Occupational Hygiene

Mike Slater

www.users.globalnet.co.uk/~diamondw/Bio.htm

Programme (MS)

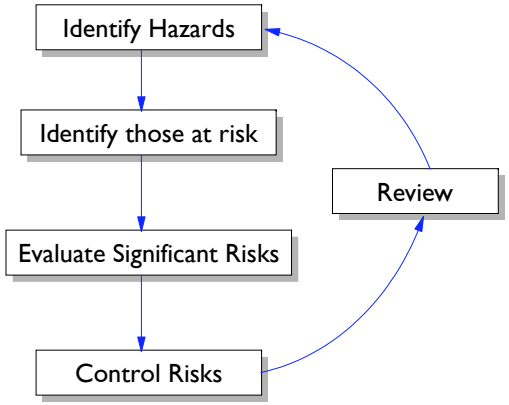
Lecture 1	Effects of hazardous substances part 1
Lecture 2	Effects of hazardous substances part 2
Lecture 3	Legislation
Lecture 4	Risk evaluation
Lecture 5	Sampling techniques
Lecture 6	Controlling exposure

Occupational Hygiene

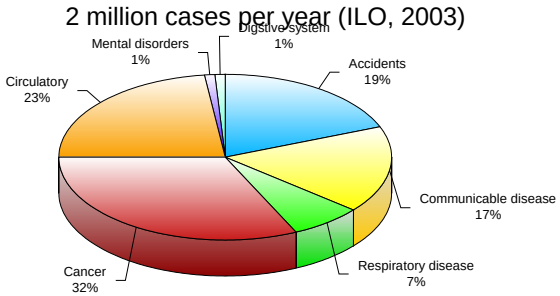
- Recognition (and anticipation)
- Evaluation
- Control

of chemical, physical and biological agents arising from the work process

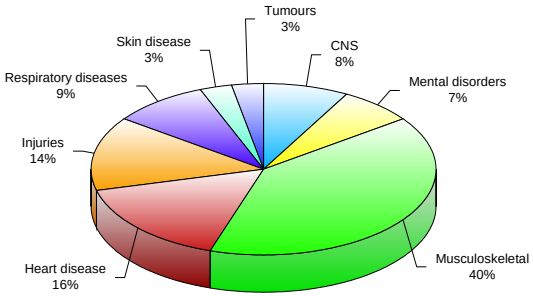
Risk Assessment



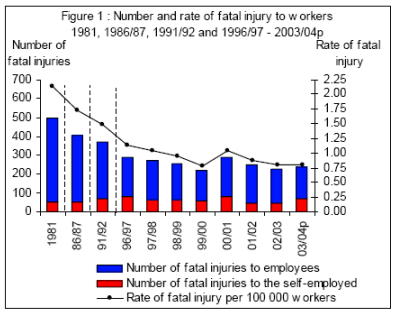
Estimated Global Work-Related Mortality



Breakdown of Costs (ILO 1999)



Fatalities from accidents at work



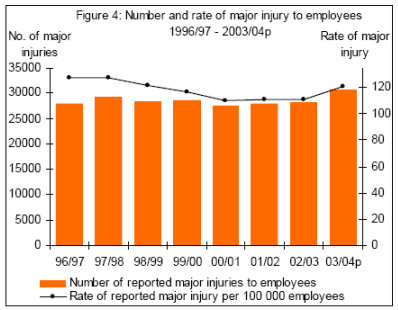
Source: HSE

Industrial Disease

"In total an estimated 6000 people die from cancer in Britain each year due to past exposures at work"

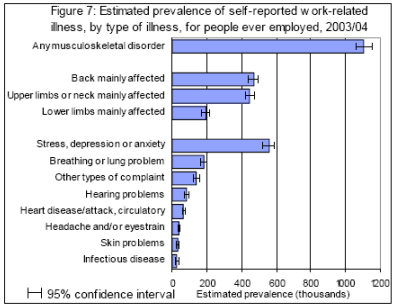
Source: HSE Occupational Health Statistics Bulletin 2003/04

