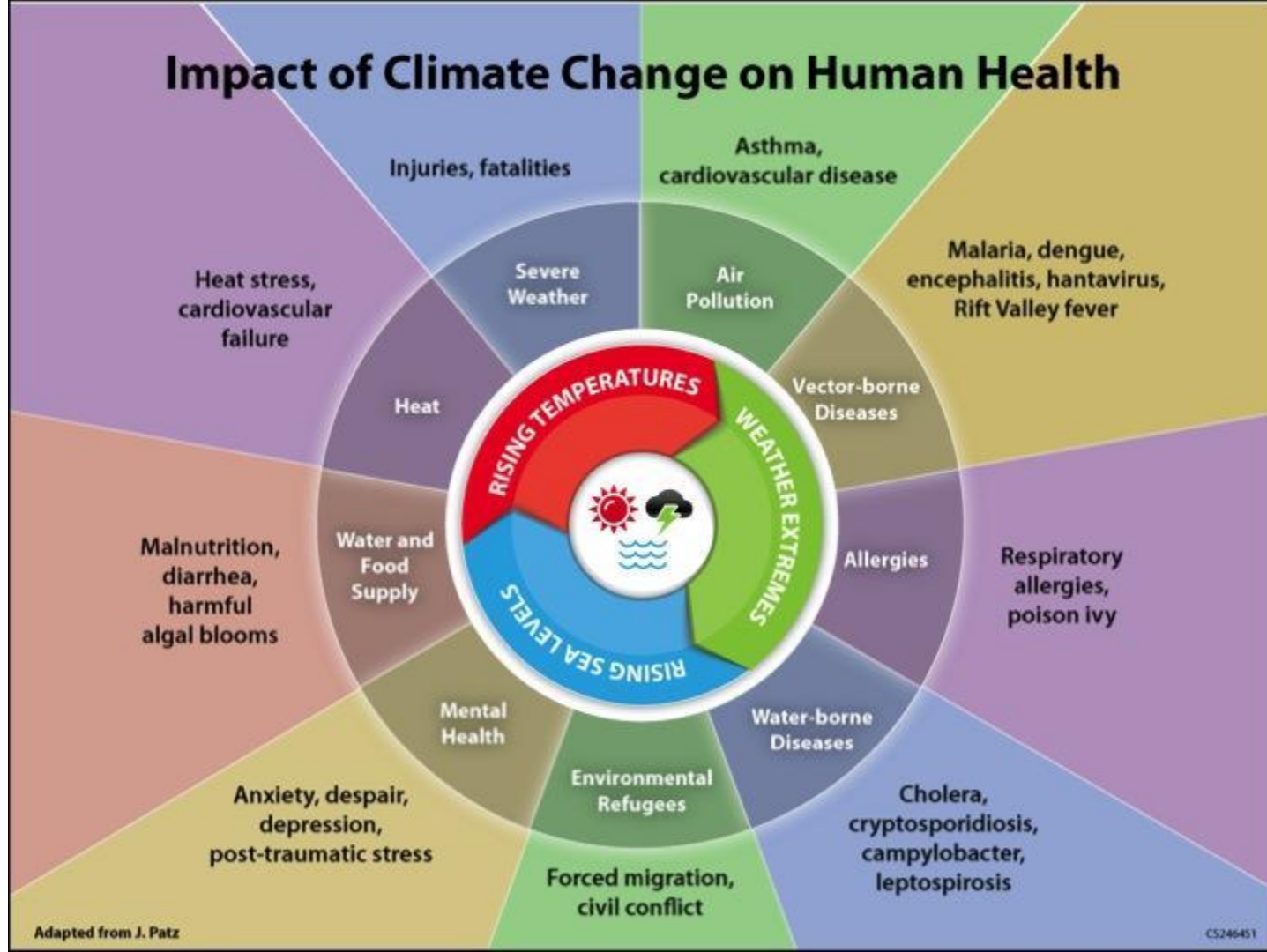


# **WATER RISKS**

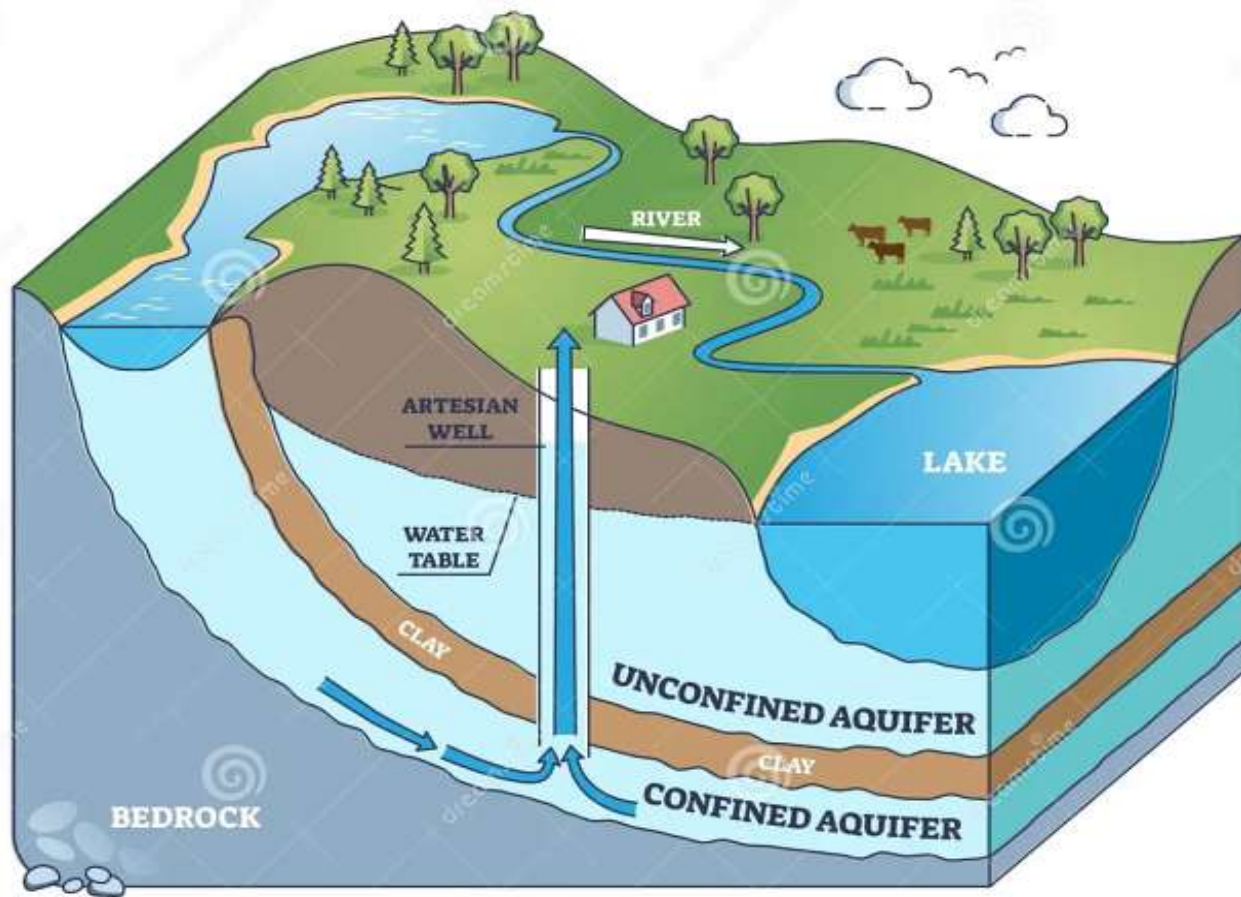
**“minimization through  
awareness raising  
&  
capacity building”**

Prof. Dr. Christiaan Max Huisden

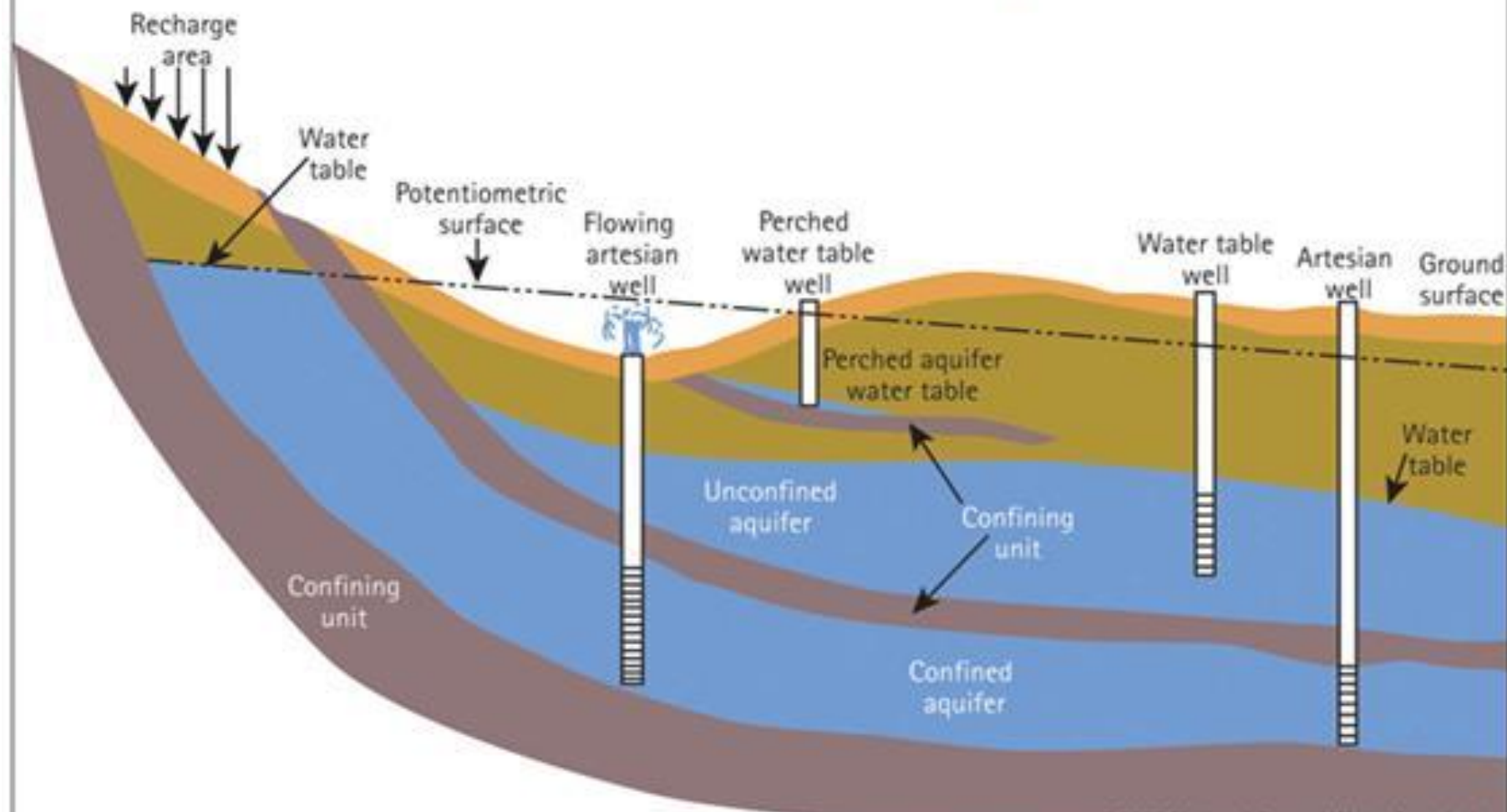
# Impact of Climate Change on Human Health



