



Understand the situation at hand

CHEMICAL HAZARDS AND EXPOSURE

In this session...

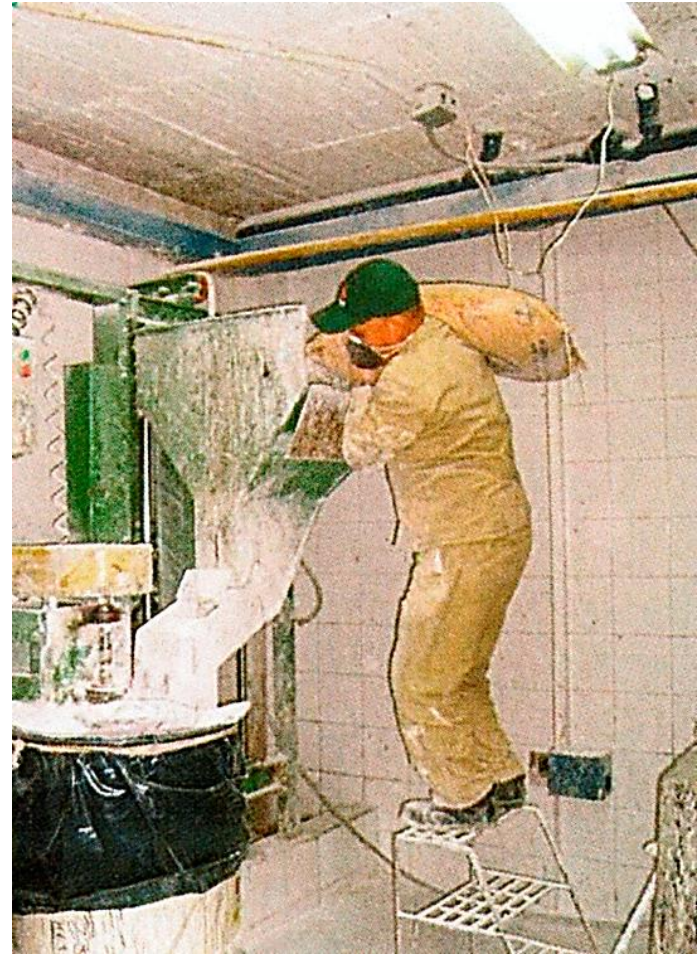
- Distinguishing between chemical hazards
- Understanding human exposure and effects
- Identify information sources



Before we start...

Distinguish between

- hazards
- exposures
- Effects (also referred to as hazard end-points)



Hazards and possible effect?



Hazard-exposure-effect relationships



Hazard the **intrinsic property** of substance/situation/conditions to **potentially** harm

Exposure the **process** of coming in contact with a hazard

Effect the **possible result** of exposure to the hazard

HAZARD + **EXPOSURE** => **EFFECT**

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~~No~~ ~~HAZARD~~ + EXPOSURE ~~=>~~ ~~EFFECT~~ ~~No~~

HAZARD + ~~EXPOSURE~~ ~~=>~~ ~~EFFECT~~ ~~No~~

Chemical hazards

...the **potential** of a substance (e.g. of gases, vapours, aerosols, dust, liquids, solids) to harm and damage