Major injuries at work



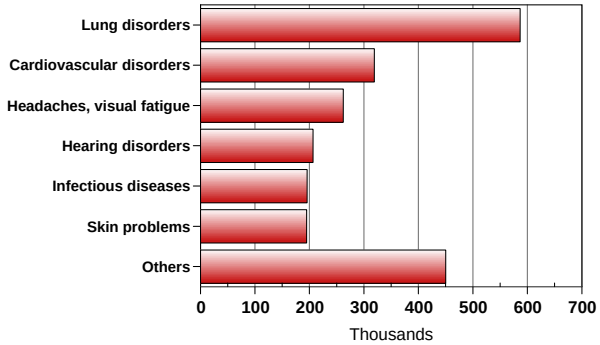
Source: HSE

Occupational Ill Health



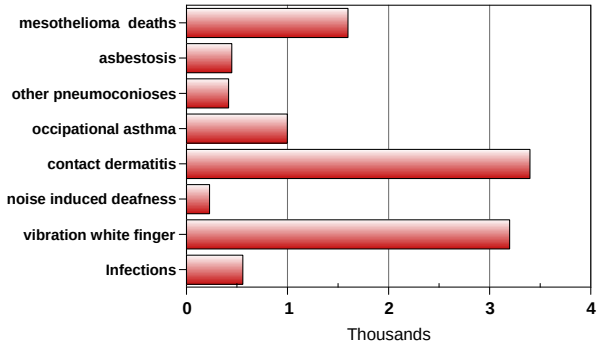
Work related ill health in Europe 1998-1999

(excluding musculoskeletal conditions and stress)



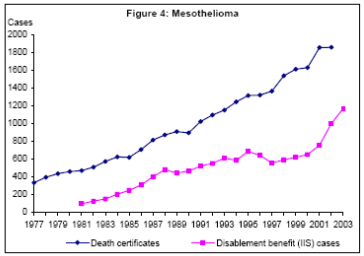
Source: Eurostat *Statistics in Focus: Population and social conditions Theme17 (2001)*
http://europe.osha.eu.int/statistics/index2.php3

UK Occupational Health Statistics (new cases 2000/01)

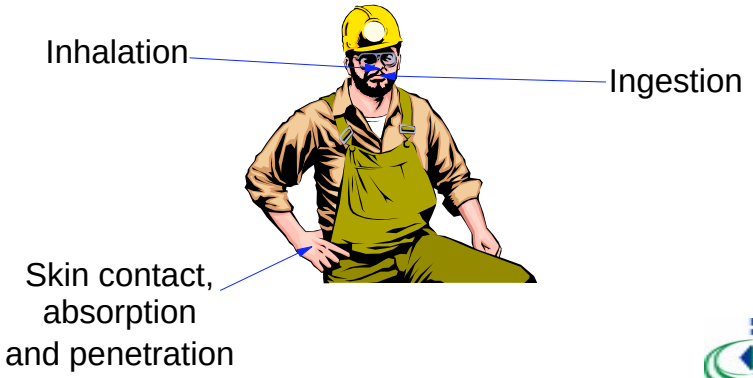


Source: Health and Safety Executive: *Health and Safety Statistics 2000/01*

Mesothelioma



Routes of Exposure

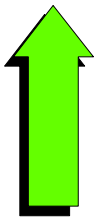


Types of Effect

- Local
  - at point of contact with the body
- Systemic
  - following distribution

Types of Effect

- chronic
- sub-chronic
- sub-acute
- acute



Types of Effect

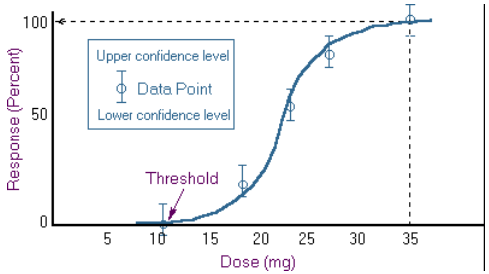
- Reversible v Irreversible
- Immediate v Delayed

Paracelsus (1493-1541)

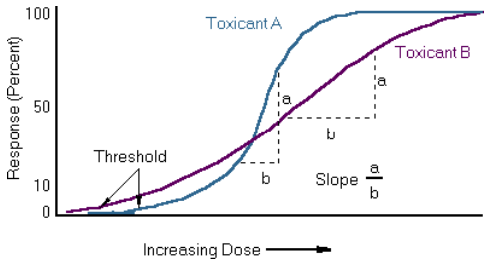
"All substances are poisons ; there is none which is not a poison. The right dose differentiates a poison from a remedy"

