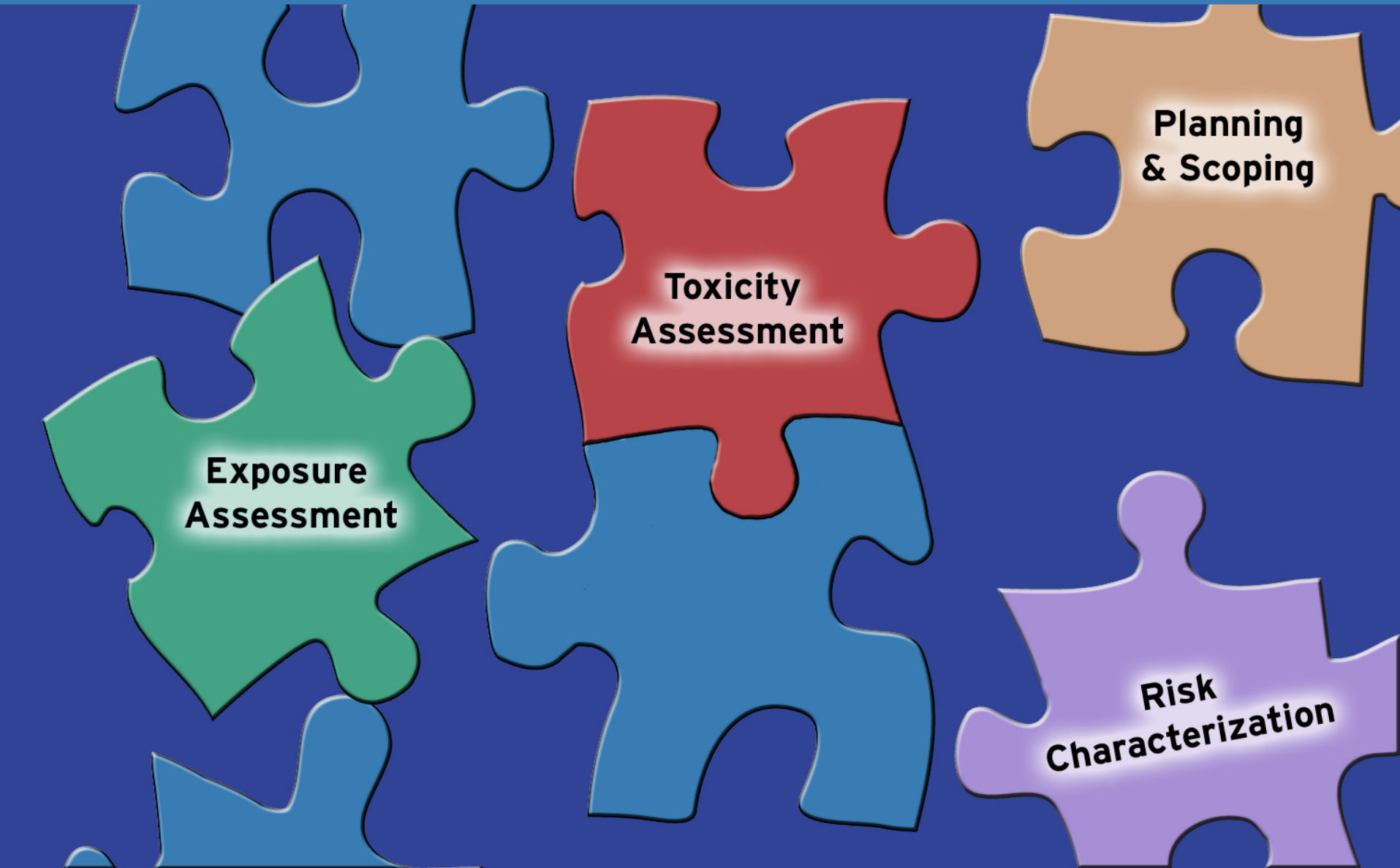
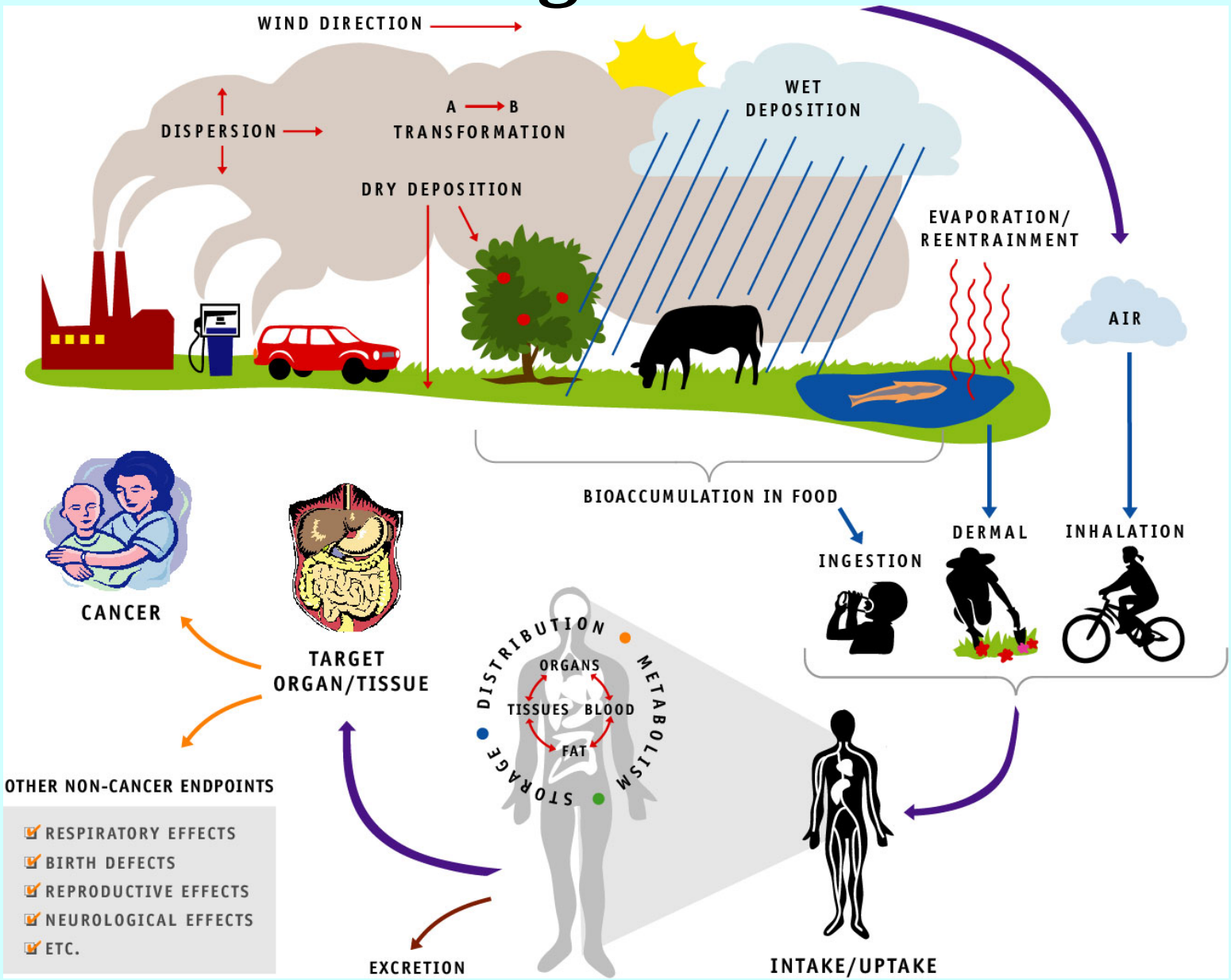
The Air Toxics Risk Assessment Process



