SENSE OF SMELL

Some materials can be detected with your nose while they are below a life-threatening threshold; others cannot be detected until a life-threatening threshold has been exceeded. Detecting chemicals with your nose is the least desirable method of recognition and should be avoided, but it can also be the first warning that something is wrong.

Enabling Objectives:

When you have completed this module, you will be able to

Recognize the basic anatomy of the nose and how it works,

Recognize the meaning of olfactory fatigue and its effect,

Identify the concept of odor threshold and how it works, and

Recognize the difference between odor threshold and permissible exposure limit (PEL) and threshold limit value (TLV).

Glossary:

Glomerulus: (See explanation under The Olfactory System)

Mitral Cells: (See explanation under The Olfactory System)

New Jersey Right to Know Hazardous Substance Fact Sheet: There are more than 1,600 fact sheets that have been completed and more than 800 have been translated into Spanish. The fact sheets are prepared on pure substances and contain information on health hazards, exposure limits, personal protective equipment, proper handling, first aid, and emergency procedures for fires and spills.

Odorant: A substance capable of eliciting an olfactory response: An odor is the sensation resulting from stimulation of the olfactory organs. Odors play an important part in our everyday life.

Odor Detection Threshold: The lowest concentration of a certain odor compound that is perceivable by the human sense of smell. The thresholds of a chemical compound are determined in part by its shape, polarity, partial changes, and molecular mass.

Olfactory Bulb: **(See explanation under The Olfactory System)**

Olfactory Epithelium: **A specialize epithelial tissue inside the nasal cavity that is involved in smell. In humans, it measures about 1 cm^2 and lies on the roof of the nasal cavity about 7 cm above and behind the nostrils. The olfactory epithelium is the part of the olfactory system directly responsible for detecting odors.**

Olfactory Fatigue: **An adaptation as the temporary, normal inability to distinguish a particular odor after a prolonged exposure to that airborne compound.**

Odor Threshold: **A term used to identify the concentration at which animals respond 50% of the time to repeated presentations of an odorant.**

Permissible Exposure Limit (PEL): **Sometimes referred to as the OSHA PEL, it is a legal limit in the United States for exposure of an employee to a chemical substance or physical agent. For chemicals, the chemical regulation is usually expressed in parts per million (ppm), or sometimes in milligrams per cubic meter (mg/m^3). Units of measure for physical agents such as noise are specific to the agent. PELs are established by OSHA.**

A PEL is usually given as a time-weighted average (TWA) although some are short-term exposure limits (STEL) or ceiling limits. A TWA is the average exposure over a specified period of time, usually a nominal eight hours. This means that for limited periods, a worker may be exposed to concentrations higher than the PEL, so long as the average concentration over eight hours remains lower.

Recognition Threshold: **The concentration at which 50% of the human panel can identify the odorant or odor, such as the smell of ammonia or peppermint.**

Threshold Limit Value (TLV): **The TLV of a chemical substance is a level to which it is believed a worker can be exposed day after day for a working lifetime without adverse health effects. Strictly speaking, TLV is sometimes loosely used to refer to other similar concepts used in occupational health and toxicology. TLVs (along with biological exposure indices or BELs) are published annually by the American Conference of Governmental Industrial Hygienists (ACGIH).**

The Olfactory System

To understand how your sense of smell works—how your nose takes in smells and the olfactory system perceives them—you need a brief introduction to the anatomy of this system. The main parts of the olfactory system are shown on this page. They consist of:

Nasal Epithelium

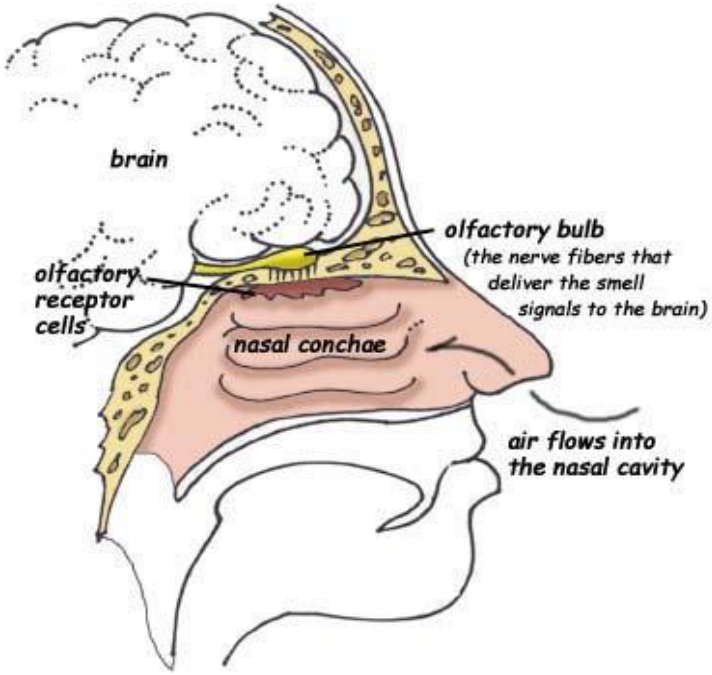
Receptor Cells

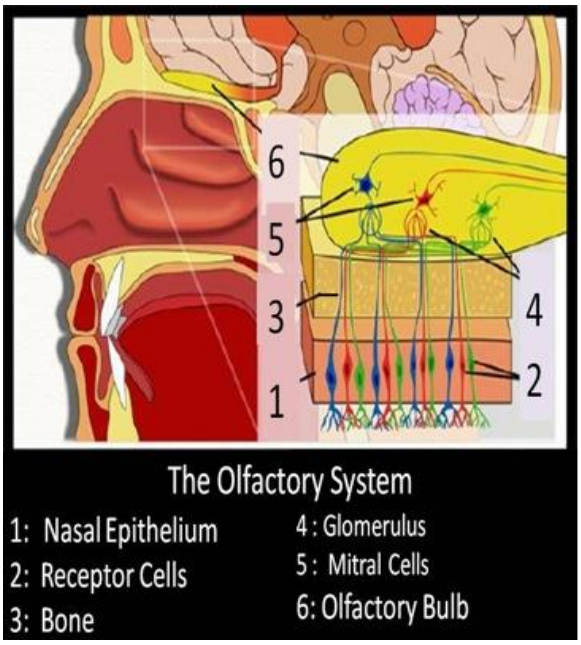
Bone

Glomerulus

Mitral cells

Olfactory Bulb





The Olfactory System—continued

Nasal Epithelium

The nasal epithelium, or the olfactory epithelium, is a specialized epithelial tissue inside the nasal cavity that is involved with the sense of smell. In humans, it measures about 1 cm^2 on each side and lies on the roof of the nasal cavity, about 7 cm above and behind the nostrils. It is the part of the olfactory system that is directly responsible for detecting odors.

Receptor Cells

Olfactory receptor cells in the cell membranes of olfactory receptor neurons are responsible for the detection of odor molecules. Activated olfactory receptors are the initial player in a signal cascade, which ultimately produces a nerve impulse that is transmitted to the brain.

There are tens of millions of olfactory receptor cells but only about 2000 glomeruli. In a remarkable example of convergence, glomeruli receive input from 5,000–1,000 olfactory receptor cells but output onto only 10–25 mitral cells. By combining so much input, the olfactory system is able to detect even very faint odors.

Glomerulus

The glomerulus (plural glomeruli) in olfaction is a structure in the olfactory bulb as shown in the graphic on the preceding page. The glomerulus is the basic unit in the odor map of the olfactory bulb. Each odor activates a different pattern of glomeruli, such that simply by analyzing the different sets of activated glomeruli, one could, in theory, decode the identity of the odor. This odor map, however, is modified by the circuitry within the olfactory bulb so that the spiking pattern of the second-order mitral cells is likely different from what is observed by looking at glomeruli activation (which, with most techniques, represents mostly pre-synaptic action-potentials in olfactory sensory neuron axons).

Mitral Cells

The mitral cells are neurons that are part of the olfactory system. They are located in the olfactory bulb in the mammalian central nervous system. They receive information from the axons of olfactory receptor neurons, forming synapses in neuropils called glomeruli. Axons of the mitral cells transfer information to a number of areas in the brain, including the piriform cortex, entorhinal cortex, and amygdala.

The Olfactory System—continued

Olfactory Bulb

In most vertebrates, the olfactory bulb is the most forward (rostal) part of the brain. In humans, however, the olfactory bulb is on the inferior (bottom) side of the brain. The olfactory bulb is supported and protected by the cribriform plate, which in mammals, separates it from the olfactory epithelium, and which is perforated by olfactory nerve axons. The bulb is divided into two distinct structures, the main olfactory bulb, and the accessory olfactory bulb.

The olfactory bulb transmits smell information from the nose to the brain, and is thus necessary for a proper sense of smell. Its potential functions fall into the following four categories:

Enhancing discrimination between odors

Enhancing sensitivity of odor detection

Filtering out many background odors to enhance the transmission of a few select odors

Permitting higher brain areas involved in arousal and attention to modify the detection or the discrimination of odors

The processes of smelling and tasting begin when molecules detach from substances and float into your nose or into your mouth. In both cases the molecules must dissolve in watery mucous in order to bind to and stimulate special receptor cells. These cells transmit messages to brain areas where we perceive odors and taste, and where we remember people, places, or events associated with these olfactory (smell) and gustatory (taste) sensations.

Conditions That Affect the Sense of Smell

The following conditions can damage or even eliminate a person's ability to smell or detect odors:

Medical Conditions: Head trauma, stroke, subdural hematoma, tumors, hemorrhage, infections, seizures and nerve damage, and Parkinson's and Alzheimer's diseases.

Physical Changes: Stuffy nose, colds, allergies, mouth breathing, dentures.

Aging and Genetics: Bone deformities, cleft palate, loss of receptors.

Toxic Damage: Acids, solvents, insecticides, chemicals.

Olfactory Fatigue:

Olfactory fatigue, or adaptation, is the temporary, normal inability to distinguish a particular odor after a prolonged exposure to that airborne compound.

