medical attention as soon as possible 4. If in doubt, call EHS Occupational Hygiene & Safety at 416-978-4467 to determine further steps.
EMERGENCY RESPONSE	**In the event of a spill:**
Small Spill	1. Only employees trained in the handling of Chlorpyrifos should clean up spills 2. Wear appropriate PPE 3. If a spill occurs on linings and underpads, spray linings and underpads with a cleaning solution. Allow to soak. 4. If a liquid spill occurs on an unlined surface, clean the area with plastic-backed pads to prevent Chlorpyrifos contaminating gloves. The area should be soaked with detergent, then washed with detergent, rinsed with water and dried with pads 5. If a solid spill occurs on an unlined surface, cover the spill with disposable towel dampened with a detergent solution 6. Discard contaminated linings, underpads and materials in hazardous waste bags 7. If in doubt, call EHS Environmental Protection Services at 416-978-7000
Large Spill	1. Evacuate people from the immediate area 2. During business hours, call EHS Environmental Protection Services at 416-978-7000. 3. During off-hours, contact the Campus Police.