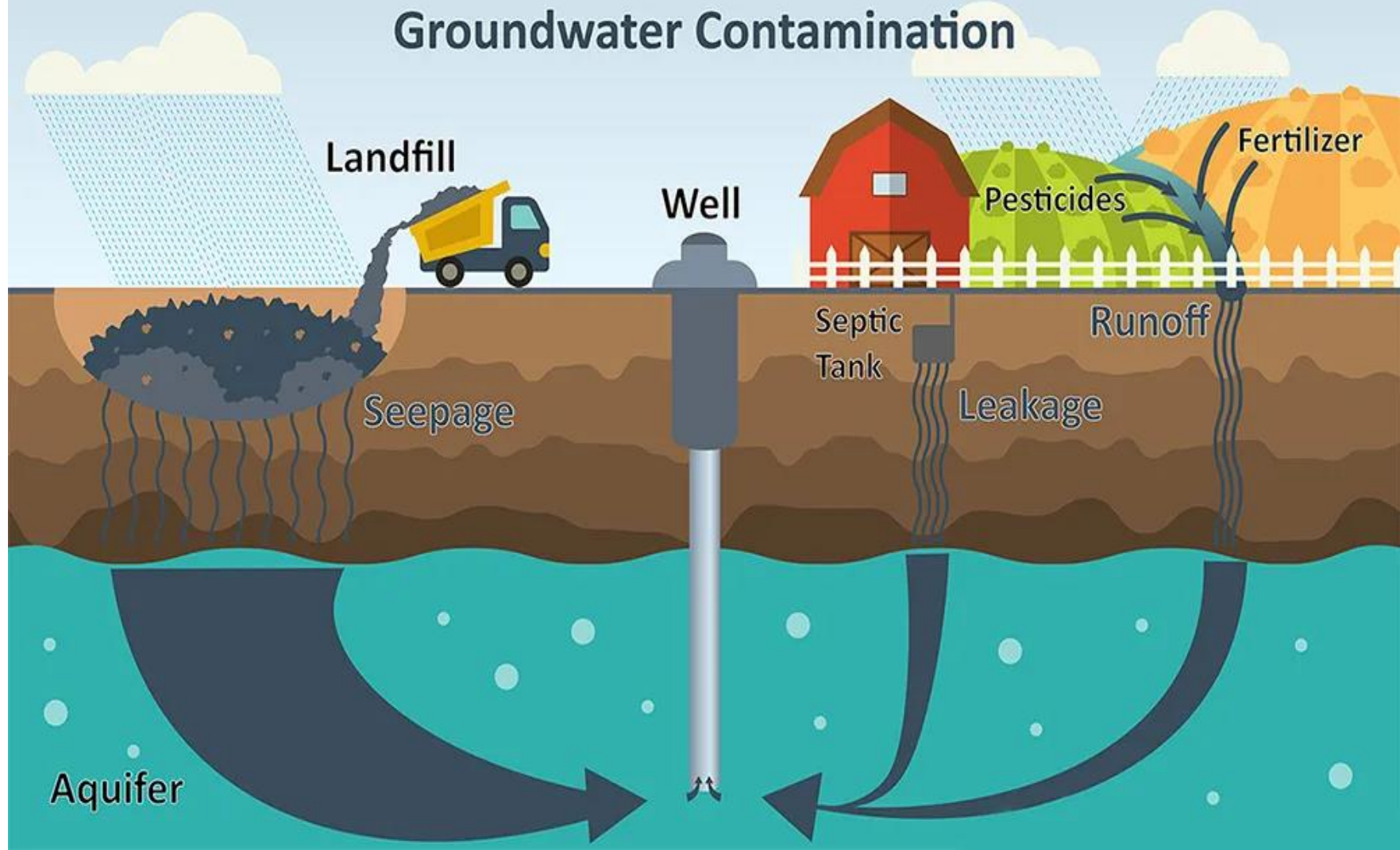
# AQUIFER



# Confined/Unconfined Aquifers



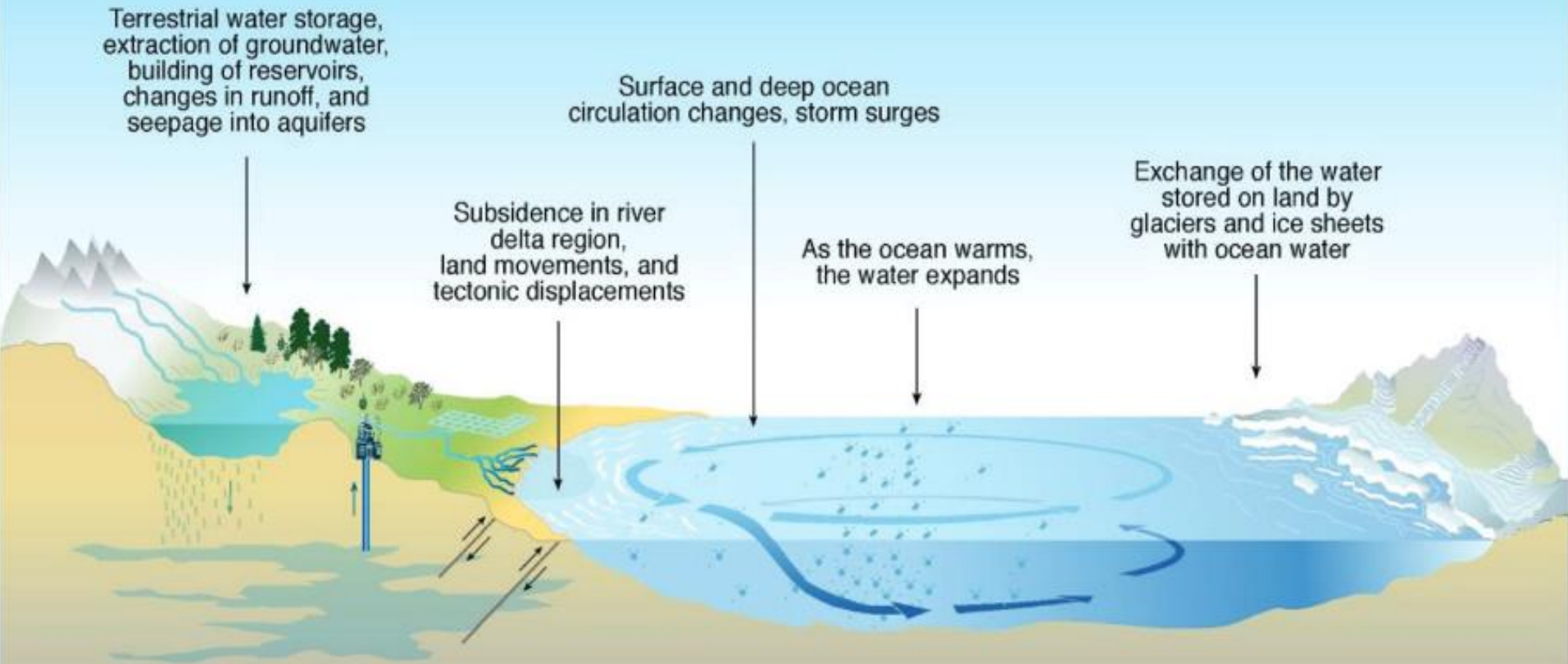
# Groundwater Contamination



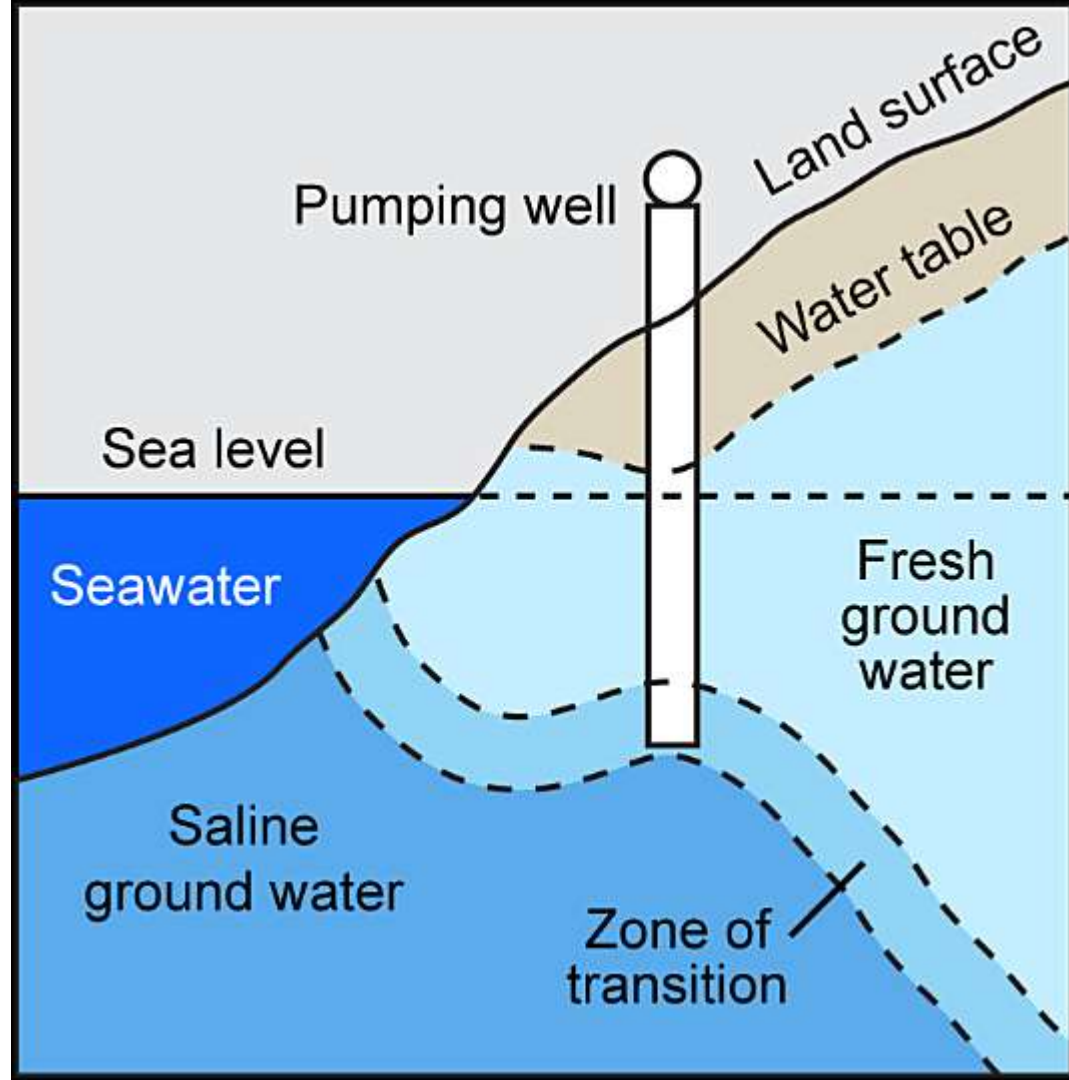


# What causes the sea level to change?

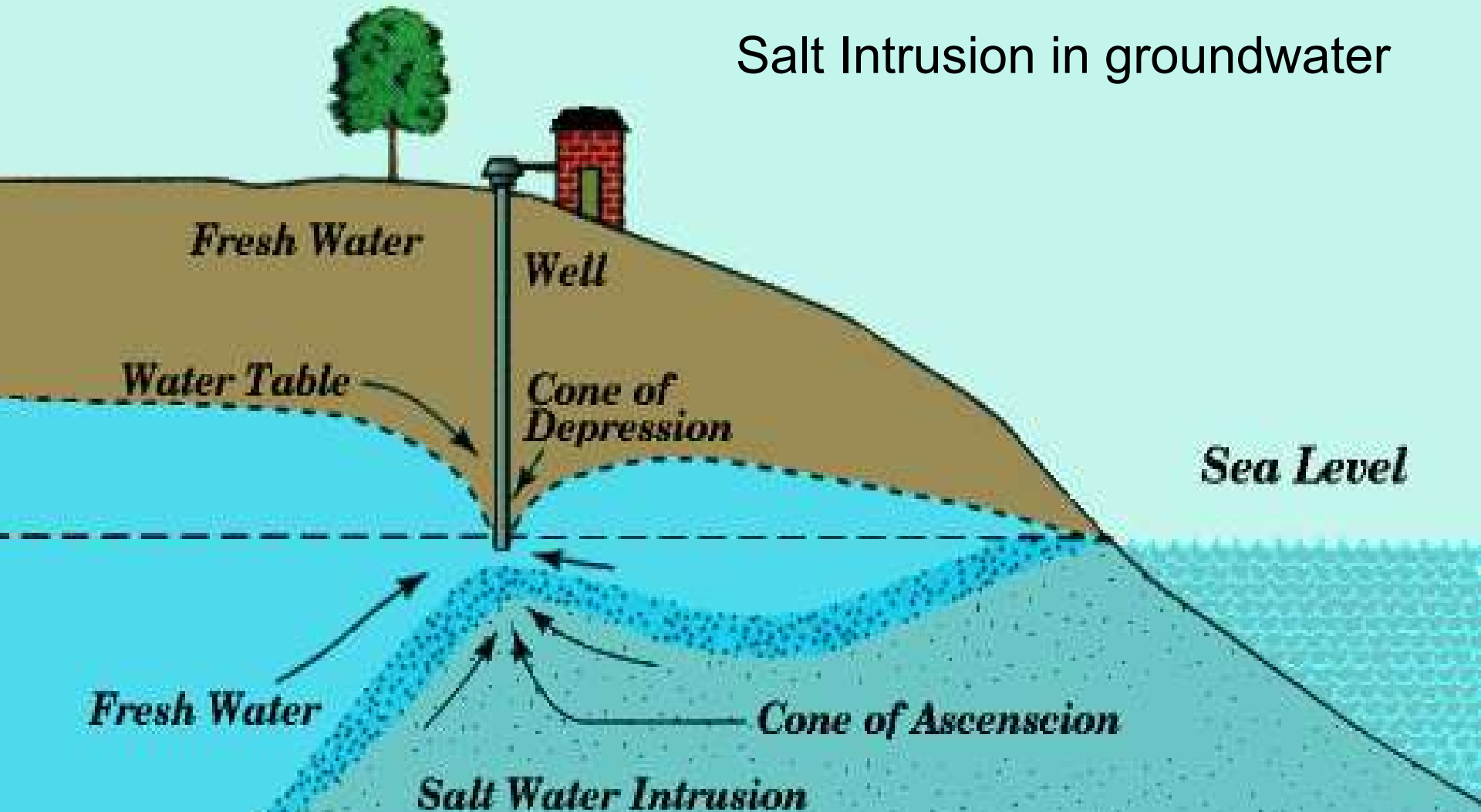
## Sea level rise



# Climate adaptation and Salt intrusion



# Salt Intrusion in groundwater

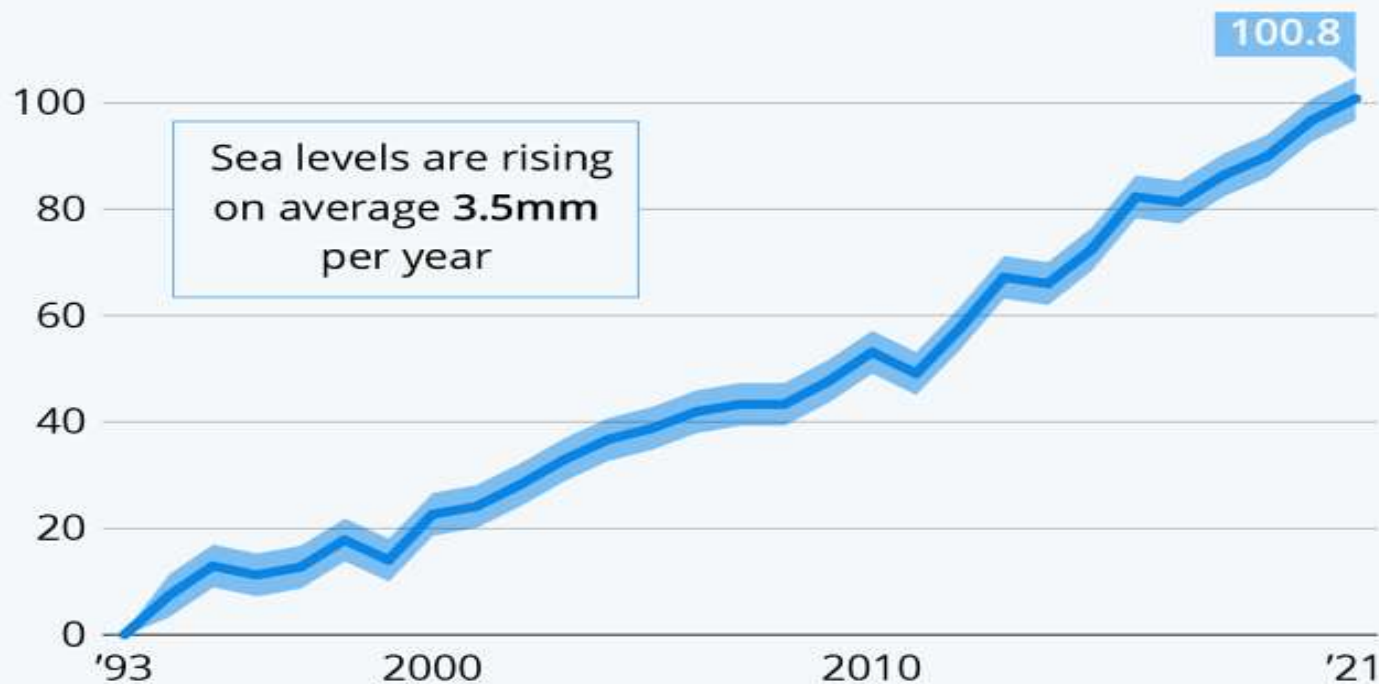




# Sea Levels Continue to Rise

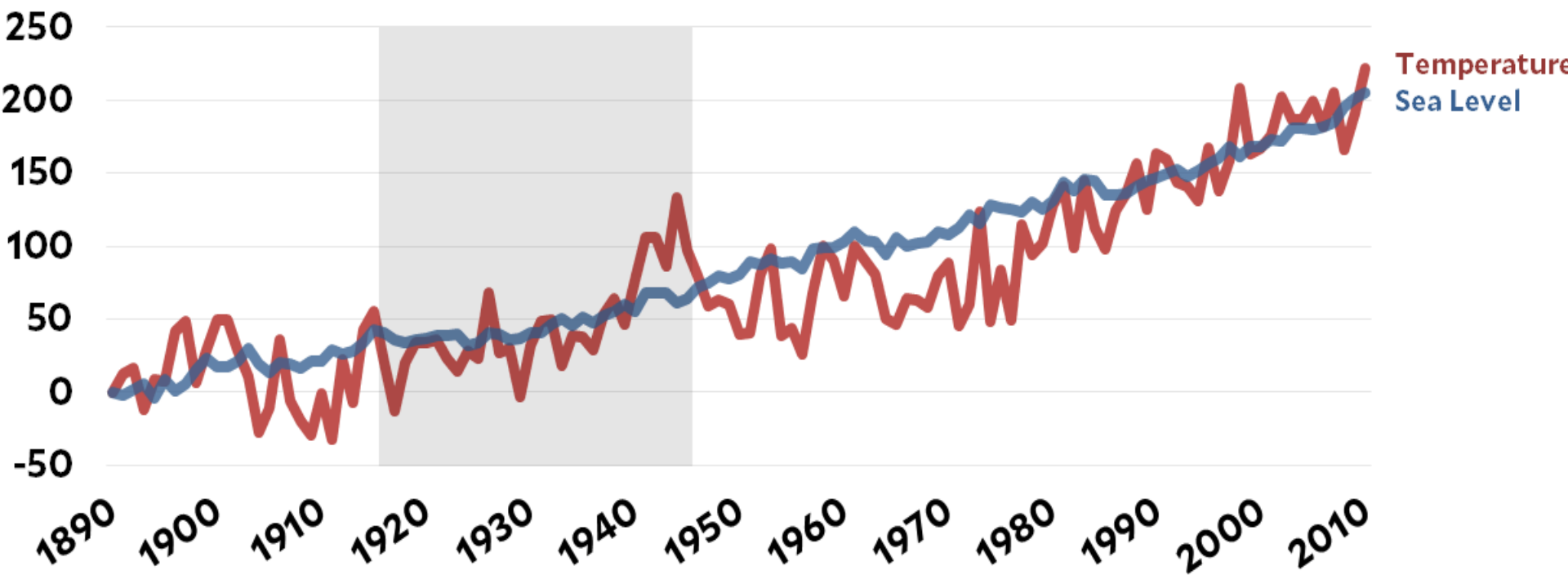
Sea level rise since 1993 (in millimeters)

