Indoor Air Contaminant & Health Effect

Part 3

WARNIDA BT ABU BAKAR
CAWANGAN KEJURUTERAAN MEKANIKAL

Indoor Air Contaminant & Health Effect

- Objective :

At the end of session, participant will be able to

- Describe indoor air pollutants and the sources
- Describe health effect due to poor IAQ

Indoor Air Contaminant & Health Effect

- Background

  Indoor air pollution is estimated by US EPA to cause thousands of cancer deaths and hundred of thousand of respiratory health problem each year

  Why it is an issue?
  - People spends 90% time indoors
  - Developed Country – 50% of workforce work in an office environment
  - According WHO – 30% of all commercial building have significant problem

Indoor Air Contaminant & Health Effect

- IEQ Elements

NO	IEQ ELEMENTS	SUB ELEMENTS	PARAMETER
1	Indoor Air Quality	Outdoor Air Performance	-
		Mould Prevention	-
		Indoor Air Pollutants Control	Low VOC material
			Non-Added Urea formaldehyde material
			Tobacco Smoke
			Air Treatment
			Legionella
			Odour
			Non-Carcinogenic Material
			Component of Furniture
			Floor Finishes
			Building Flush Out
			Ozone
		Indoor Air Quality Assessment	Pre-Occupancy Indoor Air Quality Test
			Post Occupancy Indoor Air Quality Test
		Radon	-
		CO_2 Monitoring and Control	-
		CO Monitoring	-
2	Acoustic Comfort	Internal Noise and Vibration Control	General System
			Lighting and Noise
			Acoustic Treatment
3	Thermal Comfort	-	-
4	Visual Comfort	Daylighting	-
		View and Sufficient Daylighting	-
		Glare Control	-
		Artificial Lighting	Illumination
			Artificial Lighting Glare
			Lighting Flicker
5	Housekeeping	Construction	Clean Site
		Operation and Maintenance	Cleaning Services
			Waste Disposal Service
			Pest Control
6	Safety and Health	Renovation	Dust Control
			Noise Control

Indoor Air Contaminant & Health Effect

- Common Indoor Air Pollutant

Factors Can Contribute to Airborne Pollution		
Particulates Respiratory	**Biological** Agent	Hazardous **Chemical** Substance
Tobacco smoke,Dust	Spores, Molds, bacteria, Parasites	Formaldehyde, Asbestos, VOC,CO,CO2

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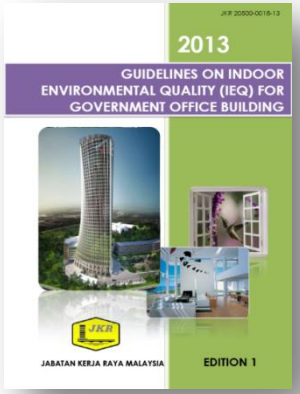

Indoor Air Contaminants	Acceptable limits		
	ppm	mg/m³	cfu/m³
<u>Chemical contaminants</u>			
(a) Carbon monoxide	10	-	-
(b) Formaldehyde	0.1	-	-
(c) Ozone	0.05	-	-
(d) Respirable particulates	-	0.15	-
(e) Total volatile organic compounds (TVOC)	3	-	-
<u>Biological contaminants</u>			
(a) Total bacteria counts	-	-	500
(b) Total fungal counts	-	-	1000
<u>Ventilation performance indicator</u>			
(a) Carbon dioxide	C1000	-	-

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Table 2: List of indoor air contaminants and the acceptable limits

Indoor Air Contaminants	Acceptable limits		
	ppm	mg/m³	cfu/m³
Chemical contaminants			
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Ventilation performance indicator			
(a) Carbon dioxide	C1000	-	-

-DOSH

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Table 1: Acceptable range for specific physical parameters

Parameter	Acceptable range
(a) Air temperature	23 – 26 °C
(b) Relative humidity	40-70%
(c) Air movement	0.15 – 0.50 m/s

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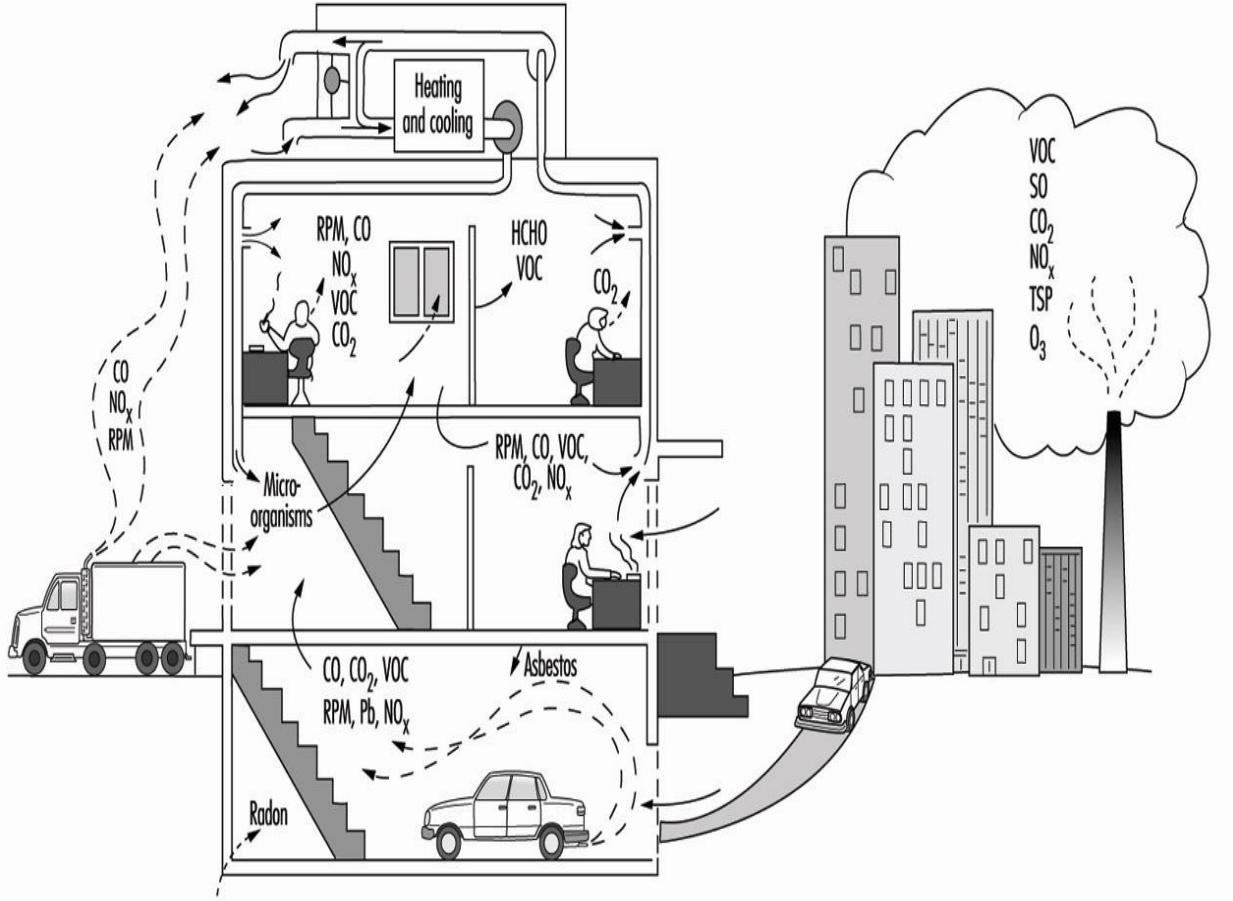
Invisible …



CO = carbon monoxide; CO_2 = carbon dioxide; HCHO = formaldehyde; NO_x = nitrogen oxides; Pb = lead; RPM = respirable particulate matter; VOC = volatile organic compounds.