Olfactory fatigue can commonly be defined as adaption to constant stimulation of our sensory system for smell. Another example of this is the touch receptor cells in the skin. These cells adapt to the stimulation of our clothes, a fortunate thing, or they would distract us constantly.

Adaption involves mechanisms at the level of the receptor cell, including the inactivation of ion channels in the membranes that generate the electrical signal. In a simplified explanation, after a stimulus causes a receptor cell to produce an electrical signal, the cell membrane soon stops allowing the ions to flow, thus preventing further signals. Removal of the stimulus followed by re-stimulation activates the process all over again.

Odor fatigue occurs when total adaptation to a particular odor has occurred through prolonged exposure. This situation would apply to milkers or dairy managers who are exposed to the smell of dairy manure on a daily basis and appear virtually unaware of the odor. While ammonia and hydrogen sulfide are odorants, and not odors per se, they are produced through processes often associated with odor, including municipal sewage treatment systems, coal burning, industries and factories, and livestock operations.

Both ammonia and hydrogen sulfide can cause olfactory losses as a result of chronic or prolonged exposure by damaging the olfactory receptors. Ammonia also can affect the central nervous system. A number of other chemical pollutants, including some insecticides, result in losses in olfaction by damaging olfactory receptors. The use of medications may worsen chemosensory disorders.

On average, olfactory receptors renew themselves every 30 days. Pollutants may alter this turnover rate or disrupt the integrity of the lipid membranes of olfactory receptors. Threshold levels have been identified for a number of pollutants above which odor or irritation occurs. Unfortunately, however, knowledge of the exact mechanisms by which pollutants alter olfaction is limited.

Olfactory Fatigue—continued

***Odor adaptation* is the process by which one becomes accustomed to an odor. The adaptation time needed is greater when more than one odor is present. When adaptation occurs, the detection threshold increases. The detection threshold limits change faster when**

an odor of high, rather than low, intensity is presented. Besides, adaptation occurs differently for each odor.

Odor Terminology and Perception

An *odorant* is a substance capable of eliciting an olfactory response whereas *odor* is the sensation resulting from stimulation of the olfactory organs. Odors play an important part in our everyday life, from appetite stimulation to serving as warning signals for disease detection. A number of diseases have characteristic odors; these diseases include gangrene, diabetes, leukemia, and schizophrenia. Odors have been implicated in depression and nausea as well. Detectable odors can have a significant impact on people by affecting moods as well as having physiological impacts on the olfactory system. People associate odors with past experiences and, from those experiences, involuntarily assess the odor as likable, dislikable, or indifferent. Effects on individuals, however, vary from one person to another.

Most often, however, *odor threshold* is used to mean *detection threshold*, which identifies the concentration at which 50% of a human panel can identify the presence of an odor or odorant without characterizing the stimulus. The *recognition threshold* is the concentration at which 50% of the human panel can identify the odorant or odor, such as the smell of ammonia or peppermint.

Although the detection threshold concentrations of substances that evoke a smell are slight, a concentration only 10–50 times above the detection threshold value often is the maximum intensity that can be detected by humans. This, however, is in contrast to other sensory systems where maximum intensities are many more multiples of threshold intensities. The maximum intensity of sight, for instance, is about 500,000 times that of the threshold intensity and a factor of 1 trillion is observed for hearing.

For this reason, smell often identifies the presence or absence of odor rather than quantifies its intensity or concentration. The ability to perceive an odor varies widely among individuals. More than a thousand-fold difference between the least and the most sensitive individuals in acuity have been observed. Differences between individuals are, in part, attributable to age, smoking habits, gender, nasal allergies, or head colds. Nonsmokers over the age of 15 show greater acuity than smokers in general.

Furthermore, females tend to have a keener sense of smell than males, a finding that has been substantiated in recent work at Iowa State University. Generally, the olfactory sensory nerves atrophy from the time of birth to the extent that only 82% of the acuity remains at the age of 20, 38% at the age of 60, and 28% at the age of 80. Consequently, olfactory acuity and like or dislike of an odor decrease with age. Infants appear to like all classes of odorous materials, perhaps because they lack previous experience and because of their innate

curiosity. Children younger than 5 years of age rated sweat and feces as pleasant but children older than 5 years rated these odors as unpleasant.

Like and dislike of a particular odor can change with odor concentration or intensity. Generally, humans can distinguish between more. Examples of varying threshold measurements of odorous substances (odorants) more than 5,000 odors but some individuals experience anosmia (smell blindness) for one or more odors. In this situation, the individual apparently has a normal sense of smell but is unable to detect one particular odor regardless of its intensity.

For example, because methyl mercaptan has an odor recognition threshold of only 0.0021 ppm, it is often mixed with natural gas as an indicator of leaks. However, approximately one person in 1000 is unable to detect the strong odor of this mercaptan. Impulses travel to the olfactory bulb located at the base of the front brain. At the bulb, fibers from the nose contact other nerves, which travel on to various parts of the brain. An estimated 100 million receptor cells are present in humans. For a substance to be detected as an odor by the receptor cells, several criteria must be met:

The substance must be volatile enough to permeate the air near the sensory area.