■ Divergence



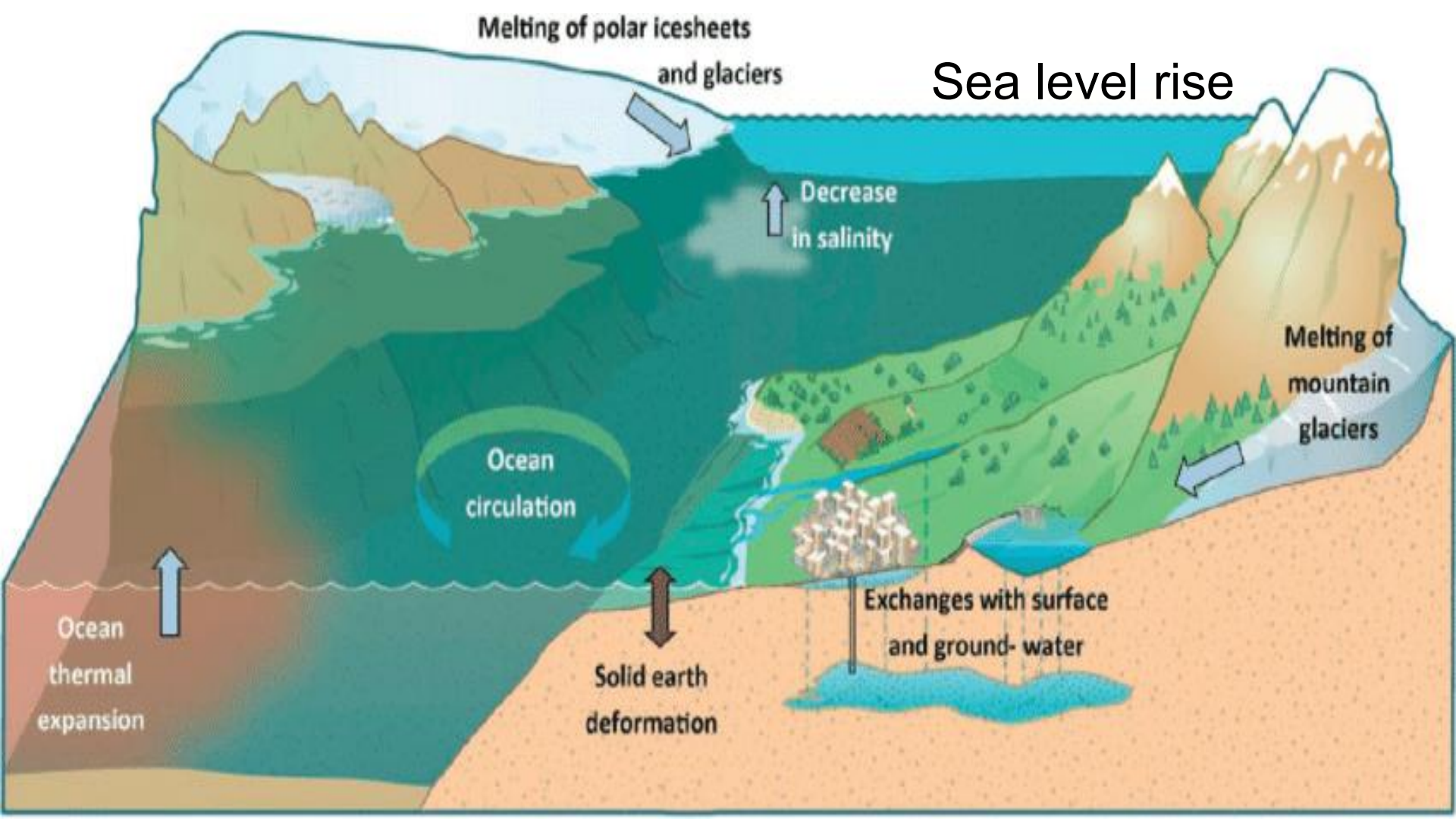
# Climate Change and Sea Level Rise

## 1890-2010



Source: Church and White (sea level), NOAA (temperature)

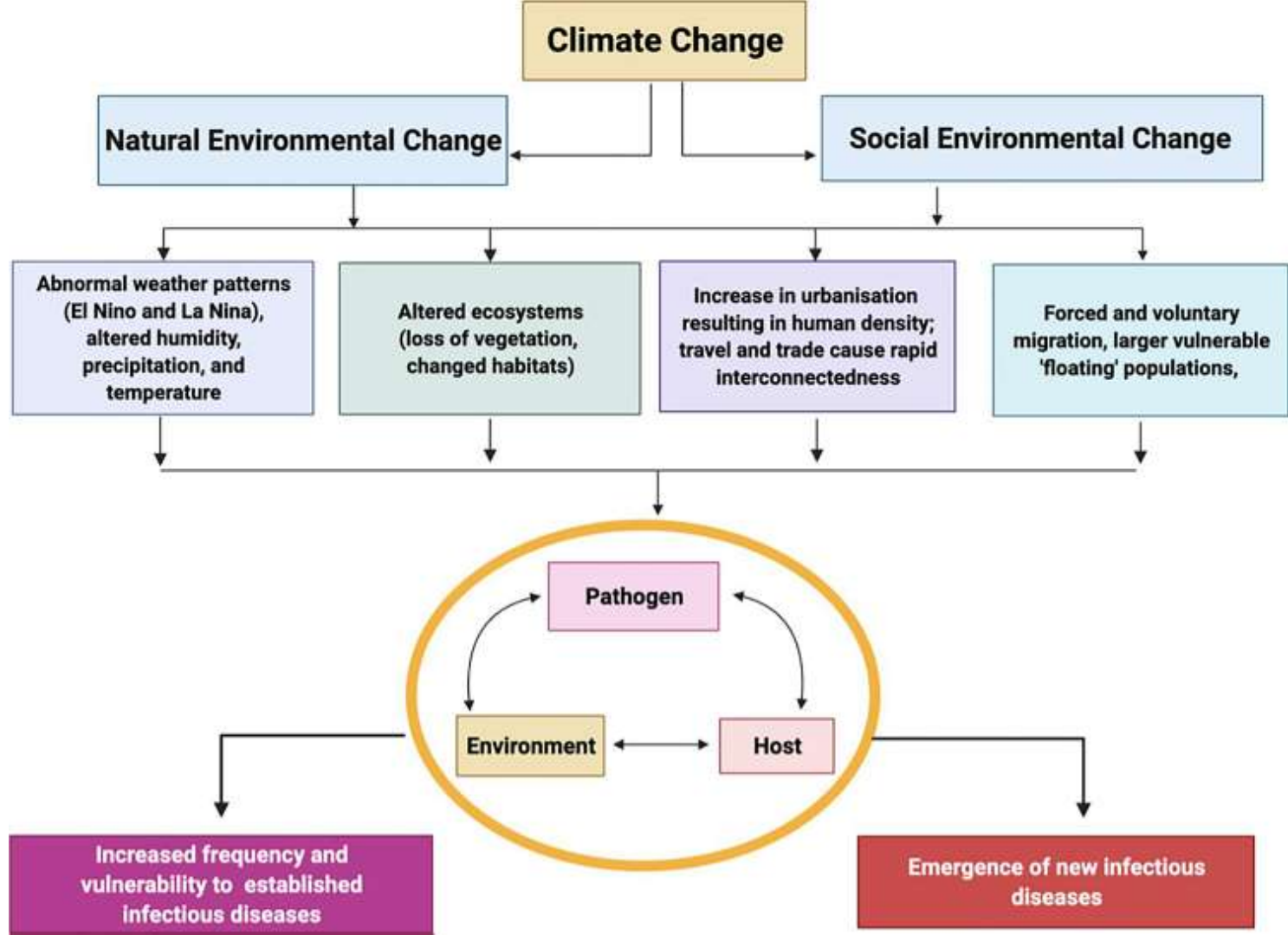
Mother Jones





Overstromingen







## FACT #3

7 FACTS SHOWING WHY OUR HEALTH DEPENDS ON THE ENVIRONMENT

ISGlobal

**31% of outbreaks  
of emerging  
infectious diseases  
are linked to  
deforestation**

Since 2000, we have cut down  
**2.3 MILLION KM<sup>2</sup>** of primary forest.

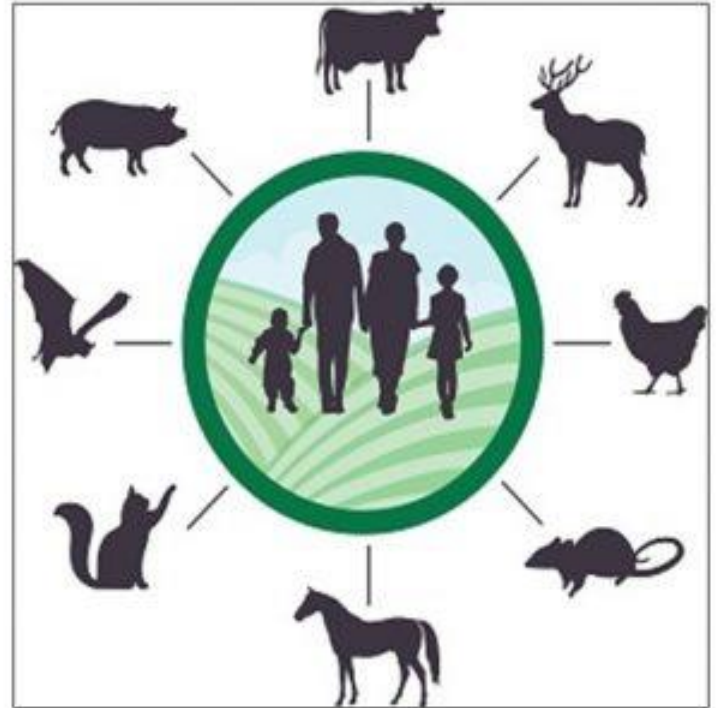
(Nearly equivalent to the area of Greenland)



Deforestation favours closer contact between humans and wild animals, creating a greater risk of zoonotic disease.

# What is a zoonotic Disease?

A **zoonotic disease** (or zoonoses -plural) is an infectious disease that is transmitted from animals to humans or from humans to animals.



Many types of animals spread zoonotic diseases.

# Climate Change and Zoonotic Diseases

A D A N G E R O U S   C Y C L E

## Expanding Wildlife Urban Interfaces (WUI)

Humans continue to use land in novel ways, expanding the WUI.



## Novel Species Interactions

Novel species interactions occur in homogenized habitats, increasing the likelihood of disease transmission.



## Homogenized Habitats

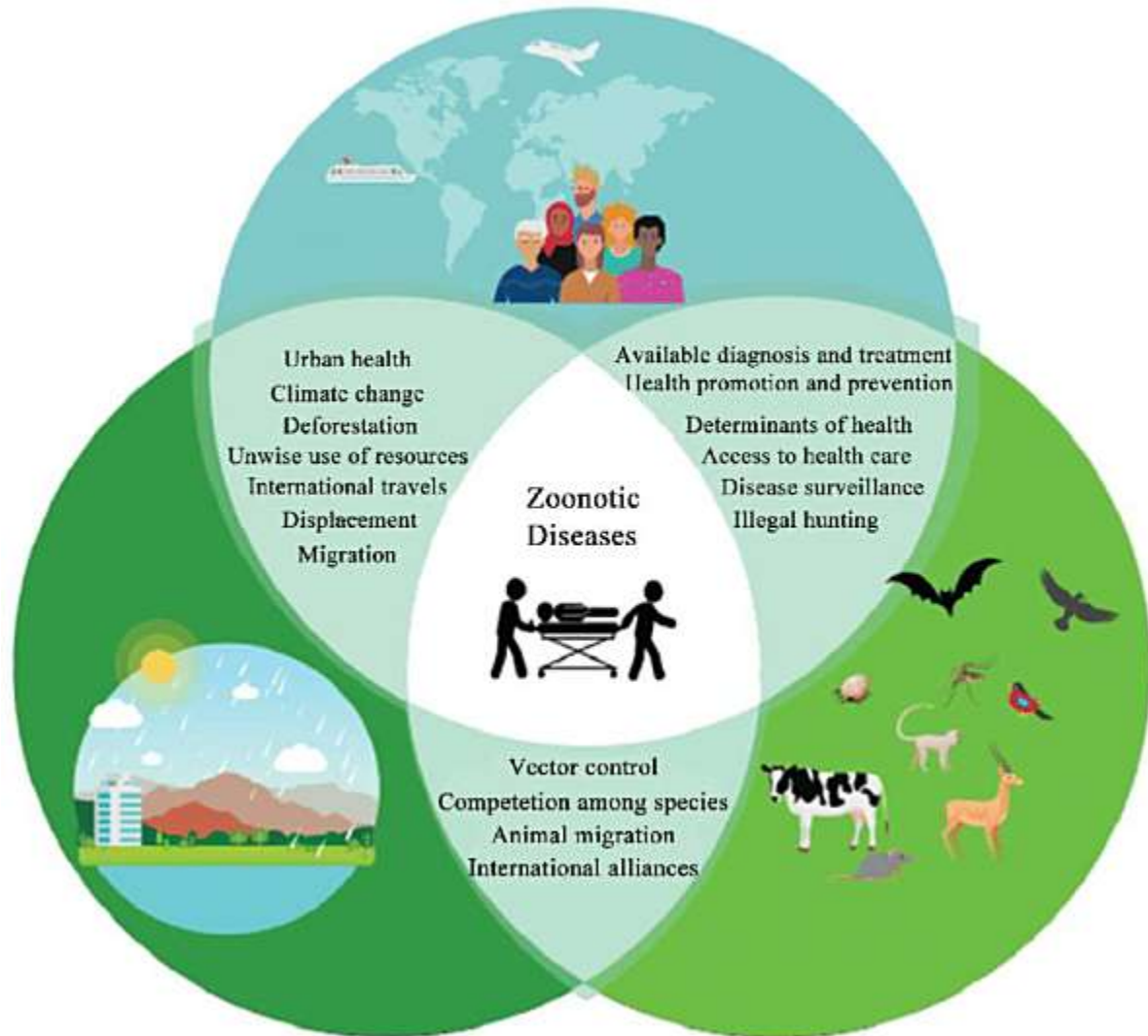
Climate change is causing temperatures to rise globally, creating habitats that are more homogeneous.



