

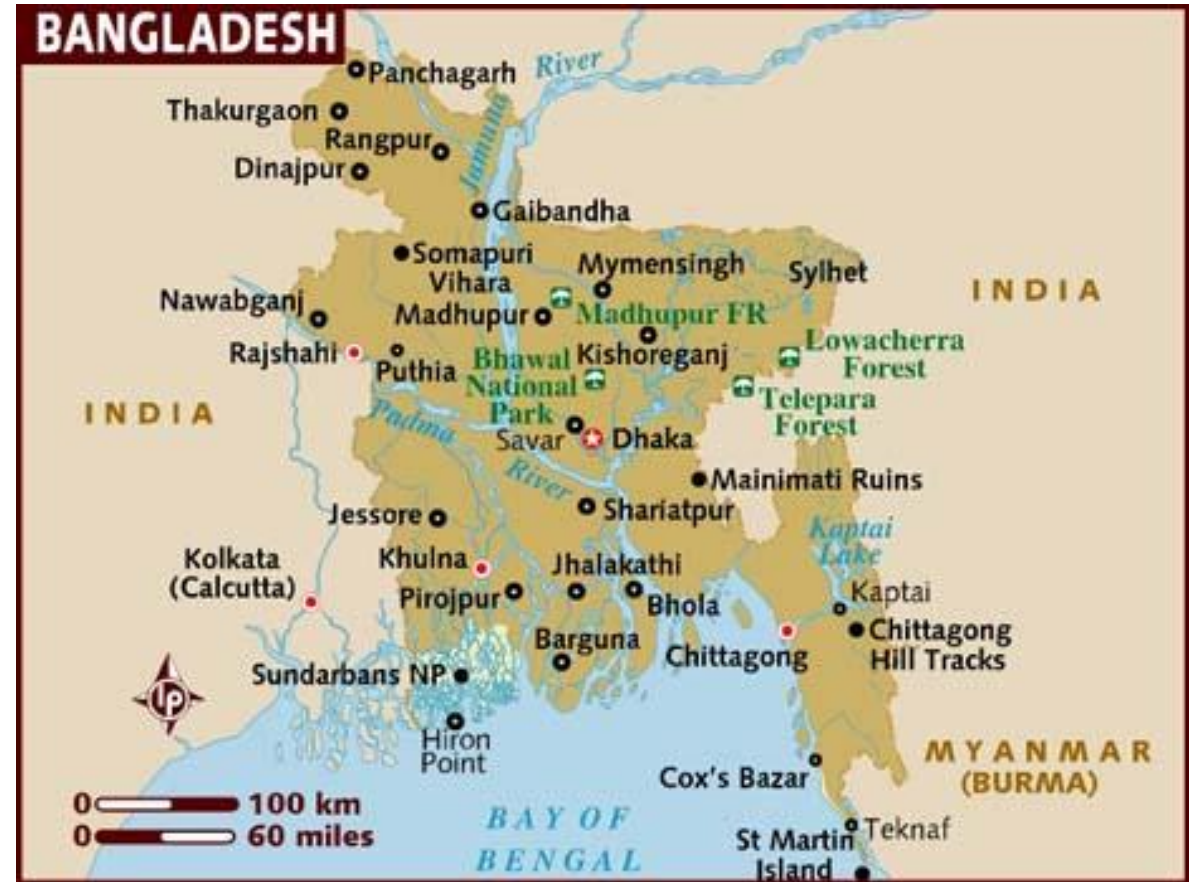
Opportunities for citizen science in reducing exposure to environmental hazards: Lead in soil and arsenic in well-water”