The substance must be at least slightly water-soluble to pass through the mucous layer and to the olfactory cells.

Odor Terminology and Perception—continued

The substance must be lipid-soluble because olfactory cilia are composed primarily of lipid material.

A minimum number of odorous particles must be in contact with the receptors for a minimum length of time.

An estimated 30% of the elderly have lost the ability to perceive the minute amount of this mercaptan used in natural gas.

The Mechanism of Smelling Odors

Many theories have been proposed to describe the mechanism of smelling odors. Most can be classified into one of two groups: a physical theory or a chemical theory.

The physical theory proposes that the shape of the odorant molecule determines which olfactory cells will be stimulated and, therefore, what kind of odor will be perceived. Each receptor cell has several different types of molecular receptor sites, and selection and proportion of the various sites differ from cell to cell.

The chemical theory, which is more widely accepted, assumes that the odorant molecules bind chemically to protein receptors in the membranes of the olfactory cilia. The type of receptor in each olfactory cell determines the type of stimulant that will excite the cell. Binding to the receptor indirectly creates a receptor potential in the olfactory cell that generates impulses in the olfactory nerve fibers. Receptor sensitivity may explain some of the variation in detection thresholds exhibited by different compounds.

“SENSE OF SMELL” Exercise 1

Fragrance #	Odor	Reminiscent of…….
#1		
#2		
#3		
#4		
#5		
#6		

"SENSE OF SMELL" Exercise 2

1. What is the name of the system that detects smells/odors?

2. Name and describe some of the conditions that could cause your loss of smell.

3. Define odor threshold.

4. For the chemicals listed below, reference the New Jersey Fact Sheets to find the correct answers.

Chemical Name: Ammonia

A. TLV_____
B. PEL_____
C. Odor Threshold_____

Chemical Name: Carbon Monoxide

A. TLV_____
B. PEL_____
C. Odor Threshold_____

Chemical Name: Formaldehyde

A. TLV_____
B. PEL_____
C. Odor Threshold_____

Chemical Name: Hydrogen Sulfide

A. TLV_____
B. PEL_____
C. Odor Threshold_____

Chemical Name: Methylene Chloride

A. TLV_____
B. PEL_____
C. Odor Threshold_____

Chemical Name: Carbon Tetrachloride

A. TLV_____
B. PEL_____
C. Odor Threshold_____

5. Do any of these chemicals have good warning properties? For example, can you smell the odor before you are potentially exposed?

Are there any chemicals listed that have poor warning properties? For example, is there a chance for over exposure by the time you have smelled the chemical?

6. Can any of the chemicals listed cause odor fatigue?

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **AMMONIA**

Synonyms: Anhydrous Ammonia
CAS No: 7664-41-7
Molecular Formula: NH_3
RTK Substance No: 0084
Description: Colorless gas with a strong, sharp, irritating odor

HAZARD DATA

Hazard Rating	Firefighting	Reactivity
3 - Health **1 - Fire** **0 - Reactivity** **DOT#:** UN 1005 **ERG Guide #:** 125 **Hazard Class:** 2.3 (Toxic Gases)	Non-flammable gas which can ignite and burn with explosive force. Stop the flow of gas or let burn. POISONOUS GASES ARE PRODUCED IN FIRE, including *Nitrogen Oxides*. CONTAINERS MAY EXPLODE IN FIRE. Use water spray to keep fire-exposed containers cool, and to absorb and disperse vapors.	**Ammonia** reacts violently with HALOGENS (such as FLUORINE, CHLORINE and BROMINE); ACIDS (such as HYDROGEN CHLORIDE, HYDROGEN FLUORIDE and HYDROGEN BROMIDE); NITROSYL CHLORIDE; CHROMYL CHLORIDE; TRIOXYGEN DICHLORIDE; NITROGEN DIOXIDE; NITROGEN TRICHLORIDE; BROMINE PENTAFLUORIDE; CHLORINE TRIFLUORIDE; CALCIUM HYPOCHLORITE; and forms explosive compounds that are pressure and temperature sensitive with MERCURY; GOLD OXIDES; and SILVER SALTS and OXIDES. **Ammonia** is incompatible with CHLOROFORMATES; CYANIDES; OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES and NITRATES); DIMETHYL SULFATE; and MANY METALS and their ALLOYS (such as ZINC, COPPER and BRASS). **Ammonia** dissolves in WATER to release heat. Keep away from HEAT, MOISTURE and DIRECT SUNLIGHT.

Isolation Distance:

Small spills – 30 meters (100 feet)

Large spills – 60 meters (200 feet)

Stop flow of gas.

Use water spray to absorb and disperse vapors.

Hazardous to the environment.

DO NOT wash into sewer.

