Indoor Air Pollution

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Indoor Air Pollution: Preface

- Indoor air pollution is an environmental issue that is growing in public concern. The CAA addresses only outdoor air pollution, while mainly OSHA and building codes regulate indoor air quality.

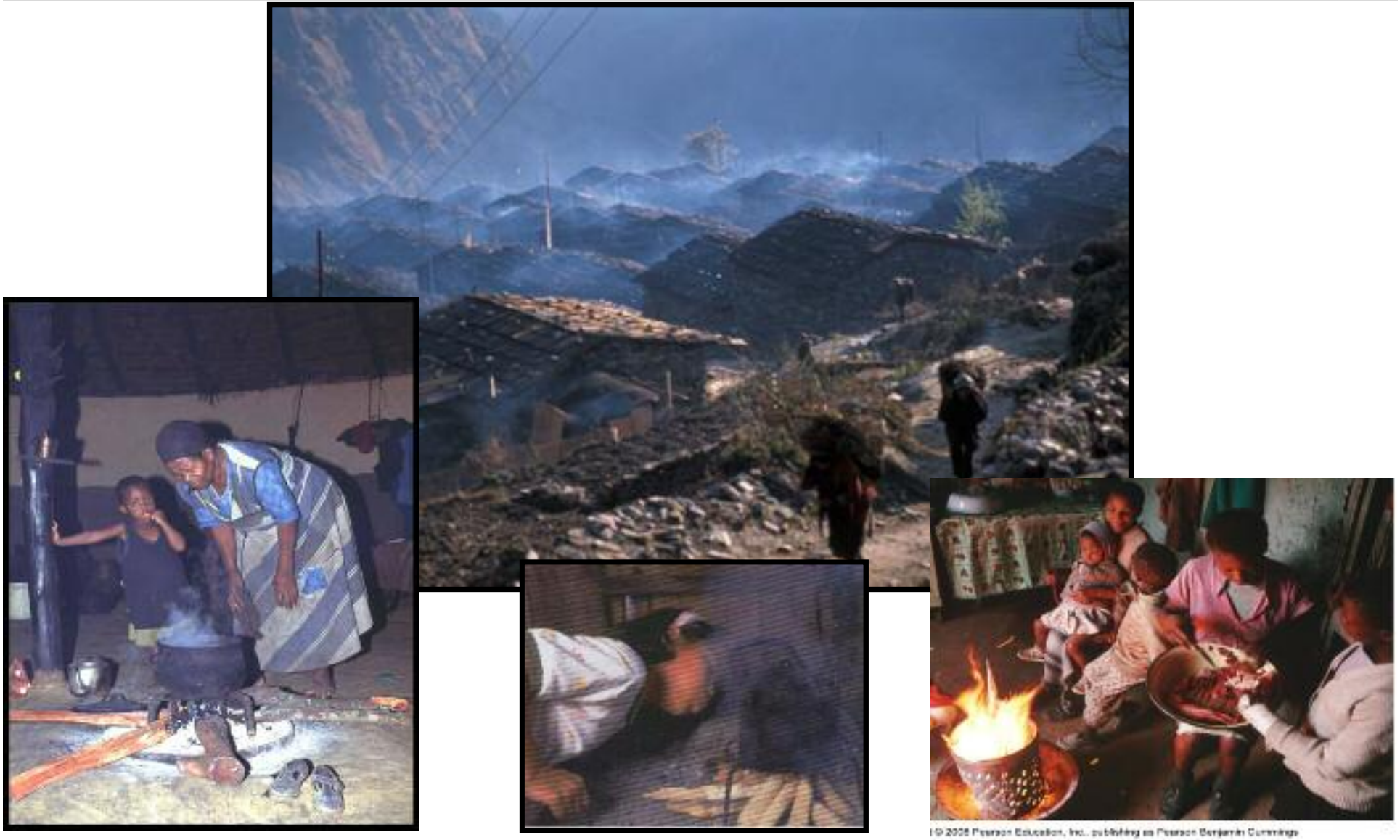
- Most people spend the majority of their daily hours indoors.

- Numerous studies have shown that indoor air is contaminated by a wide variety of pollutants, with some being in higher concentrations than outdoor air. As a result, people are often more exposed to high concentrations of pollutants indoors than out.

