Water

Water audit and water quality testing

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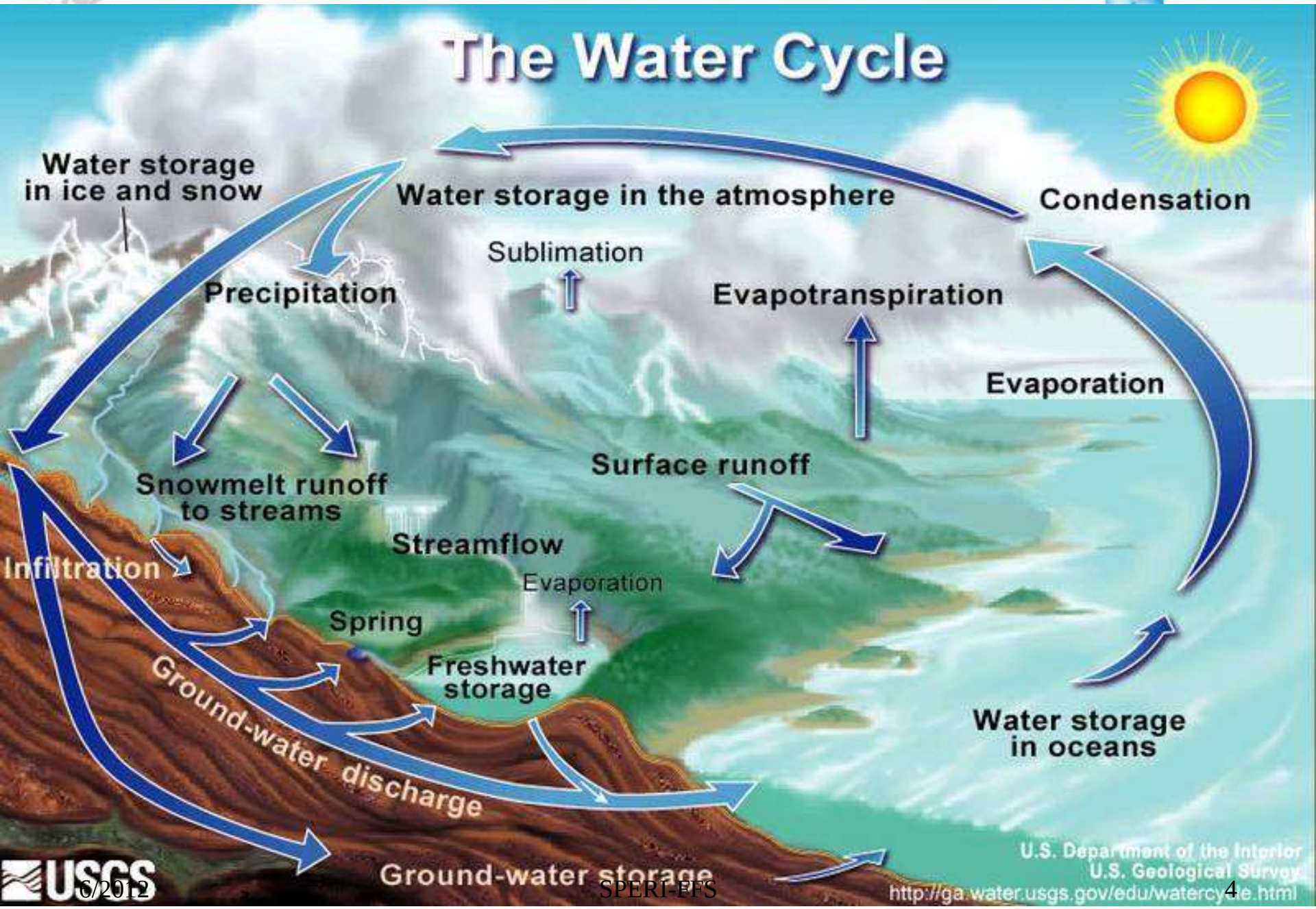
Essential questions

1. Where does our water come from?
2. Where does our water go to?
3. Do our actions have any impact on the availability of water?
    1. Quality
    2. Quantity
4. How does our water usage affect ecosystems?


The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Sublimation
Precipitation
Evapotranspiration
Evaporation
Surface runoff
Snowmelt runoff to streams
Streamflow
Infiltration
Evaporation
Spring
Freshwater storage
Ground-water discharge
Water storage in oceans
Ground-water storage
USGS
U.S. Department of the Interior
U.S. Geological Survey
http://ga.water.usgs.gov/edu/watercycle.html

WATER QUANTITY

What is a water audit?