Odor Threshold:	Less than 5 ppm
Flash Point:	Non-flammable
LEL:	15%
UEL:	28%
Vapor Density:	0.6 (air = 1)
Vapor Pressure:	658 mm of Hg at 70°F (21°C)
Water Solubility:	Soluble
Boiling Point:	-28°F (-33.4°C)
Ionization Potential:	10.18 eV
Autoignition:	1,204°F (651°C)

OSHA:	50 ppm (8-hr TWA)
NIOSH:	25 ppm (10-hr TWA), 35 ppm STEL
ACGIH:	25 ppm (8-hr TWA), 35 ppm STEL
IDLH LEVEL:	300 ppm
ERPG-1:	10 ppm
ERPG-2:	200 ppm
ERPG-3	1,000 ppm

Gloves:	Nitrile, Neoprene, Butyl, Butyl/Neoprene, Viton/ Neoprene
Coveralls:	Dupont Tychem® CPE and Kappler Zytron® 500
Boots:	Butyl/Neoprene
Respirator:	> 25 ppm - APR with full-facepiece and cartridges for **Ammonia** >250 ppm - Supplied Air >300 ppm - SCBA

Eyes:	Irritation and burns
Skin:	Irritation and burns. Contact with liquid causes frostbite.
Acute:	Nose, throat and lung irritation with coughing and shortness of breath
Chronic:	An asthma-like allergy with shortness of breath, wheezing, coughing and/or chest tightness

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention immediately.

Immerse affected part in warm water if in contact with liquid.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer to a medical facility.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **CARBON MONOXIDE**

Synonyms: Carbonic Oxide; Exhaust Gas; Flue Gas
CAS No: 630-08-0
Molecular Formula: CO
RTK Substance No: 0345
Description: Colorless, odorless gas

Hazard Rating	Firefighting	Reactivity
2 - Health **4 - Fire** **0 - Reactivity** **DOT#:** UN 1016 **ERG Guide #:** 119 **Hazard Class:** 2.3 (Poisonous Gas)	**Carbon Monoxide** is a FLAMMABLE GAS. Stop flow of gas and use water spray to disperse vapors. POISONOUS GASES ARE PRODUCED IN FIRE. Use water spray to keep fire-exposed containers cool. Vapors may travel to a source of ignition and flash back. **Carbon Monoxide** may form an ignitable vapor/air mixture in closed tanks or containers.	**Carbon Monoxide** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and ALKALI METALS (such as LITHIUM, SODIUM and POTASSIUM). *Liquified*, *cold* **Carbon Monoxide** may react vigorously with water.

Isolation Distance:

Small Spill: 30 meters (100 feet)
Large Spill: 150 meters (500 feet)
Fire: 800 meters (1/2 mile)

Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.

Keep **Carbon Monoxide** out of confined spaces, such as sewers, because of the possibility of an explosion.

Turn leaking cylinder with leak up to prevent escape of gas in liquid state.

Purge with *inert gas* before attempting repairs.

Use only non-sparking tools and equipment, especially when opening and closing containers of **Carbon Monoxide**.

Carbon Monoxide is harmful to aquatic life at very low concentrations.

Odor Threshold:	Odorless
Flash Point:	Flammable gas
LEL:	12%
UEL:	75%
Auto Ignition Temp:	1,125°F (607°C)
Vapor Density:	0.97 (air = 1)
Vapor Pressure:	>750 mm Hg at 68°F (20°C)
Specific Gravity:	0.79 (water = 1)
Water Solubility:	Very slightly soluble
Boiling Point:	-313°F (-192°C)
Melting Point:	-337°F (-205°C)
Critical Temp:	-282°F (-139°C)
Ionization Potential:	14 eV
Molecular Weight:	28

OSHA:	50 ppm, 8-hr TWA
NIOSH:	35 ppm, 10-hr TWA; 200 ppm, 15-min Ceiling
ACGIH:	25 ppm, 8-hr TWA
IDLH:	1,200 ppm

The Protective Action Criteria values are:
PAC-1 = 83 ppm PAC-2 = 83 ppm PAC-3 = 330 ppm

Gloves:	Insulated work gloves (double glove for spills)
Coveralls:	Tychem® BR, Responder ® and TK (330-minute break-through) >10% LEL wear flash protection or turnout gear
Respirator:	SCBA

Eyes:	No information available
Skin:	Skin contact with *liquid* **Carbon Monoxide** can cause frostbite
Inhalation:	Headache, dizziness, lightheadedness and fatigue, convulsions and loss of consciousness

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

In case of contact with *liquid* **Carbon Monoxide**, immerse affected part in warm water. Seek medical attention.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

Medical observation is recommended as symptoms may be delayed.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **FORMALDEHYDE**

Synonyms: Formalin; Methyl Aldehyde; Methylene Oxide
CAS No: 50-00-0
Molecular Formula: CH_2O
RTK Substance No: 0946
Description: Colorless gas with a strong odor, usually found in a *Methanol* and water solution

Hazard Rating

4 - Health
4 - Fire
0 - Reactivity

DOT#: UN 1198 (Solutions, Flammable)
UN 2209 (Solutions)

ERG Guide #: 132
Hazard Class:
UN 1198 (3, Flammable)
UN 2209 (8, Corrosive)

Firefighting

Formaldehyde is a FLAMMABLE GAS or COMBUSTIBLE SOLUTION.

