Introduction to Environmental Health Hazards

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Objectives

- To understand the definition of environmental health
- To identify the components of the environment
- To describe the interaction between different factors with the environment to produce disease
- To enumerate different environmental hazard concerns
- To describe sources of water hazards
- To describe sources of air hazards
- To be able to decide on appropriate method for water treatment
- To list the steps for environmental risk assessment

Environment

All external factors, living and non-living, surrounding man

Source: Park

Components of the environment

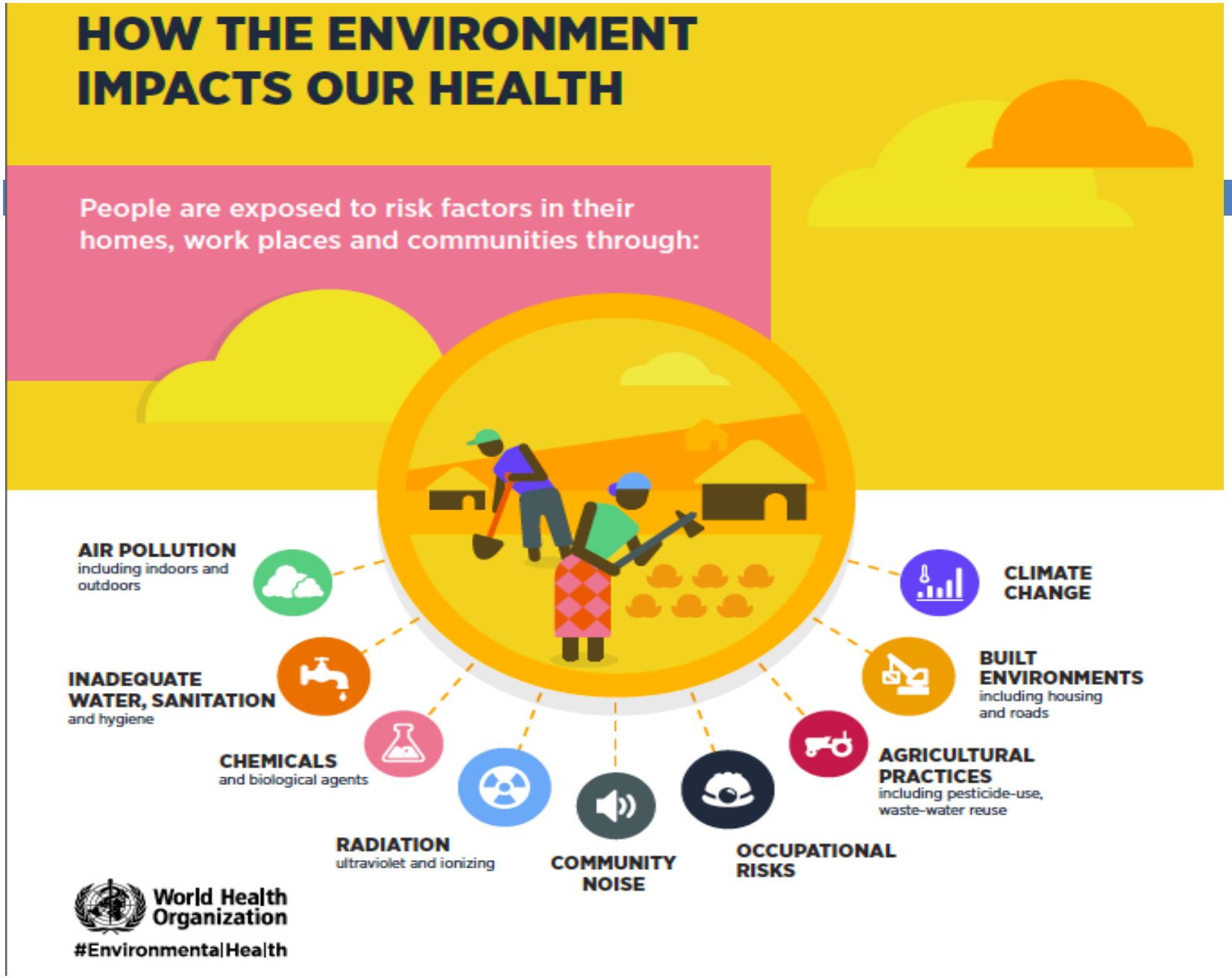
1. Physical environment
   - Noise, radiation
2. Chemical
   - Air, toxic waste, pesticides, water
3. Biological environment
   - Disease organisms, allergens, insects
4. Social environment
   - Culture, habits, access to healthcare