- A *measurement* of amount of water used
- To *gauge* water consumption and usage
- To *inform* the community and planners about the sustainability of water usage practices

Case study:
Burton & Garran (B&G) Hall

- A college-styled living arrangement for university students in Australian National University (ANU)

- Context:
  - Australia facing a crisis-level drought
  - Need to reduce water usage on a local and national level

Methodology

- Measure flow rates of shower heads
- Compare the flow rates on each level
  - Flow rates differ on each level due to a difference in hydraulic pressure
- Recommend and implement ways to reduce flow rates

Method

1. Allow water from the shower head to flow
2. Use a rubbish bin can to collect all the water over 20 seconds
3. Measure over the water collected in the trash can using measuring mugs
4. Multiply the amount by 3 to get the amount of water flowing per minute (flow rate)
5. Repeat 1 – 4 for another showerhead on the same floor
6. Repeat 1 – 5 for showerheads on all other floors
7. Compare flow rates with height above ground level
8. Calculate water consumption per year
    - Assuming that each person takes one 5-minute shower each day
9. Find a most acceptable flow rate and reduce flow to this most acceptable level
    - Not lower than the lowest (i.e. top floor)
    - Reduction large enough to save water
    - Reduce the flow area of the shower head to obtain the most acceptable flow rate

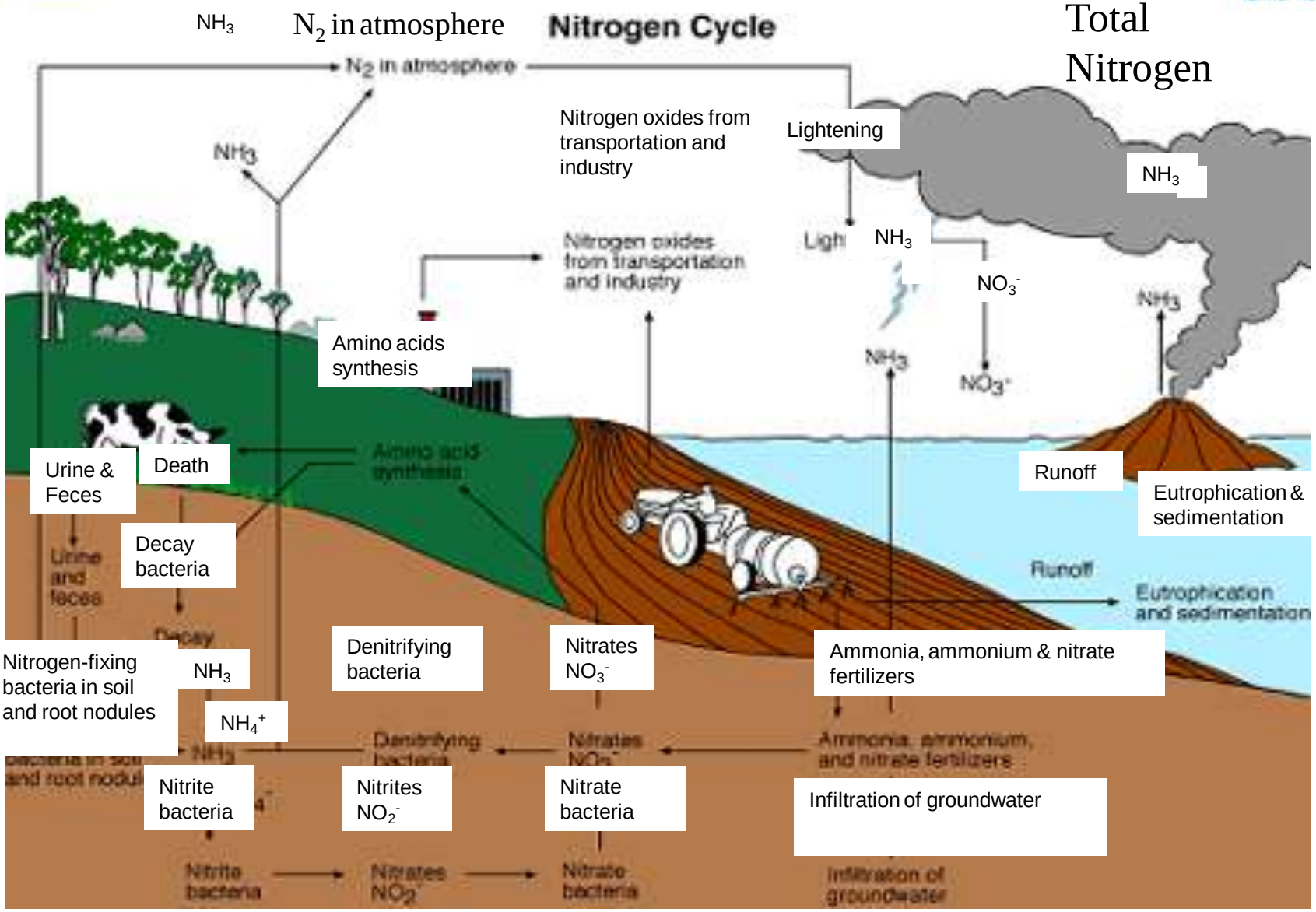
WATER QUALITY

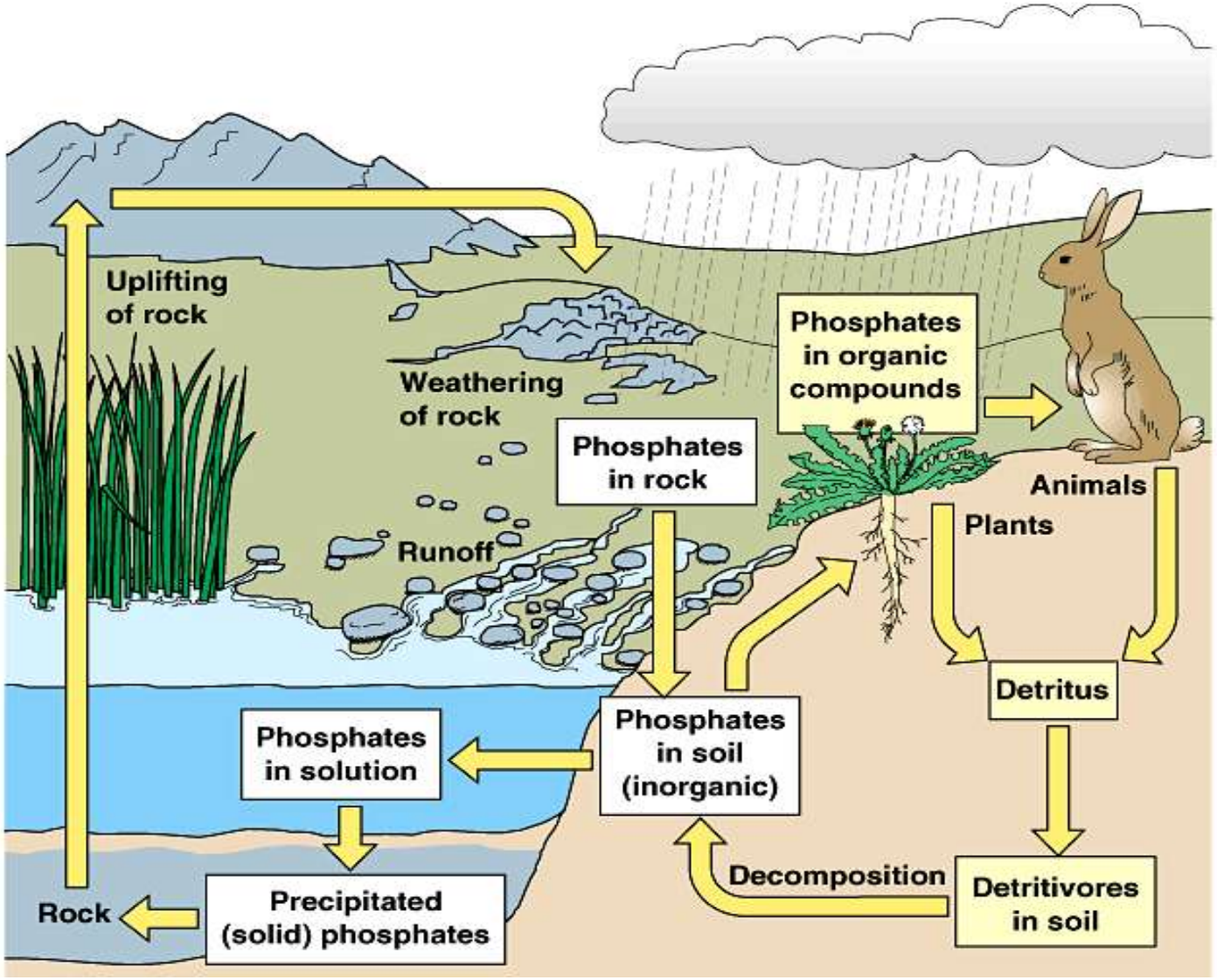
The physical, chemical and biological characteristics of water