Physical

Cause fire

Lead to explosions

Corrode structures,
building, equipment

Cause violent reactions
with other chemicals

Life and Health

Cause irritation or
allergies

Damage organs

Damage unborn child

Cause cancer

Affect fertility and
reproduction

Environment

Kill aquatic life

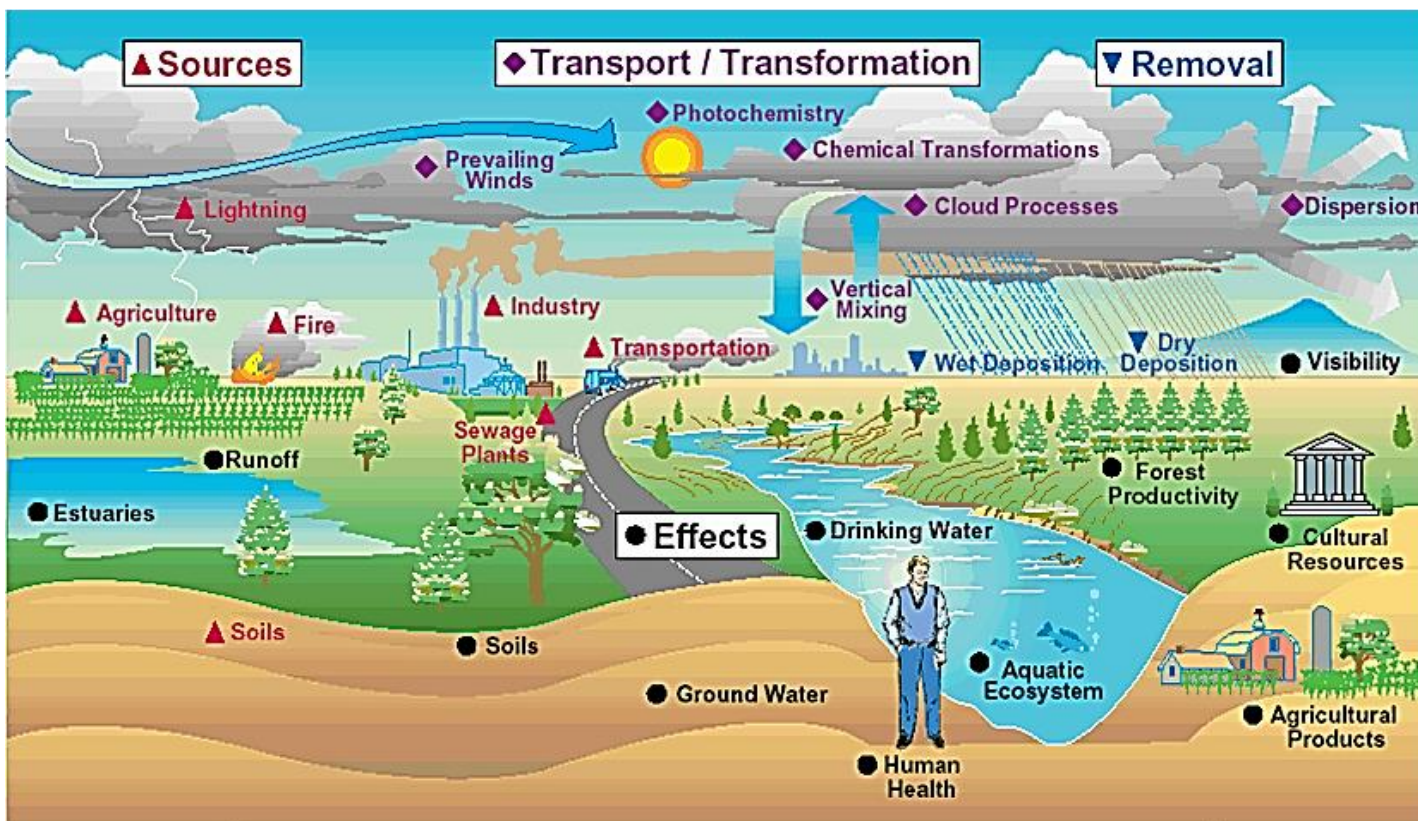
Cause nuisance odour

Contaminate (drinking
and ground) water

Contaminate air

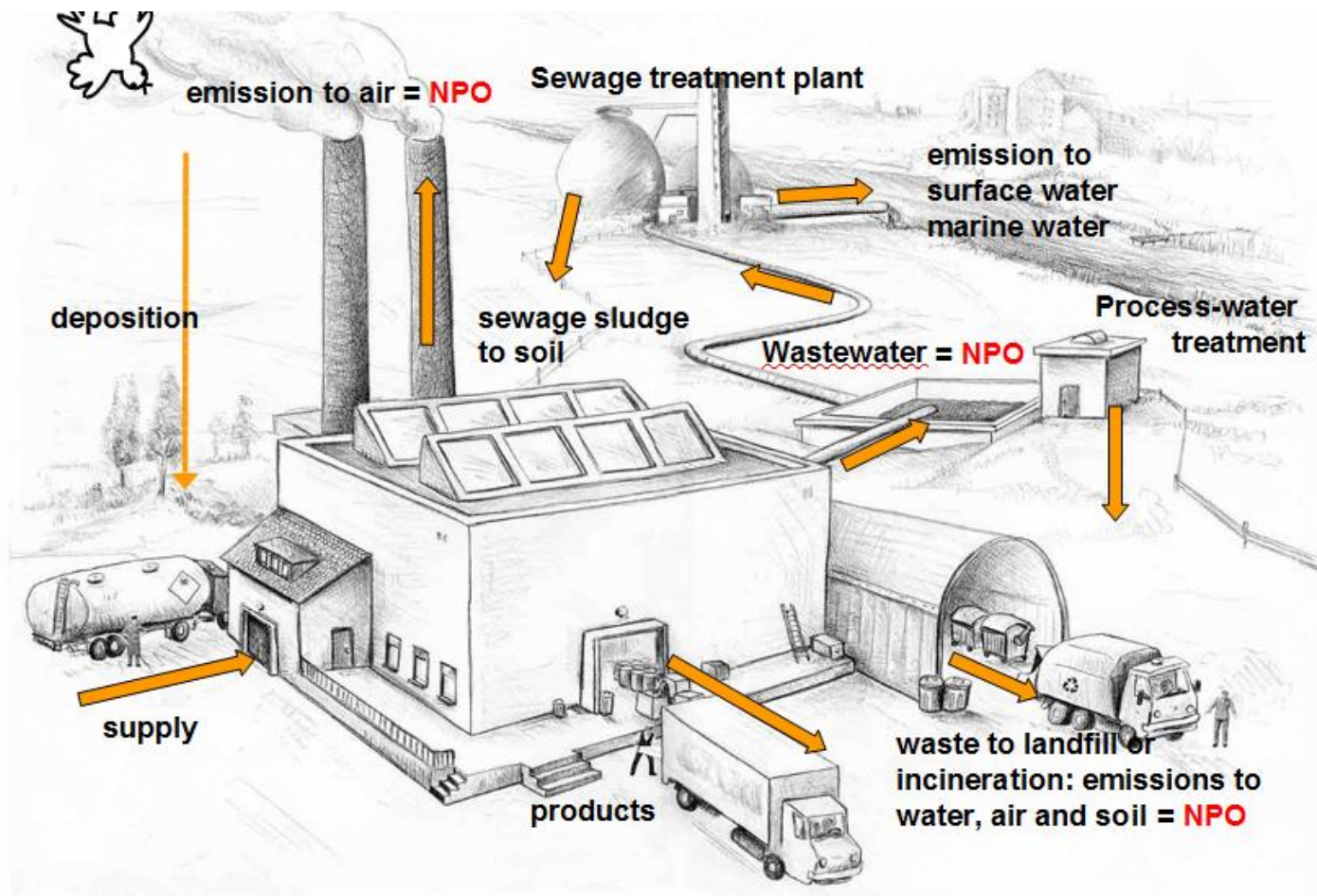
Contaminate soil

Chemicals and potential hazards in our ecosystem



Source: USEPA

Emission of chemicals to the environment



Exposure pathways

Overview

- Factory personnel exposure (manager, supervisor, worker, contractors)
- Society exposure (neighbourhood, downstream population)
- Interim handling personnel (transporters, customs officials, point of sale staff,...)
- Consumer exposure
- Environment exposure (air, water, soil)



Effects/hazard-end-points

Overview

Human toxicity

- carcinogenicity
- mutagenicity/ genotoxicity
- reprotoxicity
- developmental toxicity
- neurotoxicity
- endocrine disruption
- mammalian toxicity
- respiratory sensitization
- skin/eye irritation and corrosivity

Environmental toxicity and fate

- persistence
- bioaccumulation
- biodegradation
- aquatic toxicity
- ozone depletion
- green house gas effects/global warming contribution



Human exposure to chemical hazards

Exposure routes / routes of entry



Source: ILO

- **Inhalation** of airborne chemicals (gases, vapours or airborne particulates (dust, smokes, aerosols))
- **Skin contact** and **absorption** through skin and eyes in gaseous. Liquid or solid form
- **Ingestion** of chemicals in liquid and solid form
- Injections
- Radiation

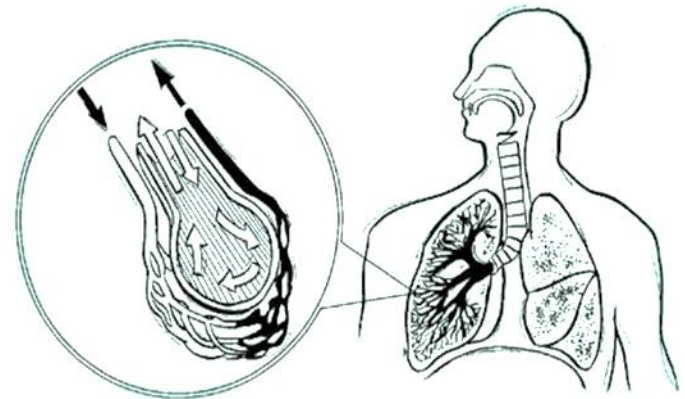
Human exposure to chemical hazards

Inhalation

The respiratory system represents an efficient entry point for chemicals = 90 square metres surface.

A worker inhales about **10 cubic metres of air** in the course of an eight-hour shift.

Most common form of workplace exposure



Source: GIZ



Extreme care must be taken because chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing. The smaller the particles are, the more easily they are inhaled.

Human exposure to chemical hazards

Second most common form of workplace exposure

Skin contact and absorption

Contact with chemicals with skins/eyes can lead to

- (1) **Direct effects** on skins and eyes
 - Dermatitis = dry, rough and sore skin
 - Allergies, especially due to repeated exposure
 - Burns, corrosion
- (2) **Systemic effects** when absorbed into the body (blood stream)



Source: GIZ

Human exposure to chemical hazards

Accidental or deliberate ingestion

Hazardous agents get into the body through digestive tract, e.g.