Blood Alcohol Conc. g/100ml	Effect
0.01 - 0.05	Subclinical
0.032 - 0.12	Euphoria
0.09 - 0.25	Excitement
0.18 - 0.30	Confusion
0.25 - 0.40	Stupor
0.35 - 0.50	Coma
0.45 +	Death

Dose - Response



Dose - Response



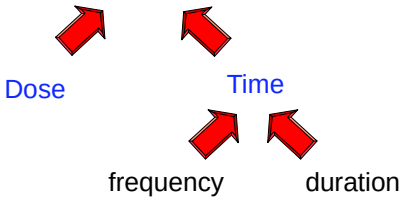
LD50 - some examples

ETHYL ALCOHOL	7060
SODIUM CHLORIDE	3000
NAPHTHALENE	1760
FERROUS SULFATE	1500
ASPIRIN	1000
FORMALDEHYDE	800
AMMONIA	350
CAFFEINE	192
PHENOBARBITAL	150
CHLORPHENIRAMINE MALEATE	118
DDT	100
STRYCHNINE SULFATE	2
NICOTINE	1
DIOXIN	0.0001
BOTULINUS TOXIN	0.00001

Hazard and Risk

Hazard - the potential to cause harm

Risk α Hazard x Exposure

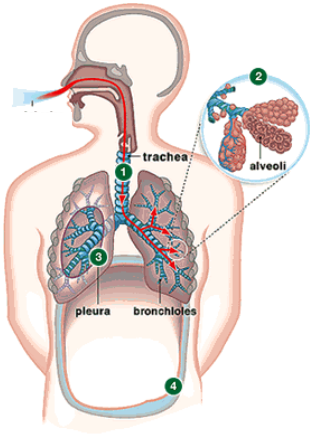


The Respiratory System as a Target Organ

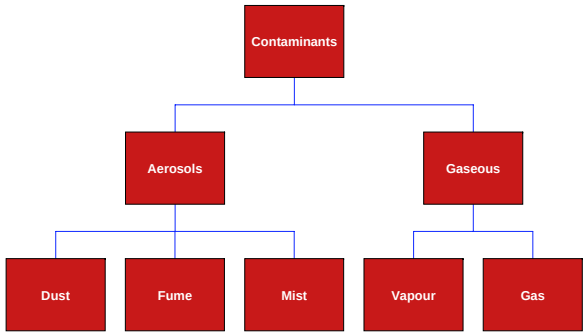
DIAMOND
Environmental Ltd

The Respiratory System - Harmful Effects

- Irritation
- Delayed chemical pneumonia
- Allergies
- Fibrosis
- Cancer



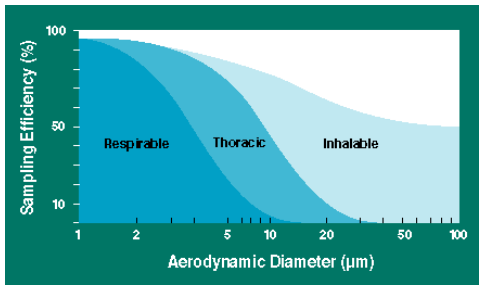
Airborne Contaminants



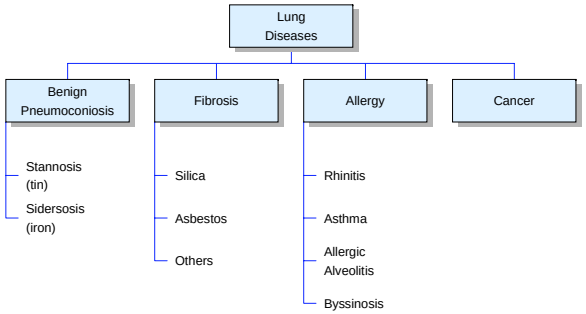
Gaseous Contaminants

- Irritation
  - region affected depends on solubility
- Pneumonitis
  - following severe irritation of deep lung
  - effect may be delayed
- Systemic effects
  - following absorption

ISO Criteria for Dust



Lung Diseases



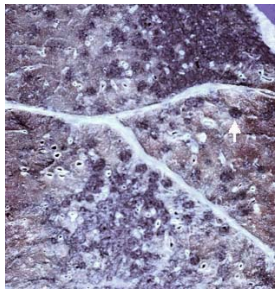
Benign Pneumoconiosis

- Dust deposits on lung
- No direct physiological effect
- Can mask other problems
- Agents include
  - iron oxide
  - barium
  - tin oxide