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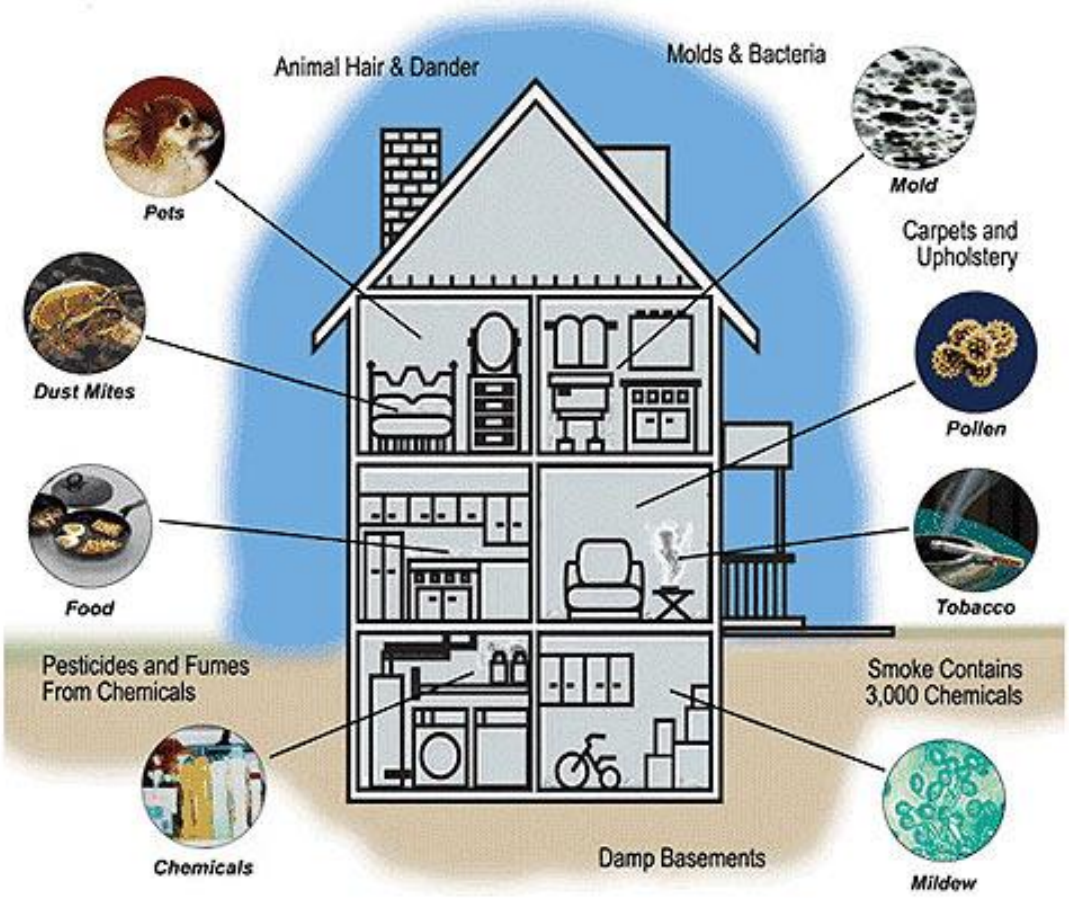

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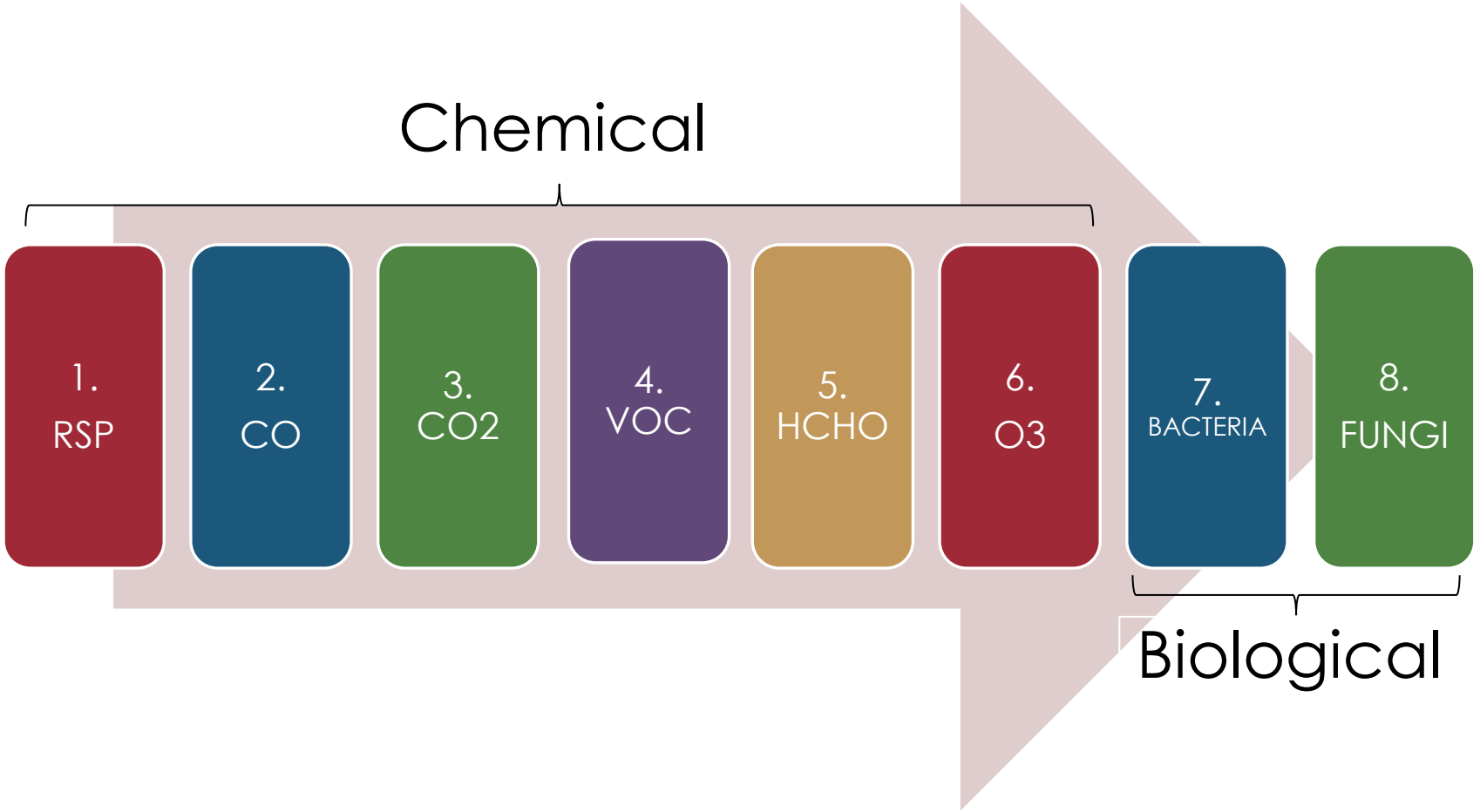
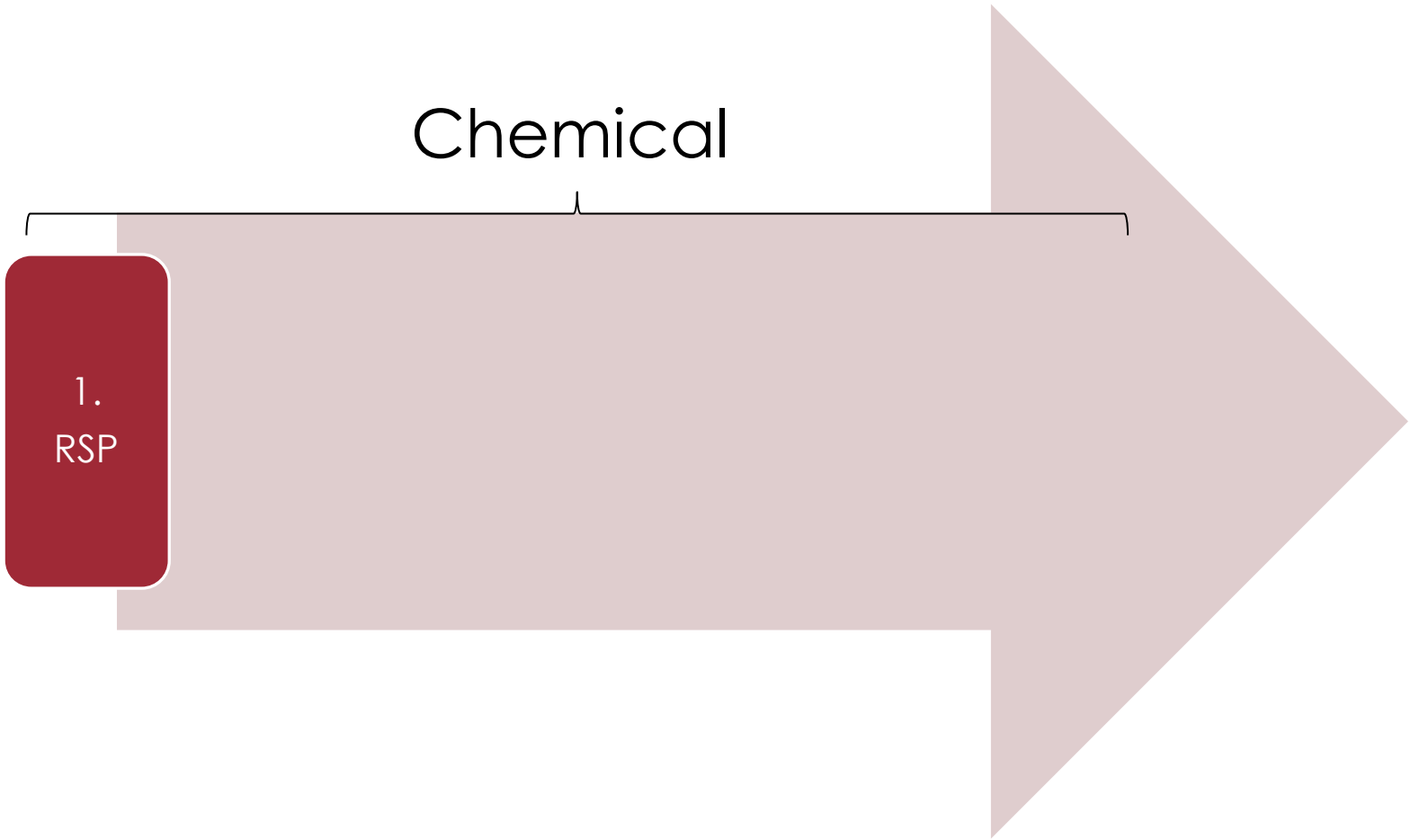
- Sources of poor IAQ :- Outdoor & indoor
  - The occupant
  - Inadequate materials or materials with technical defects
  - The work performed within building
  - Excessive or improper use of normal products
  - Combustion gas (e.g. smoking)
  - Cross contaminant from poor ventilation
- Form – Gases, vapors and particulates