The Big Picture



The General Four Step Risk Assessment Process

The Detailed Air Toxics Risk Assessment Process

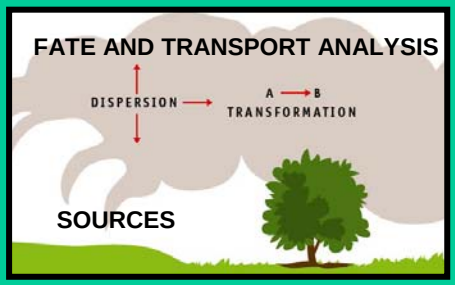
Planning and Scoping

Exposure Assessment

SOURCE IDENTIFICATION

Chemical Release

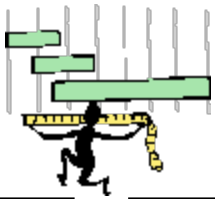
FATE AND TRANSPORT ANALYSIS



CHEMICAL CONCENTRATIONS
Air, Soil, Water, Food
(monitor/model)

POPULATION CHARACTERISTICS

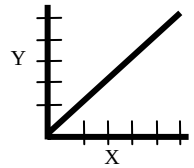
Measures of Exposure



Toxicity Assessment

Hazard Identification

Dose/ Response Assessment



Risk Characterization

EXPOSURE information

DOSE/RESPONSE information

Quantitative and Qualitative Expressions of Risk/Uncertainty

Cancer vs. Noncancer

Cancer Risk

- Nonthreshold (generally)
- Slope Factors
  - Inhalation Unit Risk
  - Oral Potency Factor

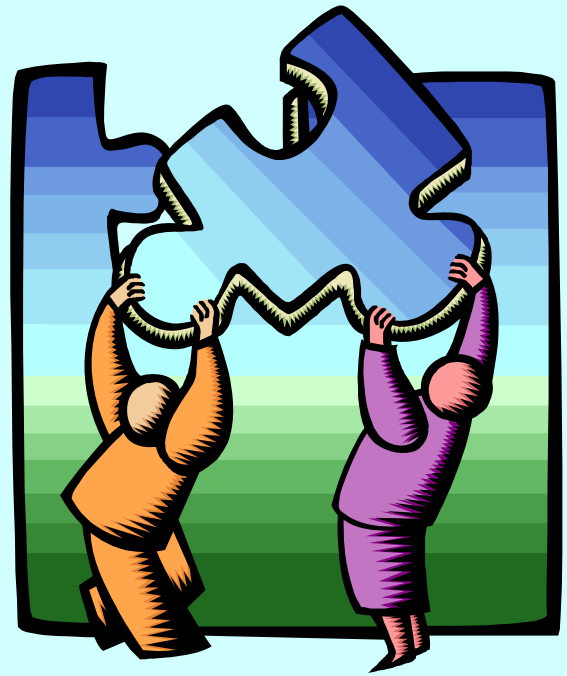
Non-Cancer Hazard

- Threshold (generally)
- Reference Values
  - RfC (inhalation)
  - RfD (oral)

The Major Steps… Putting it all together

Review and combine the outputs from toxicity and exposure assessments

- **Quantify risks from individual chemicals for each pathway separately (e.g., inhalation, ingestion), then…**
- **Combine risks from multiple chemicals *within* each pathway, then…**
- **Combine risks *across* exposure pathways to give total risk**



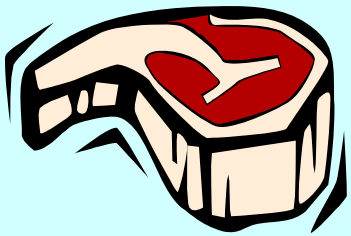
Example – Multipathway Risk Characterization

Assess Exposure

Combine with Toxicity Data

Inhalation Pathway-Specific Risk

+



Assess Exposure

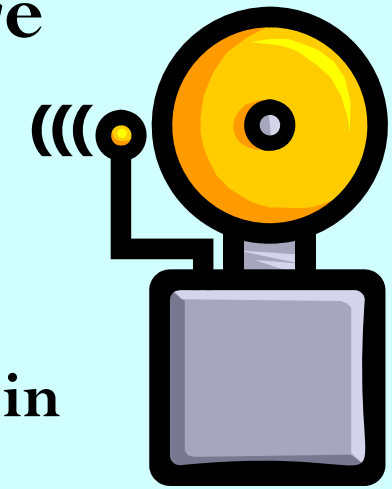
Combine with Toxicity Data

Ingestion Pathway-Specific Risk

Total Risk

Remember!!!