Environmental Health

"Environmental health is the science and practice of preventing human injury and illness and promoting well-being by:

- *identifying and evaluating environmental sources and hazardous agents and*
- *limiting exposures to hazardous physical, chemical, and biological agents in air, water, soil, food, and other environmental media or settings that may adversely affect human health"*

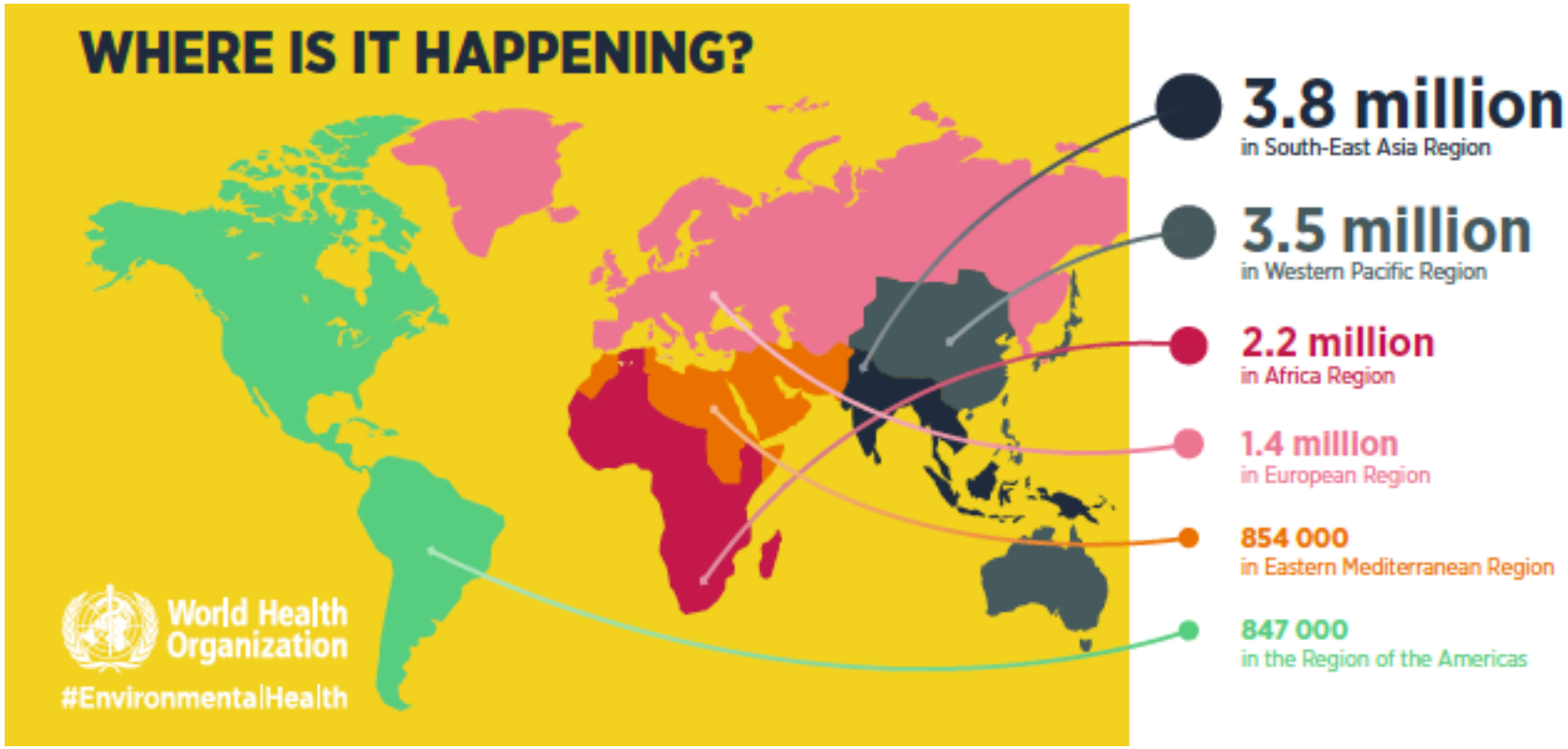
Source: National Environmental Health Association. Definition of Environmental Health. Available at: https://www.neha.org/about-neha/definitions-environmental-health. Accessed on Feb 18, 2019.