Over 295 parameters tested
80,000 tests conducted monthly

Escherichia Coli, Enterococci, Coliphage, Clostridium perfringens, BOD5, COD, Oil & Grease, Caffeine, Detergent (as MBAS), Phenolic Compounds, Bromide, Bromate, Chlorite, Chlorate, Antimony, Arsenic, Barium, Beryllium, Boron, Calcium, Cadmium, Chromium, Copper, Cyanide, Iron, Lead, Manganese, Magnesium, Mercury, Molybdenum, Nickel, Potassium, Silica, Strontium, Sodium, Tin, Thallium, Zinc, Nitrate, Nitrite, Selenium, Bromoform, Dibromochloromethane, Bromodichloromethane, Chloroform, Trihalomethanes ratio, Monochloroacetate, Dichloroacetate, Trichoroacetate, Trichlorophenol, 2,4,6, Cyanide, Dichloroacetonitrile, Dibromoacetonitrile, Carbon tetrachloride, Dichloromethane, Dichloroethane, 1,2-, Dichloroethene, 1,2-, Trichloroethene, Tetrachloroethene, Vinyl chloride, Benzene, Ethylbenzene, Styrene, Toluene, Xylenes, Benzo[a]pyrene, Dichlorobenzene, 1,2-, Dichlorobenzene, 1,4-, Di(2-ethylhexyl) phthalate, Dioxane, 1,4-, Acrylamide, Epichlorohydrin, Hexachlorobutadiene (HCBD), Microcystin-LR, Nitrilotriacetic acid (NTA), 1,2-Dibromo-3-chloropropane, 1,2-Dibromoethane, 1,2-Dichloropropane (1,2-DCP), 1,3-Dichloropropene, 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid), 2,4-DB [4-(2,4-Dichlorophenoxy) butyric acid], 2,4-D (2,4-dichlorophenoxyacetic acid), Alachlor, Aldicarb Sulfoxide and Aldicarb Sulfone, Aldrin, Dieldrin, Atrazine, Carbofuran, Chlordane, Chlorotoluron, Chlorpyrifos, Cyanazine, DDT and metabolites, Dichlorprop, Dimethoate, Endrin, Fenoprop (2,4,5-TP; 2,4,5-trichlorophenoxy propionic acid), Isoproturon, Lindane, MCPA (4-Chloro-2-methylphenoxyacetic acid), Mecoprop (MCPP; [2(2-methyl-chlorophenoxy) propionicacid]), Methoxychlor, Metolachlor, Molinate, Pendimethalin, Pentachlorophenol (PCP), Permethrin, Pyriproxyfen, Simazine, Terbuthylazine (TBA), Trifluralin, Gross Alpha activity, Gross Beta activity, Radon 222 concentration, Uranium, Edetic acid, Ammonia, Chloride, Colour, Conductivity, pH, Total Alkalinity, Total coliforms, Total Organic Carbon, Turbidity, Aluminium, Colony Counts, Mono-chloramine, Residual Fluoride, Total Residual Chlorine, Total hardness, Perchlorate, Sulphate, Total Suspended Solids, Total dissolved solids, Nitrate, Nitrite, Phosphate, Total Nitrogen, Total Phosphorus, Chlorophyll-a, Cryptosporidium, Giardia, Naproxen,Gemfibrozil, Ketoprofen, Ibuprofen, Trichlorocarban, Diclofenae sodium, Feacal Coliform, imidacloprid, fipronil, fernvalerate,

Turbidity and Total Suspended Solids (TSS)


NH_3
N_2 in atmosphere
Nitrogen Cycle
Total Nitrogen
N_2 in atmosphere
NH_3
Nitrogen oxides from transportation and industry
Lightening
NH_3
Nitrogen oxides from transportation and industry
Ligh
NH_3
NO_3^-
NH_3
NH_3
NO_3^-
Amino acids synthesis
Urine & Feces
Death
Amino acid synthesis
Runoff
Eutrophication & sedimentation
Urine and feces
Decay bacteria
Runoff
Eutrophication and sedimentation
Nitrogen-fixing bacteria in soil and root nodules
NH_3
Denitrifying bacteria
Nitrates NO_3^-
Ammonia, ammonium & nitrate fertilizers
NH_4^+
NH_3
Denitrifying bacteria
Nitrates NO_3^-
Ammonia, ammonium, and nitrate fertilizers
Nitrite bacteria
Nitrites NO_2^-
Nitrate bacteria
Infiltration of groundwater
Nitrite bacteria
Nitrates NO_2^-
Nitrate bacteria
Infiltration of groundwater