Use dry chemical, CO_2, water spray or alcohol-resistant foam as extinguishing agents.

Use water spray to reduce vapors.

POISONOUS GASES ARE PRODUCED IN FIRE.

CONTAINERS MAY EXPLODE IN FIRE.

Use water spray to keep fire-exposed containers cool.

Reactivity

Formaldehyde reacts violently with NITROGEN OXIDES; OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); mixtures of PERCHLORIC ACID and ANILINE; NITROMETHANE; MAGNESIUM CARBONATE; and HYDROGEN PEROXIDE.

Formaldehyde reacts with PHENOL and HYDROGEN CHLORIDE to form toxic *Bis(Chloromethyl) Ether*.

Formaldehyde is not compatible with STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); IODINE; IRON; SILVER; ISOCYANATES; AMINES; ANHYDRIDES; and LIQUID OXYGEN.

Pure **Formaldehyde** may polymerize (self-react).

Isolation Distance:

Spill: 50 meters (150 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.

Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.

Use only non-sparking tools and equipment, especially when opening and closing containers of **Formaldehyde**.

Keep **Formaldehyde** out of confined spaces, such as sewers, because of the possibility of an explosion.

DO NOT wash into sewer.

Formaldehyde is harmful to aquatic life at low concentrations.

Odor Threshold:	0.05 to 1 ppm
Flash Point:	140° to 181°F (60° to 83°C) (solutions)
LEL:	7%
UEL:	73%
Auto Ignition Temp:	572°F (300°C) (gas); 806°F (430°C) (solution)
Vapor Density:	1.07 (air = 1) (gas)
Vapor Pressure:	760 mm Hg at 68°F (20°C)
Specific Gravity:	0.8 to 1.1 (water = 1)
Water Solubility:	Soluble
Boiling Point:	-3°F (-19.4°C)
Freezing Point:	-134°F (-92°C)
Ionization Potential:	10.88 eV
Molecular Weight:	30

OSHA:	0.75 ppm, 8-hr TWA; 2 ppm, 15-min STEL
NIOSH:	0.016 ppm, 10-hr TWA; 0.1 ppm, 15-min Ceiling
ACGIH:	0.3 ppm, Ceiling
IDLH:	20 ppm

The Protective Action Criteria values are:
PAC-1 = 0.9 ppm PAC-2 = 14 ppm PAC-3 = 56 ppm

Gloves:	Butyl, Nitrile, Neoprene and Viton (>8-hr breakthrough)
Coveralls:	Tychem® BR, Responder® and TK (>8-hr breakthrough)
Respirator:	SCBA

Eyes:	Severe irritation, burns and possible damage
Skin:	Severe irritation and burns
Inhalation:	Nose, mouth, throat and lung irritation, with coughing, and severe shortness of breath (pulmonary edema)
Chronic:	Cancer (nasopharynx and leukemia) in humans

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water. Seek medical attention.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

Medical observation is recommended as symptoms may be delayed.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **HYDROGEN SULFIDE**

Synonyms: Dihydrogen Sulfide; Sulfurated Hydrogen; Sewer Gas
CAS No: 7783-06-4
Molecular Formula: H_2S
RTK Substance No: 1017

Description: Colorless gas with the odor of rotten eggs

Hazard Rating

4 - Health

4 - Fire

0 - Reactivity

DOT#: UN 1053

ERG Guide #: 117

Hazard Class: 2.3 (Poisonous)

Firefighting

FLAMMABLE GAS

Stop flow of gas and use water spray, dry chemical or CO_2 to extinguish fire.

Use water spray to disperse vapors.

POISONOUS GASES ARE PRODUCED IN FIRE, including *Sulfur Oxides*.

CONTAINERS MAY EXPLODE IN FIRE.

Use water spray to keep fire-exposed containers cool.

Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source.

Flow or agitation of **Hydrogen Sulfide** in *liquid* form may generate electrostatic charges.

Hydrogen Sulfide may form an ignitable vapor/air mixture in closed tanks or containers.

Reactivity

Hydrogen Sulfide reacts violently and/or explosively with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); METALS; METAL POWDERS; METAL OXIDES; and STRONG NITRIC ACID.

Hydrogen Sulfide is not compatible with STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE).

Hydrogen Sulfide may react with rusty iron pipes and some plastics.

Isolation Distance:

Small Spill: 30 meters (100 feet)

Large Spill: 300 meters (1,000 feet)

Fire: 800 meters (1/2 mile)

Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.

Use only non-sparking tools and equipment, especially when opening and closing containers of **Hydrogen Sulfide**.

Turn leaking cylinder with leak up to prevent escape of gas in liquid state.

Keep **Hydrogen Sulfide** out of confined spaces, such as sewers, because of the possibility of an explosion.

DO NOT wash into sewer.

For water spills, neutralize with agricultural lime, crushed limestone or sodium bicarbonate.

Hydrogen Sulfide is very toxic to aquatic organisms.