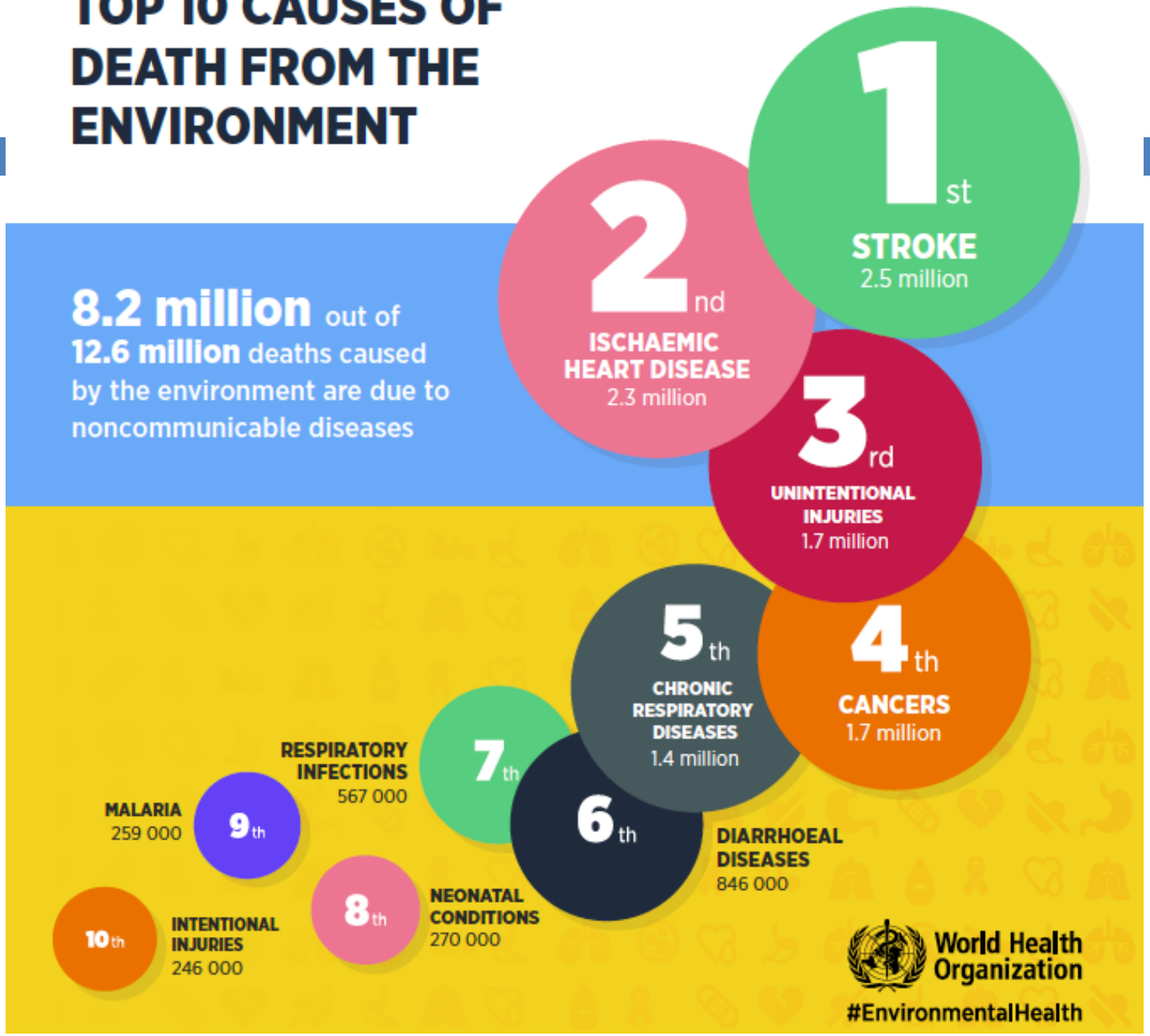
Source: World Health Organization. Environmental impacts on health. Available at: https://www.who.int/quantifying_ehimpacts/publications/PHE-prevention-diseases-infographic-EN.pdf?ua=1 Accessed on Feb 18, 2019