- Exposure to some pollutants may be two to five times higher indoors than outdoors.

- At present, more than 900 compounds have been identified as potential sources of indoor air pollution and the list continues to grow (Brooks and Davis, 1992).

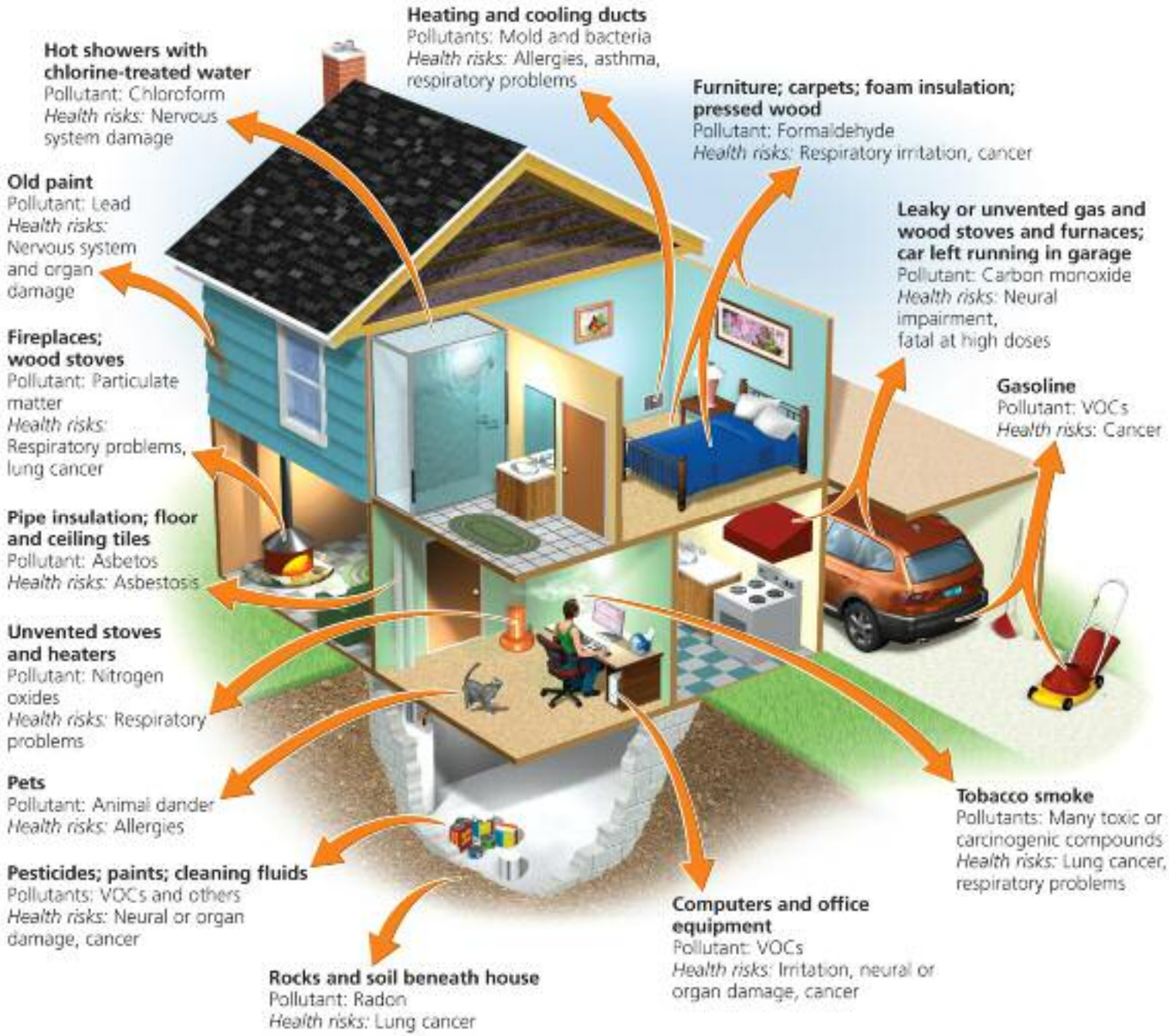
Indoor Air Pollution: Sources




Fireplace


VARNISH
CLEAR
COTE


SOLVENT


Heating and cooling ducts
Pollutants: Mold and bacteria
Health risks: Allergies, asthma, respiratory problems
Hot showers with chlorine-treated water
Pollutant: Chloroform
Health risks: Nervous system damage
Furniture; carpets; foam insulation; pressed wood
Pollutant: Formaldehyde
Health risks: Respiratory irritation, cancer
Old paint
Pollutant: Lead
Health risks: Nervous system and organ damage
Leaky or unvented gas and wood stoves and furnaces; car left running in garage
Pollutant: Carbon monoxide
Health risks: Neural impairment, fatal at high doses
Fireplaces; wood stoves
Pollutant: Particulate matter
Health risks: Respiratory problems, lung cancer
Gasoline
Pollutant: VOCs
Health risks: Cancer
Pipe insulation; floor and ceiling tiles