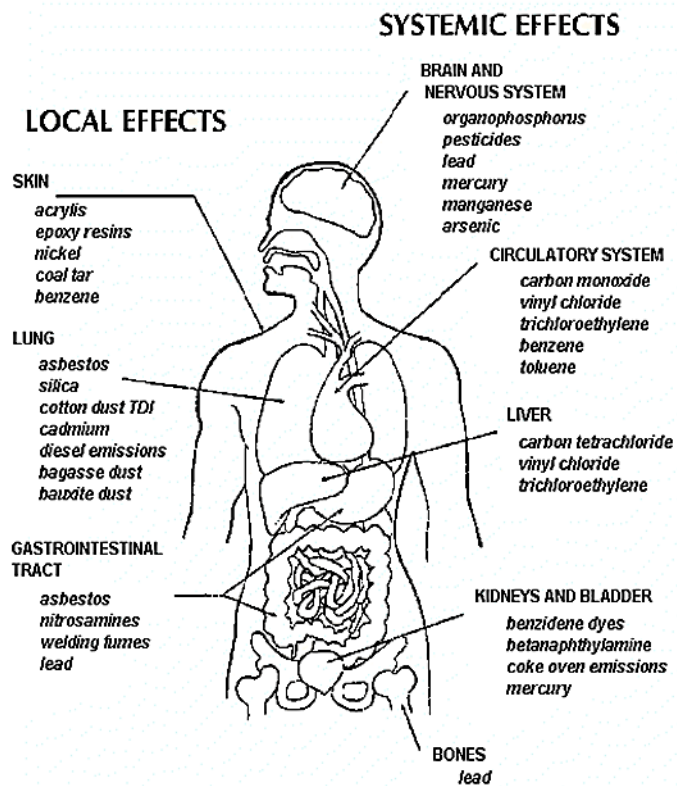
- Smoking, drinking, eating in workplace
- Consuming contaminated water or food
- Accidental ingestion of chemicals (e.g. use of used bottles for storage of chemicals)



Source: ILO

Human health effects of chemical exposure

1. **Direct effects** to lung, skin, eyes, digestive tract
2. **Systemic effects** of chemical substances entering body through inhalation, skin absorption, ingestion or injection and being **sorbed into** and transported by **bloodstream** to body's organs, bones, fat, muscles, ...
 - damage internal organs, especially the liver, lungs and kidneys, nerves, cause cancer, damage foetuses, cause heritable genetic damage, ...



Human health effects of chemical exposure

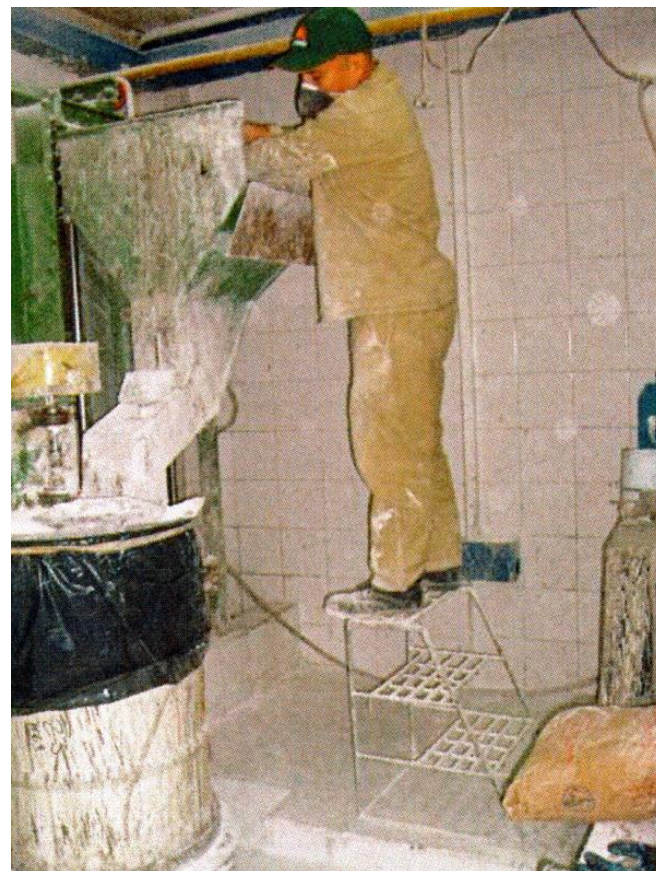
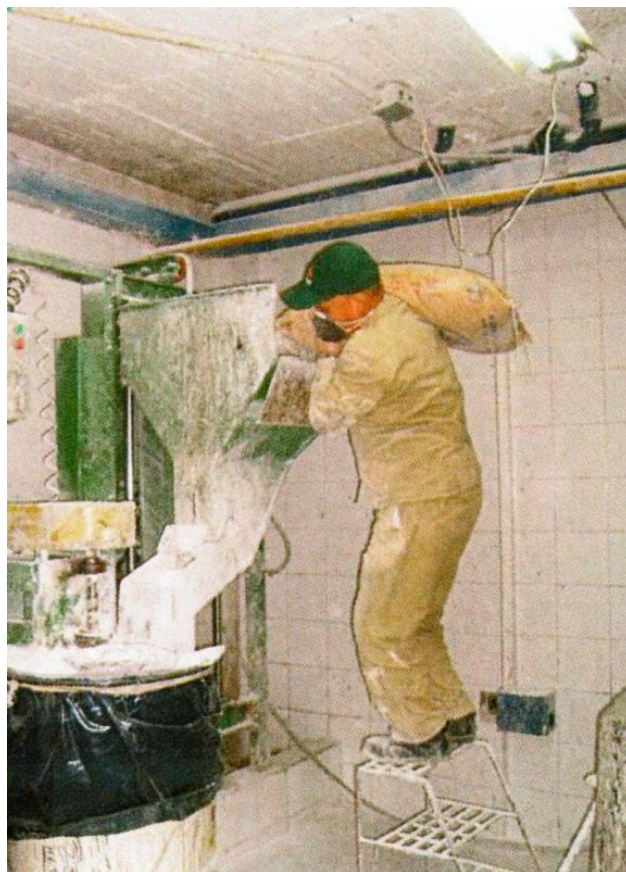
Examples of hazard end-points

- Irritation of skin, eyes and respiratory tract (i.e. by acids, alkalis and solvents)
- Narcosis and anesthesia (i.e. by organic solvents)
- **Systemic poisoning** of liver, kidneys, nervous system and reproductive system, leading to sterility and miscarriages (i.e. by organic solvents, and heavy metals)
- **Cancer** = uncontrolled growth of cells (i.e. by asbestos, heavy metals and organic solvents)
- **Damage to the foetus** – especially during the first three months of pregnancy
- **Genetic damage** to following generations