Indoor Air Contaminant & Health Effect



Indoor Air Contaminant & Health Effect



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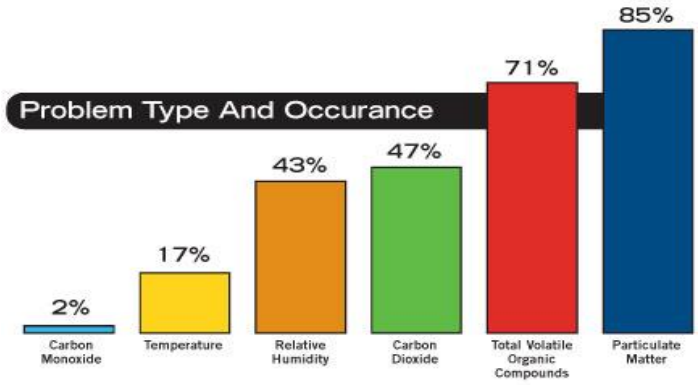
1. **Respirable particulate (RSP)** (<10 micron diameter)
   - Sources :-
   - Dust : Tiny solid particles
   - dirt from carpets or
   - dirt carried in from outdoor
   - Outdoor sources such as from haze
   - Tobacco smoke



Survey for 10,000 North America home by EPA

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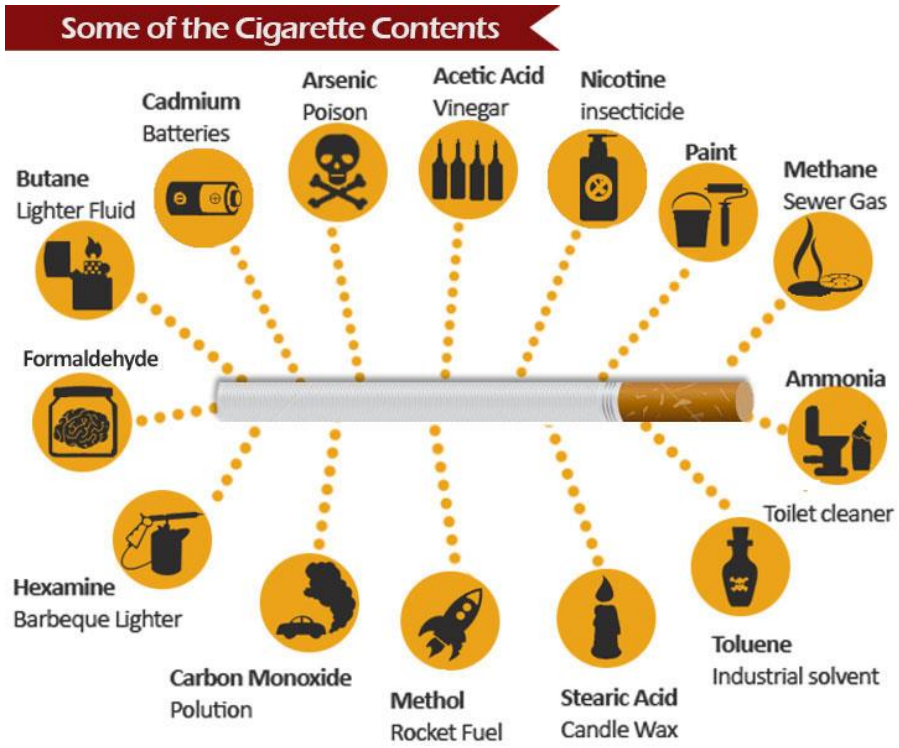
- ETS : Environmental tobacco smoke
  - The substance in indoor air that originate from tobacco smoke
  - Gases :various toxic smoke : voc, formaldehyde, ammonia etc.
  - Smoke, particle, dust



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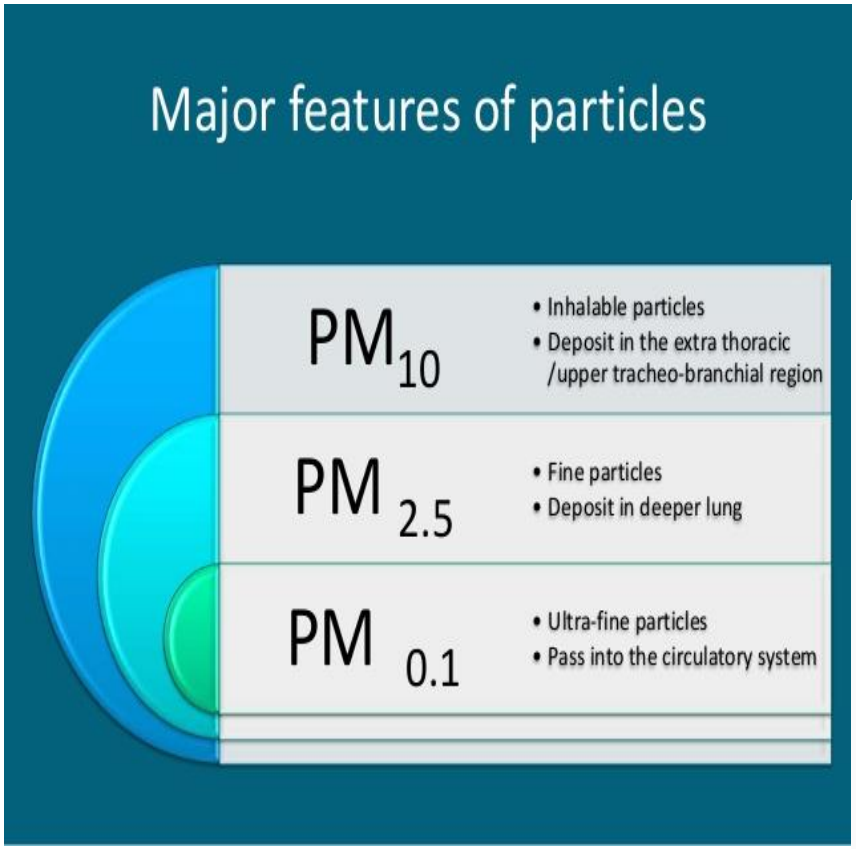
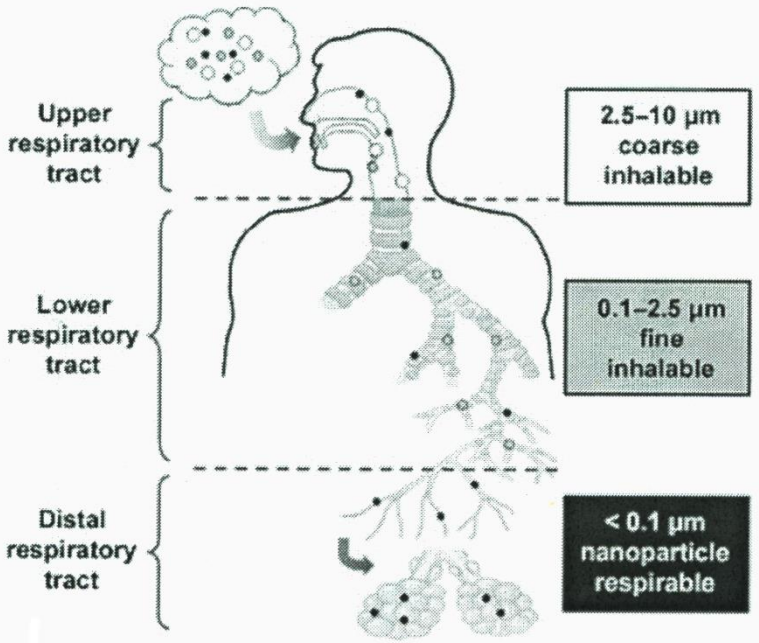




Diagrammatic representation of the translocation patterns of coarse (inhalable), fine (thoracic) and ultrafine/nanosized (respirable) particles in the human respiratory system.