Odor Threshold:	0.008 to 0.1 ppm (>100 ppm causes olfactory fatigue)
Flash Point:	Flammable
LEL:	4%
UEL:	45%
Auto Ignition Temp:	500°F (260°C)
Vapor Density:	1.18 (air = 1)
Vapor Pressure:	14,000 mm Hg at 68°F (20°C)
Specific Gravity:	0.99 (water = 1)
Water Solubility:	Soluble
Boiling Point:	-76°F (-60°C)
Freezing Point:	-122°F (-86°C)
Ionization Potential:	10.46 eV
Molecular Weight:	34.08

NIOSH: 10 ppm, 10-min Ceiling
ACGIH: 1 ppm, 8-hr TWA; 5 ppm, STEL
IDLH: 100 ppm

The Protective Action Criteria values are:
PAC-1 = 0.51 ppm PAC-2 = 27 ppm PAC-3 = 50

Gloves:	*Insulated* Neoprene, Viton and Barrier® (>8-hr breakthrough for *Inorganic gases* and *vapors*)
Coveralls:	Tychem® BR, Responder® and TK (>8-hr breakthrough)
Respirator:	>1 ppm - full facepiece PAPR with cartridges specific for **Hydrogen Sulfide** >10 ppm - SCBA

Eyes:	Irritation
Skin:	Contact with liquid causes frostbite
Inhalation:	Nose, throat and lung irritation, with coughing, and severe shortness of breath (pulmonary edema) Nausea, dizziness, headache, unconsciousness and even death

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention.

Immerse affected part in warm water. Seek medical attention.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility. Medical observation is recommended as symptoms may be delayed.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **METHYLENE CHLORIDE**

Synonyms: Dichloromethane; Methylene Dichloride
CAS No: 75-09-2
Molecular Formula: CH_2Cl_2
RTK Substance No: 1255
Description: Colorless, volatile liquid with a sweet odor

HAZARD DATA

Hazard Rating

2 - Health

1 - Fire

0 - Reactivity

DOT#: UN 1593

ERG Guide #: 160

Hazard Class: 6.1 (Poison)

Firefighting

Methylene Chloride may burn, but does not readily ignite.

Use dry chemical, CO_2, water spray or foam as extinguishing agents.

POISONOUS GASES ARE PRODUCED IN FIRE, including *Hydrogen Chloride* and *Phosgene*.

Use water spray to keep fire-exposed containers cool.

Reactivity

Methylene Chloride reacts violently with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); CHEMICALLY ACTIVE METALS (such as POTASSIUM, SODIUM, MAGNESIUM and ALUMINUM); and STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE).

Methylene Chloride is not compatible with LIQUID OXYGEN; TITANIUM; and AMINES.

Isolation Distance:

Small Spill: 30 meters (100 feet)

Large Spill: 60 meters (200 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers.

DO NOT wash into sewer.

Methylene Chloride may be hazardous in the environment. Special attention should be given to ground water contamination.

Odor Threshold:	25 to 150 ppm
Flash Point:	Nonflammable
LEL:	13%
UEL:	23%
Auto Ignition Temp:	1,033°F (556°C)
Vapor Density:	2.9 (air = 1)
Vapor Pressure:	440 mm Hg at 77°F (25°C)
Specific Gravity:	1.3 (water = 1)
Water Solubility:	Very slightly soluble
Boiling Point:	104°F (40°C)
Melting Point:	-142°F (-97°C)
Ionization Potential:	11.32 eV
Molecular Weight:	85

OSHA:	25 ppm, 8-hr TWA; 125 ppm, STEL
NIOSH:	Lowest feasible concentration
ACGIH:	50 ppm, 8-hr TWA
IDLH:	2,300 ppm
	ERPG-1: 200 ppm, ERPG-2: 750 ppm; ERPG-3: 4,000 ppm

Gloves:	Polyvinyl Alcohol and Silver Shield®/4H® (>8-hr breakthrough)
Coveralls:	Tychem® Responder® and TK; Zytron® 500; ONESuit® TEC; and Trellchem® HPS and VPS (>8-hr breakthrough)
Respirator:	>25 ppm - Supplied air

Eyes:	Irritation and burns
Skin:	Irritation and burns
Inhalation:	Nose, throat and lung irritation with coughing, wheezing and shortness of breath
	Headache, nausea, fatigue, dizziness, lightheadedness, and unconsciousness
Chronic:	Cancer (liver and lung) in animals

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **CARBON TETRACHLORIDE**

Synonyms: Tetrachlorocarbon; Perchloromethane; Carbon Tet
CAS No: 56-23-5
Molecular Formula: CCl_4
RTK Substance No: 0347
Description: Colorless liquid with an Ether-like odor

Hazard Rating	Firefighting	Reactivity
3 - Health **0 - Fire** **0 - Reactivity** **DOT#:** UN 1846 **ERG Guide #:** 151 **Hazard Class:** 6.1 (Poisonous)	Extinguish fire using an agent suitable for type of surrounding fire. **Carbon Tetrachloride** itself does not burn. POISONOUS GASES ARE PRODUCED IN FIRE, or when in contact with hot surfaces, including *Phosgene* and *Hydrogen Chloride*. Use water spray to keep fire-exposed containers cool.	**Carbon Tetrachloride** reacts with CHEMICALLY-ACTIVE METALS (such as SODIUM, POTASSIUM and MAGNESIUM); ZINC; ALUMINUM; POWDERED BERYLLIUM; FLUORINE; DIMETHYLFORMAMIDE; CALCIUM DISILICIDE; CALCIUM HYPOCHLORITE; and mixtures of ETHYLENE and BENZOYL PEROXIDE to cause fires and explosions. **Carbon Tetrachloride** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE).