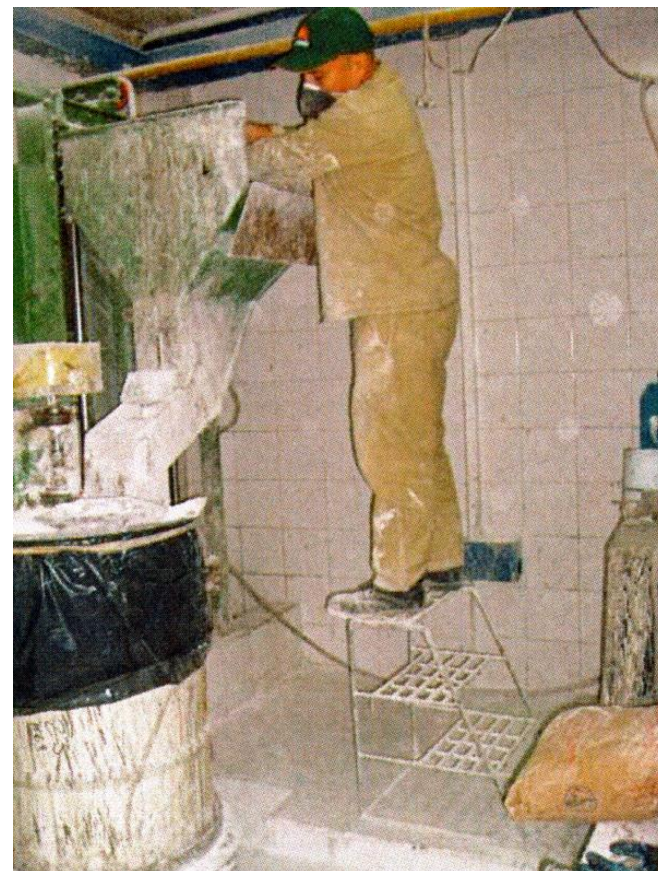
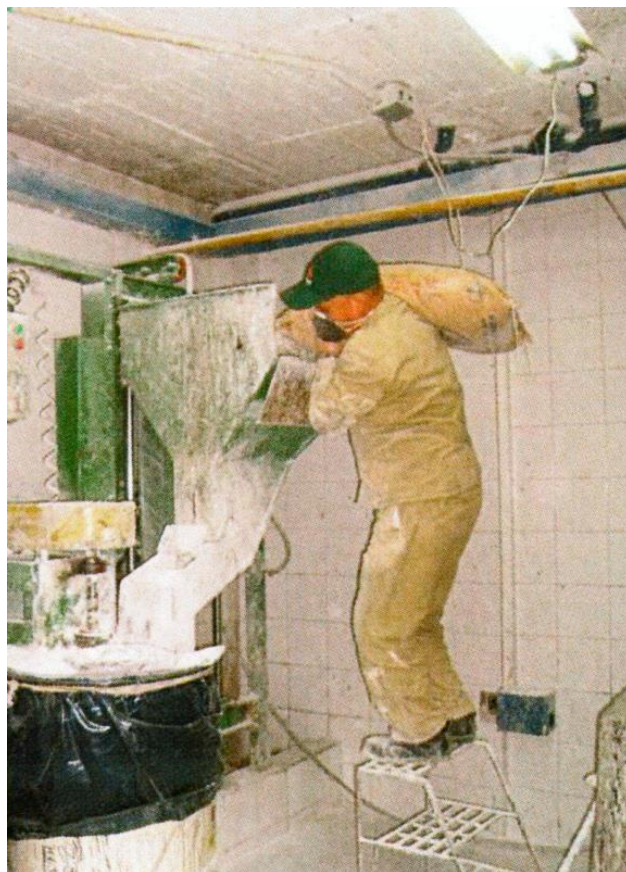
Exercise

Worker emptying bag of unhydrated lime



Exercise

Worker emptying bag of unhydrated lime



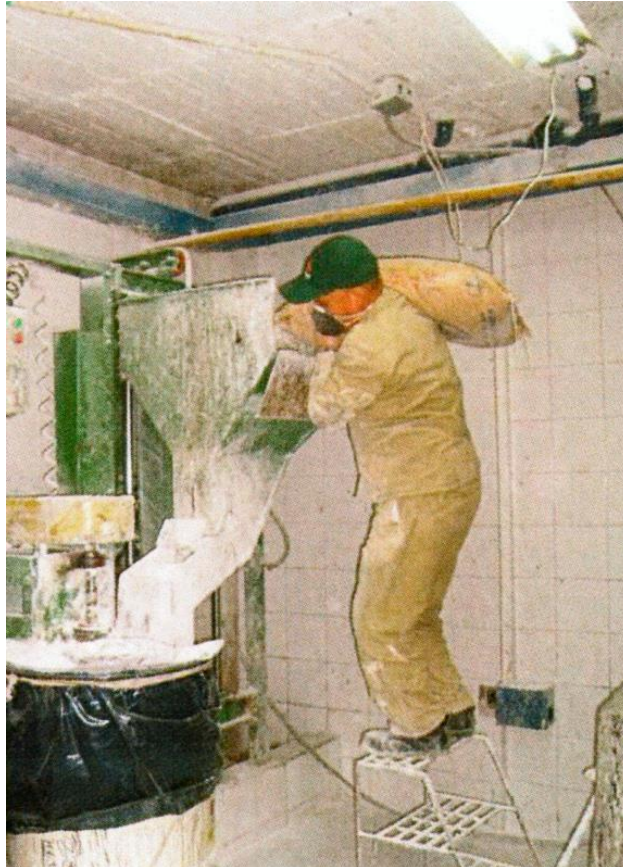
Hazard?

Exposure?

Effect?

Exercise

Worker emptying bag of unhydrated lime



Hazards of unhydrated lime

- Irritant to skin and eyes
- Irritant to lungs

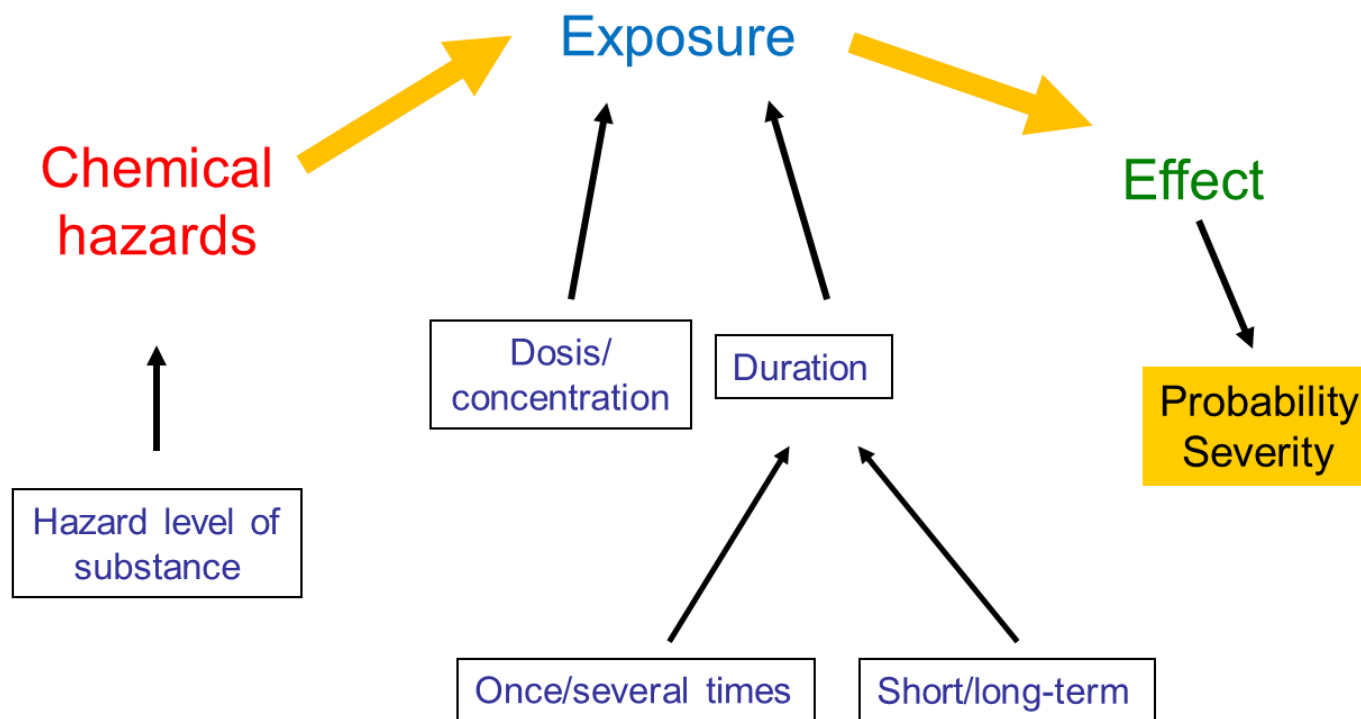
Exposure

- Eye and skin contact with dust
- Inhalation of dust

Effects

- Blisters/burning of skins
- Irritation/burning, including permanent damage to eye
- Lung function impairment/burning to lung

Understanding influencing factors....