Bahaya jerebu halus dalam paru-paru

Tan Su Lin, Astro Awani | Oktober 06, 2015 22:44 MYT

Berbanding zarah jerebu bersaiz 10 mikron, zarah jerebu 2.5 mikron atau PM 2.5 adalah begitu kecil ia mampu meresap masuk ke dalam tisu paru-paru apabila memasuki badan manusia. - Gambar Fail

KUALA LUMPUR: Kajian membuktikan zarah yang amat halus adalah ancaman berbahaya kepada kesihatan manusia.

Antaranya zarah jerebu dalam julat saiz 2.5 mikron apabila disedut secara terus ke dalam badan manusia boleh mengakibatkan kerosakan paru-paru.

Pakar Runding Respiratori, Institut Perubatan Respiratori, Datuk Dr Abdul Razak Muttalif menjelaskan berbanding zarah jerebu bersaiz 10 mikron, zarah jerebu 2.5 mikron atau PM 2.5 adalah begitu kecil ia mampu meresap masuk ke dalam tisu paru-paru apabila memasuki badan manusia.

"Saiz itu sangat penting sebab kalau zarah bersaiz 10 mikron atau PM10, ia lebih besar dan sekat sampai hidung sahaja. Kalau PM2.5 dia sangat halus apabila bernafas ia boleh sampai ke hujung paru-paru dipanggil 'alveoli'. Jadi kesan kepada paru-paru sangat bahaya kalau lagi halus zarah jerebu itu." katanya ketika ditemui Astro AWANI.

Satu zarah berukuran sangat kecil, purata diameter, 10 mikron atau 'particulate matter' PM10.

Zarah dalam julat saiz 2.5 mikron pula adalah jauh lebih kecil.

Diameternya 20 kali lebih kecil daripada sehelai rambut manusia yang lazimnya berukuran 50 hingga 70 mikron

Golongan berisiko yang terdedah kepada penyakit akibat jerebu dan zarah halus termasuk warga tua, kanak-kanak serta individu yang mempunyai penyakit asma dan jantung.

Simptomnya termasuk batuk, sakit tekak dan sesak nafas selain saluran pernafasan menjadi semakin sempit.

"Pertamanya, kita akan rasa kerongkong gatal atau batuk. Kedua, sebab zarah begitu halus ia boleh jadi halangan untuk badan kita melawan kuman, jadi senang untuk kuman masuk ke dalam paru-paru dan akibatkan jangkitan."

"Bagi mereka yang menghidap asma atau penyakit paru-paru kronik, zarah-zarah ini akan menyekat saluran pernafasan mereka kerana saluran pernafasan mereka sudah sempit jadi kalau sekat lagi ia akan menyukarkan pernafasan."

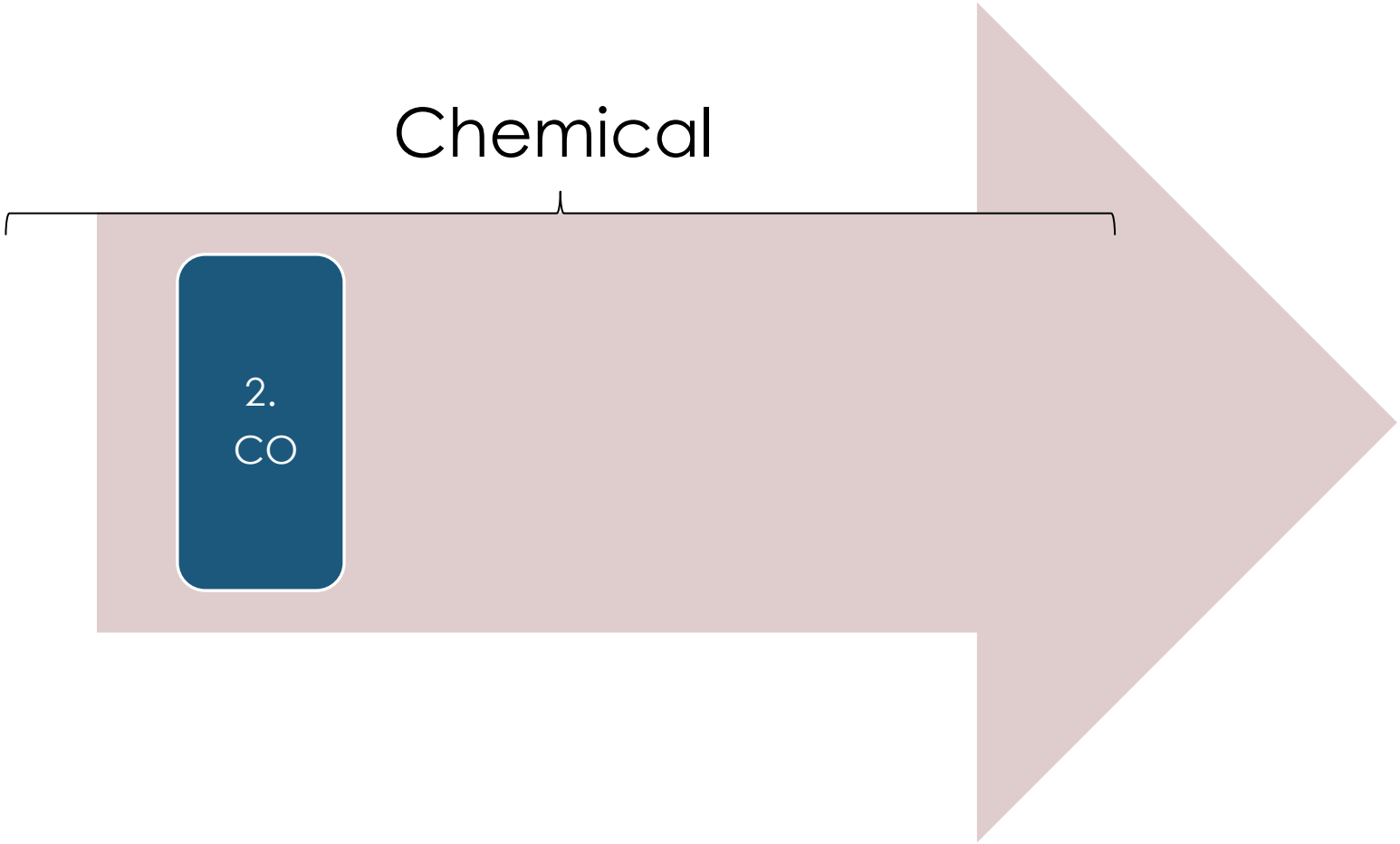
Abdul Razak menjelaskan kesan pendedahan kepada zarah jerebu juga boleh mengakibatkan kanser paru-paru dalam jangka masa panjang.

"Kajian menunjukkan zarah jerebu ini bermungkinan merosakkan sel-sel DNA dalam badan manusia. Kalau DNA sudah rosak, ia boleh menjadi sel kanser. Kedua, ia boleh menjadi mutasi mengakibatkan sel kita bertukar daripada sel normal kepada sel kanser."
"Selain itu, kajian juga menunjukkan kalau terdedah kepada jerebu berpanjangan, ada kemungkinan penambahan 8 peratus dalam kes-kes kanser dalam jangka masa panjang." katanya.

Kementerian Kesihatan sebelum ini mengesahkan berlaku peningkatan kes seperti penyakit asma, jantung dan masalah kulit ekoran keadaan jerebu yang melanda negara sejak beberapa minggu lalu.

Peningkatan kes itu dicatatkan terutamanya di kawasan yang mencatatkan Indeks Pencemaran Udara (IPU) melebihi 100.

