


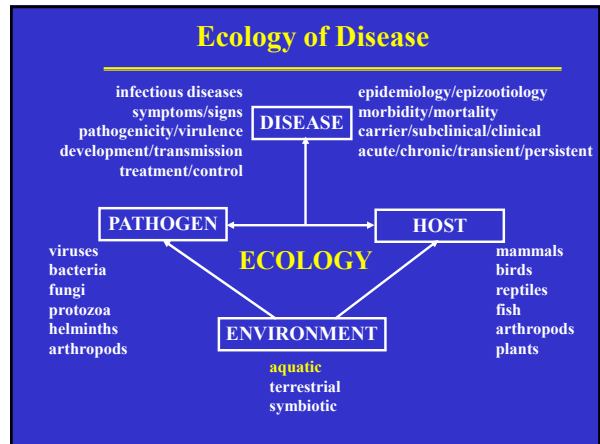
Ecology of Disease

Theme: **WATER**



Prof Peter O'Donoghue

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WATER

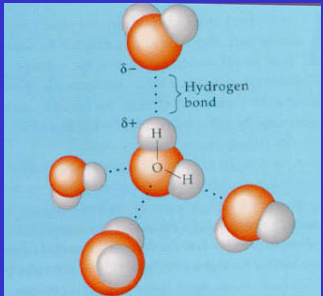
According to the Oxford dictionary:

- wa'ter (waw-), n. 1. colourless transparent tasteless scentless compound of oxygen & hydrogen in liquid state convertible by heat into steam & by cold into ice, kinds of liquid consisting chiefly of this seen in sea, lake, stream, spring, rain, tears, sweat, saliva, urine, serum, etc.

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WATER

H₂O molecule polar charge contributes to:

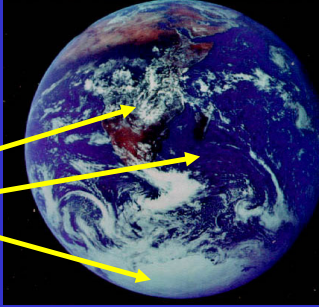


- cohesion (binding)
- adhesion (wetting)

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WATER

exists in three physical states



- gas (vapour)
- liquid (fluid)
- solid (ice)*

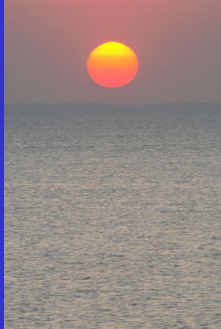
*floats!

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WATER

thermal bank
(acts to stabilize global temperature)

high specific heat
due to kinetic energy



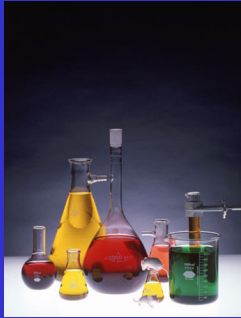
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WATER

ionic:

acidic H^+
 alkaline OH^-

$pH = -\log[H^+]$




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WATER

solvent dissolves:

- salts
- sugars
- proteins


Fluid of life!
 cells composed of 70-95% water



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WATER

- ~ 97% oceans and seas
- ~ 2% polar ice caps and glaciers
- ~ 1% soil moisture and ground water
- ~ 0.1% vapour in atmosphere
- ~ 0.01% freshwater lakes and rivers



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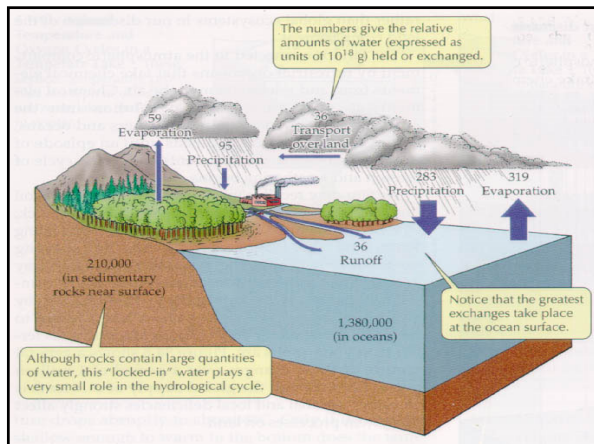
HYDROLOGIC CYCLE