Understanding influencing factors....

"The dose makes the poison" (Latin: "*sola dosis facit venenum*")
Paracelsus, 1538

Example: **Cooking salt**

Dosis/ concentration	Duration	Probability of adverse health effect
1 spoon	Once	Low
20 spoons	One or twice	Maybe
100 spoons	More then twice	High

Low
risk



High
risk

To keep in mind...

Short term exposure to a high-level concentration

- may result in acute (or immediate) effects

Exposure to even a low concentration over a long period of time

- may be tolerated for a while but may result in even higher cumulative dose, resulting in chronic effects.



Be aware of combined effects!

Most common situation:

- Workers exposed to two or more chemicals.

Challenge:

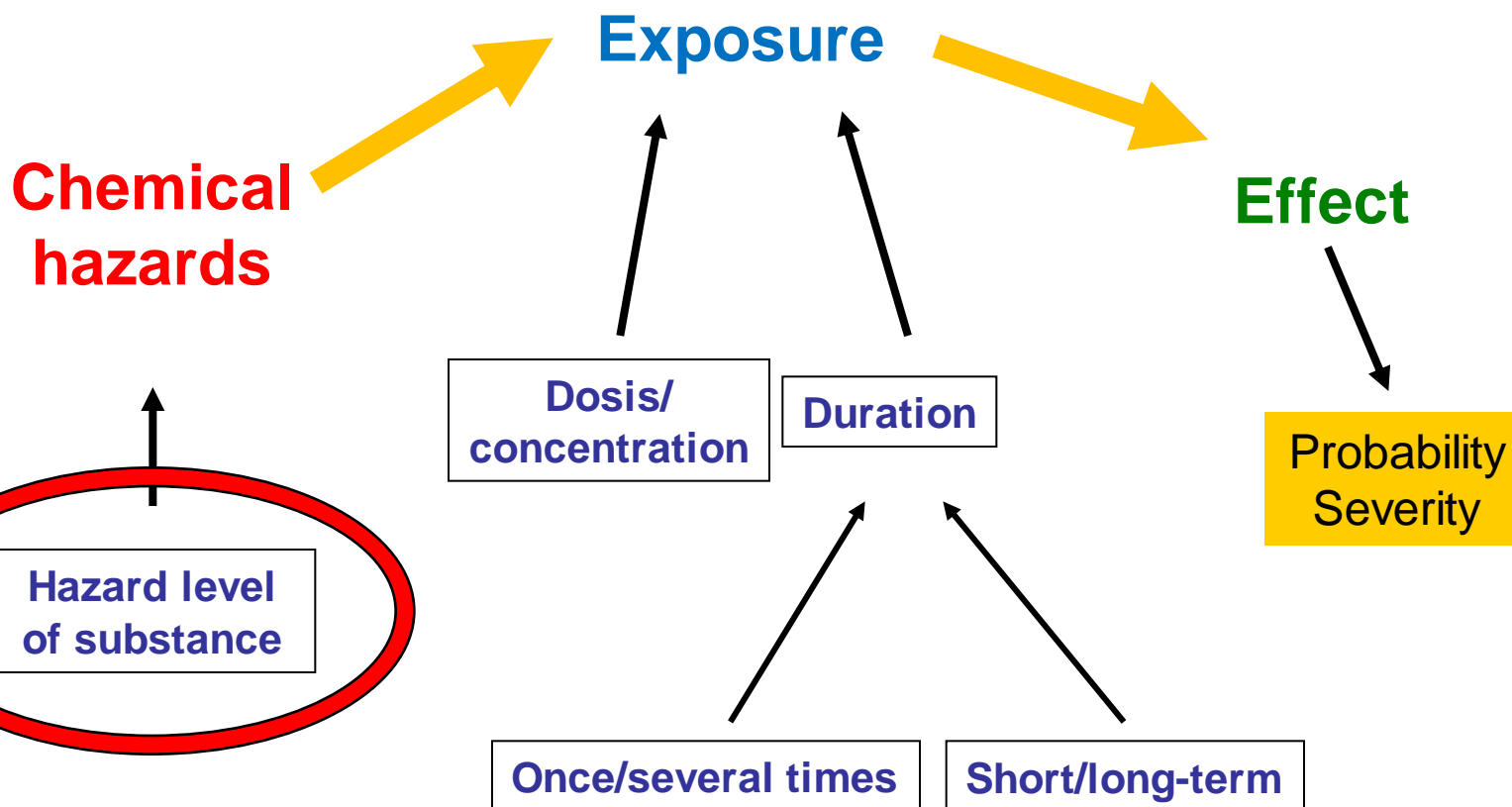
- The combined effects of chemicals mostly unknown.

Possible prevention:

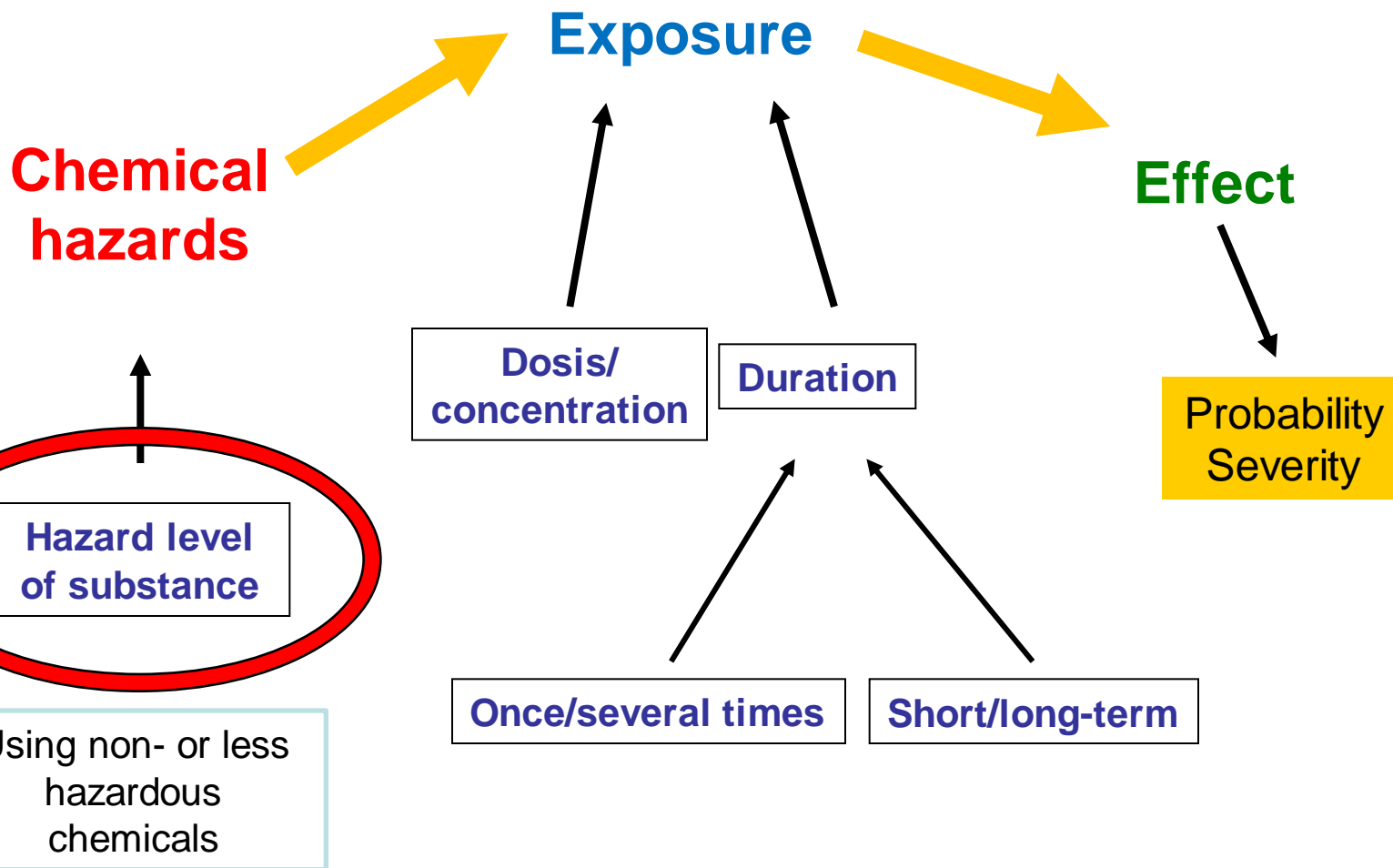
- Avoid mixing several chemicals together. The combination may result in very dangerous effects.