Indoor Air Contaminant & Health Effect

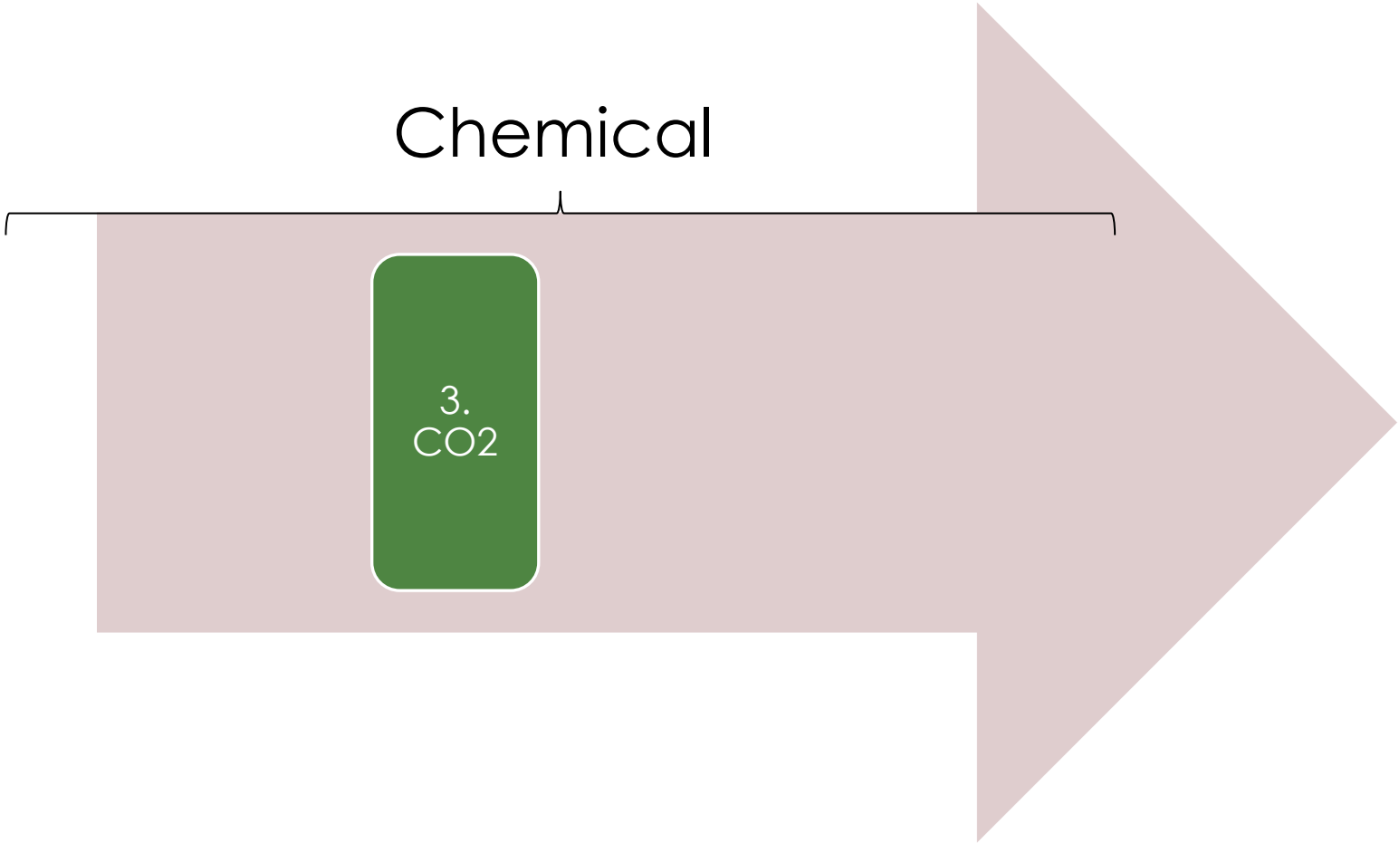


2. CO

- Colorless, odorless, and tasteless gas
- Slightly lighter than air
- Highly toxic to human in higher quantity - cardiovascular disease
- Produced from partial oxidation of carbon containing compounds, it forms when there is not enough oxygen to produce CO2
- E.g. - gas stoves; gasoline equipment, dryer ,oven, water heater automobile exhaust and tobacco smoke.




Indoor Air Contaminant & Health Effect



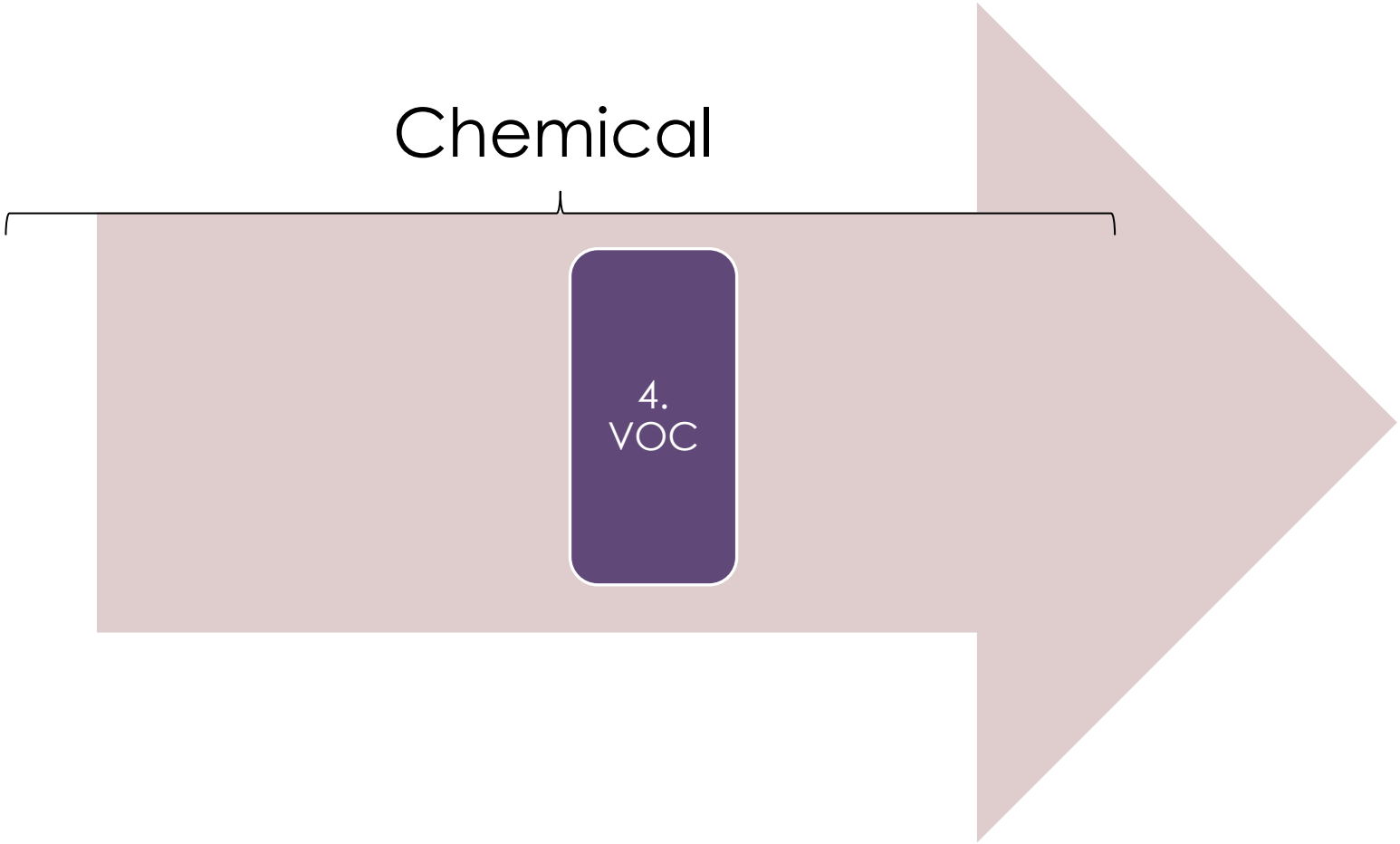
3. CO_2

- One of the common gases found in atmosphere
- Product of combustion - tobacco smoke, human activity – cooking, burning coal and oil
- human respiration , ocean release and respiration,
- Not hazardous in normal level in building.
- At concentrations (>30,000ppm) may cause headache, loss of judgment, dizziness, drowsiness, and rapid breathing
- Ventilation play role.