World Health Organization Estimates

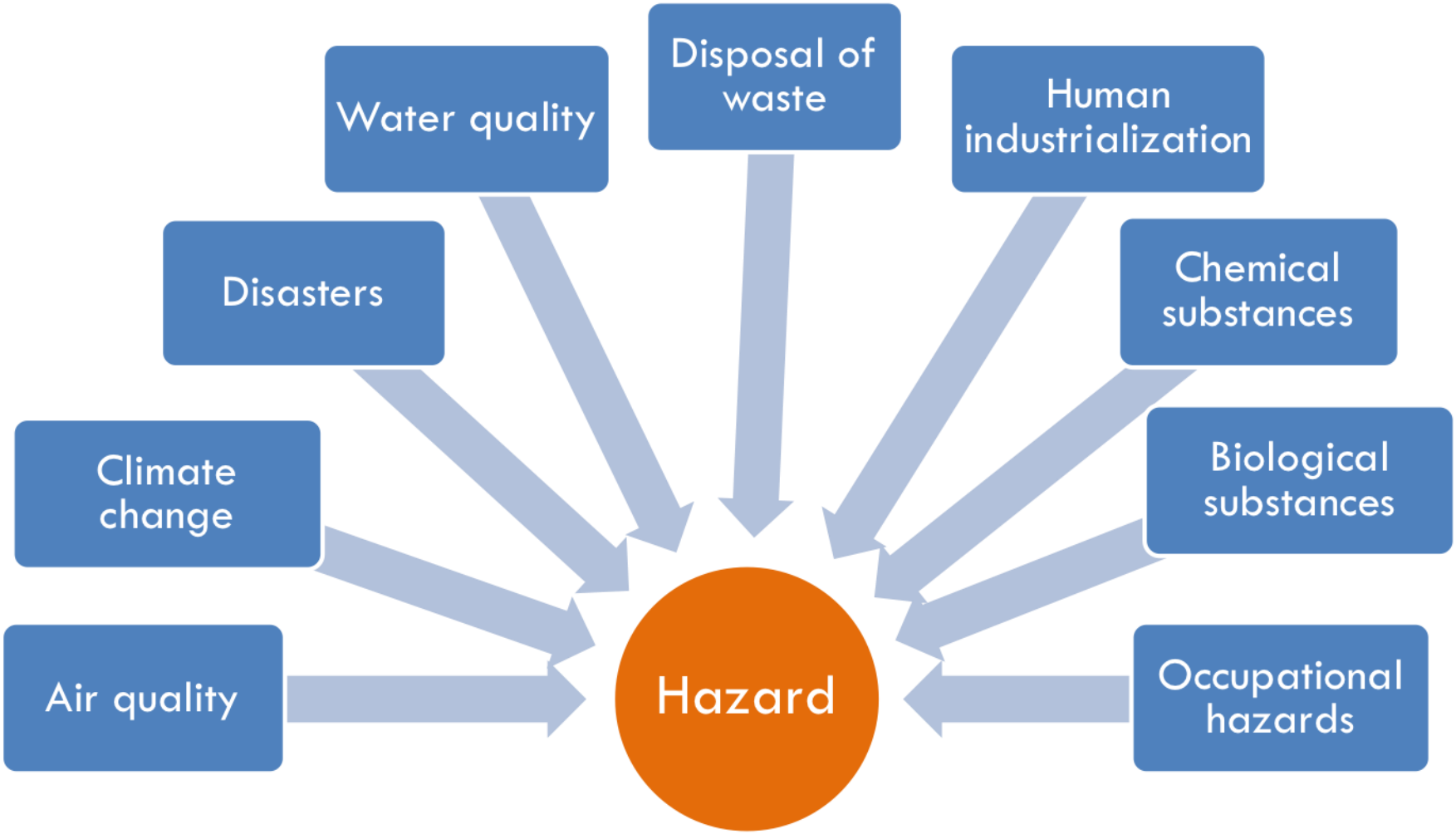
- 23% of global deaths are related to environment



TOP 10 CAUSES OF DEATH FROM THE ENVIRONMENT



Environmental Health Concerns



How do humans damage the environment?