Fibrosis

- Deposition of scar tissue in lungs
- Reduces lung function
- Agents of concern
  - crystalline silica
  - asbestos
  - talc

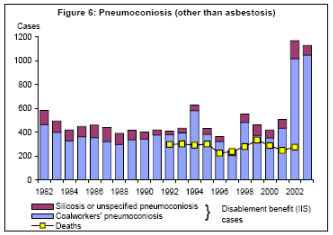
Silicosis



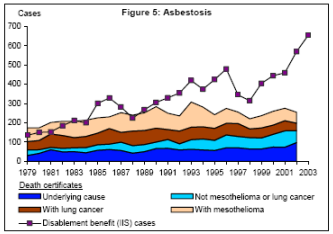
Slice of lung from a 61-year-old ceramics worker

Shows diffuse pleural fibrosis (upper right) note multiple, hard, black silicotic nodules

Fibrosis



Asbestosis



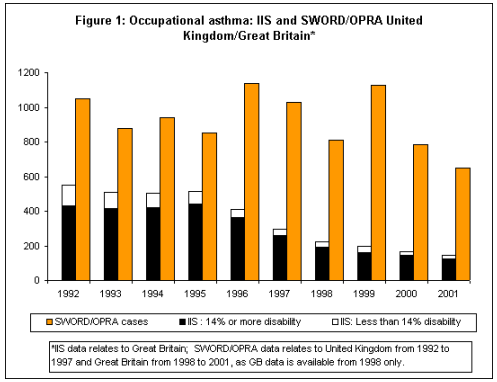
Allergic Conditions

- Rhinitis
- Asthma
- Allergic alveolitis
- Byssinois

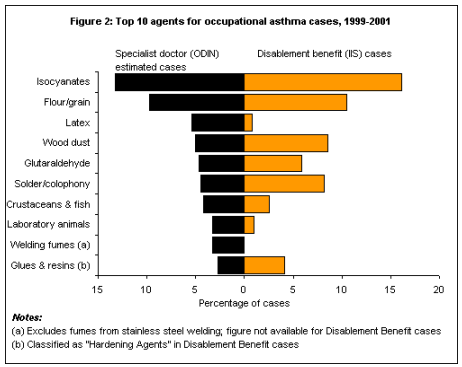
Asthma

- Chronic disease of the airways characterised by
  - narrowing or constriction of the airways
  - bronchial inflammation
  - excessive mucous production
- These result in symptoms including
  - cough
  - wheeze
  - breathlessness.

Asthma



Asthma



Allergic Alveolitis

Normally caused by organic dusts, including :

- Mouldy hay
- Bird droppings
- Mushroom spores

Byssinosis

- Allergic condition caused by agent in cotton, flax, hemp etc.
- Specific agent responsible unknown
- Early stages of processing
  - e.g carding

Occupational Cancer

Occupational Cancer

- 4% of all cancers in UK (HSE estimate)
- 6,000 deaths per year

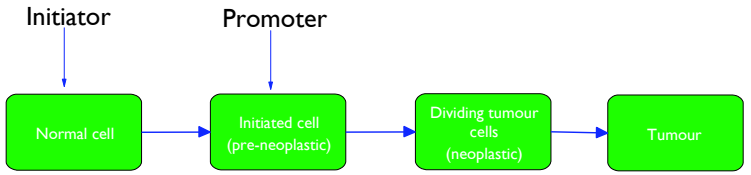
Carcinogens

- Direct acting or metabolites
- Long latency period
- Initiation - promotion - progression

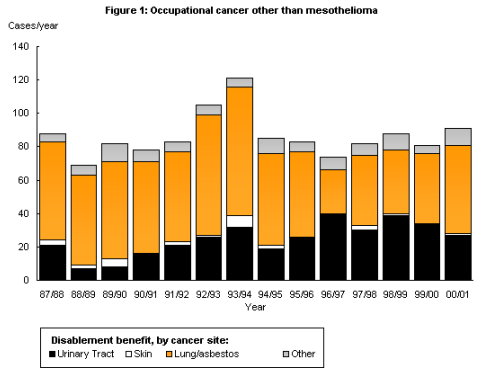
Latency Periods

Site	Agent	Average (years)	Range (years)
Skin	Arsenic	25	4-46
	Coal tar and pitch	20	1-50
	Solar radiation	25	15-40
Lung	Asbestos	18	15-48
Blood	Benzene		3-19
Bladder	Aromatic amines	15	2-40