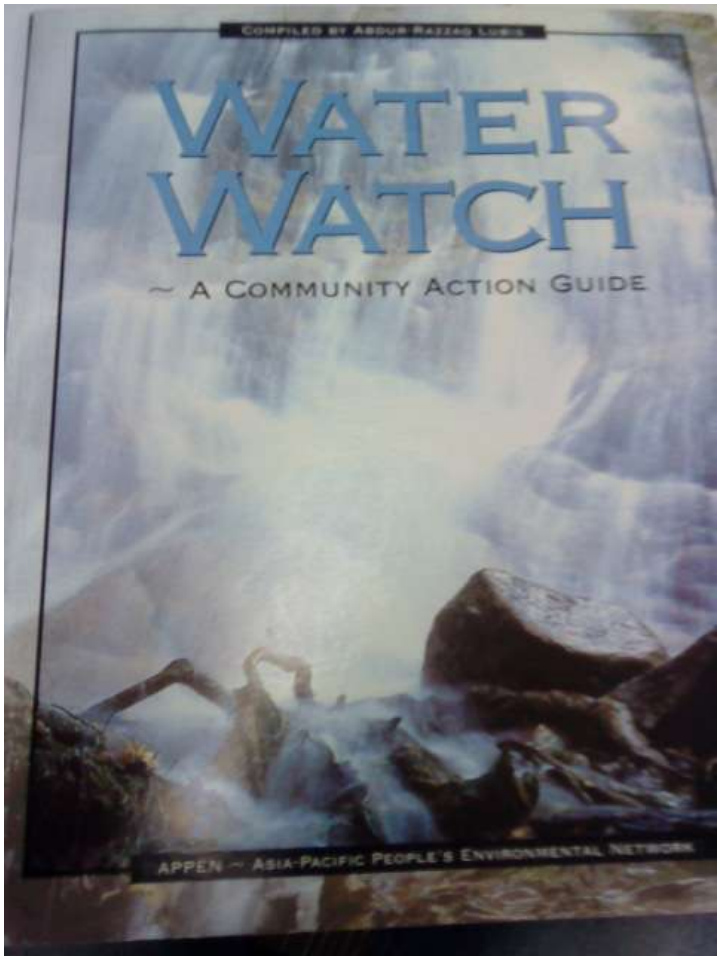
Total Phosphorus

Why test water quality?

- Standards & guidelines are established to protect water for designated uses such as drinking, recreation, agricultural irrigation, or protection & maintenance of aquatic life

- Ensure that public drinking-water supplies are as safe as possible

- Protect aquatic life, including fish & fish-eating wildlife such as birds



How to test water quality with the available test kits

- Temperature
  - Use the crystalline thermometer to measure the air temperature first, then the water temperature. Read the number in the middle. (Units: degrees Celsius)
- Turbidity
  - Compare the colour of the turbidity sticker at the bottom of the test jar, when the test jar is filled with water, with the Turbidity Chart. (Units: JTU)