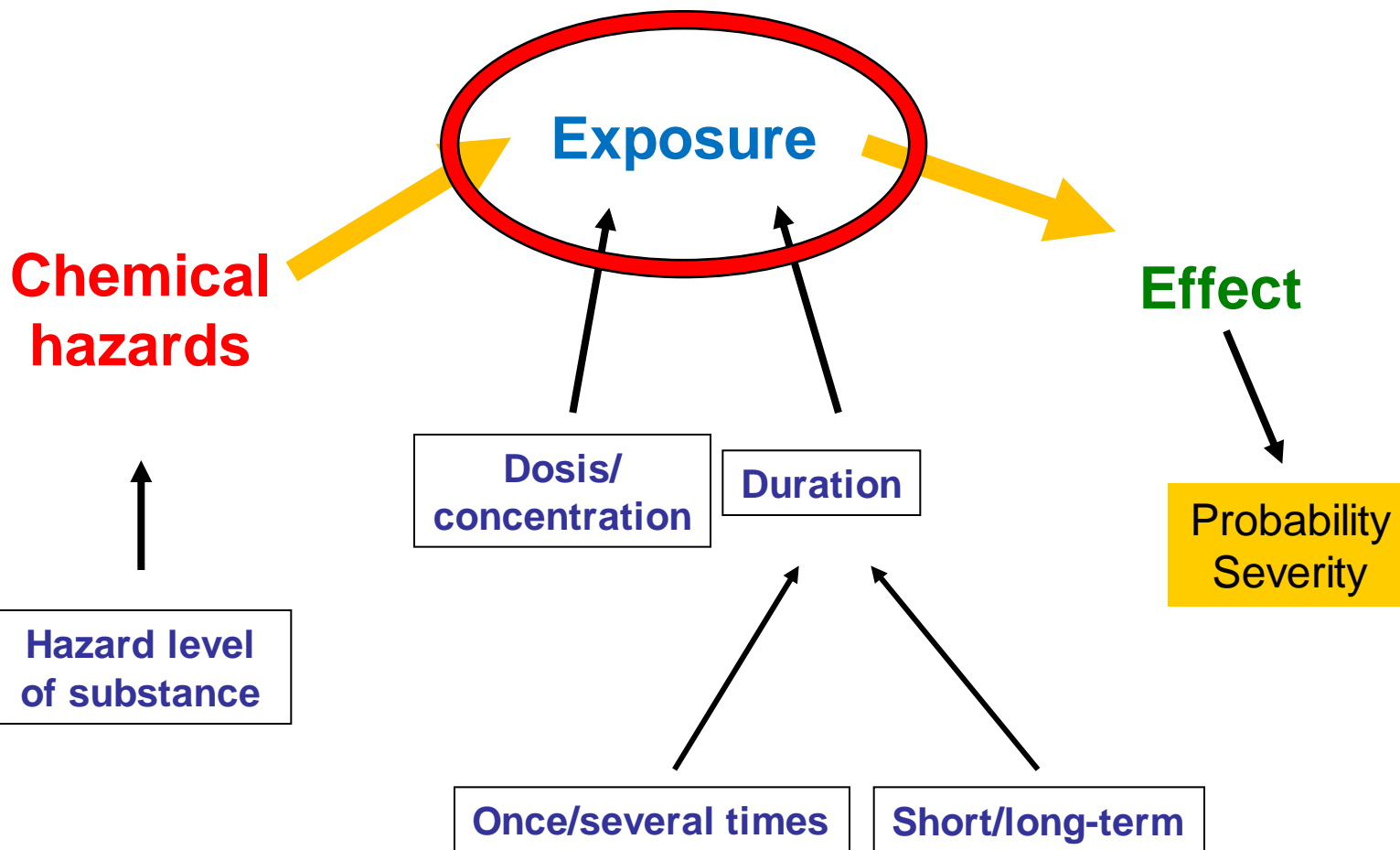
Starting points for risk management



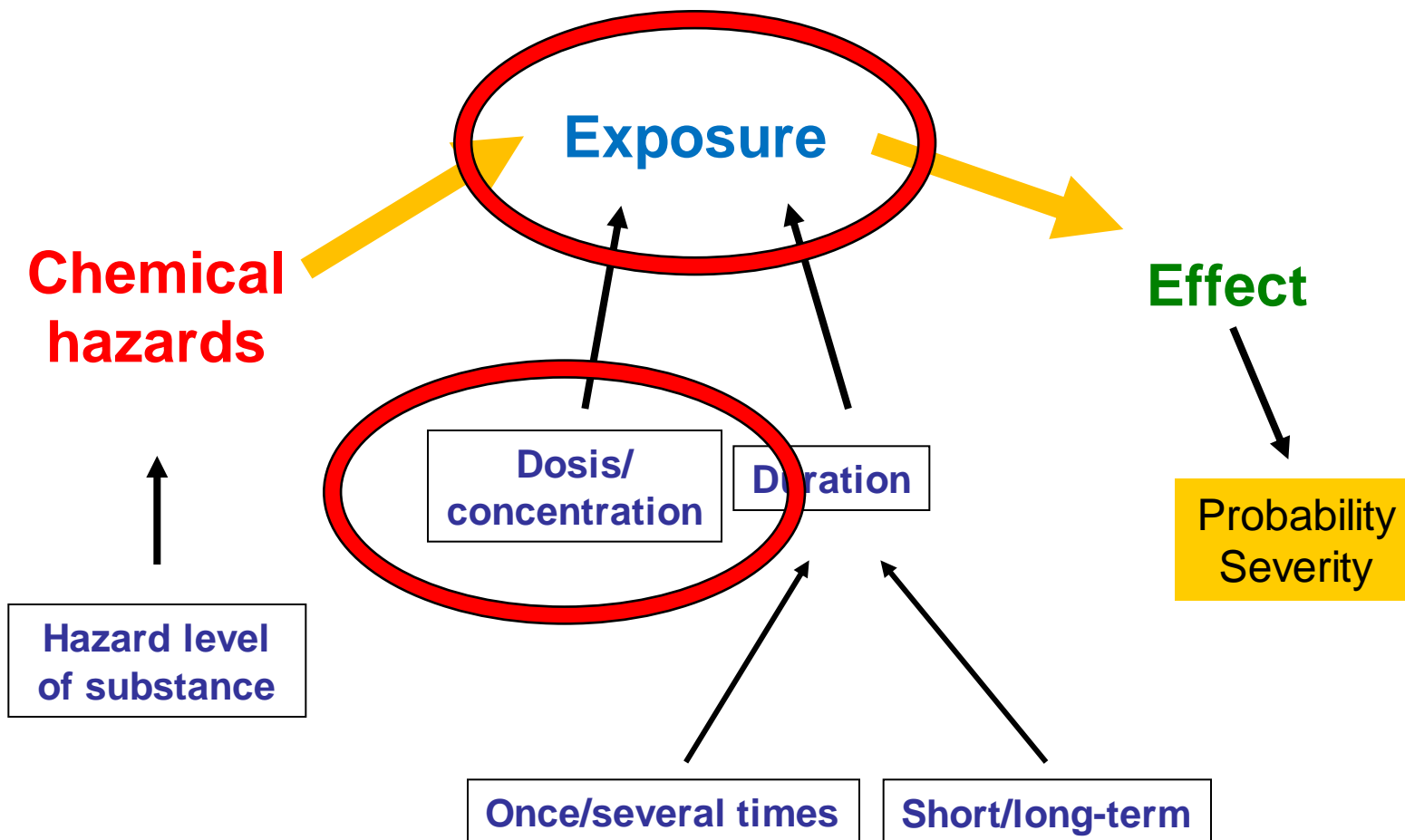