Air

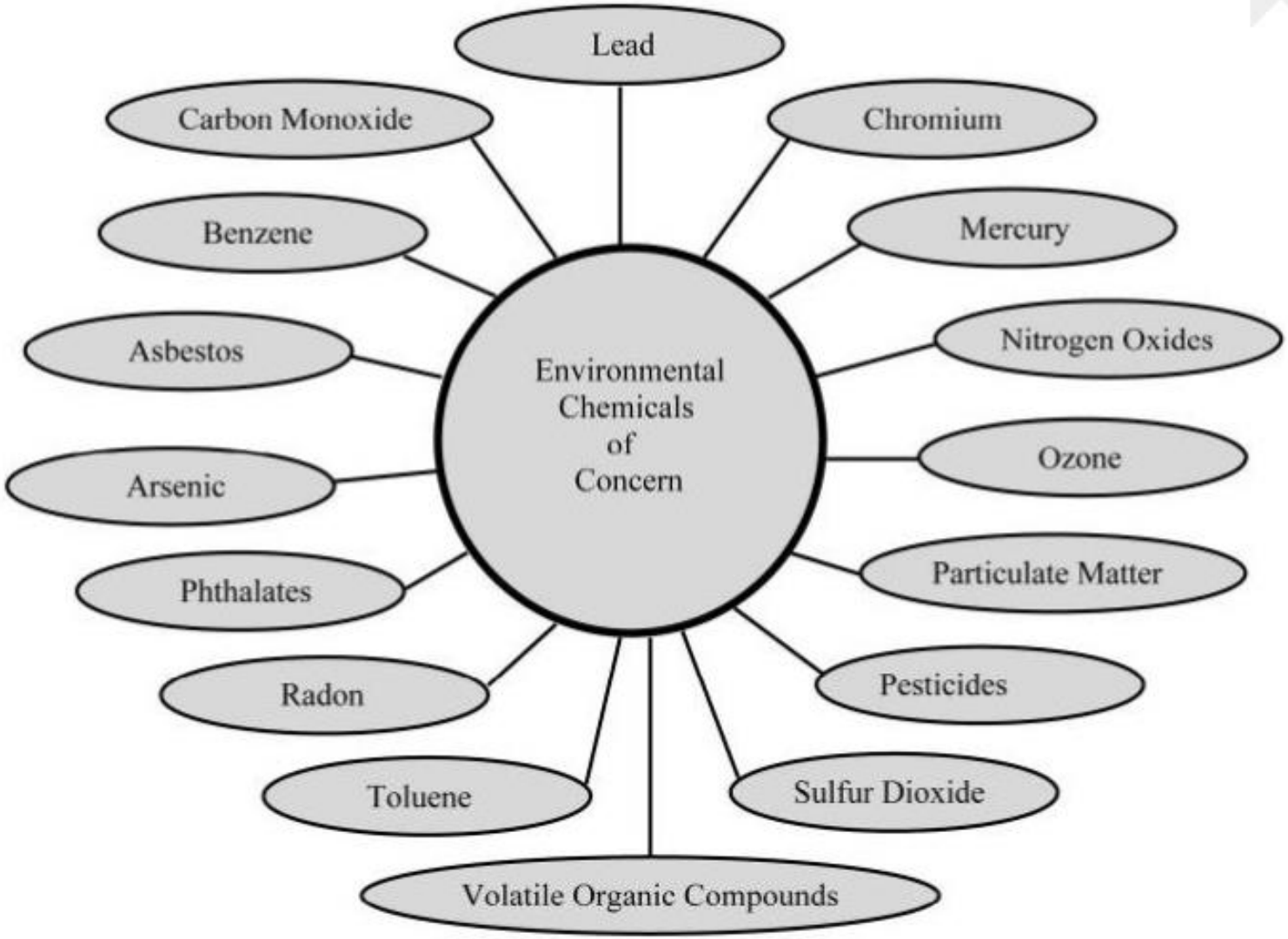
Water

Soil

Biota

Chemicals

Chemical Concerns



Source: Spellman FR, Stoudt ML. The Handbook of Environmental Health, Scarecrow Press, 2013. ProQuest Ebook Central, https://ebookcentral-proquest-com.sdl.idm.oclc.org/lib/sauduniversity-ebooks/detail.action?docID=1126478.

Air Quality

Air pollution

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere.