with Lex van Geen and Franziska Landes

Earth2Class Workshops at Lamont-Doherty Earth Observatory

Originally presented 27 Jan 2018

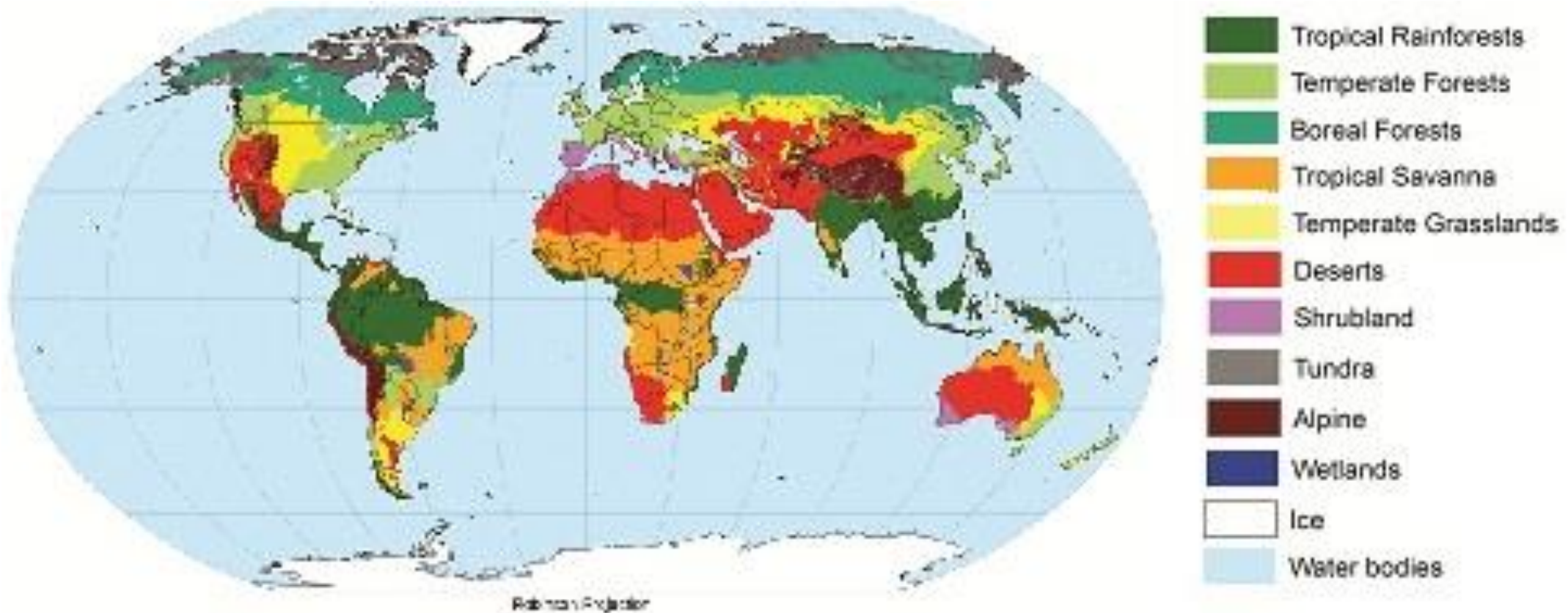
Areas of interest -- Bangladesh



Peru

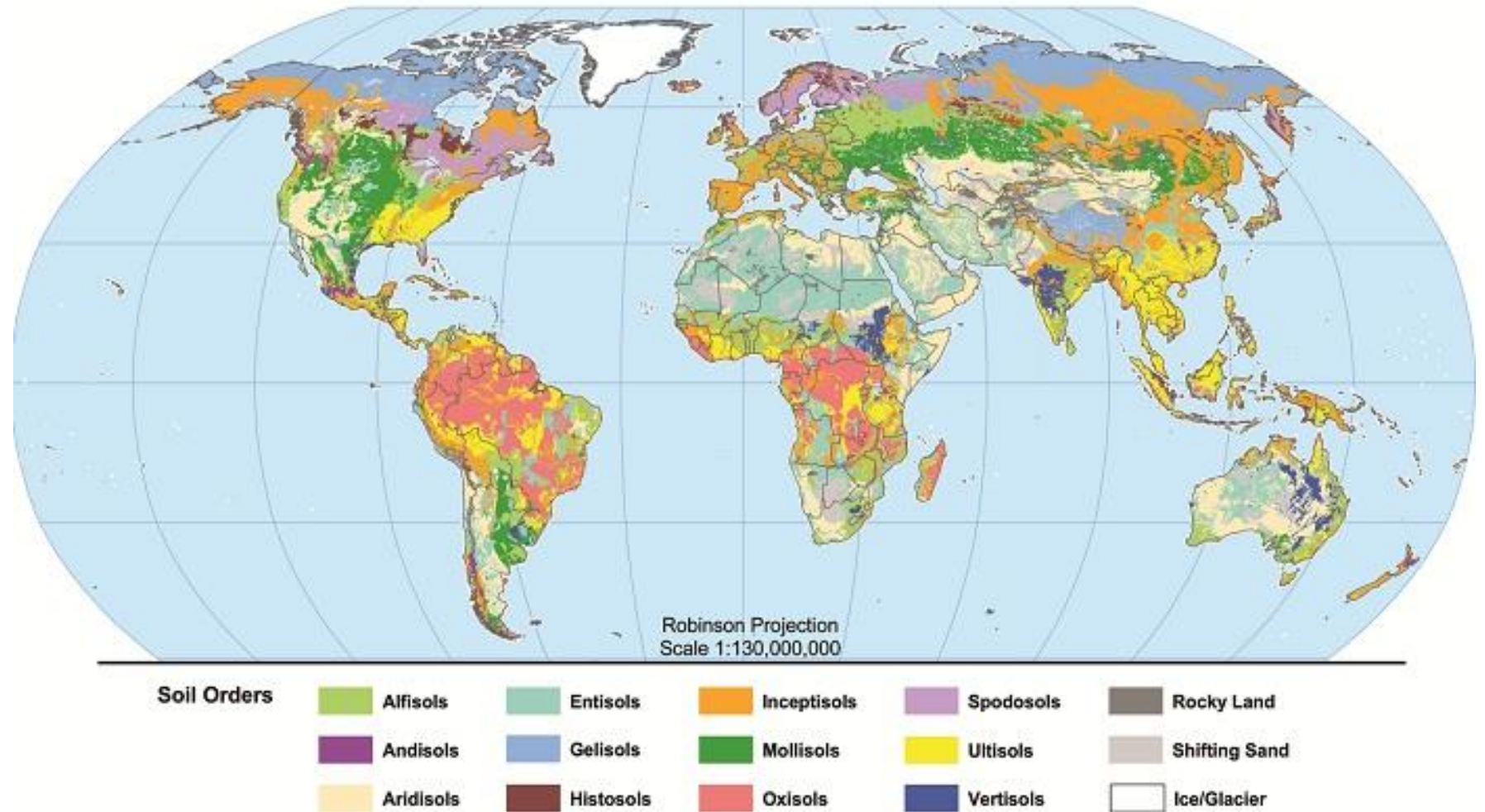


Climates around the World

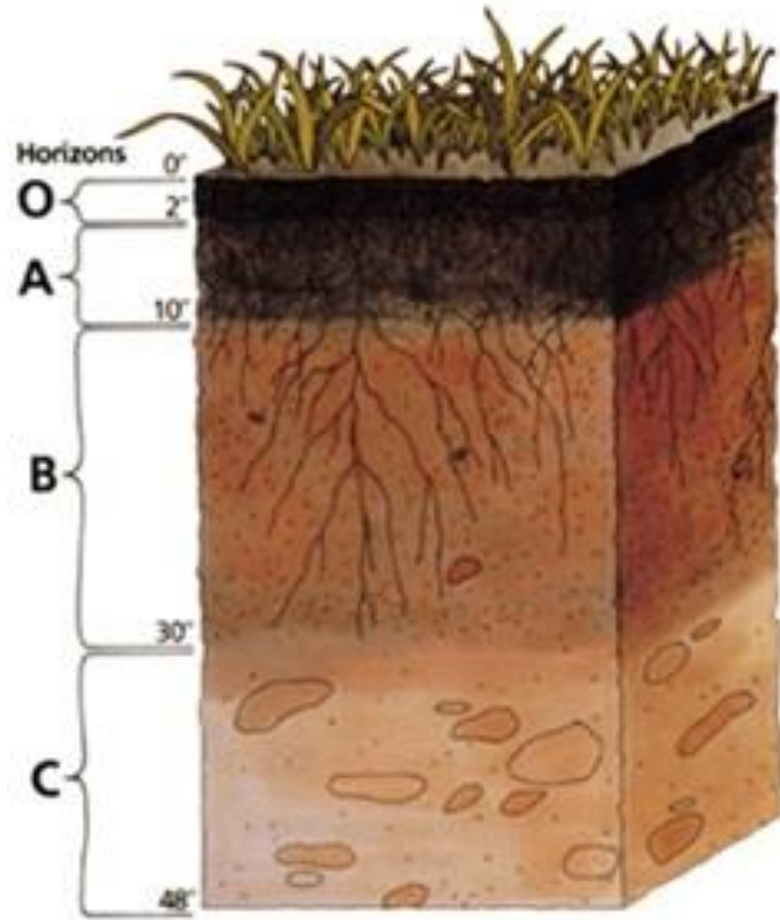


<http://www.soils4teachers.org/around-the-world>

Soil types around the world



Soil horizons



- O – surface/ humus, organic matter
- A – topsoil – minerals and organic matter; best for organisms
- B – subsoil – rich in leached minerals; not very good for organisms
- C -- fragmented parent material
- R – solid bedrock