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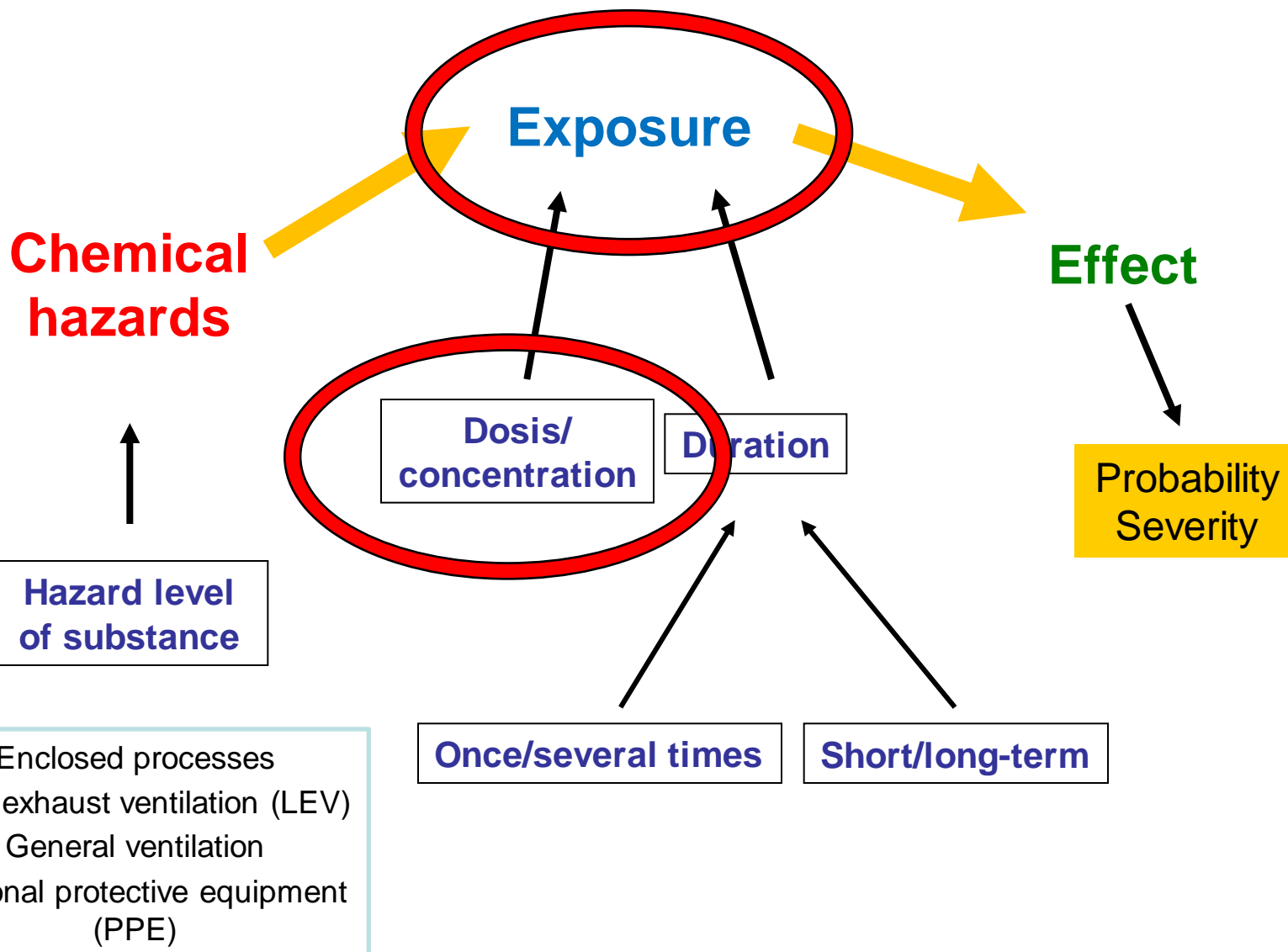
Starting points for risk management