We normally go through this entire process twice!!!



First, we calculate and present the risks posed by cancer causing chemicals within and then across pathways

…and next, we…

Calculate and present the noncancer hazards posed by various chemicals within and then across pathways

Inhalation Cancer Risk

How do you usually calculate it?

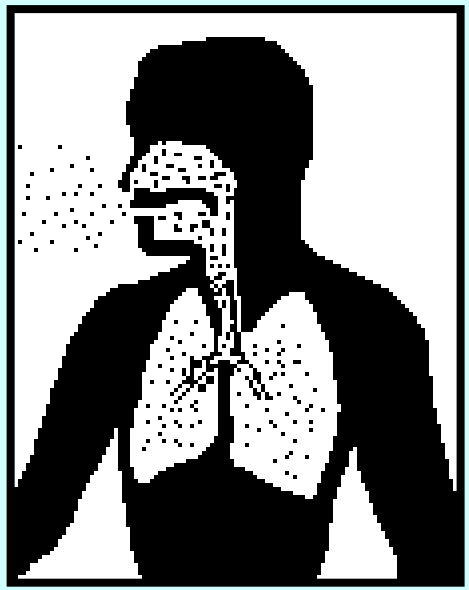
The basic equation for calculating risk from breathing a carcinogenic air toxic is:

Risk = EC x IUR

Where:

EC = concentration of the chemical in air at the point of exposure ($\mu g/m^3$)

IUR = Inhalation Unit Risk ($risk/\mu g/m^3$)



Inhalation Cancer Risk

What happens when multiple carcinogens are present?

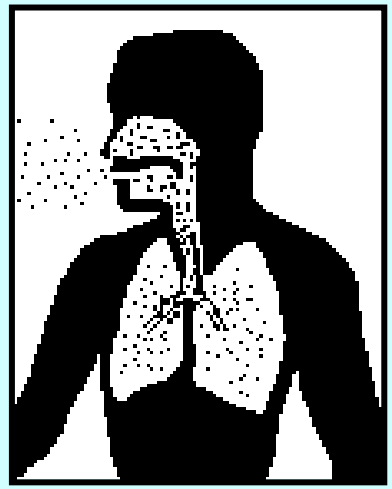
The equation is the same – however, you usually sum over all the different carcinogens present in the air

$$Risk = (EC_1 \times IUR_1) + (EC_2 \times IUR_2) + \ldots + (EC_i \times IUR_i)$$

Where:

EC_i = concentration of the i^{th} chemical in the air at the point of exposure ($\mu g/m^3$)

IUR_i = Inhalation Unit Risk of the i^{th} chemical in the air ($risk/\mu g/m^3$)



Cancer Risk

What do the answers mean?

Cancer risk is a *probability* (e.g., 2×10^{-5})of an individual developing cancer because of the exposure in question

Inhalation NonCancer Hazard

How do you usually calculate it?

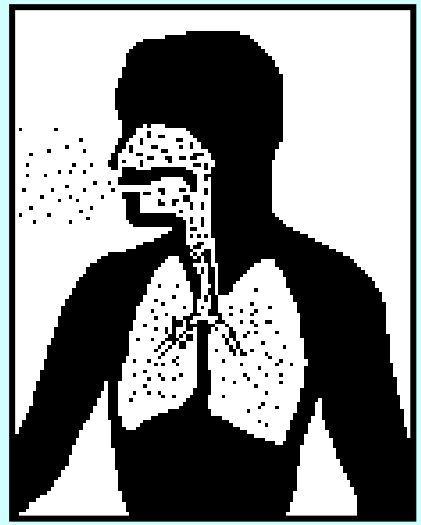
The basic equation for calculating hazard from breathing an air toxic that causes a noncancer effect is:

Hazard Quotient = EC/RfC

Where:

EC = concentration of the chemical in air at the point of exposure (mg/m^3)

RfC = Reference Concentration (mg/m^3)



NonCancer Hazard

What happens when multiple noncarcinogens are present?