## Increased Biodiversity

Species can move more freely between homogenized habitats, increasing the level of biodiversity.







# Sea Level Rise & Population Impact



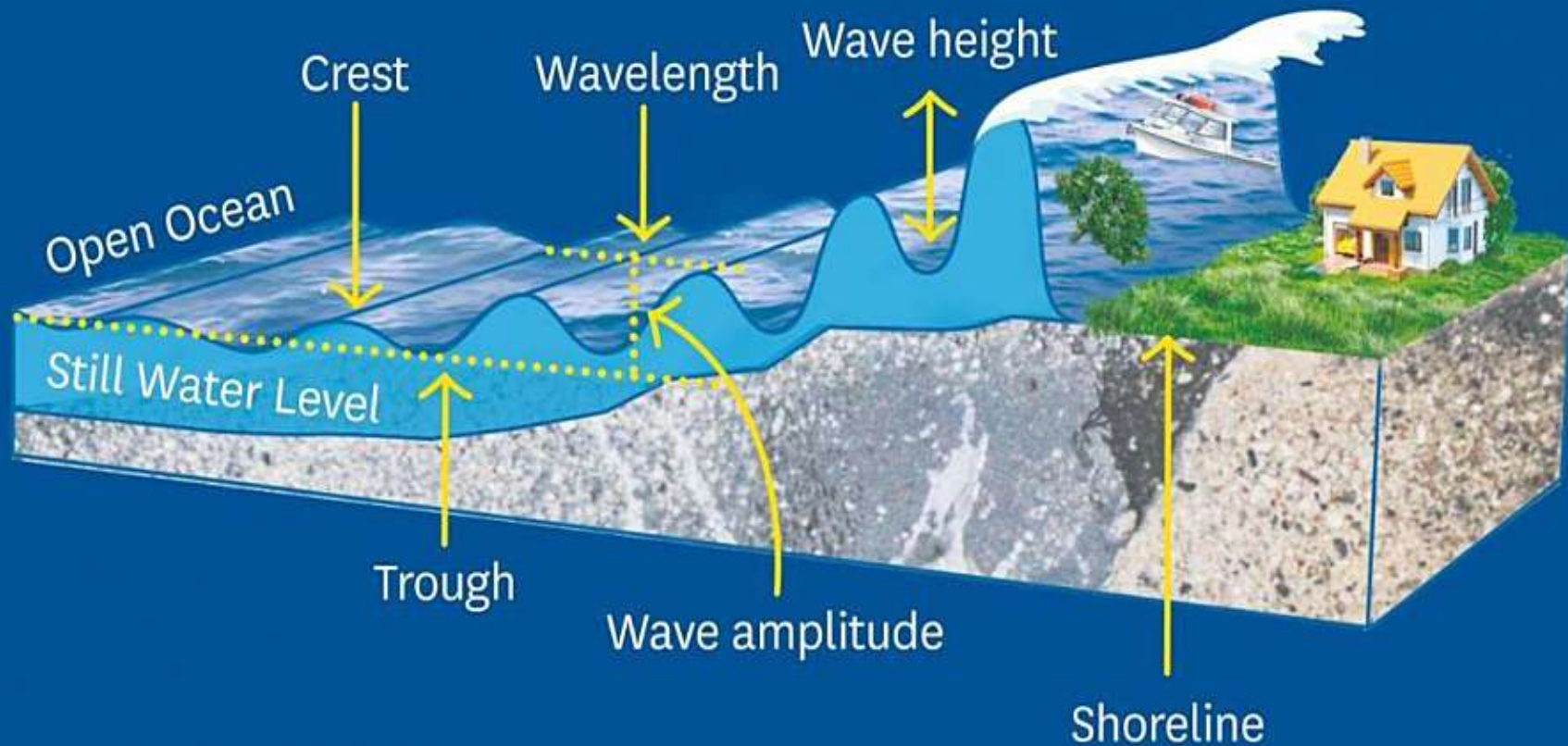
**Today's Population Living Below  
Projected High-Tide Line**