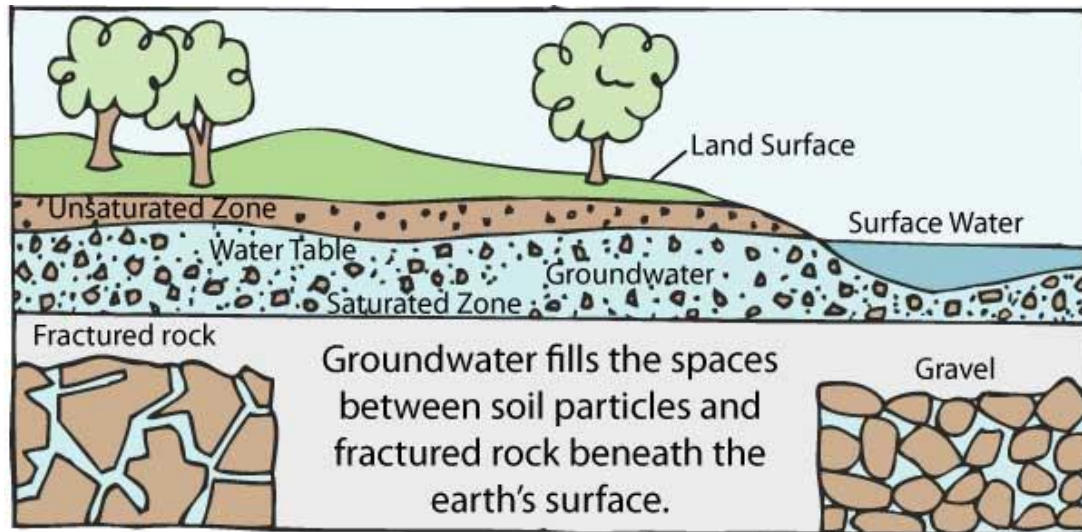
Life in the Soil



- Bacteria
- Earthworms
- Nematodes (roundworms)
- Arthropods (insects)
- Plant roots
- Air spaces
- Water

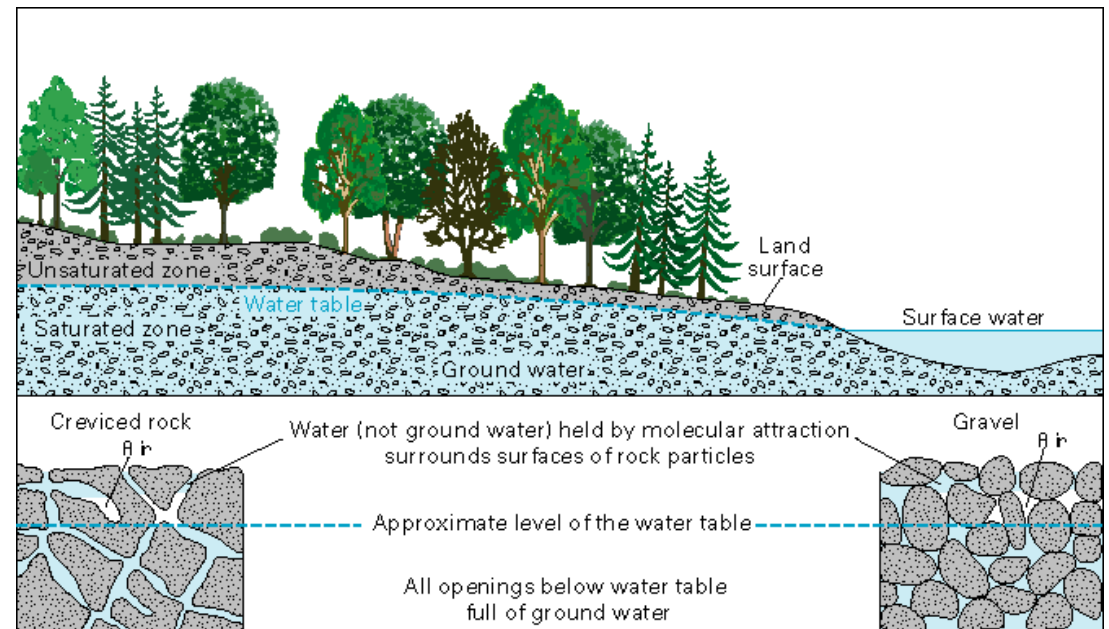
<http://www.soils4teachers.org/biology-life-soil>