Pollutant: Asbetos
Health risks: Asbestosis
Unvented stoves and heaters
Pollutant: Nitrogen oxides
Health risks: Respiratory problems
Pets
Pollutant: Animal dander
Health risks: Allergies
Tobacco smoke
Pollutants: Many toxic or carcinogenic compounds
Health risks: Lung cancer, respiratory problems
Pesticides; paints; cleaning fluids
Pollutants: VOCs and others
Health risks: Neural or organ damage, cancer
Computers and office equipment
Pollutant: VOCs
Health risks: Irritation, neural or organ damage, cancer
Rocks and soil beneath house
Pollutant: Radon
Health risks: Lung cancer

Pollutant categories

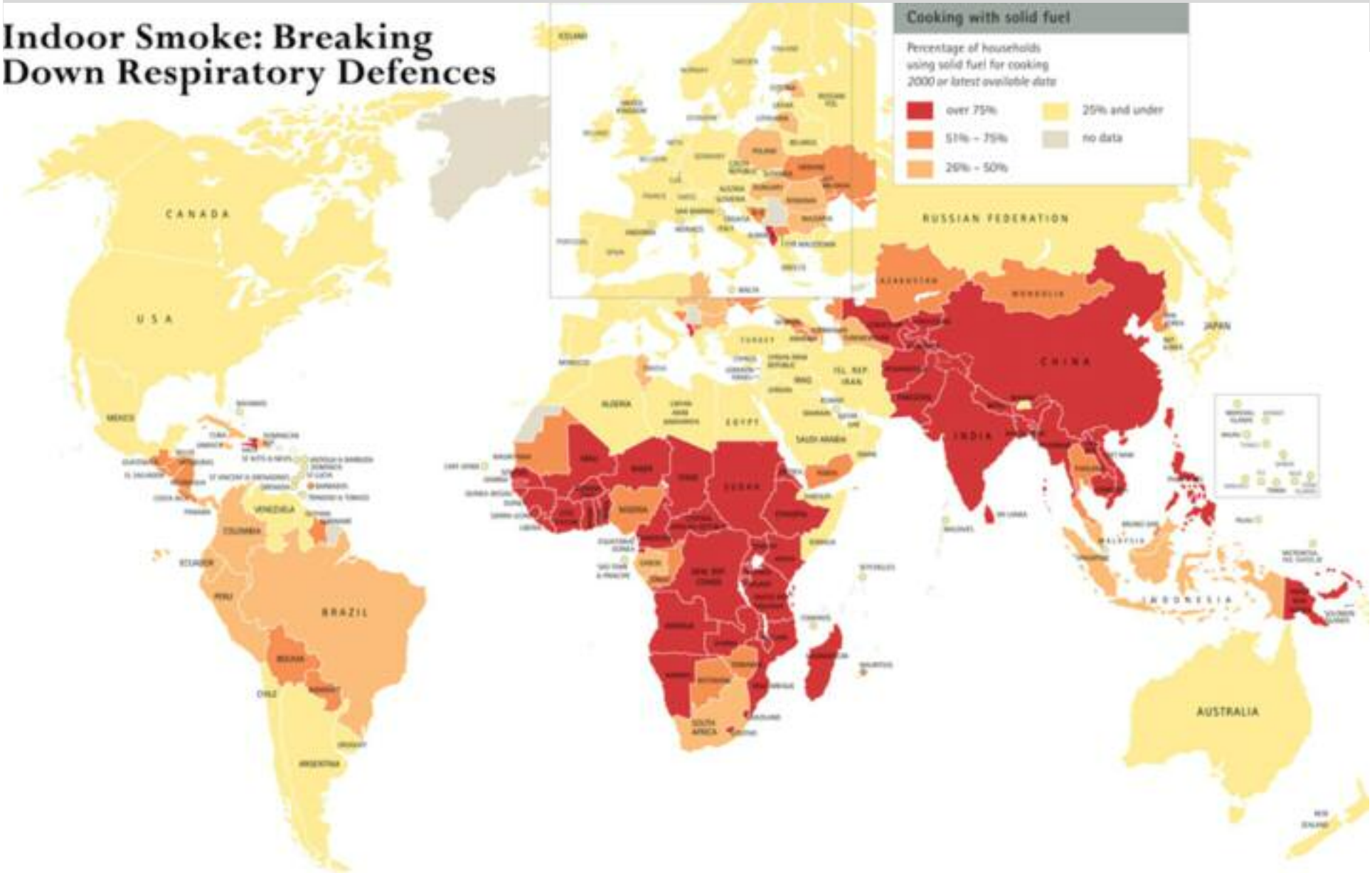
Pollutant category	Example of substance	Typical source / cause
Inorganic gases	carbon monoxide; nitrogen dioxide; ozone	combustion processes; traffic emissions; reaction with organic compounds
Organic gases*	volatile organic compounds; formaldehyde	building products; solvents; cosmetics
Non-biological particles	n/a	combustion; road pollution; industrial sources; air-borne soil and sand
Biological particles	dust / dust mites; pollen	naturally occurring bacteria and organisms