Pollutants

An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Types of pollutants

- Primary (directly emitted)
  - Sulphur oxide, Nitrogen oxides, carbon monoxide (CO), CO_2, volatile organic compounds, particulate matter, persistent free radicals, chlorofluorocarbons, ammonia, odors, radioactive material
- Secondary (form in air when primary pollutants interact)
  - Ozone, smog, peroxyacetyl nitrate

Water Sanitation and Availability

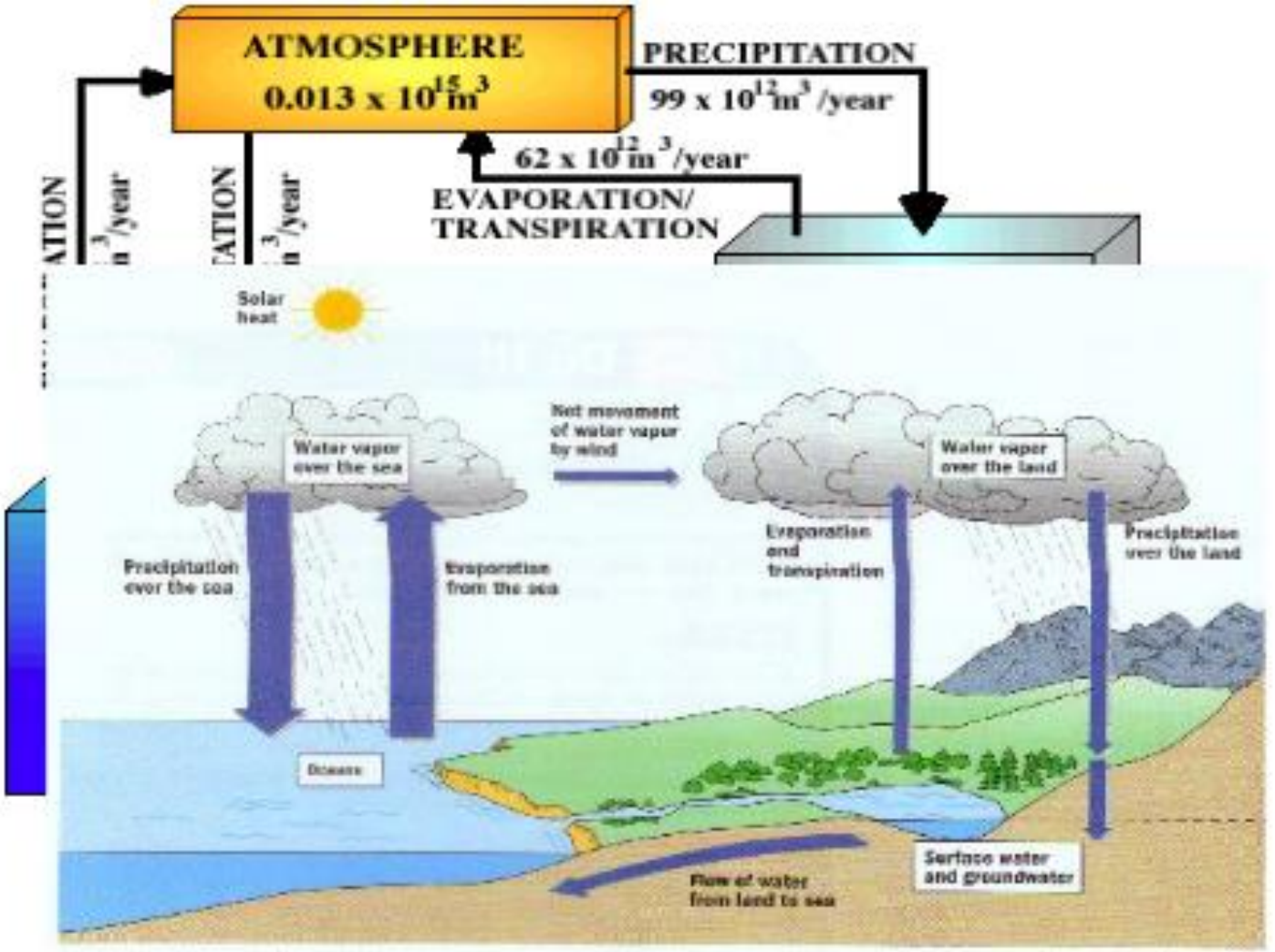
Issues with water

- Humans need 2 litres of water per day
- Water should be available
- Should be sanitary

In order for water to be safe for human consumption

- Free of pathogenic agents
- Free of harmful chemical substances
- Pleasant to taste
- Usable for domestic purposes