Steps in Tumour Development

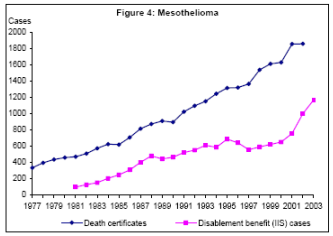


Occupational Cancer



n.b. these official statistics grossly underestimate the true number of cases

Mesothelioma



n.b. almost all cases attributable to exposure to amphibole asbestos

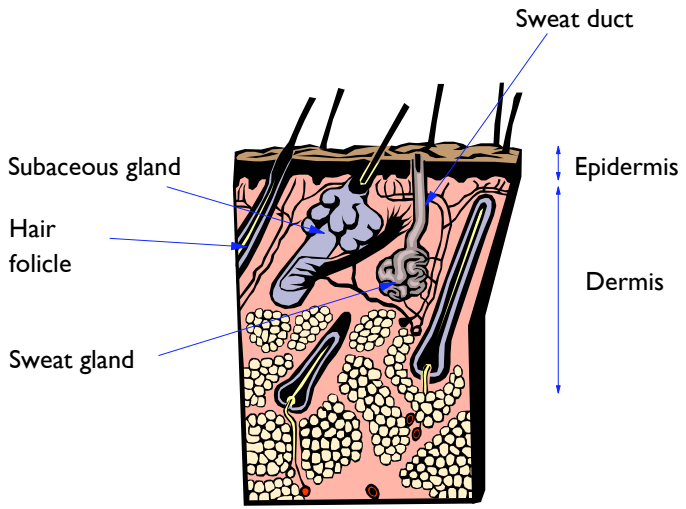
IARC Classification

- Group 1
  - Known human carcinogen
- Group 2A
  - Probable human carcinogen
- Group 2B
  - Possible human carcinogen
- Group 3
  - Not classifiable for human carcinogenicity
- Group 4
  - Probably not carcinogenic to humans

The Skin as a Target Organ

The Skin

- Largest organ of body (approx 400 cm^2 in most adults)
- Varying thickness (0.5 - 4 mm)
- Diverse functions:
  - Protection, excretion, sensation
  - Maintenance of fluid, electrolytes, temperature

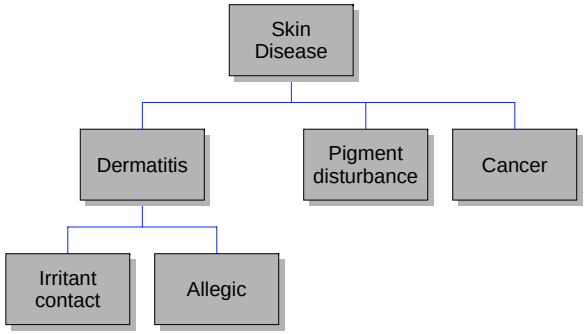


The Skin

As well as being a site of absorption,
the skin is a target for :

- corrosive materials (e.g. acids and alkalis)
- primary irritants (e.g. solvents)
- some sensitisers (e.g. epoxy resins)

The Skin



Skin Disease

Contact dermatitis

Foliculitis

Skin Disease

Depigmentation

"Chrome ulcers"

Contact Dermatitis

- Localised effect in response to chemical
- Irritation results from inflammation and swelling, with sensory response
- Cell death and damage to blood vessels can result

Irritant Contact Dermatitis

- Chemical damage
  - protected by oils and dead cells
- Physical damage
  - fibres, particulates can penetrate and abrade skin
- Removal of oils and damage to keratin layer
  - solvents
  - soaps and detergents

Skin Sensitisers

Some examples :

- Chromium VI compounds
- Nickel salts
- Epoxy resins
- Natural rubber latex

Photosensitisation

- UV stimulated reaction of chemicals on the skin

Pigment Disturbance

- Phenolic compounds can interfere with melanin production
- Silver

Skin Carcinogens

- PAHs in soot, unrefined and used oils, tar
- Arsenic
- UV light