*Organic gases are usually made up of carbon and hydrogen molecules

Combustion Products

Sources	Combustion products
Gas stoves and appliances	Carbon monoxide (CO)
Wood and coal stoves	Nitrogen dioxide (NO_2)
Gas and propane engines	Sulfur dioxide (SO_2)
Fireplaces	Nitrogenated compounds (NO_x)
Tobacco smoke	Particulate matter (PM)
Candles and incense	
Mosquito coils	

Indoor Smoke: Breaking Down Respiratory Defences



Solvents & Volatile Organic Compounds

Alkanes, aromatic hydrocarbons, alcohols, aldehydes, ketones

Sources:

- Solvents, fabric softeners, deodorizers and cleaning products
- Paints, glues, resins, waxes and polishing materials
- Spray propellants, dry cleaning fluids
- Pens and markers
- Binders and plasticizers
- Cosmetics: hair sprays, perfumes

Volatile Organic Compounds

The most diverse group of indoor air pollutants

Released by everything from plastics and oils to perfumes and paints

- Ex. formaldehyde, which leaks from pressed wood and insulation, irritates mucous membranes and induces skin allergies

- Ex. pesticides, which are found indoors more often than outdoors due to seepage

Acute:

- Irritation of eyes and respiratory tract
- General: headache, dizziness, loss of coordination, nausea, visual disorders
- Allergic reactions, including asthma and rhinitis

Chronic:

- Damage to liver, kidney, blood system and central nervous system (CNS)
- Some may cause cancer in humans (formaldehyde)

Examples of Hazardous VOC Sources

Compound	Indoor sources
acetaldehyde	floor materials, machine lubricants, wood products
benzene	furnishings, paints, varnishes, wood products, plastics tobacco
chloroform	fabrics, pesticides, soft furnishings
ethylbenzene	insulation products, polystyrene, paints, varnishes, plastics, photo-copiers
formaldehyde	floor materials, insulation products, paints, varnishes, fibre-board, chip-board, tobacco
tetrachloroethylene	caulks, sealants, dry-cleaning
toluene	adhesives, caulks, sealants, paint, thinners, dyes, cosmetics, inks

Formaldehyde

- Although an organic compound, formaldehyde (HCHO) is not chemically classed as a VOC because of its low boiling point range of –19.5°C
- The emission rate in the indoor environment depends strongly on temperature and humidity.
- HCHO is the simplest and most common of the aldehydes range. At normal ambient room temperatures, it is colourless gas with a pungent suffocating odour (ECA 1990).