Freshwater replenished by endless cycle of:

- evaporation (of surface water)
- atmospheric transport (by prevailing winds)
- condensation (cloud formation)
- precipitation (rainfall)
- ground transport (surface water, aquifers)

Self-cleansing system (pathogens removed)
 Easily polluted/contaminated (pathogens added)

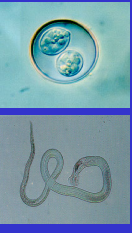
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WATER BODIES

- conduit for pathogens
 - passive (non-motile cysts)
 - active (motile host-seekers)
- sustain hosts
 - definitive (sexual development)
 - intermediate (asexual development)
 - paratenic (effectively no development)
 - vectors (variable development)



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PATHOGENS

Ever-increasing range of:

- viruses (hepatitis, polio)
- bacteria (typhoid fever, cholera)
- protozoa (*Giardia*, *Cryptosporidium*)
- nematodes (*Ascaris*, *Toxocara*)
- cestodes (*Taenia*, *Echinococcus*)
- trematodes (*Schistosoma*, *Fasciola*)

Enhanced detection through molecular biological/technological innovation

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EPIDEMIOLOGY

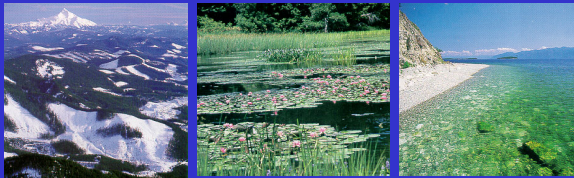
Transmission via:

- drinking water (consumption)
- food preparation (washing, cooking)
- immersion (bathing, work/leisure)



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PATHOGEN INFLUX



highlands riverine wetlands coastal

adopt “whole-of-catchment” approach

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CATCHMENT AUDIT

- | | |
|-------------|--|
| composition | - hydrology
- landscape |
| attributes | - water quality
- flora/fauna
- cultural value |
| uses | - domestic
- agricultural
- industrial |

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RISK ASSESSMENT

Hazards posed to:

- public health
- animal health
- catchment health

Complex integrative science involving huge number of disciplines (medicine, veterinary science, microbiology, hydrology, engineering, etc.)

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MICROBIOLOGY

Characterize microbial pathogens with respect to:

- source (anthropogenic, zoonotic)
- dispersal (movement, buoyancy, flocculation)
- survival (viability, infectivity, virulence)

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Two success stories about water-borne infections



Meningoencephalitis
transmitted by bathing

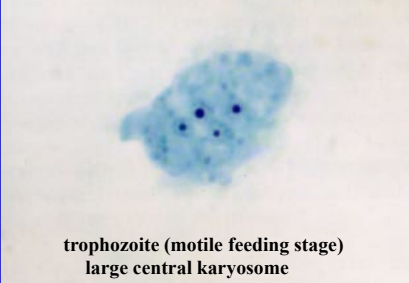


Guinea worm
transmitted by drinking

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Naegleria fowleri

Cause of PAM (primary amoebic meningoencephalitis)
vahlkampfid amoebae (single lobopodium)

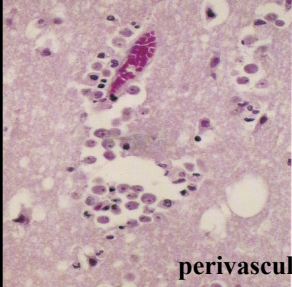
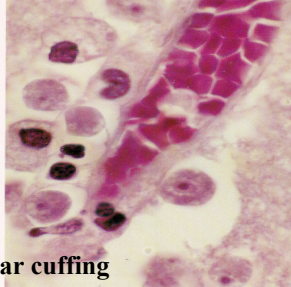


trophozoite (motile feeding stage)
large central karyosome

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Naegleria lesions


- suppurative infection of brain and meninges
- headache, vomiting, pyrexia
- stiff neck, mental confusion, coma, death