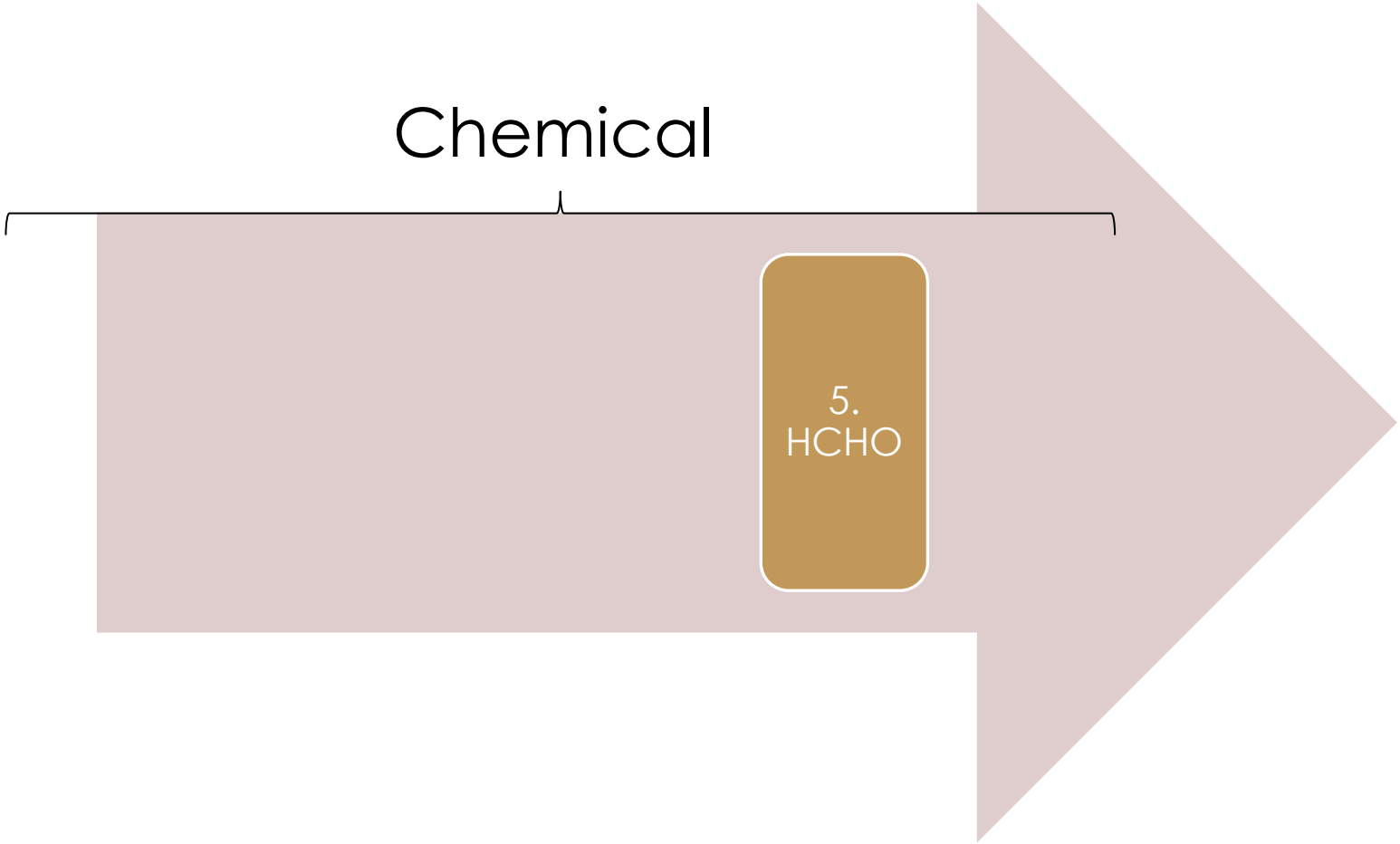
Indoor Air Contaminant & Health Effect



4. VOC

- Emitted gas by wide array of product
  - *chemical compounds whose composition makes it possible for them to evaporate under normal indoor atmospheric conditions*
- Example : paints, cleaning supplies, pesticides, carpets, building materials and furnishings - pressed wood products, office equipment such as copiers and printers, graphics and craft materials including glues and adhesives, **permanent markers,** air **fresheners**

Indoor Air Contaminant & Health Effect



5. Formaldehyde (HCHO)

- Colorless gas – from VOC gases
- Important chemical used widely by industry to manufacture building materials and numerous household products
- Sources :
  - pressed wood products made using adhesives that contain urea-formaldehyde (UF) resins.
  - particleboard (used as sub-flooring and shelving and in cabinetry and furniture);
  - hardwood plywood paneling (used for decorative wall covering and used in cabinets and furniture);
  - laminating agents
  - cosmetics & toiletries
- Emissions will generally decrease as products age. When the products are new, high indoor temperatures or humidity can cause increased release of formaldehyde from these products

ESTĒE LAUDER SHISEIDO
LANCÔME PARIS THE BODY SHOP Dove
Dior L'ORÉAL OLAY

5. Formaldehyde (HCHO)

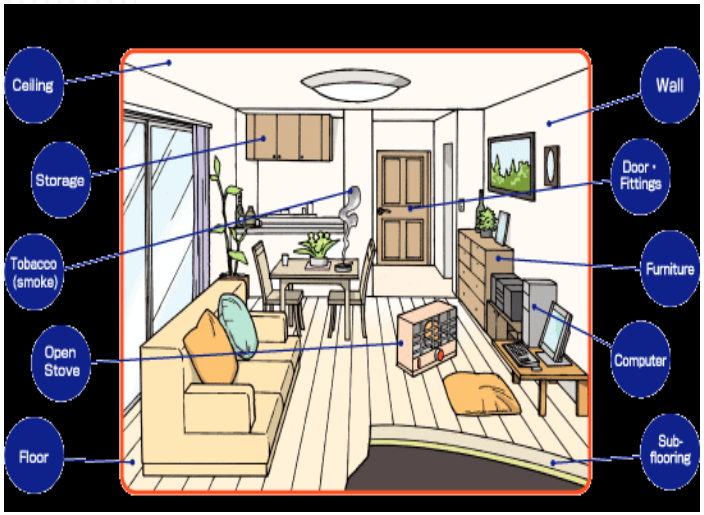
Health Effects of Formaldehyde

Low Level Exposure

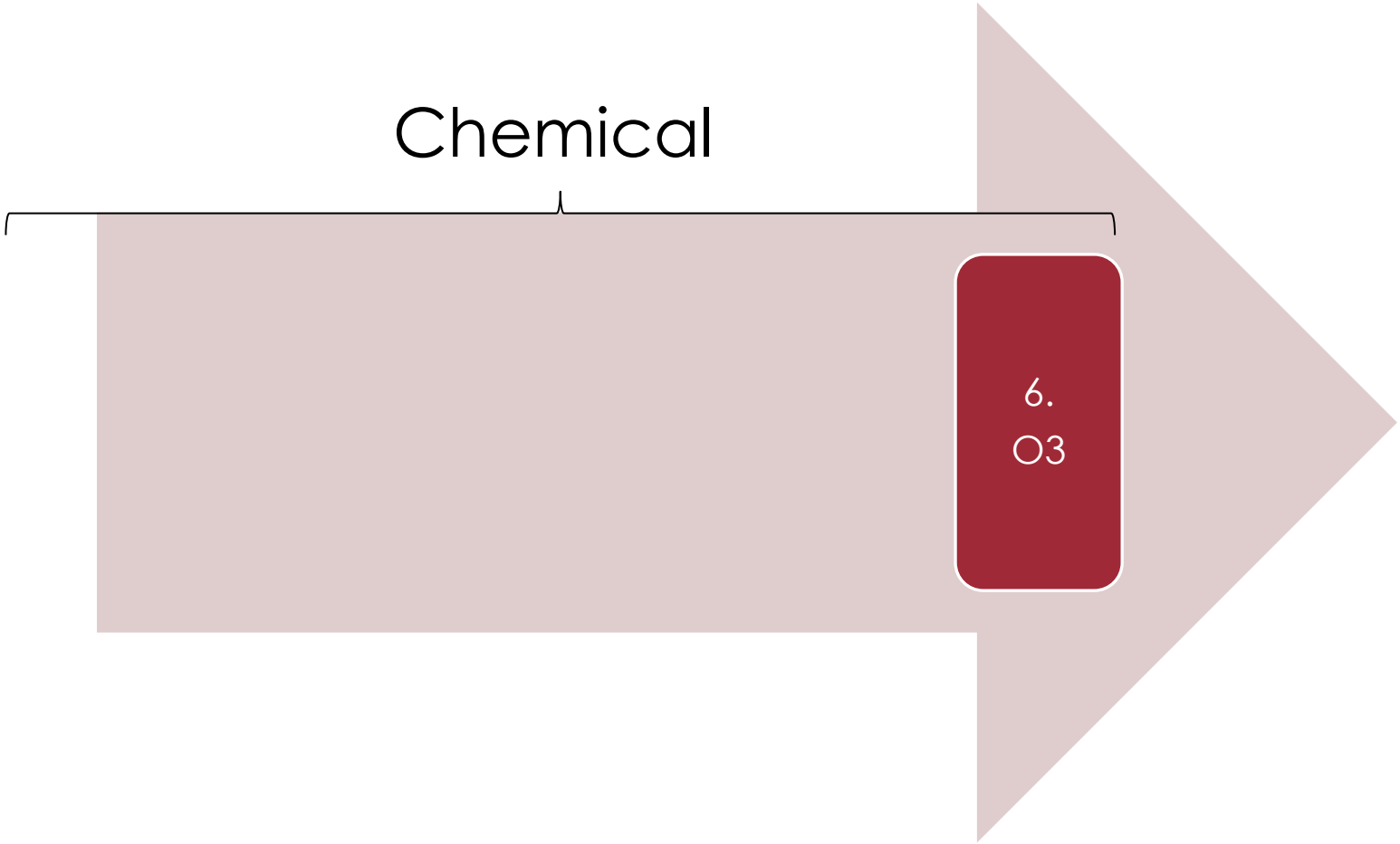
- Runny nose
- Sore throat
- Cough
- Sleeping difficulties
- Headache
- Fatigue
- Breathing difficulties
- Sinus irritation; nose bleed
- Chest pain
- Decreased lung capacity
- Bronchitis
- Nausea

Acute Exposure

- Abdominal pain
- Anxiety
- Coma
- Convulsions
- Diarrhea
- Respiratory problems (pneumonia)
- Dizziness
- Drowsiness



Indoor Air Contaminant & Health Effect



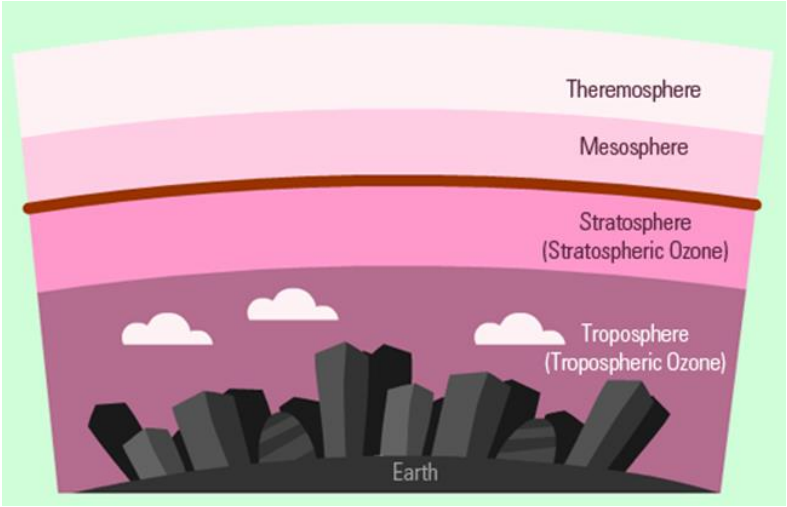
6. Ozone (O3)

- Ozone is a natural gas, It is blue in color and has a strong odor.