- Indoor formaldehyde is emitted from a wide range of sources, including tobacco smoke, combustion gases from gas appliances, disinfectants, water based paints, and paper products (WHO 1997).
- The most common form of formaldehyde is urea formaldehyde (UF) resin – the cause of significant indoor pollution due to its wide-ranging use.
- UF is used as the bonding agent in the production of particleboard, such as MDF and chipboard, plywood sheets, and UF foam insulation.

Temperature, humidity and air movement

- The hygrothermal conditions have an affect on the rate of emission and activity of pollutants.
- Combined with air movement, these factors also play a key role in our overall well-being, or thermal comfort, inside buildings. Cumulatively, they are linked to symptoms associated with sick-building syndrome (SBS) and building related illness (BRI).
- Temperatures inside buildings are dependent upon outside temperatures, heat losses and gains, and the heating installation.
- Humidity depends on moisture generation from breathing, washing, cooking and bathing.
- Ventilation provides air for breathing, although excess ventilation can cause draughts, affecting our thermal comfort.

Room	Temperature range (°C)
bathrooms	26-27
bedrooms	17-19
hall/stairs/landing	19-24
kitchen	17-19
living room	20-23
toilet	19-21

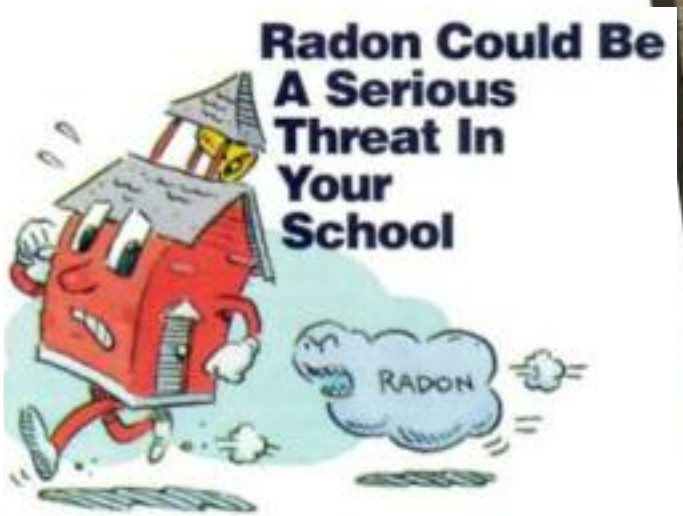
Radon-222

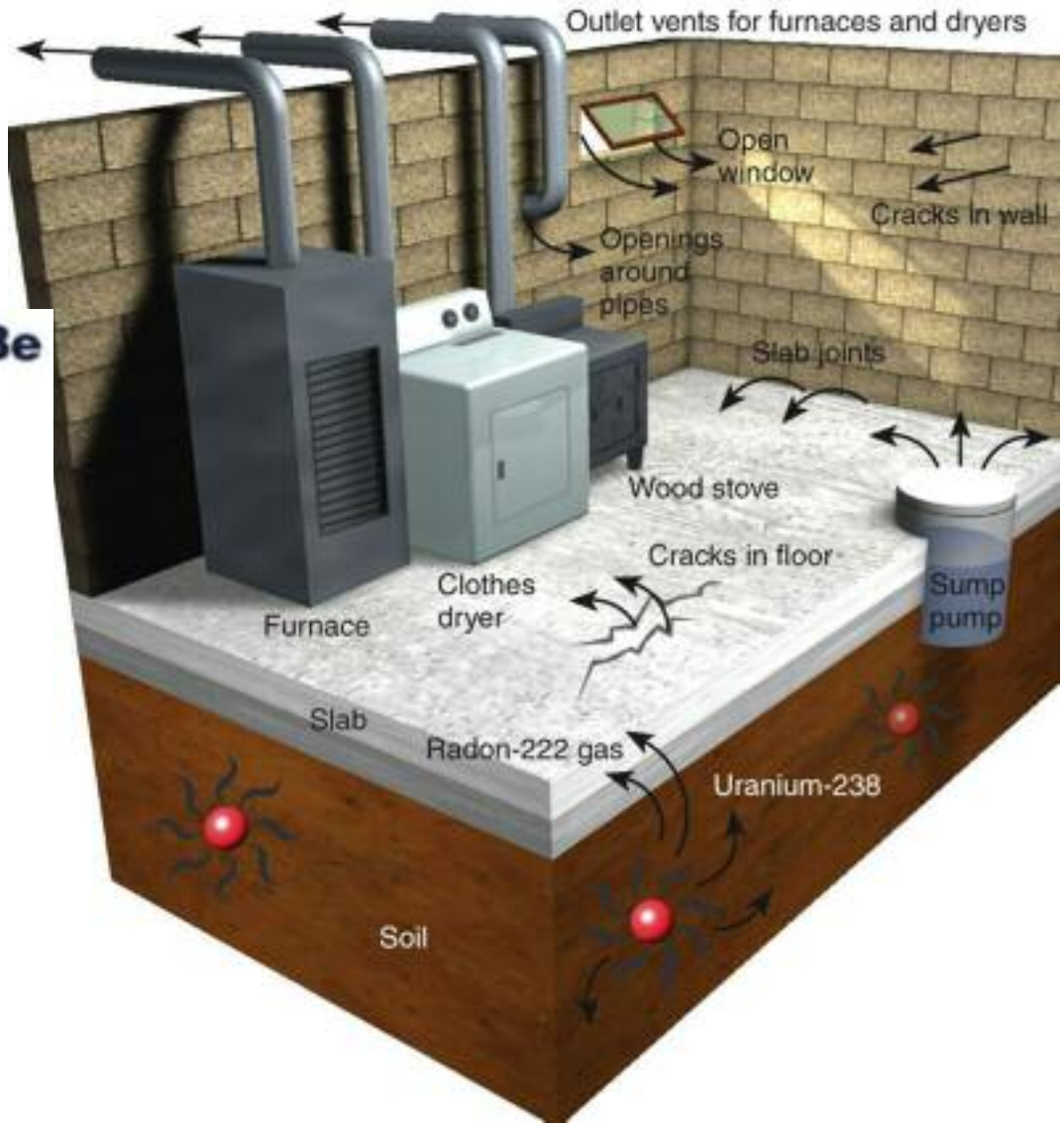
- colorless, tasteless, odorless, radioactive gas from decay of U-238 found in some soils & rocks
- Radioactive gas released from soil and rocks
- can seep into some houses (Highest levels occur in basements and on the ground floor)

- 55% of our exposure to radiation comes from radon
  - May harm lungs from long term exposure.
  - increases the risk of lung cancer
  - causes 20,000 deaths a year in the U.S.