Volume of water on earth depends on hydrologic cycle



Sources of water

- Rain
- Surface water
  - River, stream, lake
- Ground water
  - Wells, springs

Water pollution

- Water appears naturally with impurities (not hazardous):
  - Dissolved gasses (CO_2, N, H_2S)
  - Dissolved minerals (Ca, Mg, Na)
  - Suspended impurities (Clay, sand, mud)
- Pollution of water due to industrialization (hazardous)
  - Sewage
  - Toxic waste
  - Agricultural pollutants (insecticide, fertilizers)
  - Heat and radioactive materials

Water related diseases

- Biological causes:
  - Viral, bacterial, protozoal, helminthic, snail, cyclopes,
- Chemical causes:
  - Cyanides, dyes, heavy metals, bleaching agents, ammonia
  - Directly cause disease or indirectly (fish life)

Water purification

- Filtration
- Storage
- Disinfection
  - Depends on source:
    - Wells and springs -> only disinfection
    - Surface water -> needs more treatment

Water storage

- To preserve water from further contamination and pollution
- Provides a small amount of purification
  - Number of bacteria die out
  - Suspended impurities fall by gravity
  - Chemical composition changes (↓free ammonia, ↑nitrates)
- Must be stored within a certain period
  - Prolonged periods cause vegetable growth (algae)

Methods for disinfection

- Heat (boiling for 10-20 min kills most organisms and sterilizes water)
- Chlorination (kills bacteria but not spores and viruses)
- Ozonation
- Bleaching powder (chlorinated lime)
- Bromination

Challenges with disinfection

- Sterilization is impractical at a large scale (only feasible at homes)
- Chlorination is the most widely method used
- Organisms resistant to chlorination (E coli, salmonella, polio, HAV)
- Decision for disinfection method depends on:
  - Costs; availability of technology and method
  - Target organism to get rid of
  - Ability to produce residual to provide post-treatment disinfection

Source: National Research Council (US) Safe Drinking Water Committee. Drinking Water and Health: Volume 2. Washington (DC): National Academies Press (US); 1980. II, The Disinfection of Drinking Water. Available from: https://www.ncbi.nlm.nih.gov/books/NBK234590/

Risk Assessment

What is risk assessment?

"Risk assessment is the process of estimating the potential impact of a chemical, physical, microbiological or psychosocial hazard on a specified human population or ecological system under a specific set of conditions and for a certain time frame."

In other words, we try to estimate the risk for exposure to a specific hazard in the environment, based on the several assumptions

Environmental risk assessment involves assessing impacts of

- chemical pollutants and contaminants in air, water, soil and food
- pathogenic microbiological contaminants in food and water
- radiation sources
- electromagnetic fields (EMFs)
- climate and climate change

Things to keep in mind when attempting risk assessment

- Heavily relies on assumptions (not what really happens)
- Does not take into account the different interaction of environment with other factors
- Exposures and outcomes on which the risk assessment is based are poorly defined

Types of environmental risk assessment

- Individual and population-based
- Quantitative and qualitative
  - Categories of risk vs. numeric estimation

The five stages of environmental hazard risk assessment

Source: enHealth. Environmental health risk assessment guidelines for assessing human health risks for environmental hazards, 2012. Available at: https://www.health.gov.au/internet/main/publishing.nsf/content/A12B57E41EC9F326CA257BF0001F9E7D/$File/Environmental-health-Risk-Assessment.pdf Accessed on Feb 18, 2019.

Issue Identification

- What is the problem in question?
- Can the problem be addressed by the proposed risk assessment?
- Do we have the technology and capabilities to apply the assessment process?
- Are there any factors that contribute to persistence of that risk?
- Did the risk come about as a breach in public health measures?

Hazard Identification

- How severe are the health effects? And are they reversible?
- Is there interaction between this hazard and other agents in the environment?
- Is the onset of the effect immediate or delayed after exposure to hazard?
- Is there a critical window for exposure?

Dose-response Relationship

- Does the exposure to the hazard exhibit a dose-response relationship for the effect to appear?
- Is there a critical threshold for exposure? (cut-off point over which the effects will take place)