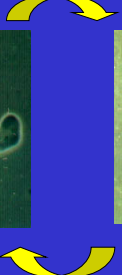
perivascular cuffing

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Naegleria fowleri



trophozoite
in brain



intranasal
inoculation

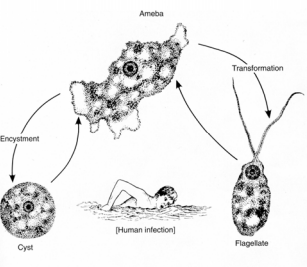


cyst
free-living

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Naegleria fowleri


- fulminant and rapidly fatal in children
- entry to brain via nasal mucosa and olfactory nerves
- 5-20 day course
- develop thermotolerance in:
 - shallow stagnant pools
 - geothermal springs
 - heated pools (esp. for toddlers)
 - heated spas



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Primary Amoebic Meningoencephalitis

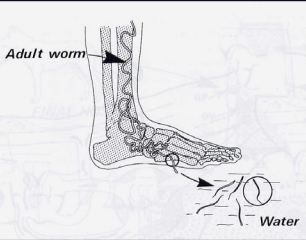
- no effective treatment
- prevention in pools achieved through water treatment (chlorination)
- prevention in field achieved through education (warnings posted at spas)



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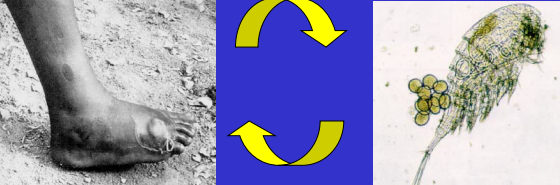
Dracunculus

- helminth parasite
- nematode (guinea worm)
- elongate adults in subcutaneous tissue
- release larvae through ulcerated blister
- larvae develop in copepods



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Dracunculus (guinea worm)



female worms 1m in subcutaneous tissue

larvae released in water taken up by copepods

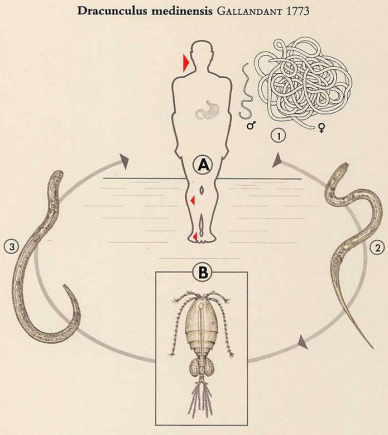
the fiery serpent of biblical times?

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Transmission via water

cycle approx 1 year

larvae ingested with copepod




Dracunculus medinensis GALLANDANT 1773

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Pathogenesis

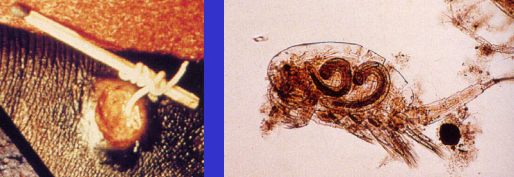
- gravid females cause:
 - erythema
 - papule
 - blister
- eventually ulcerates discharging larvae
- inflammation, urticaria



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Guinea worm

- chemotherapy contra-indicated (dead worm allergy)
- cure by worm removal (wind on stick)
- infections controlled by water filtration (through panty hose to remove copepods)
- virtually eradicated in endemic areas



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What's examinable?

Water-borne microbes – need to know:

- source (anthropogenic, zoonotic)
- dispersal (movement, buoyancy, flocculation)
- survival (viability, infectivity, virulence)
- mode of infection (ingestion, inhalation, contact)
- treatment options (removal, disinfection)



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