- Environmental scientists have classified O3 into two: **Good Ozone** and **Bad Ozone.**

6. Ozone (O3)

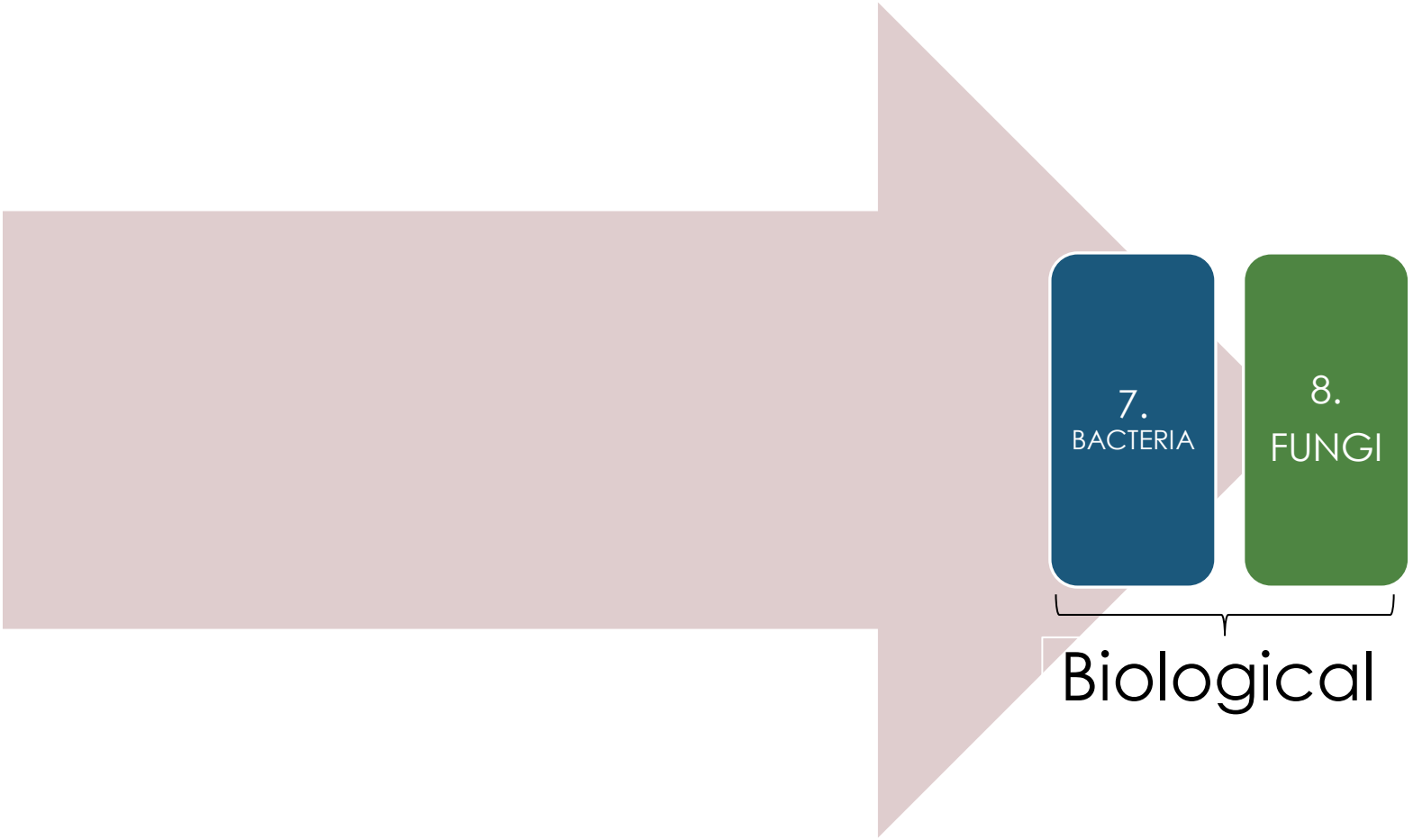
- **Good ozone** (also called Stratospheric Ozone) occurs naturally in the upper Stratosphere. The stratosphere is the layer of space 6 to 30 miles above the earth's surface
- it shields us from the sun's harmful UV rays
- it protects humans, life and animals on earth.



6. Ozone (O3)

- **Bad Ozone**
- Bad Ozone does not exist naturally. Human actions cause chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC).
- Each time there is a reaction of chemicals such as those found in cars, power plants and factory emissions, printing equipment in the presence of sunlight (UV light), Bad Ozone is created.
- Bad ozone contaminates (dirties) the air and contributes to what we typically experience as "smog" or haze

Indoor Air Contaminant & Health Effect



Indoor Air Contaminant & Health Effect

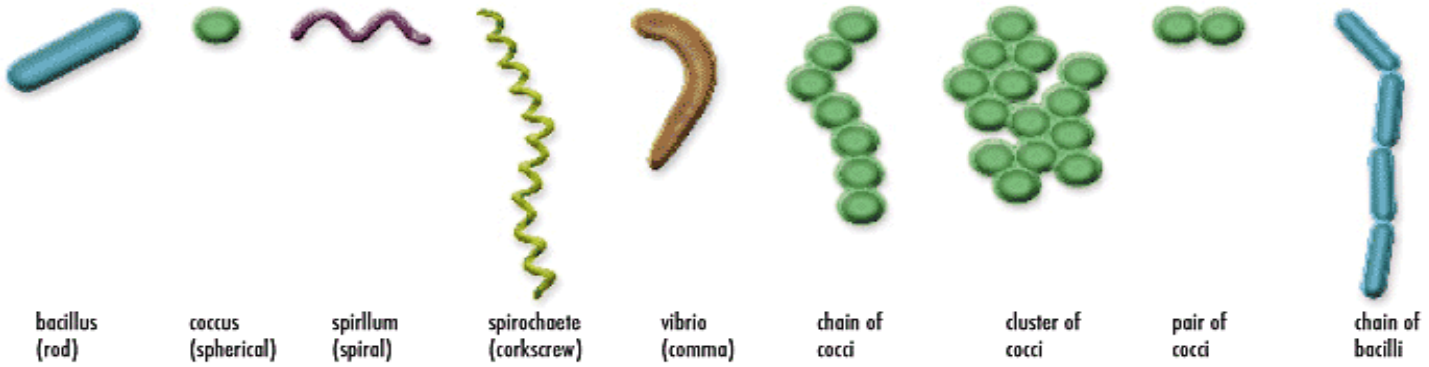
- Type of **Biological Contaminants**
  - Pollen
  - Dander
  - Insect
  - Mites
  - Viruses
  - **Bacteria**
  - **Fungi**
  - Protozoa

7. Bacteria

- Bacteria are **single celled microbes**. The **cell structure is simpler than that of other organisms** as there is no nucleus or membrane bound organelles. Instead their control centre containing the genetic information is contained in a single loop of DNA. Some bacteria have an extra circle of genetic material called a plasmid. The plasmid often contains genes that give the bacterium some advantage over other bacteria. For example it may contain a gene that makes the bacterium resistant to a certain antibiotic.