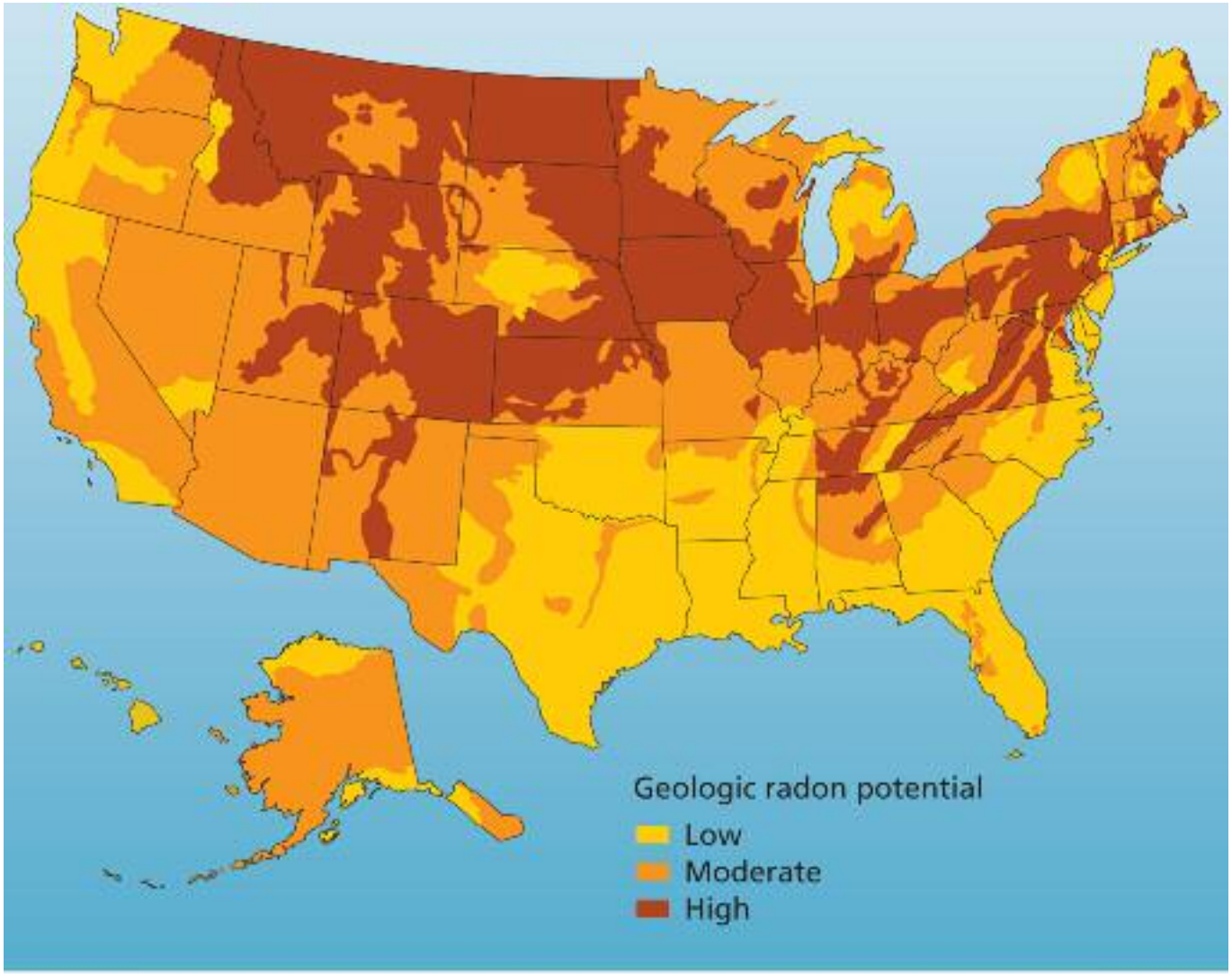
- Reducing the risk
  - Sealing cracks in floors and walls
  - Simple systems using pipes and fans