Isolation Distance:

Small Spill: 60 meters (200 feet)
Large Spill: 270 meters (900 feet)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.

DO NOT wash into sewer.

Carbon Tetrachloride is harmful to aquatic organisms and is hazardous to the environment and ozone layer.

Odor Threshold:	>10 ppm
Flash Point:	Non-combustible
Vapor Density:	5.3 (air = 1)
Vapor Pressure:	91 mm Hg at 68°F (20°C)
Specific Gravity:	1.59 (water = 1)
Water Solubility:	Very slightly soluble
Boiling Point:	169°F (76°C)
Ionization Potential:	11.47 eV
Molecular Weight:	153.8

OSHA:	10 ppm, 8-hr TWA; 25 ppm, 15-min Ceiling; and 200 ppm, as a 5-min maximum Peak in any 4-hr work period
NIOSH:	2 ppm, 60-min STEL
ACGIH:	5 ppm, 8-hr TWA; 10 ppm, 15-min STEL
IDLH:	200 ppm

Gloves:	Silver Shield®/4H®, Viton, Viton/Butyl and Nitrile (>8-hr breakthrough)
Coveralls:	DuPont Tychem® BR and LV, Responder® and TK; ONESuit® TEC; and Kappler Zytron® 300, 400 and 500 (>8-hr breakthrough)
Respirator:	>2 ppm - Supplied air

Eyes:	Severe irritation, burns
Skin:	Severe irritation, burns, rash with blisters
Inhalation:	Headache, nausea, vomiting, diarrhea, dizziness, lightheadedness and passing out
Chronic:	Carcinogen (liver) in animals. Limited evidence that it may damage the developing fetus and male reproductive glands (testes)

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention immediately.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water. Seek medical attention.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer to a medical facility.

"SENSE OF SMELL" Exercise 2

1. What is the name of the system that detects smells/odors?

Olfactory System

2. Name and describe some of the conditions that could cause your loss of smell.

Med conditions, physical changes, aging, genetics, toxic damage

3. Define odor threshold.
Term used to identify the concentrations at which animals respond 50% of the time to repeated presentations[exposures] of an ordorant

4. For the chemicals listed below, reference the New Jersey Fact Sheets to find the correct answers.

Chemical Name: Ammonia

- **A.** TLV___25ppm / 35ppm [STEL]
- **B.** PEL____50ppm IDLH-300ppm
- **C.** Odor Threshold__<5ppm [less than 5ppm]

Chemical Name: Carbon Monoxide

- **A.** TLV___25ppm
- **B.** PEL___50ppm IDLH-1,200ppm
- **C.** Odor Threshold___NONE[Odorless]

Chemical Name: Formaldehyde

- **A.** TLV_____.3ppm-CEILING [NEVER TO EXCEED]
- **B.** PEL____.75ppm 2ppm[STEL] IDLH-20ppm
- **C.** Odor Threshold___.05 to 1ppm

Chemical Name: Hydrogen Sulfide

- **A.** TLV____1ppm
- **B.** PEL____? IDLH-100ppm
- **C.** Odor Threshold____.008ppm to .1ppm [.100ppm causes olfactory fatique]

Chemical Name: Methylene Chloride

- **A.** TLV_____50ppm
- **B.** PEL_____25ppm
- **C.** Odor Threshold____25ppm to 150ppm

Chemical Name: Carbon Tetrachloride

- **A.** TLV___5ppm 10ppm[STEL]
- **B.** PEL____10ppm IDLH-200ppm
- **C.** Odor Threshold__>10ppm [greater than 10ppm]

5. Do any of these chemicals have good warning properties? For example, can you smell the odor before you are potentially exposed?

Ammonia does due to odor threshold[less than 5ppm] being below the PEL[50ppm]
Hydrogen Sulfide does due to odor threshold[.008-.1ppm] being below the TLV[1ppm]

Are there any chemicals listed that have poor warning properties? For example, is there a chance for over exposure by the time you have smelled the chemical?

Formaldehyde-due to range of threshold[chance of exposure]
Methylene Chloride-Threshold starts at the PEL[you are over exposed before smelling it]
Carbon Monoxide-No odor threshold[odorless]
Carbon Tetrachloride-threshold starts above the PEL[over exposed before smelling it]

6. Can any of the chemicals listed cause odor fatigue?

Hydrogen Sulfide causes odor fatigue at concentrations >100ppm[greater than 100ppm]