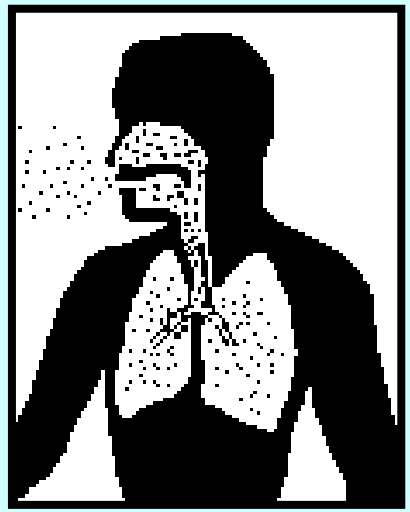
The equation is the same – however, you usually sum over all the different noncarcinogens present in the air (note the new name for the sum)

$$\text{Hazard Index} = (EC_1)/(RfC_1) + (EC_2)/(RfC_2) + \ldots + (EC_i)/(RfC_i)$$

Where:

EC_i = concentration of the i^{th} chemical in the air at the point of exposure (mg/m^3)

RfC_i = reference concentration of the i^{th} chemical in the air (mg/m^3)



NonCancer Hazard

What do hazard answers mean?

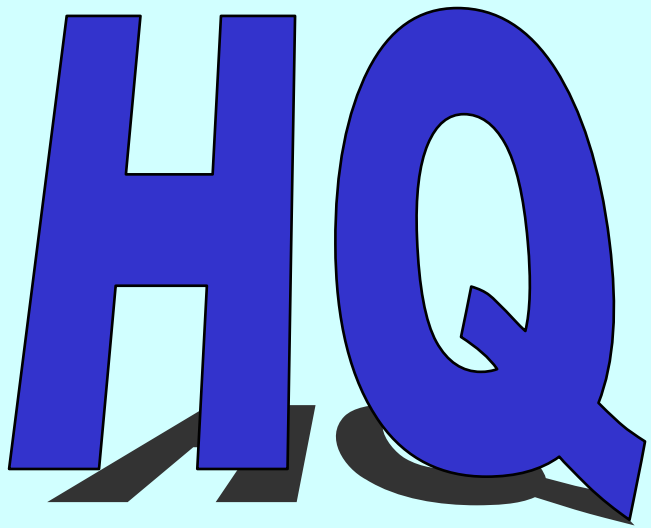
The HQ is a simple comparison (i.e., a ratio) of a chemical's concentration in air to a level below which no adverse effect is likely to occur in the general population, including sensitive subpopulations

The HQ IS NOT a unitless probability like cancer risk - that is why you cannot add cancer *risk* and noncancer *hazard* (they're apples and oranges!)

NonCancer Hazard

What do hazard answers mean?

The level of hazard associated with an HQ > 1 does not necessarily increase linearly with an increasing ratio



How correct are our risk estimates?

Perform a thorough evaluation of uncertainties associated with the assessment

How do they affect the results (direction and magnitude)?

Uncertainty analysis is one of the main steps of the risk characterization process

Some Important Areas of Uncertainty

- Physical setting uncertainties
  - Likelihood that exposure pathways are occurring
  - Sources and chemicals not included in the assessment
- Model applicability and assumptions
- Parameter value uncertainties
- Toxicity assessment uncertainties
  - Multiple substance exposures
  - Chemicals with no toxicity values
  - TOSHI analyses

For More Information

- **Fate, Exposure, and Risk Analysis:**

www.epa.gov/ttn/fera

- **Toxicity Values:**

www.epa.gov/ttn/atw/toxsource/summary.html

- **Air Quality Dispersion Models:**

www. epa.gov/scram001/dispersionindex.htm