# Tsunamis



# HOW A TSUNAMI WORKS

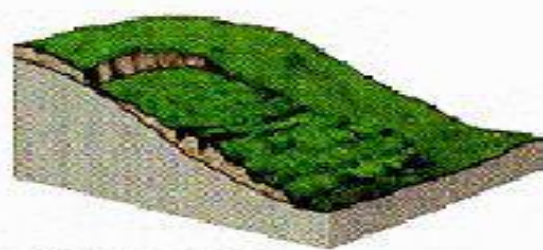




# Erosie



**kruipen of creep**



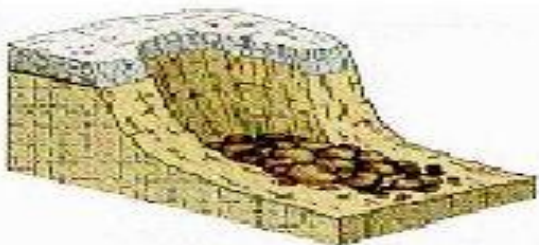
**afvloeien**



**afschuiven**



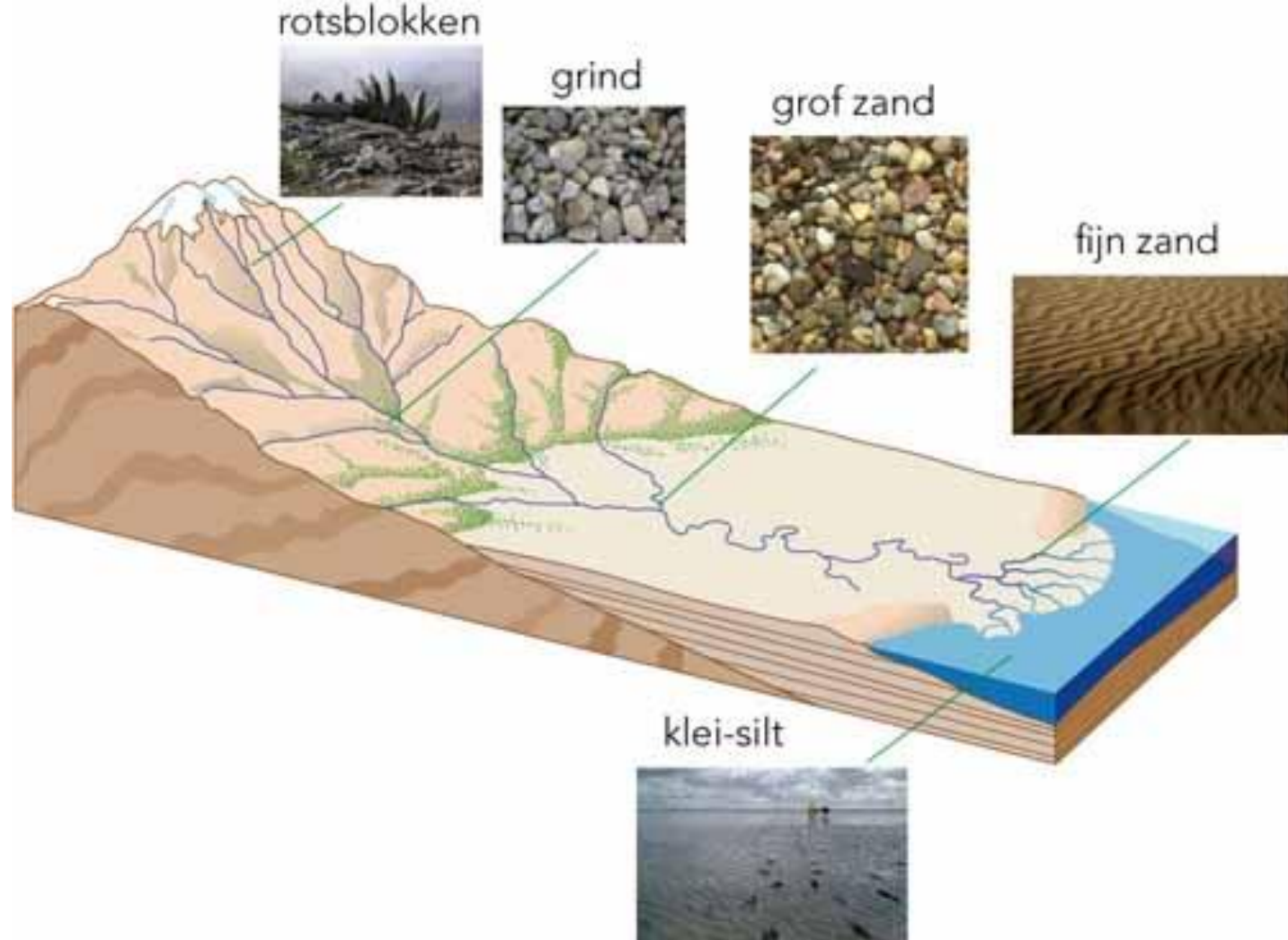
**puinlawine**



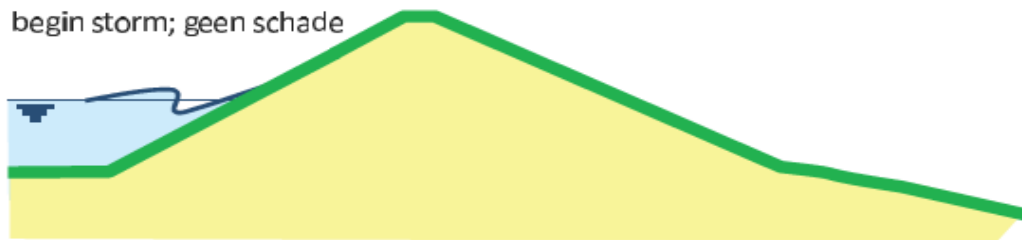
**afstorten  
van stenen**



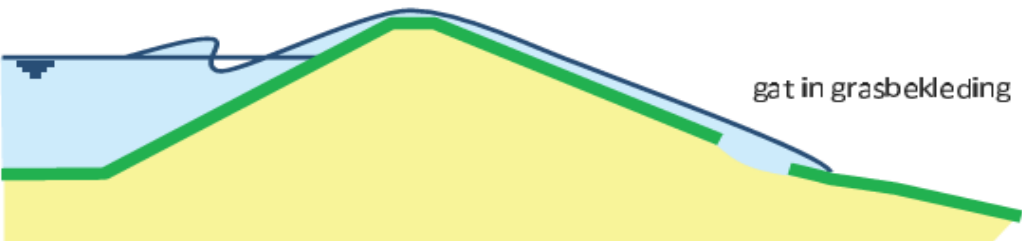
**modderstroom**



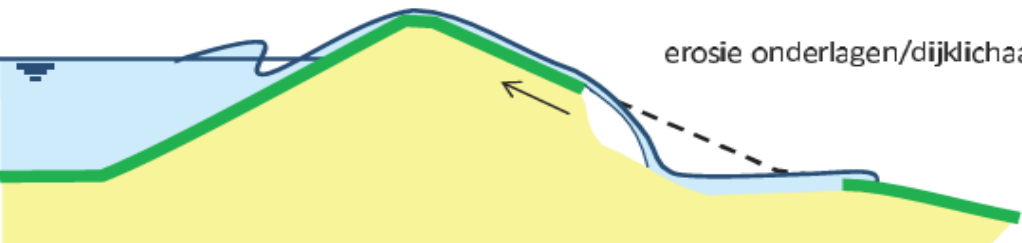
begin storm; geen schade



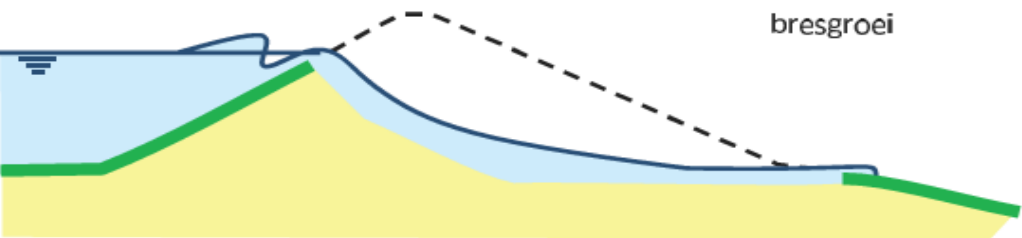
gat in grasbekleding



erosie onderlagen/dijklichaam



bresgroei





# Overstromingen



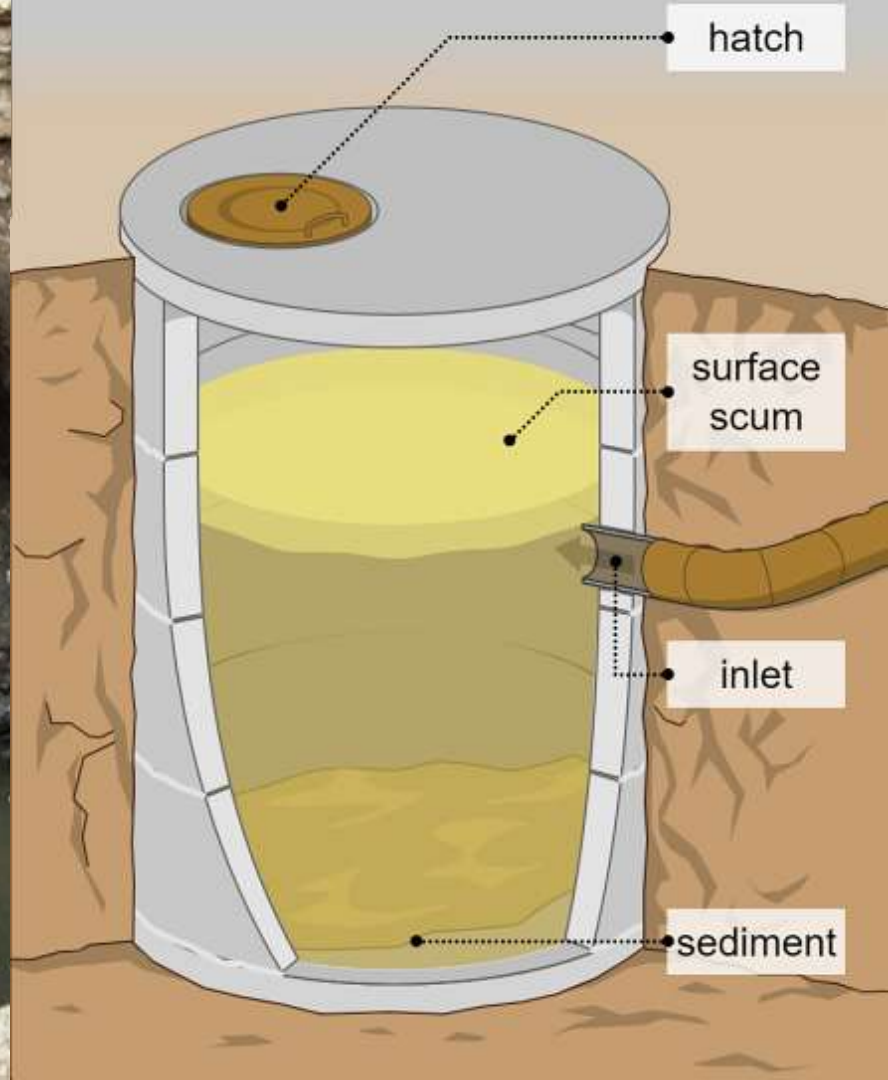




# Begraafplaatsen & Beerputten

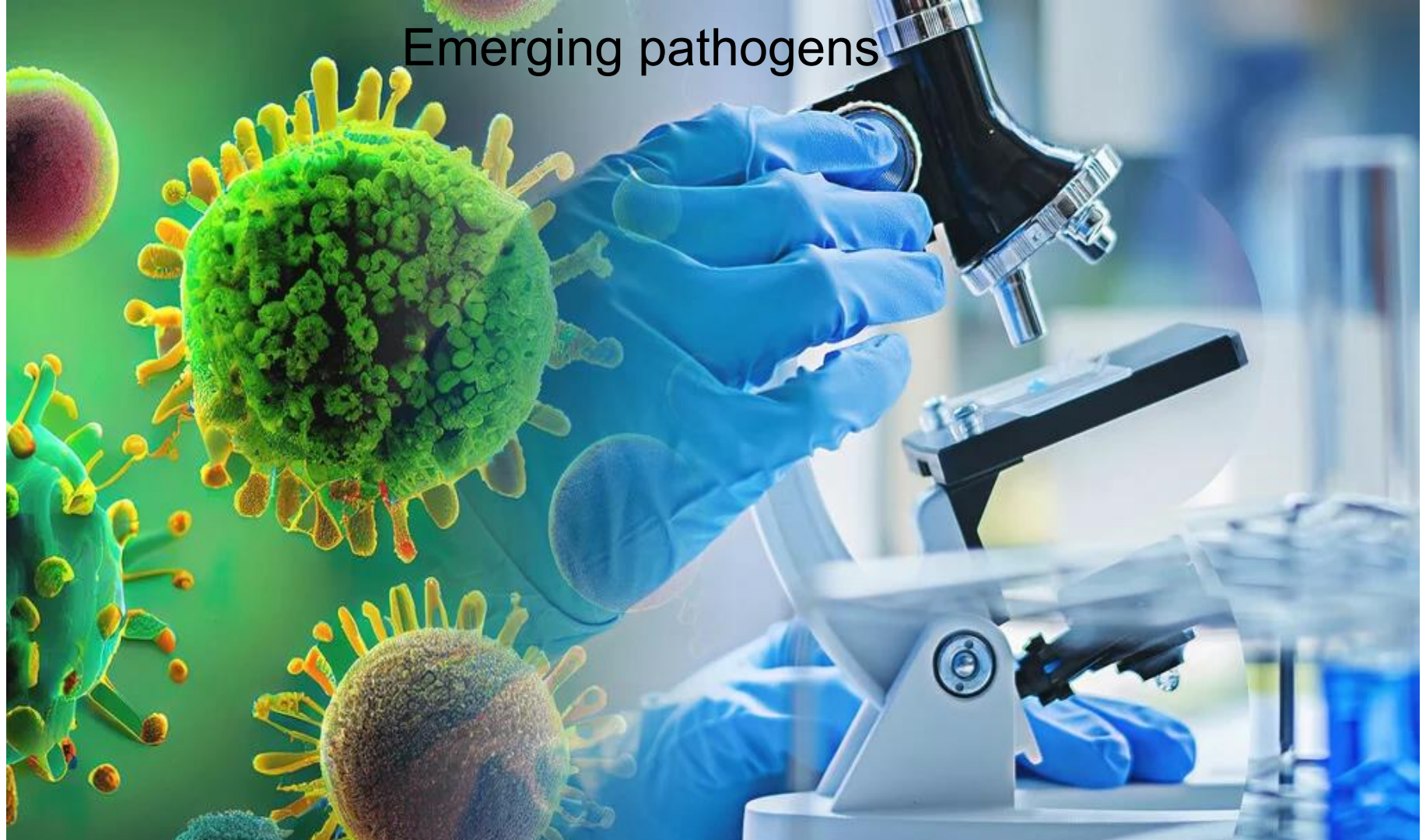


# Begraafplaatsen & Beerputten





# Emerging pathogens





**Table 1**Examples of recently emerging pathogens

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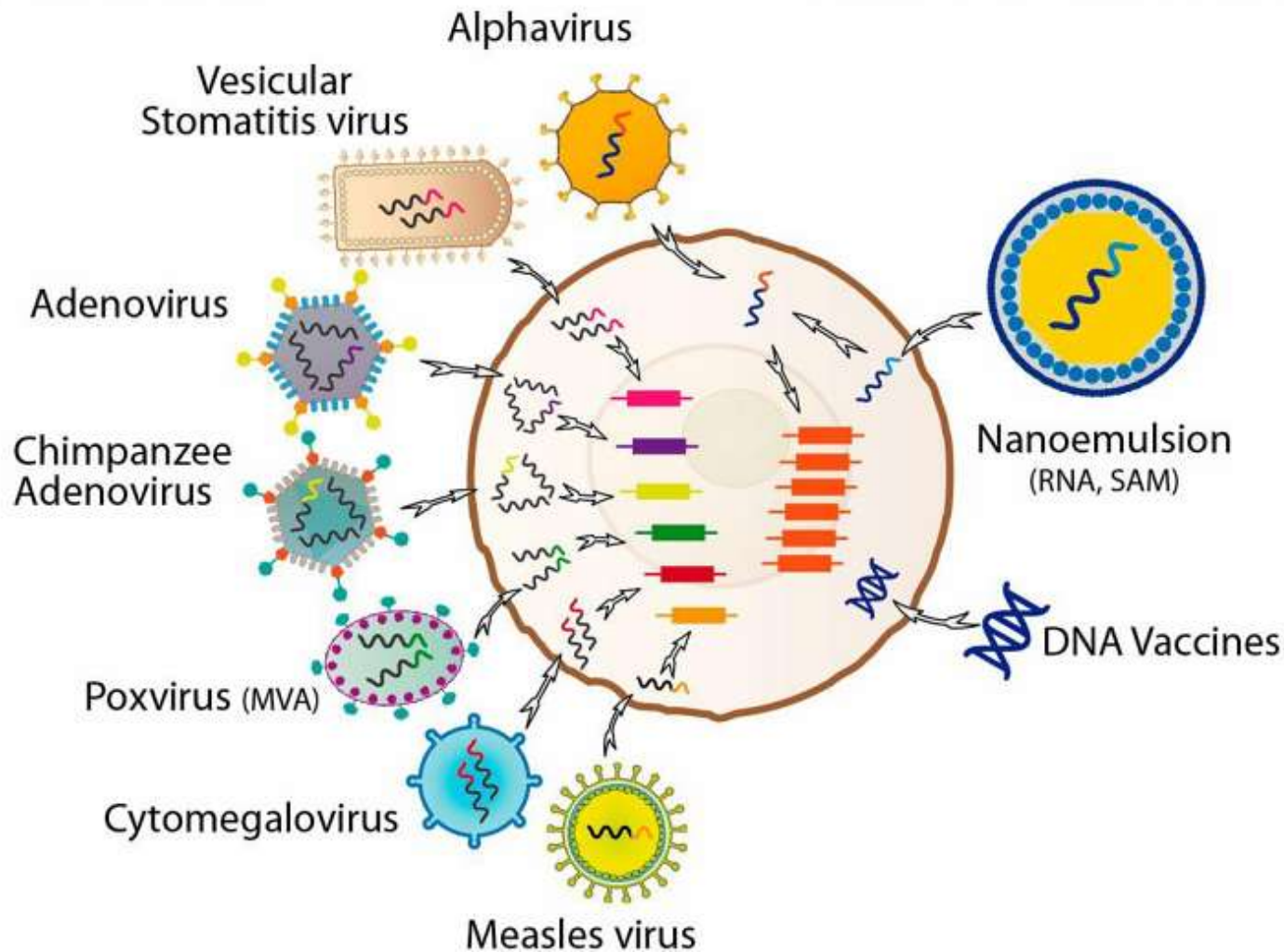
<b>Microbe</b>	<b>Disease</b>	<b>Year</b>
Rotavirus	Infantile gastroenteritis	1973
<i>Legionella pneumophila</i>	Legionnaires disease	1977
Ebola virus	Ebola hemorrhagic fever	1977
<i>Borrelia burgdorferi</i>	Lyme disease	1982
HIV	AIDS	1983
Hepatitis C virus	Hepatitis	1989
<i>Vibrio cholerae</i> O139	Cholera	1992
Sin Nombre virus	Hantavirus pulmonary syndrome	1993
Human herpesvirus 8	Kaposi sarcoma in AIDS patients	1995
Influenza virus A H5N1	Influenza	1997 <sup>A</sup>
SARS coronavirus	Severe acute respiratory syndrome	2002

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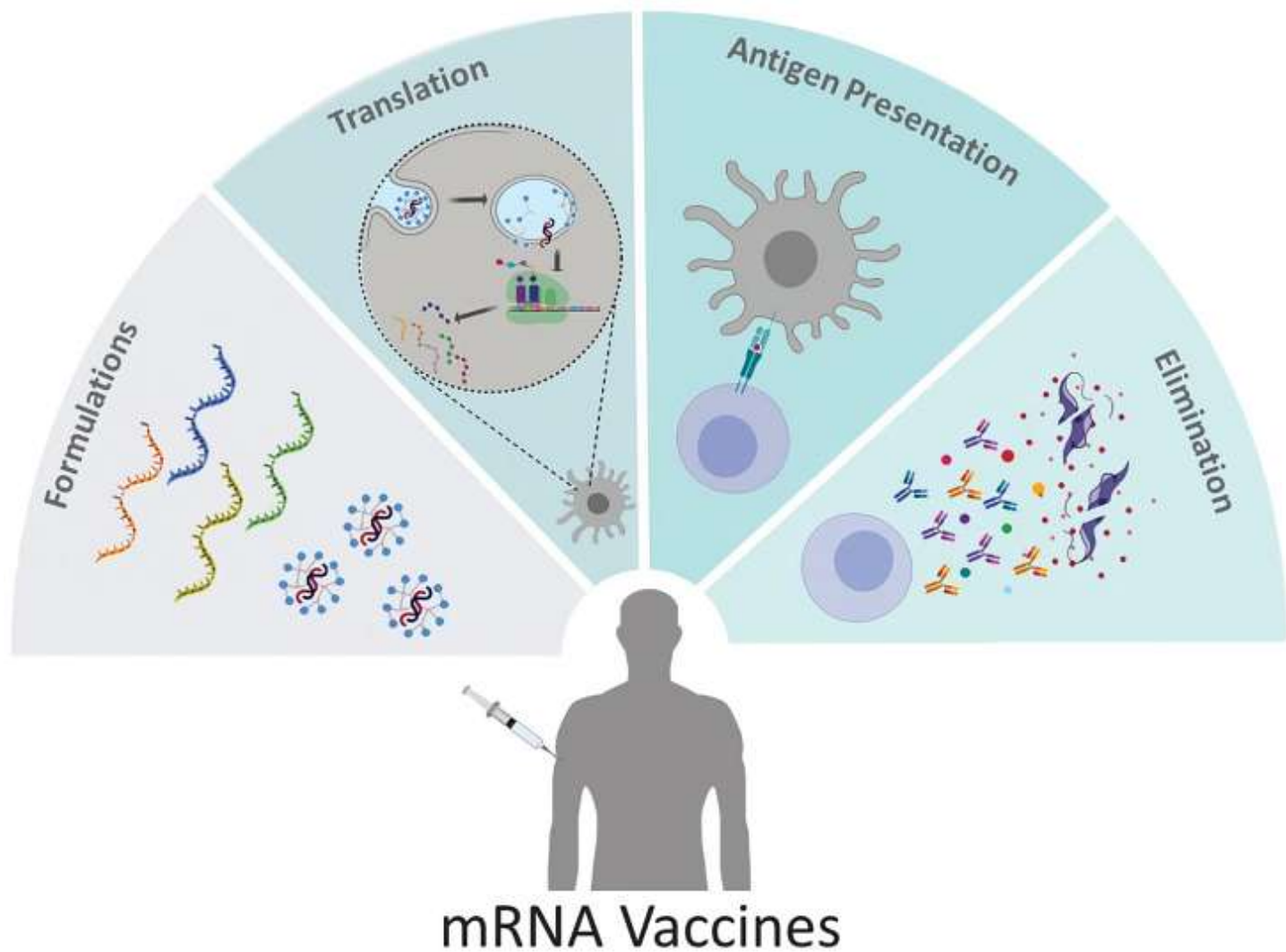
<sup>A</sup>First human cases; virus previously known to infect birds.