Ground-water characteristics



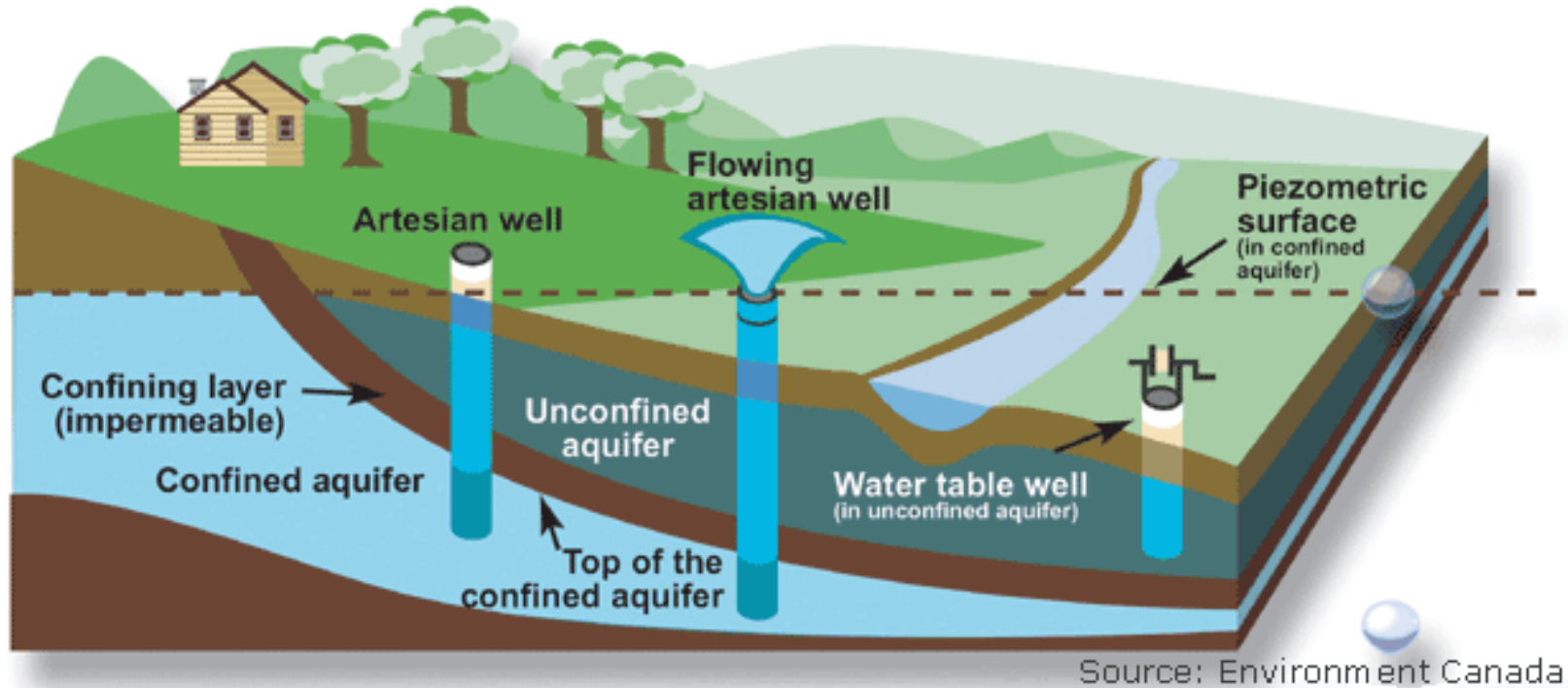
- Supplies 51% of US population/ 99% of rural population
- 64% used for irrigation to grow food
- Major source of recharge for rivers and wetlands

- Zone of aeration
- Zone of saturation
- Water table
- Porous, porosity
- Permeable, impermeable
- Aquifer
- Aquiclude