Sources & paths of entry for indoor radon-222 gas

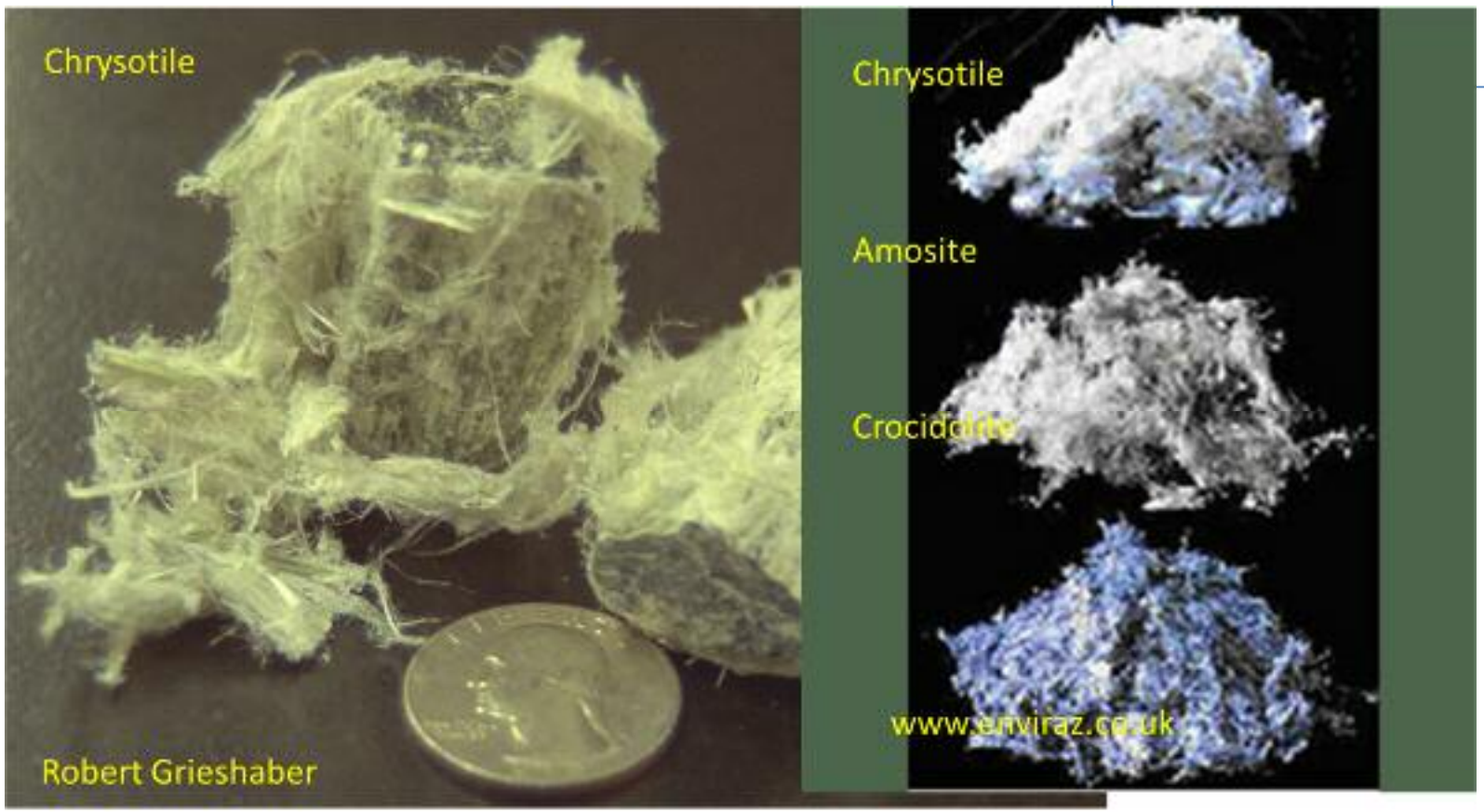




Radon risk across the US



Mineral Asbestos




Mine

Attic insulation

www.technicaon-asbestos.co.uk


Ship insulation


Lamp wicks


Pipe insulation

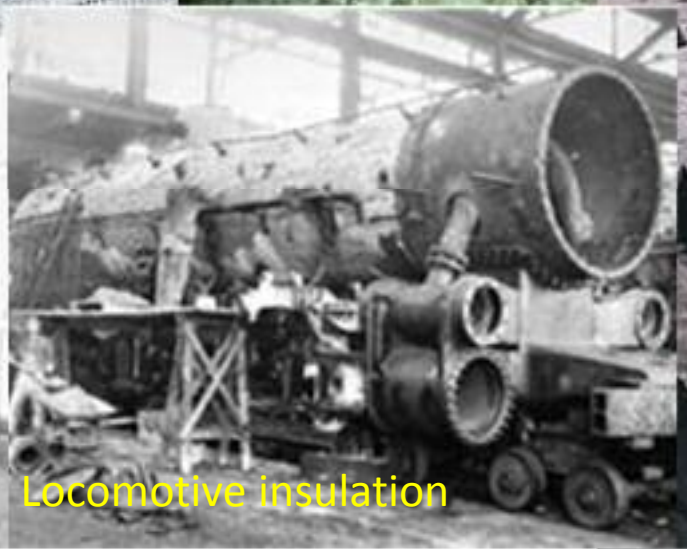

Fire blanket


Home insulation


Roofing products


Brake pads

oraclesolutionsltd.co.uk


Locomotive insulation

Asbestos

Sources:

- Used for insulation and as fire-retardant: asbestos cement, floor and roof tiles, water pipes and others
- Levels increase if asbestos-containing materials are damaged
- Levels can be high in clothes of working parents

Health effects:

- No acute toxicity
- Asbestos results from occupational exposure
- Main risk for children: long-term exposure may cause cancer in adulthood

Living organisms can pollute indoors

- Dust mites
  - feed on human skin & dust
    - live in materials such as bedding & furniture fabrics
  - can cause asthma attacks & allergic reactions

- Fungi, mold, mildew, airborne bacteria
  - cause severe allergies, asthma, & other respiratory ailments

- Animal dander
  - worsen asthma