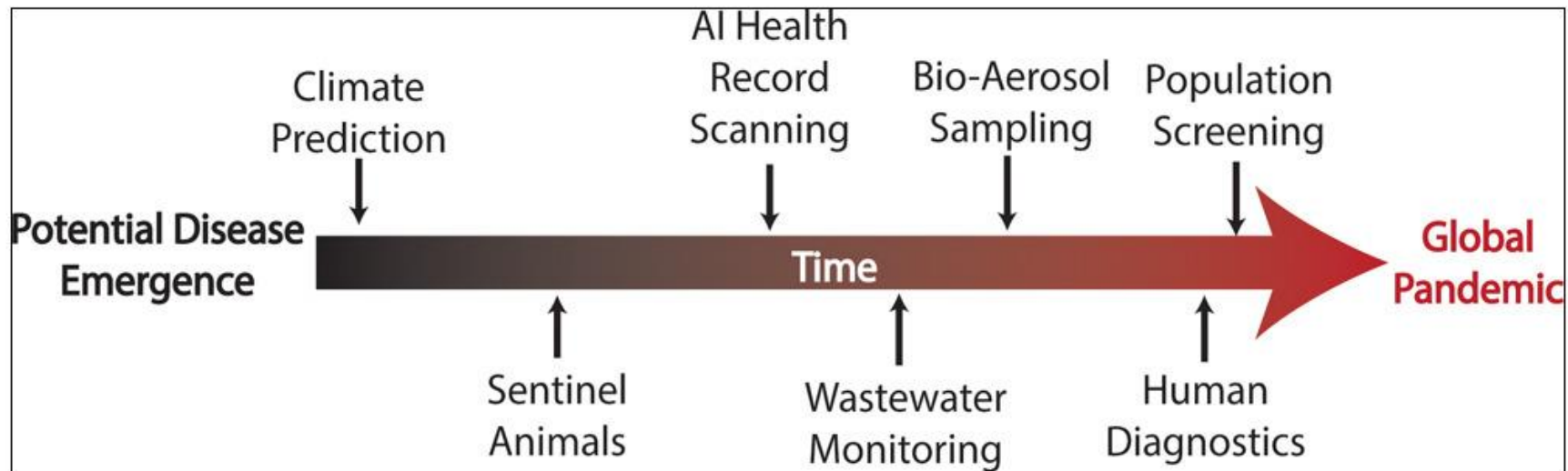
# VIRAL VECTORS

# FULLY SYNTHETIC VACCINES



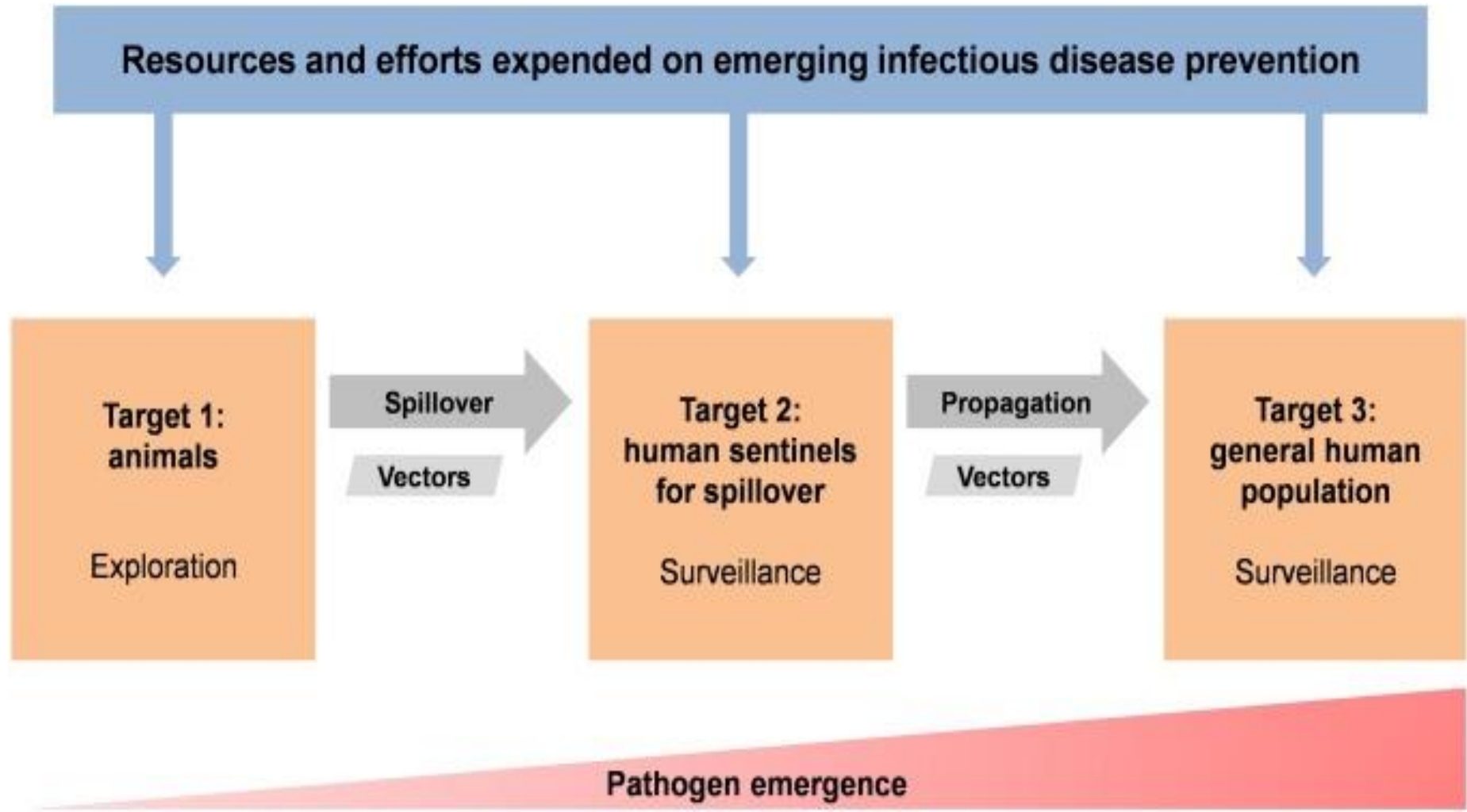
# Targets







# Prevention

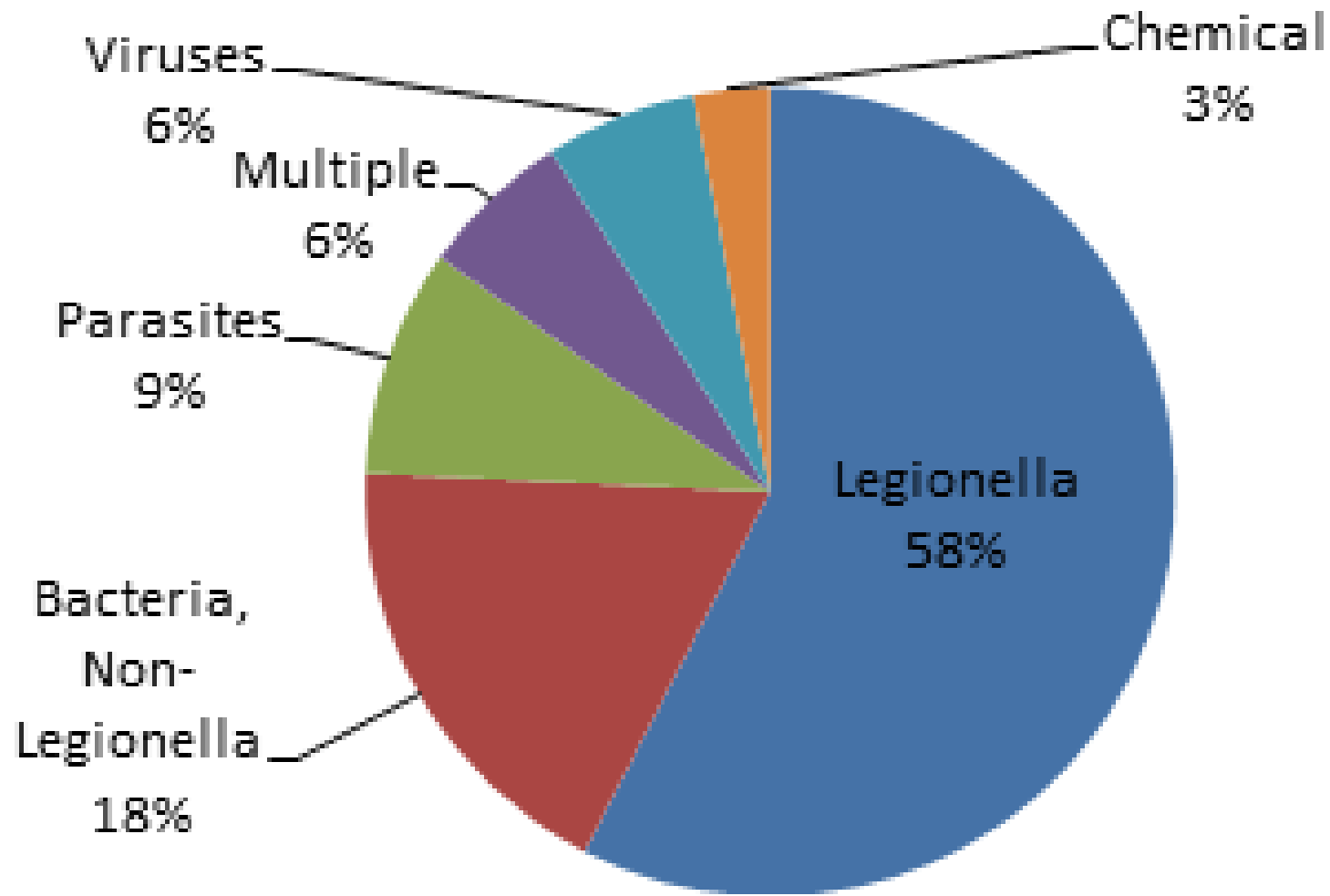


Category	Comments
<i>Water-borne diseases</i>	Caused by the ingestion of water contaminated by human or animal faeces or urine containing pathogenic bacteria or viruses; includes cholera, typhoid, amoebic and bacillary dysentery and other diarrhoeal diseases.
<i>Water-washed diseases</i>	Caused by poor personal hygiene; includes scabies, trachoma and flea-, lice-, and tick-borne diseases, which are also water-washed.
<i>Water-based diseases</i>	Caused by parasites found in intermediate organisms living in water; includes dracunculiasis, schistosomiasis and some other helminths.
<i>Water-related diseases</i>	Transmitted by insect vectors which breed in water; includes dengue, filariasis, malaria, onchocerciasis, trypanosomiasis and yellow fever.

# Categories of waterborne disease

- Diseases spread by contact with contaminated water
  - Bathing, wading
  - Contact with floodwaters
  - Pathogen lives naturally in the water
  - *Leptospira*
- Diseases spread by inhalation of contaminated water
  - Aerosols
  - *Legionella*

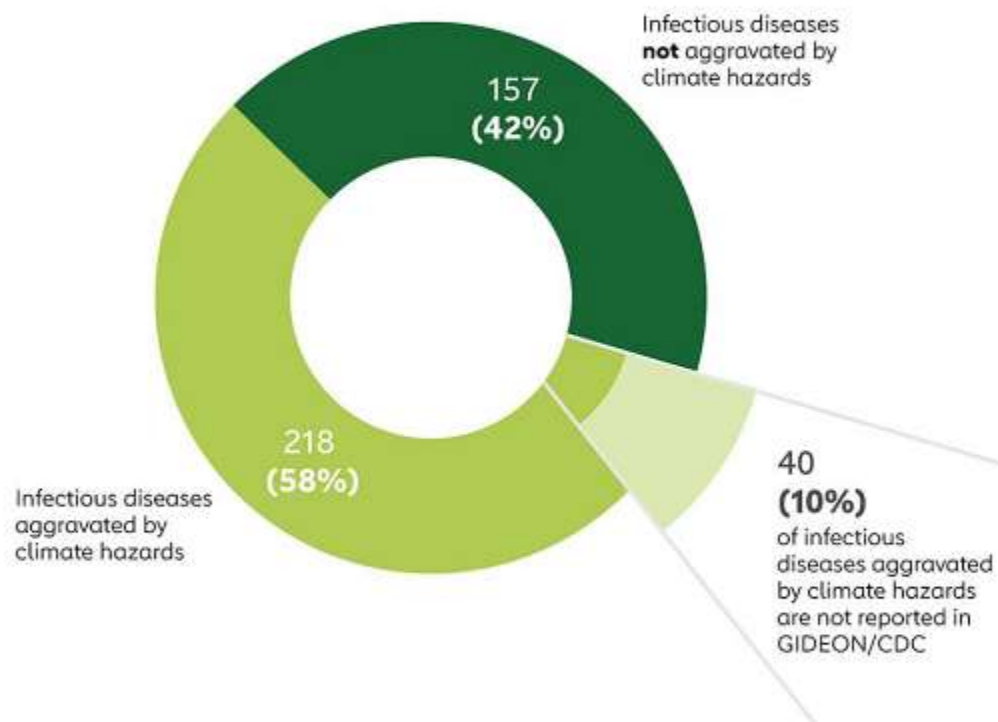
# Disease Outbreaks, 2009-2010





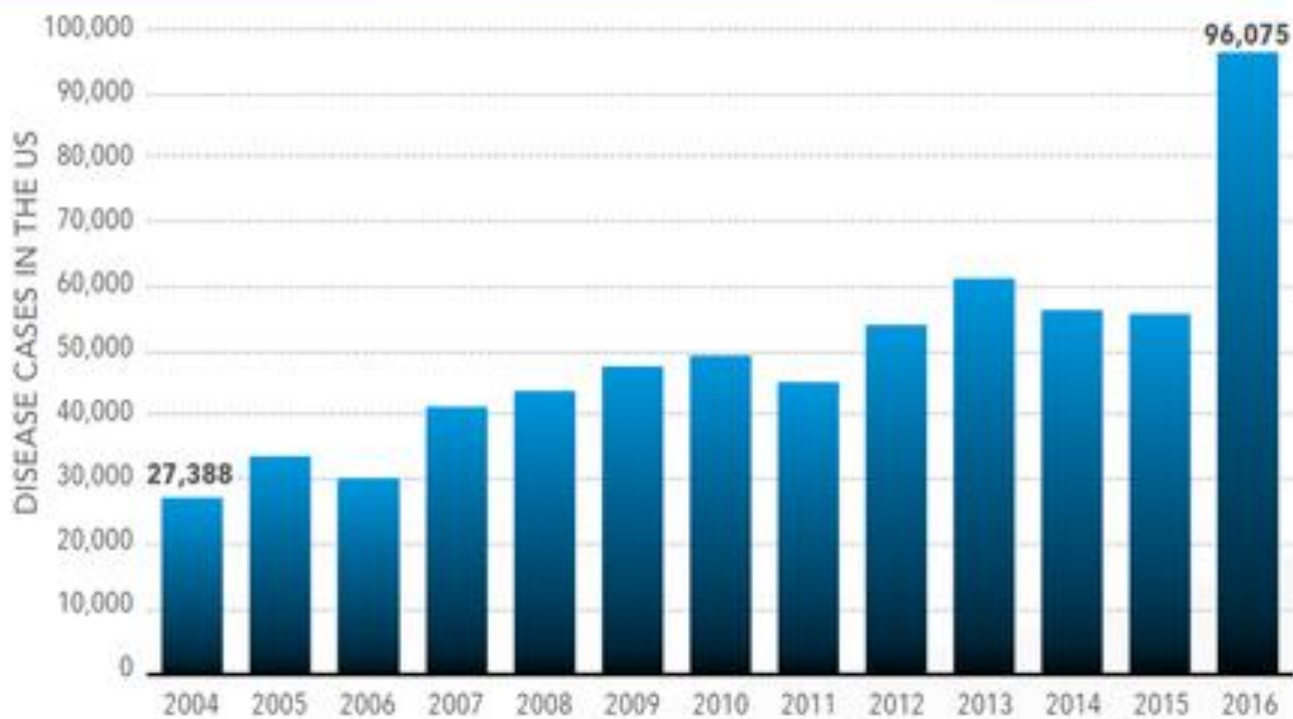
<b>Water-borne diseases</b>	<b>No.of cases in 2015</b>
Cholera	-
Typoid	973
Shigellogis	805
Amoebisis	450
Food poisoning	139
Diarrhea	2908
Other infectious diseases	2405
Leptospirosis	89
Hepatitis A	432
Helminthiasis	731