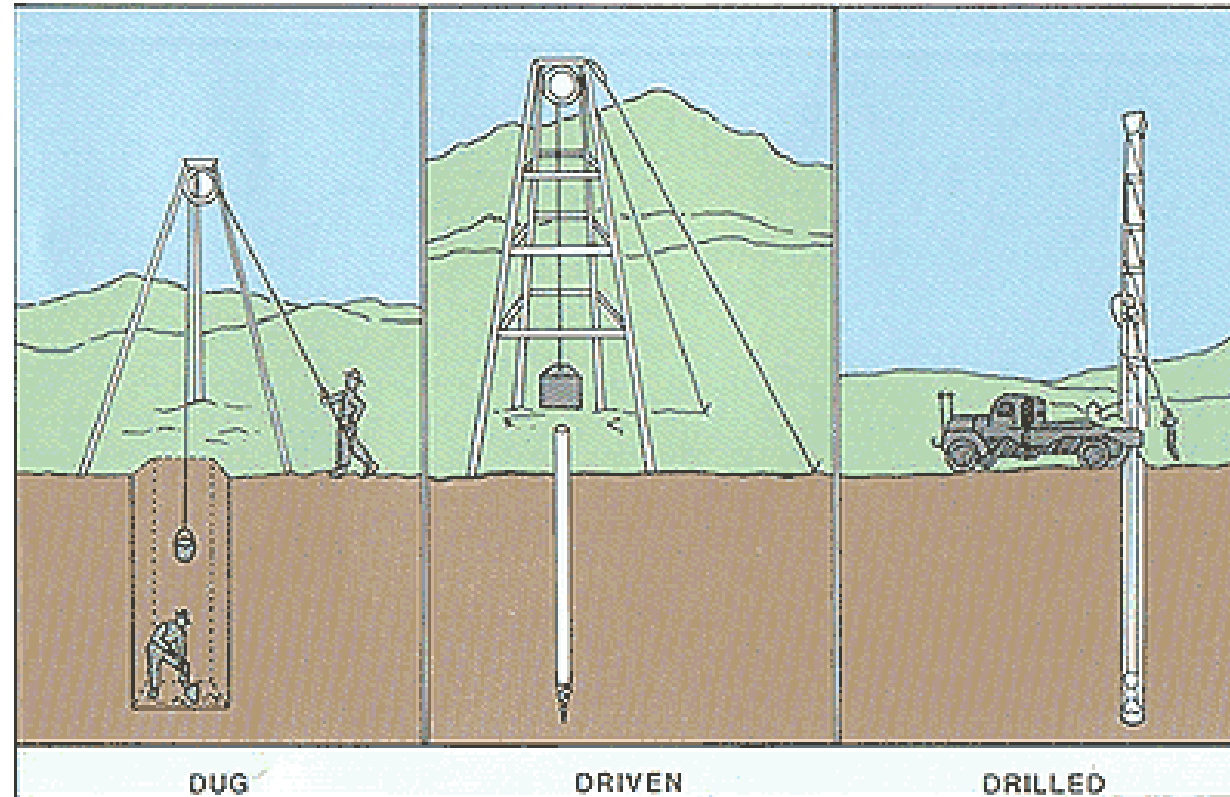
Wells – tapping into groundwater

Aquifers and wells

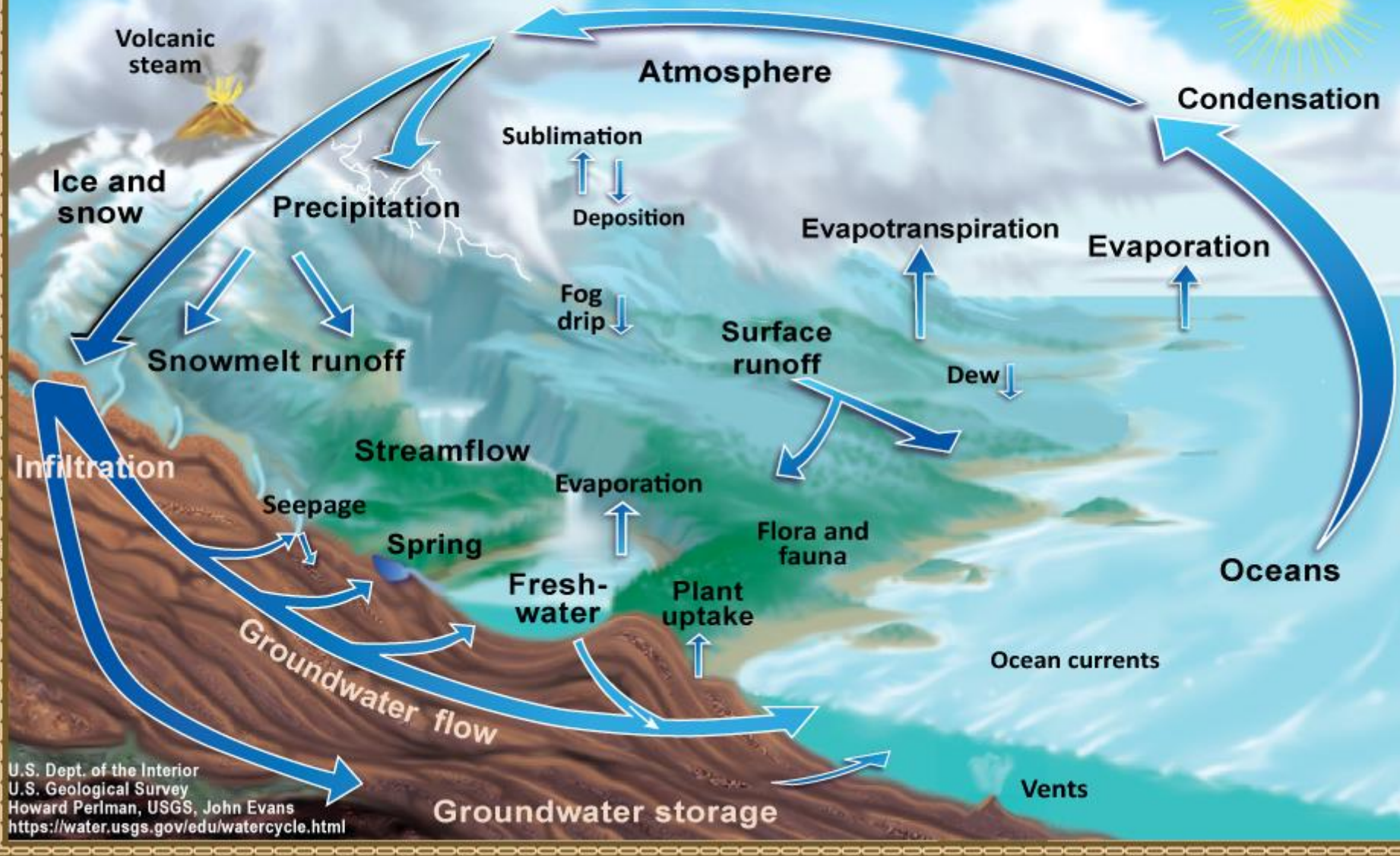


Source: Environment Canada

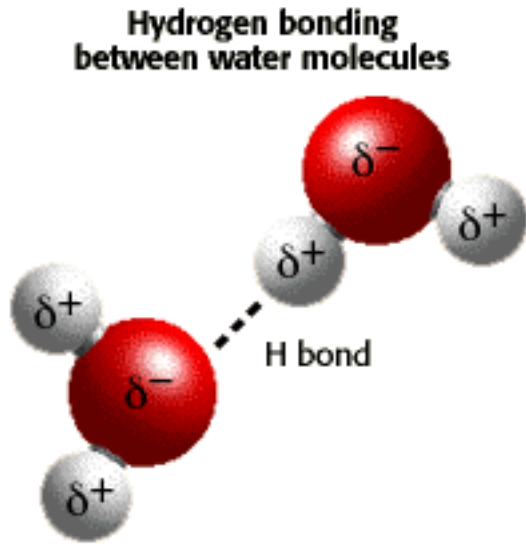
Types of wells



The Water Cycle

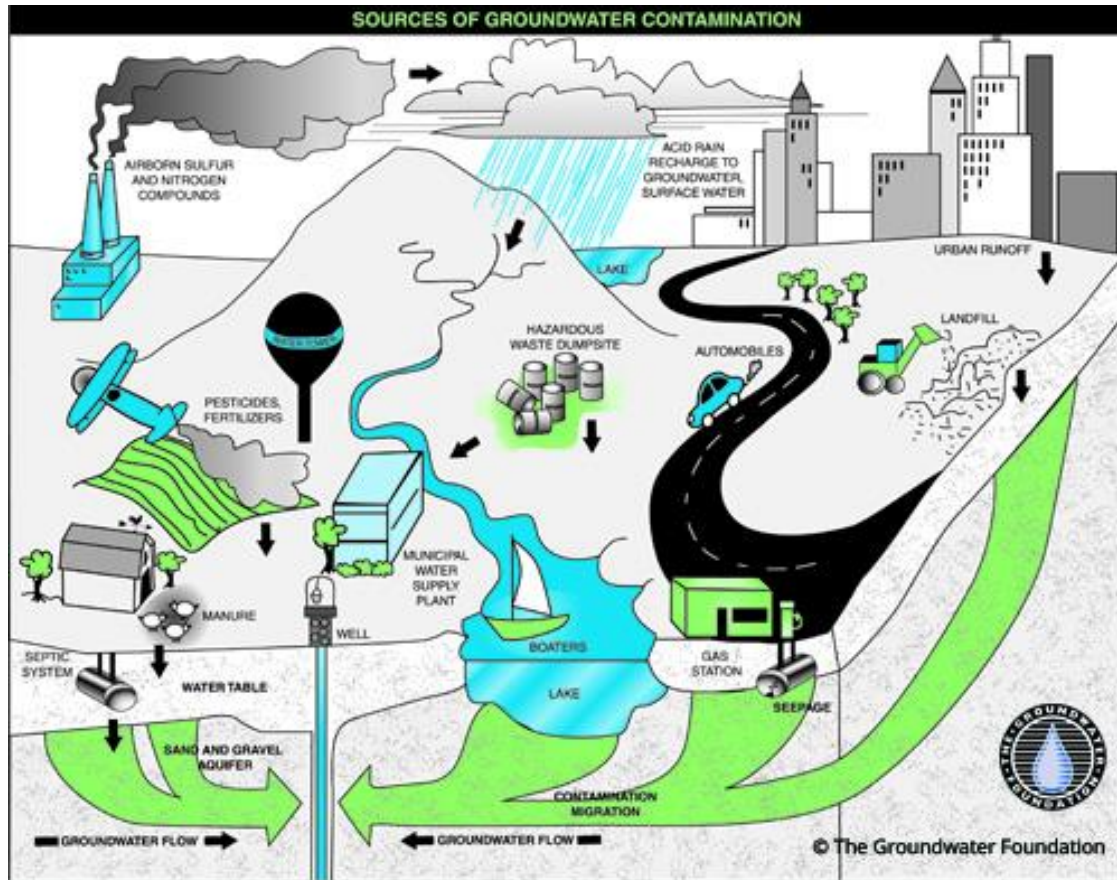


Water – more than H₂O!



- Polar molecule
- Rarely pure (pH = 7.0)
- “Universal Solvent”
- Able to dissolve thousands of molecules and ions
- Many are beneficial
- Some are harmful---
pollutants/contaminants

Groundwater Contaminants



- Contaminants may occur naturally, inadvertently, or intentionally
- Road salt, motor oils, septic tanks, urban runoff
- Fertilizers, pesticides, farm wastes
- Pharmaceuticals and personal products
- Toxic chemicals, hazardous wastes, landfill leakage
- Airborne compounds
- Other

“Heavy Metals” – especially Pb and As

Lead (Pb)

- Found in air, soil, water, our bodies
- Fossil fuels (leaded gasoline), lead-based paints, industrial uses (plumbing, cosmetics, etc.)
- May travel long distances from source in air or water
- Many type of compounds

<https://www.epa.gov/lead/learn-about-lead>

Arsenic (As)