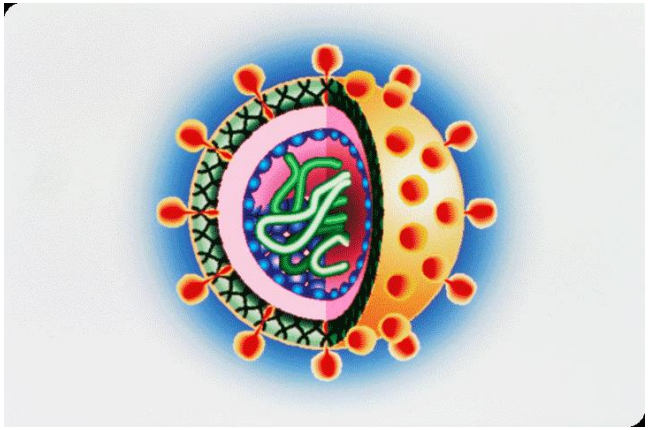
7. Bacteria

Basic shape of bacteria

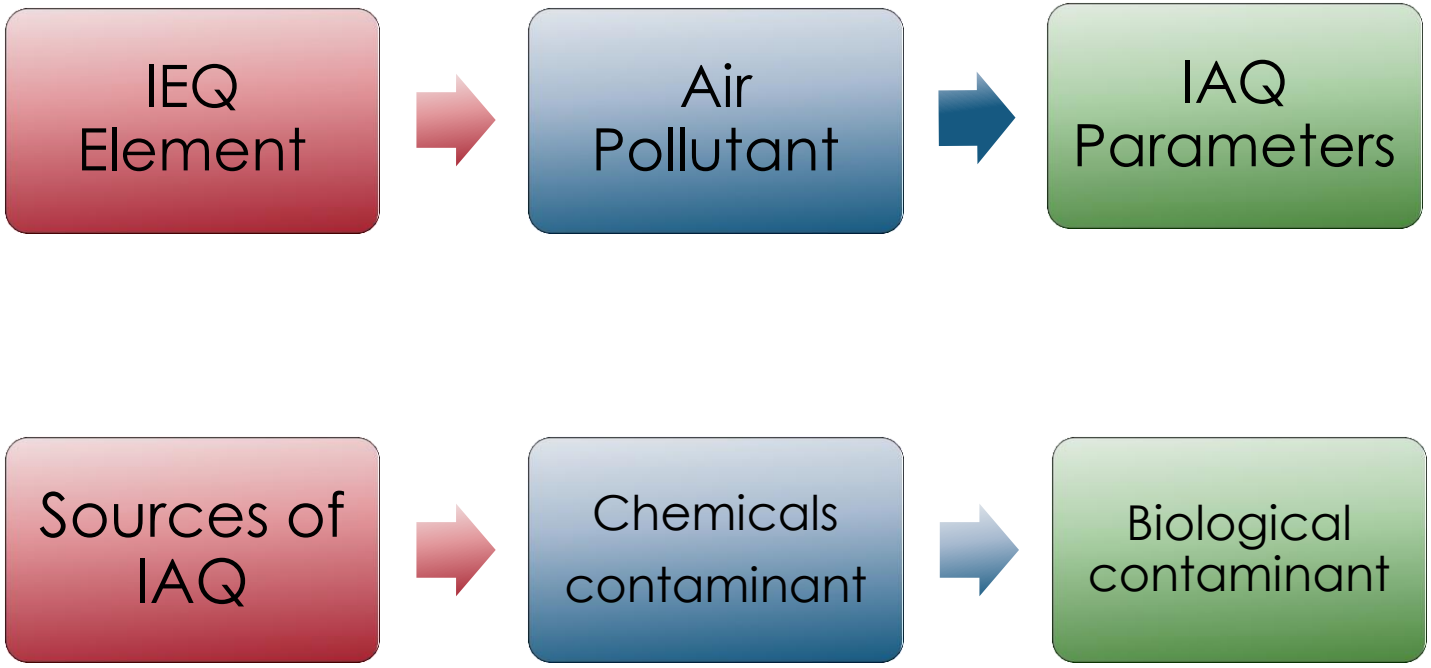


8. Viruses

- Viruses are **the smallest of all the microbes**. They are said to be so small that 500 million rhinoviruses (which cause the common cold) could fit on to the head of a pin. They are unique because they are **only alive and able to multiply inside the cells of other living things.** The cell they multiply in is called the host cell.



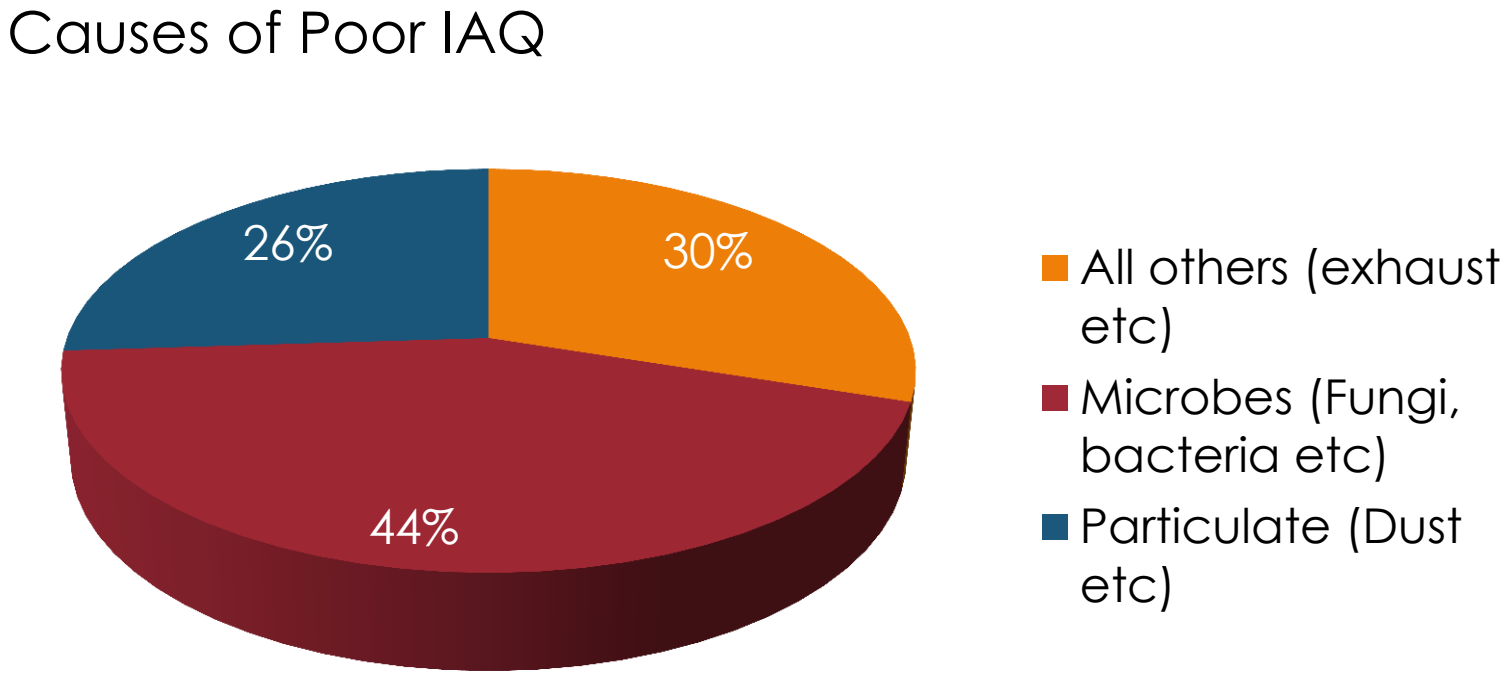
Indoor Air Contaminant & Health Effect



IAQ …

Why bother … ???

Study Shows…



Healthy Building International (HBI) over 953 buildings with 147 million square feet

Indoor Air Contaminant & Health Effect

Common IAQ Issues
(summary of US NIOSH Studies)
(over 500 building investigated)

Inadequate ventilation	53%
Indoor Pollutant sources	15%
Entrainment of outdoor contaminants	10%
Microbial problem	5%
Building fabric contamination	4%
Others	13%

Indoor Air Contaminant & Health Effect

Why is there an increase in IAQ problem?

- More time indoors
- More chemical pollutants in buildings
- Tighter building and reduced ventilation
- Maintenance

Indoor Air Contaminant & Health Effect

IAQ – Growing Public Concern

- Changed from natural ventilation to tight building concept
- Rely on ACMV to provide general ventilation but may suffer from insufficient IAQ
- Changing on building materials. Synthetic had largely replaced the natural construction/finishing materials, e.g. wood/stone
- Modern finishing emits VOC into building environment
- Additional VOC from cleaning etc.

Indoor Air Contaminant & Health Effect

- Common Health Effects of Indoor Contaminants
  - Eye, nose and throat irritation
  - Coughing and sneezing
  - Headaches
  - Fatigue
  - Irritability
  - Allergies, sinus congestion
  - Dizziness
  - Difficulty in concentrating

Indoor Air Contaminant & Health Effect

Health Effects Depend on Several Factors

- The Contaminant
- The amount of the contaminant present
- The length of time a person is exposed to contaminant
- The vulnerability of the person
- Children/ adult/ older
- Gender
- The way of life – healthy life

Indoor Air Contaminant & Health Effect

- Summary
  - IAQ directly affect occupant health, comfort and productivity
  - When IAQ is good, building are more desirable place to work, to learn, to conduct business, and to rent.