## Infectious diseases affected by climatic hazards




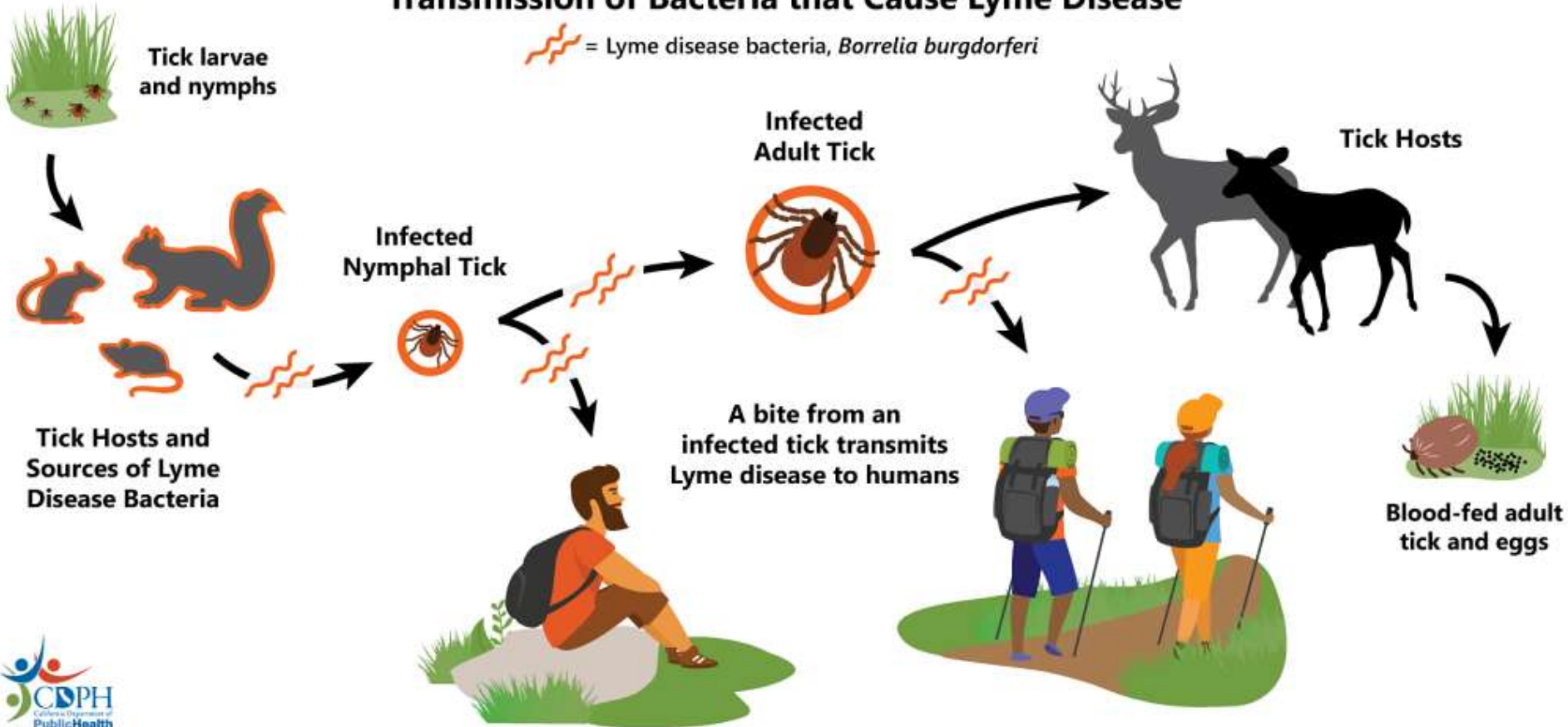
Adapted from Figure 4. Mora, C., McKenzie, T., Gaw, I.M. et al. Over half of known human pathogenic diseases can be aggravated by climate change. *Nat. Clim. Chang.* (2022). <https://doi.org/10.1038/s41558-022-01426-1>

**Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.**



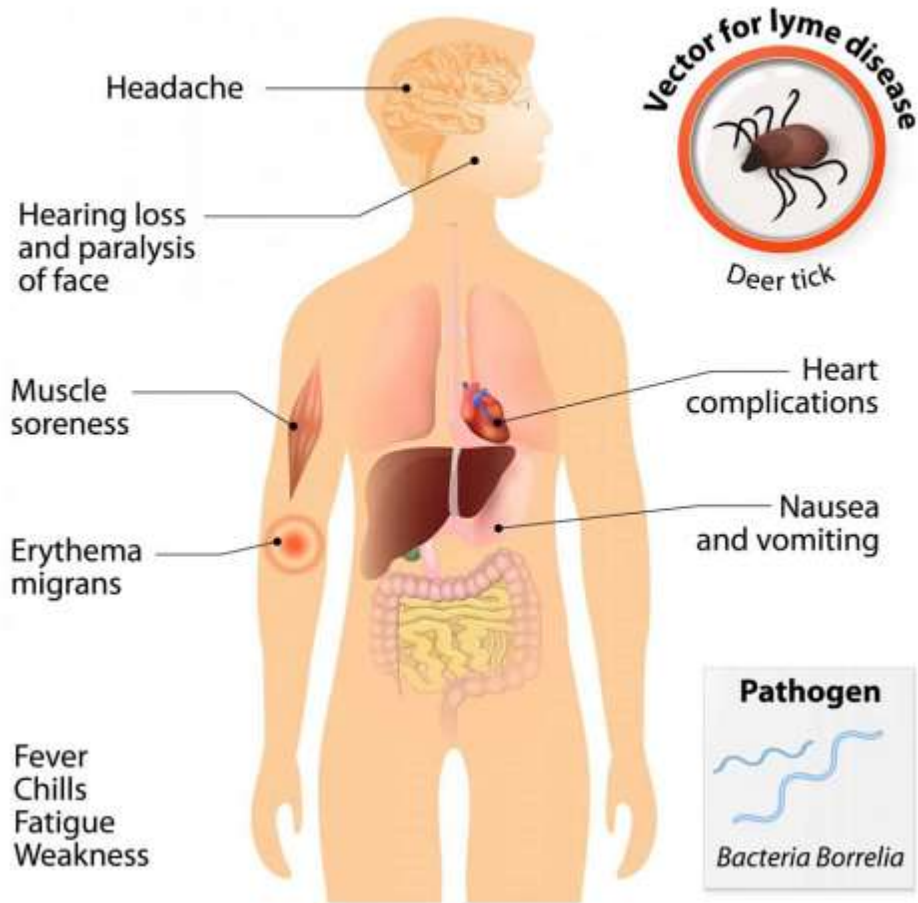
# Transmission of Bacteria that Cause Lyme Disease

 = Lyme disease bacteria, *Borrelia burgdorferi*





# LYME DISEASE



# Malaria

Malaria is caused by a protozoan parasite named Plasmodium, and it is spread by the Anopheles (female) mosquito that causes acute life-threatening disease.

It is a major worldwide health concern where immunocompromised persons, children, and pregnant women have the highest morbidity and mortality rates.

**Types, Causes, Symptoms,  
Risk, Complications, Diagnosis  
and Prevention**



1 A bite from an infected mosquito transmits malaria.

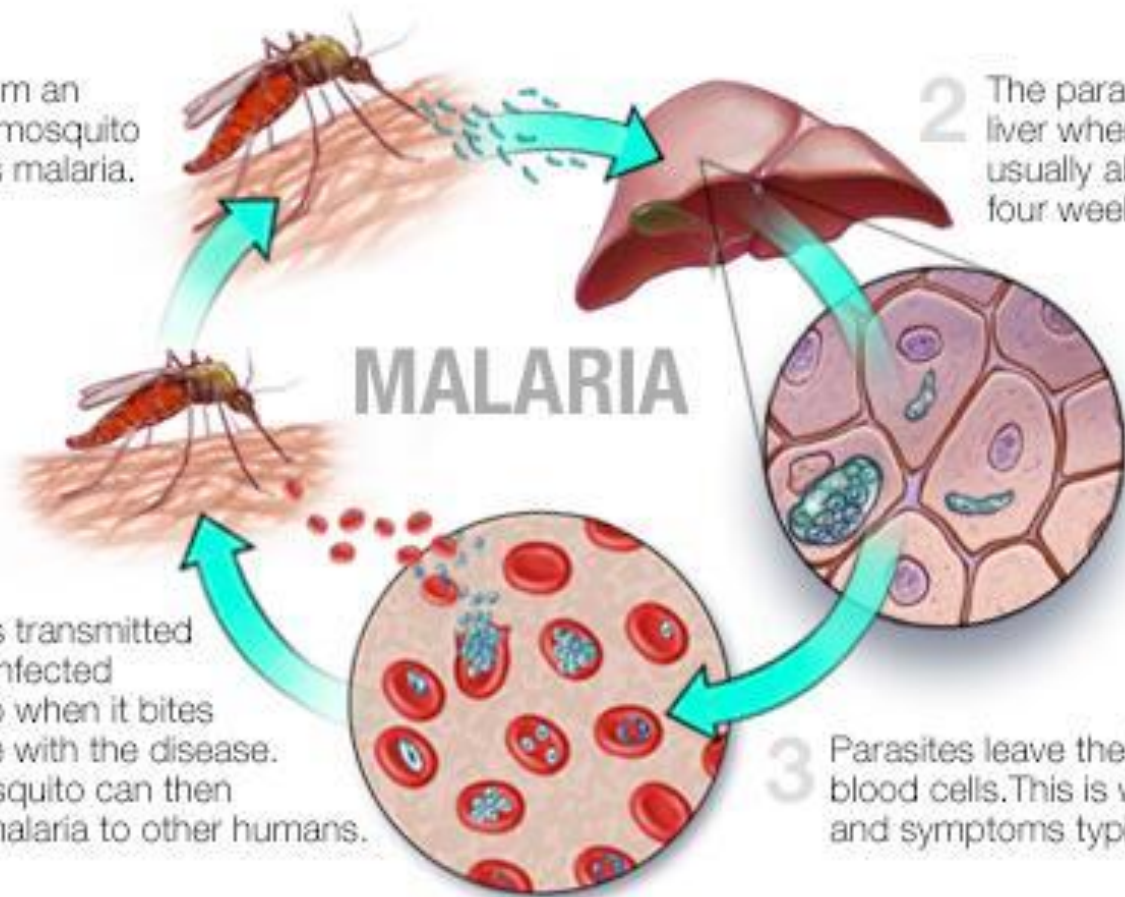
2 The parasites travel to your liver where they lie dormant, usually about ten days to four weeks.

## MALARIA

4 Malaria is transmitted to an uninfected mosquito when it bites someone with the disease. That mosquito can then spread malaria to other humans.