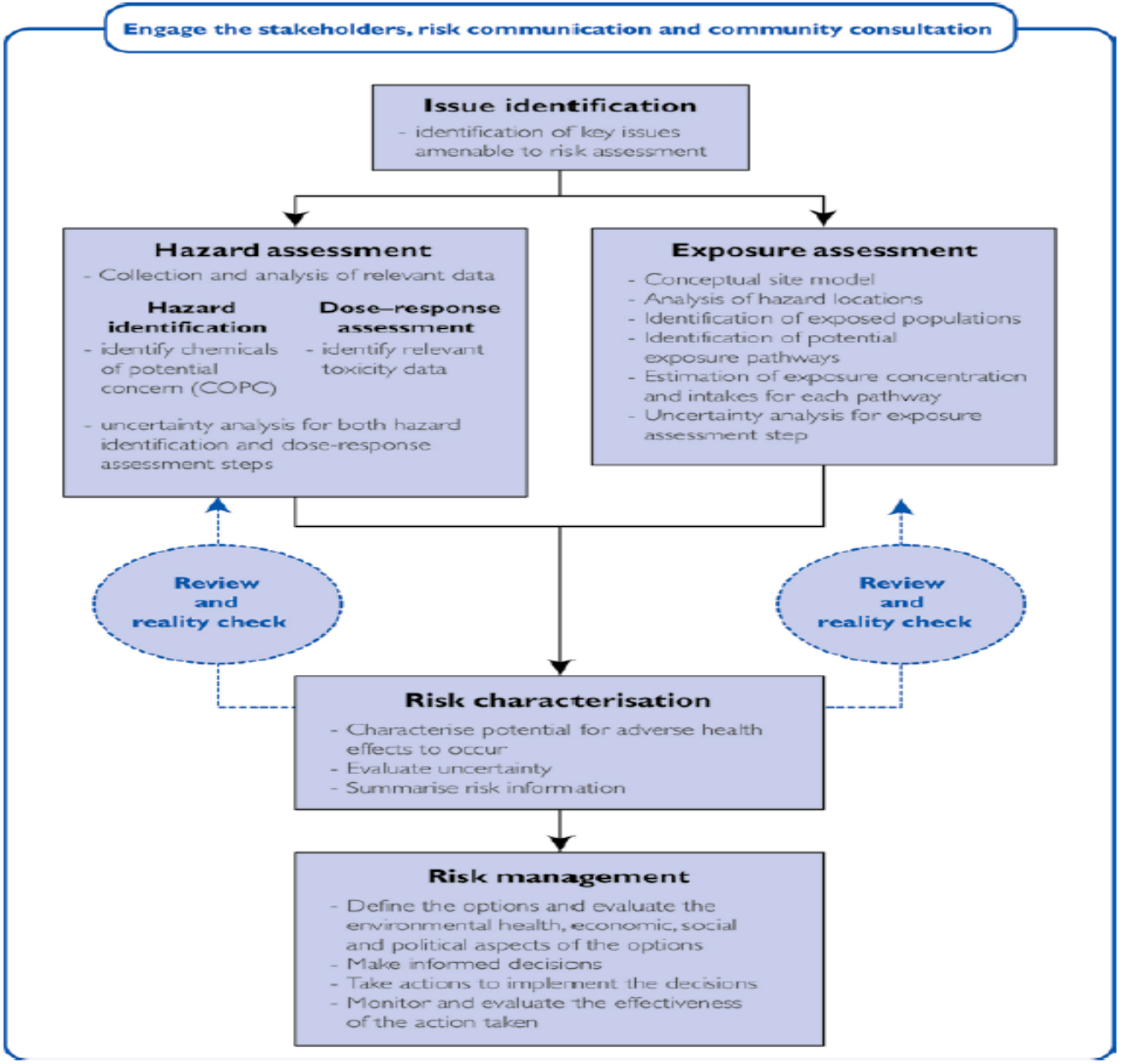
Exposure Assessment

- What is the nature of exposure?
- Is there a specific frequency of exposure?
- Is there a latency period for exposure?
- Can the critical time of exposure be determined? In order to be targeted for prevention and control measures
- Has the route for exposure been identified? Is there more than one route?
- Is exposure one time, continuous or intermittent?

Risk Characterization

- Is there genetic variability in exposure to the hazard?
- Do personal characteristics play a role in exposure to hazard? Or do they play a role in the development of the health outcome following exposure to hazard?
- Should we consider any population characteristics or dynamics?

Figure 1: Environmental health risk assessment model



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Prevention and control

Monitoring water

- Biological surveillance of water:
  - Sanitary surveys
  - Inspection of manufacturing of water bottles and ice
  - Inspection of reservoirs and wells
  - Establishing policies and procedures for extracting water from wells, and maintaining water safety and storing water

Monitoring air pollution

- Monitoring the concentration of:
  - Sulphur dioxide
  - Smoke
  - Suspended particles

References

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Any

Questions?