- Naturally found in rocks, soils, water, plants, animals
- From volcanic activity, erosion, forest fires
- Wood preservative and other industrial uses
- Agriculture, mining, smelting

<https://safewater.zendesk.com/hc/en-us/articles/212074607-What-are-the-sources-of-arsenic-contamination-in-water->

Pb

- Cumulative toxicant that affects multiple body systems; particularly harmful to young children.
- Distributed to the brain, liver, kidney and bones; stored in the teeth and bones, where it accumulates over time.
- Usually assessed through the measurement of lead in blood.
- Lead in bone is released into blood during pregnancy and becomes a source of exposure to the developing fetus.
- No known level of lead exposure that is considered safe.
- Lead exposure is preventable.

As

- Naturally present at high levels in groundwater of a number of countries.
- Highly toxic in its inorganic form.
- Contaminated water used for drinking, food preparation and irrigation of food crops poses greatest threat to public health
- Long-term exposure to arsenic can cause cancer and skin lesions; associated with cardiovascular disease, diabetes.
- In utero and early childhood exposure linked to negative impacts on cognitive development and increased deaths in young
- Most important action in affected communities is prevention of further exposure by provision of a safe water supply.

<http://www.who.int/mediacentre/factsheets/fs372/en/>

Differences in Addressing Problems between “1st World” and “3rd World” Communities

- Federal, state, local, and private resources highly developed and based on decades of engineering/science
- Survival- and local resource-dominated strategies
- Laws and regulations, enforcement codes
- Awareness levels in populations
- Resources that can be brought to bear to solve problems

Even so, problems can arise locally

- [Trace metal contaminants in NYC urban garden soils](#)
- [Lead in home gardens and urban soils – MN Extension Service](#)
- [Ambient levels of metals in NJ soils](#)

- So how can you and your students find out whether problems exist “in your backyard”?
- What techniques must be used by “experts” so decisions makers have necessary data?
- What then should be done to address these concerns locally and internationally?