3 Parasites leave the liver and infect red blood cells. This is when malaria signs and symptoms typically develop.

© MAYO CLINIC



# Symptoms of **Malaria**

## **Central**

- Headache

## **Systemic**

- Fever

## **Muscular**

- Fatigue
- Pain

## **Back**

- Pain

## **Skin**

- Chills
- Sweating

## **Respiratory**

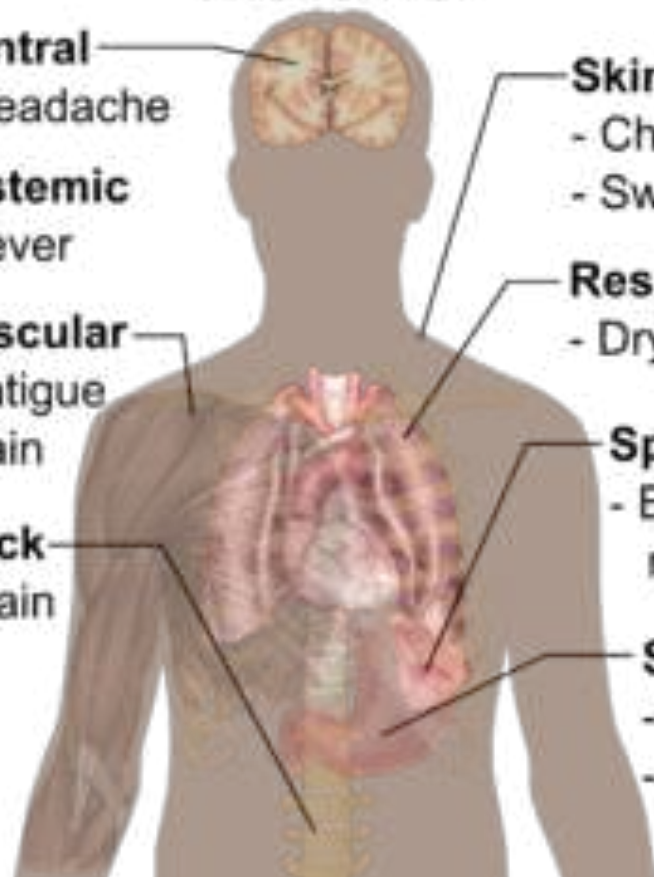
- Dry cough

## **Spleen**

- Enlarge-  
ment

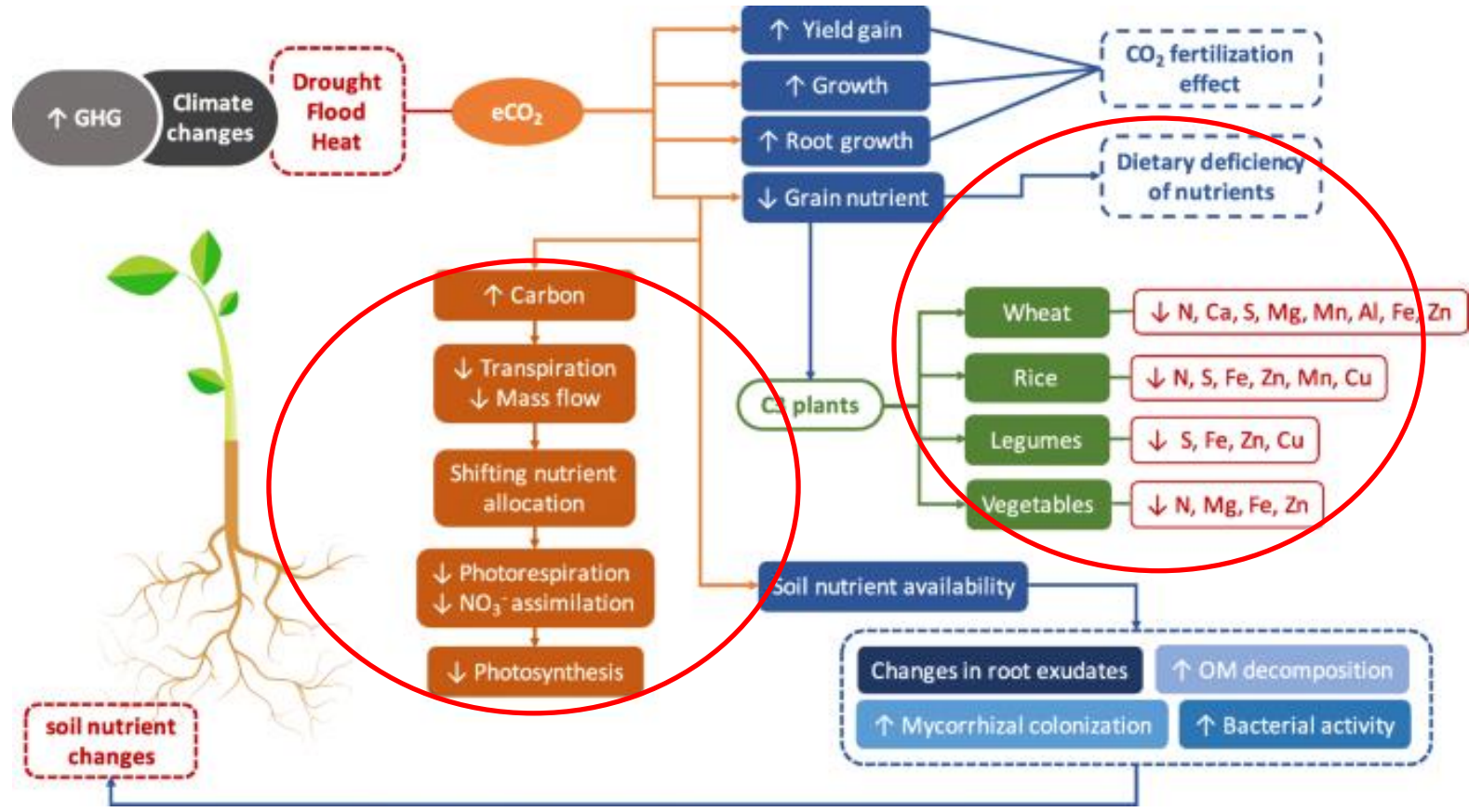
## **Stomach**

- Nausea
- Vomiting

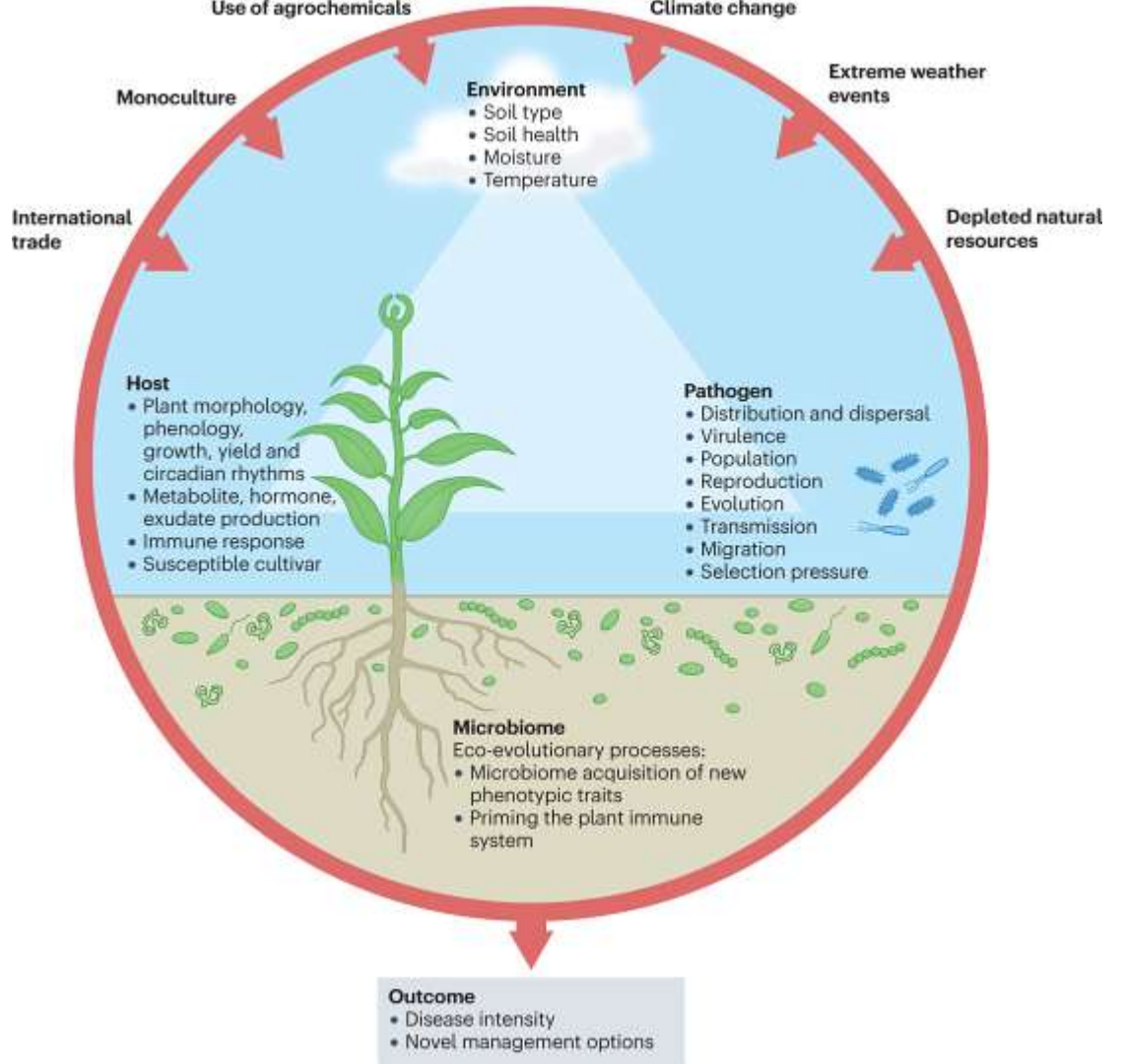


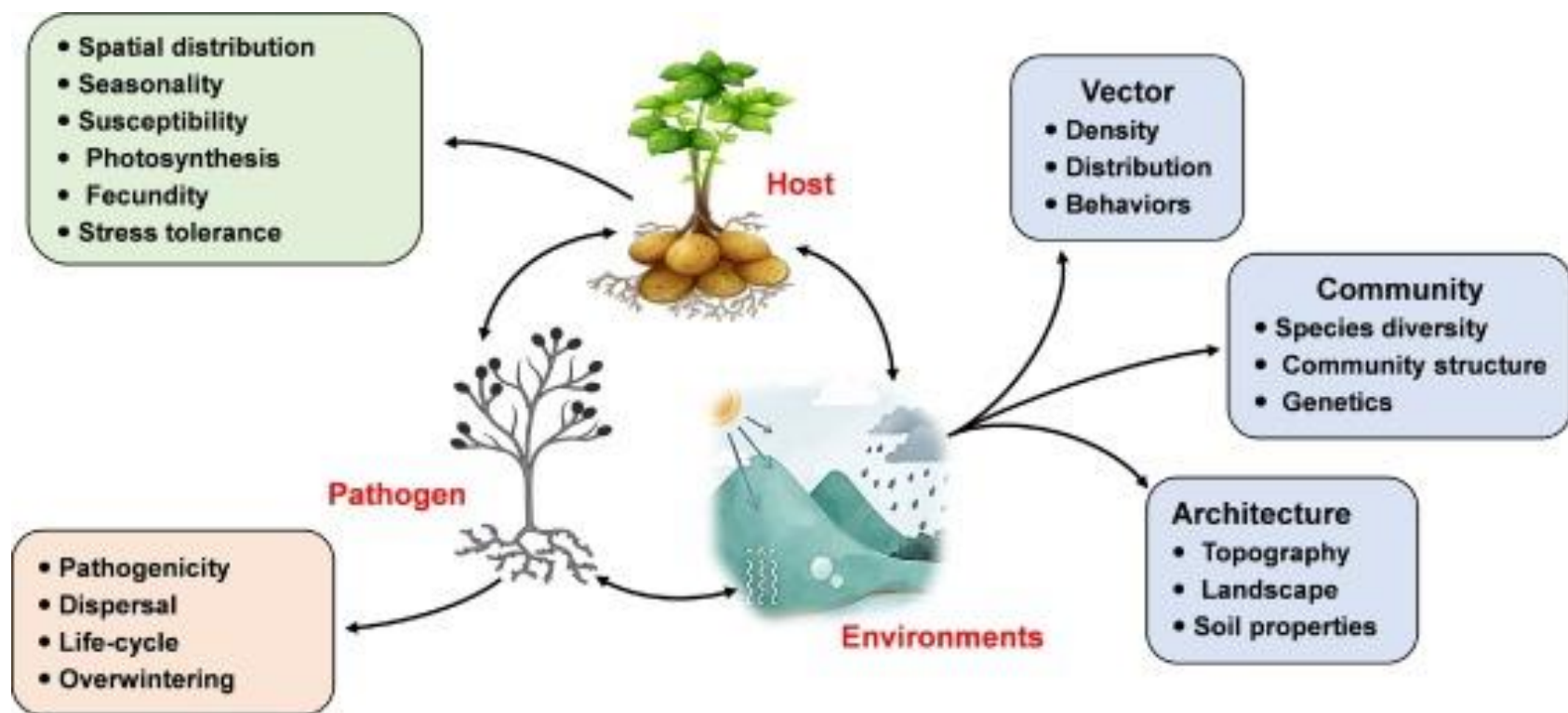


# Quality Crop plants and Climate Change



# Plant Pathogens and Climate Change







The image shows a river with greenish water, surrounded by dense green trees and foliage. The water appears stagnant and is covered with a layer of green algae or water plants. The text is overlaid on the image, with red arrows pointing upwards from the bottom text to the top text.

**Rivier is biologisch dood!**

**Zuurstofconcentratie daalt**

**Waterplanten sterven af**

**Water kleurt groen, waterplanten krijgen  
onvoldoende licht**

**Enorme ontwikkeling waterplanten en algen**



# Dode rivieren





Dode rivieren





Dode rivieren



# Oil & Gas





# Oil & Gas





# Cyanide

## How Does Cyanide Kill?



### Immediate Symptoms

Headache  
Nausea/vomiting  
Dizziness  
Rapid heart rate

### Symptoms of Longer Exposure

Unconsciousness  
Convulsions  
Respiratory failure  
Coma  
Death

### Treatment

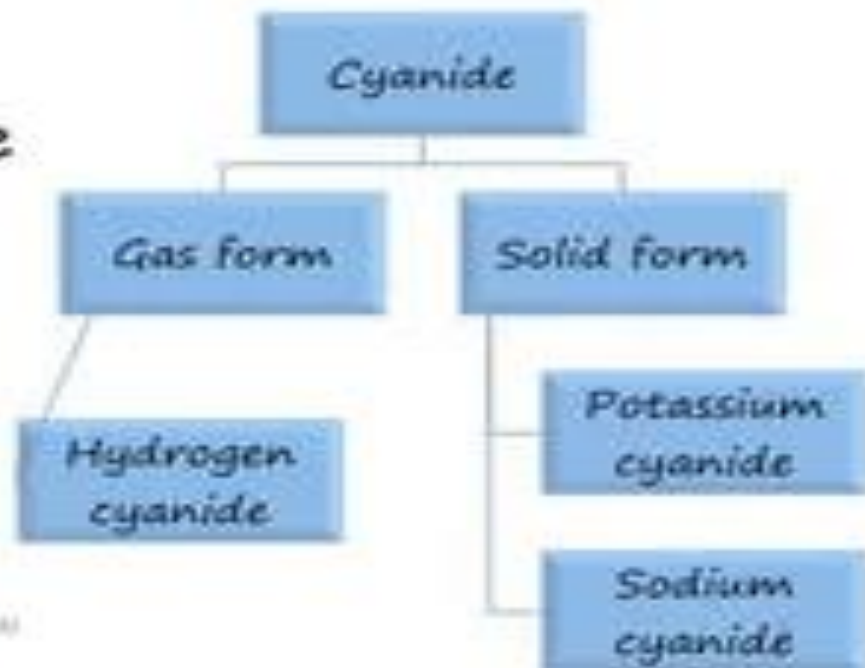
Get to fresh air  
Rapidly wash body with soap and water

Seek medical care  
Remove clothing



# What is cyanide?

- Highly lethal systemic poison causing rapid death
- Derivatives of cyanide





# Cyanide poisoning

- Cyanide is extremely potent, i.e. **lethal dose of KCN for an adult is 200 mg**
- Toxicity depends on form, duration and route of exposure
- Acute toxicity can occur via **inhalation, ingestion, dermal and parenteral**

# Oil Wars

VS

54%

Sovjet-Unie/  
Rusland

15%

China

9%

China

28%

India

22%

Korea

18%

IRAN

Exploitatie  
olievelden



National Iranian Oil Company

National Iranian  
Oil Company  
100% Staat



OLIEVELDEN



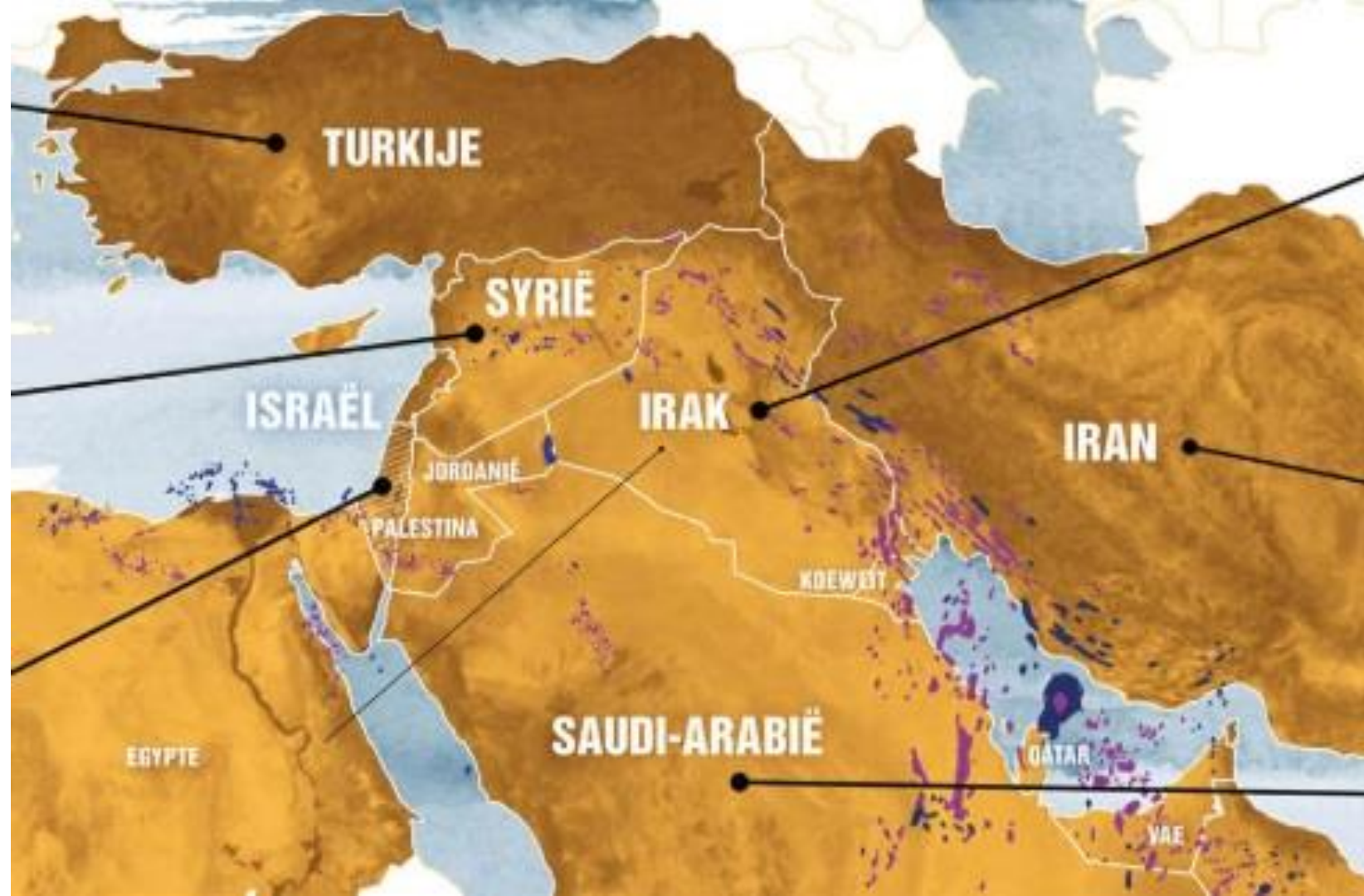
GASVELDEN



IMPORT  
WAPENS  
(1950-2017)



EXPORT  
OLIE  
(2017)









# Water Wars