Starting points for risk management

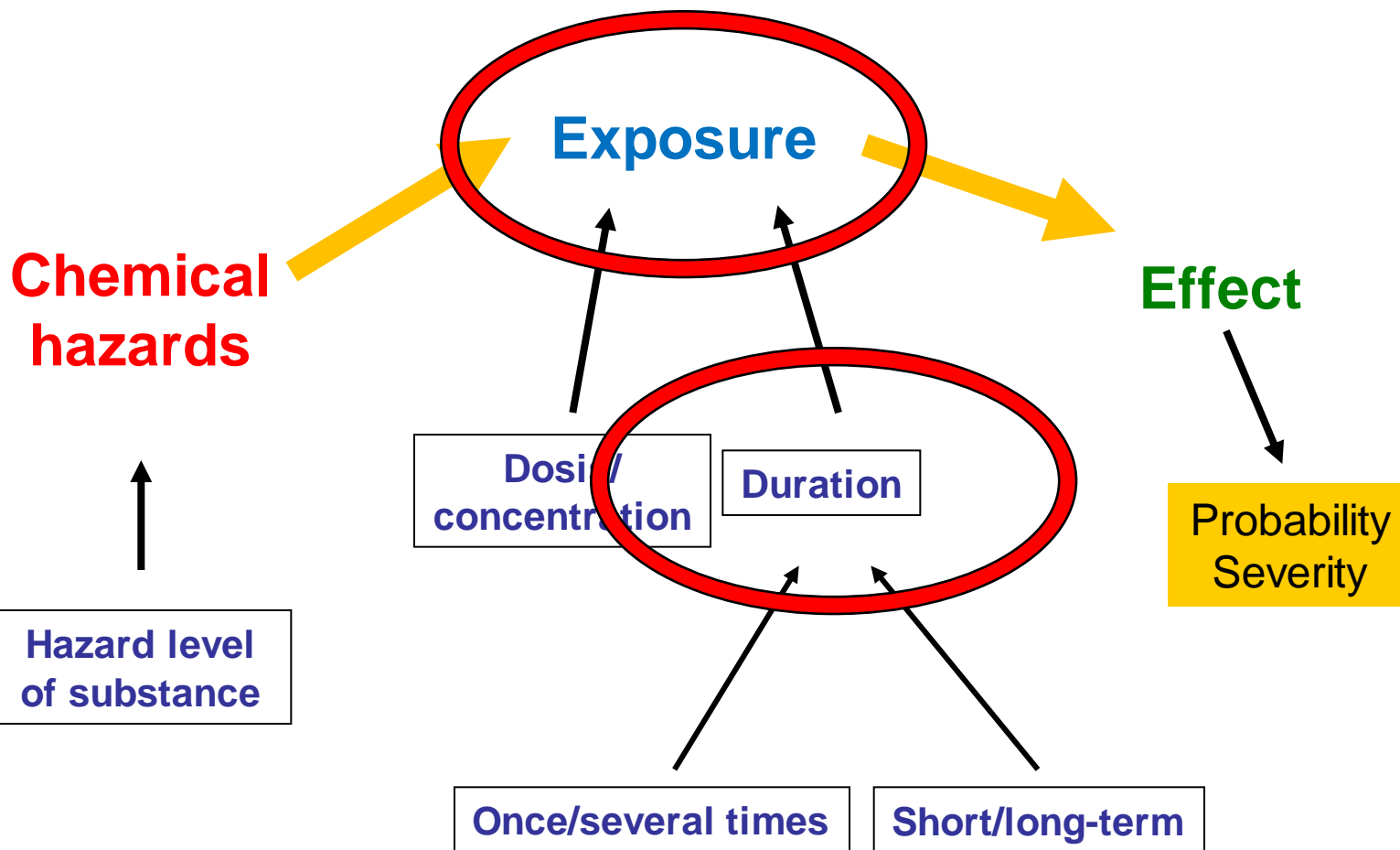


Starting points for risk management

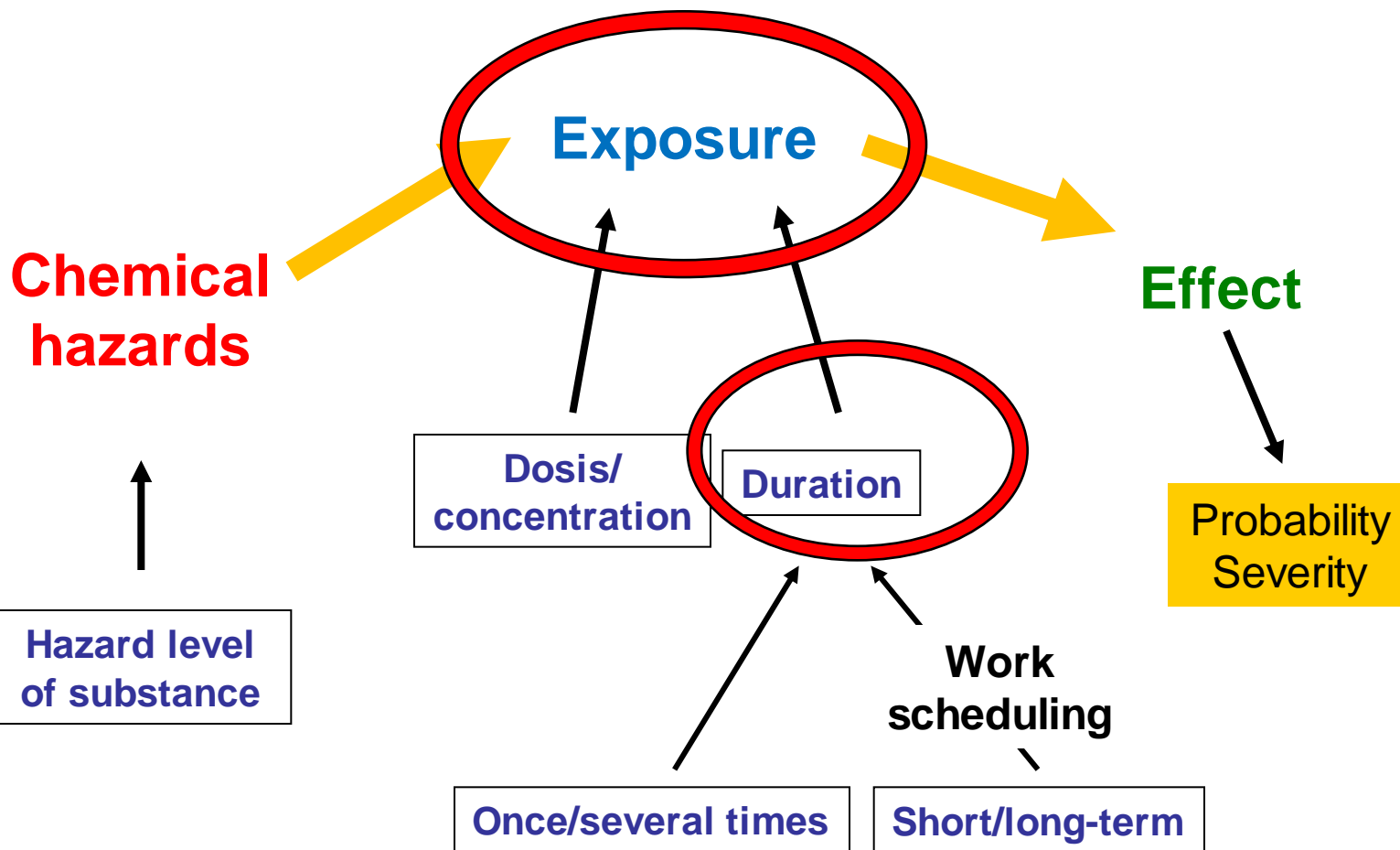


- Enclosed processes
- Local exhaust ventilation (LEV)
- General ventilation
- Personal protective equipment (PPE)

Starting points for risk management



Starting points for risk management



Special focus on...

Substances of very High Concern (SvHC)

When

- Carcinogenic
- mutagenic,
- toxic for reproduction, and/or
- persistent, bioaccumulative and toxic (PBT)
(See lists under European REACH regulation)

Substances of High Concern (SHC)



Using information sources at company level

Identify hazard type

- Labels and markings on containers
- Safety data sheets
- Manufacturer/supplier information

Assess hazard level

- Safety data sheets
- Globally Harmonised System of Classification and Labelling of Chemicals (GHS) documentation
- Internet sources and applications

Verify safe dosage and concentration limits

- Safety data sheet
- Internet sources (GESTIS, ACGIH ...)





Now we have more time for your questions