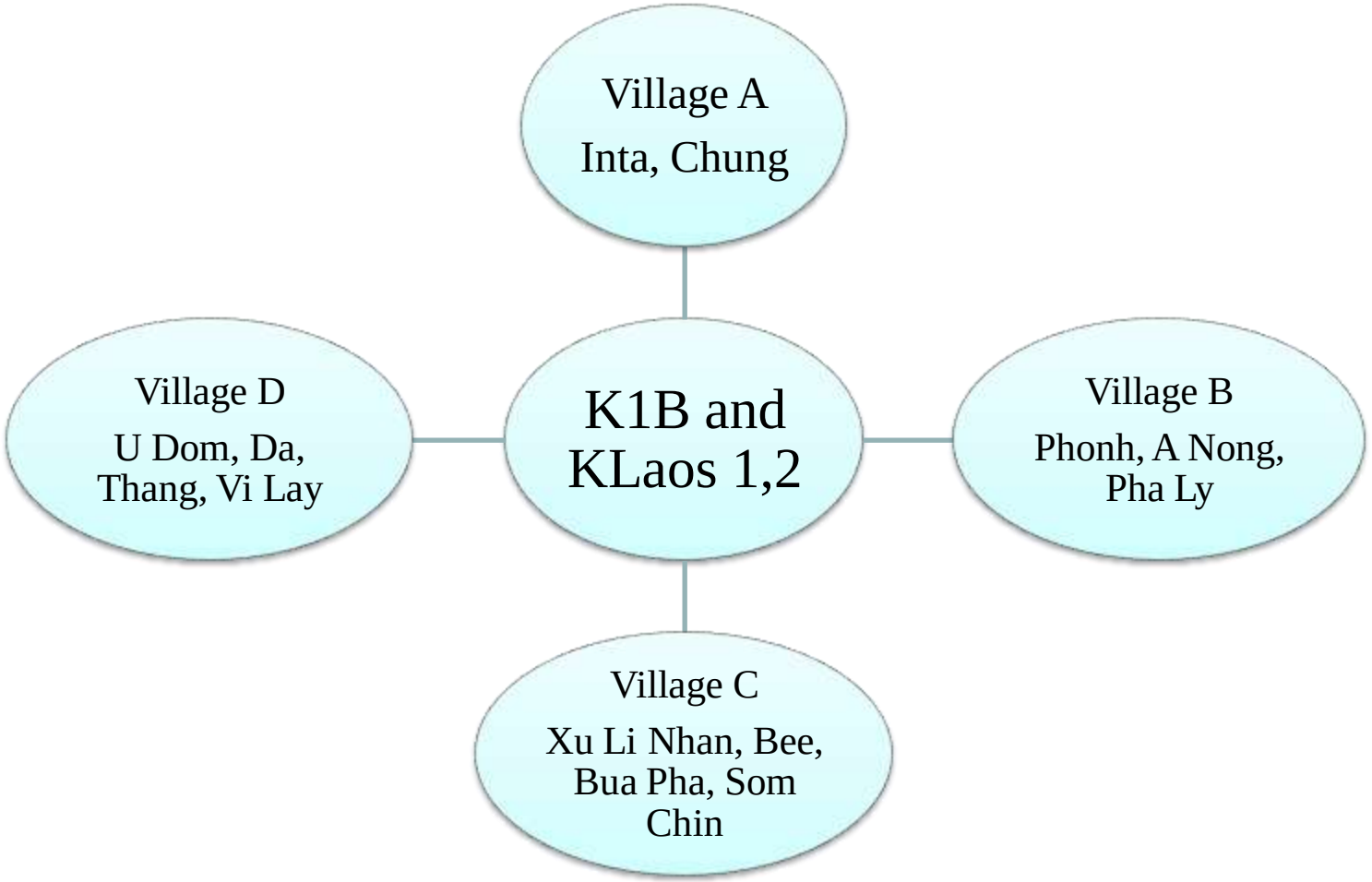
!!! Dispose of test water from the vials into the buckets labeled 'Used water' (the pH and DO tablets are toxic)

- Dissolved oxygen
  - First make sure that the temperature of the water has been recorded. This is because the colder the water, the more oxygen that can dissolve in the water.
  - Fill up the small vial with water, to the brim. Drop two Dissolved Oxygen TesTabs into the vial and screw the cap shut.
  - Shake (through repeated inversions) the vial for about 5 minutes until the tablets are dissolved. Wait another 5 minutes for the colour to appear. Then compare the colour of the water in the vial with the Dissolved Oxygen colour chart. (Units: ppm)
- pH
  - Fill the larger test tube/vial up to the 10 mL mark. Drop one pH Wide Range TesTab into the test tube.
  - Cap and shake the test tube (by repeatedly inverting it) until the tablet has dissolved. Then compare the colour of the water in the test tube with the pH colour chart.

GROUP WORK

WATER AUDIT AND WATER QUALITY TESTING

Divide into groups



Scenario

- A water technology company wants to install some water filters to improve water supply in a few villages. It needs to decide on which villages it should go to.

Scenario

- As representatives from your village, you want to convince the company that they should install the water filters in your village.

Deliverable

- Present to the company officials on 11 June, afternoon, with the following information:
  - Background of your village
    - Location
    - Population
    - Jobs / livelihoods
  - Analysis of data (at least 3 days worth of data)
    - Water quality (include important parameters)
      - Include your method
    - Water usage (to understand cultural/behavioural factors behind water usage)
      - Include your method
    - Water flow (map of watershed)
    - Conclusion: Why does your village need water filters?

For tomorrow's field activity

- Try testing the water quality of 3 types of water:
  - River water
  - Rice water from cooking
  - Laundry water with phosphates
- Using insects as indicators of water quality

10 minutes

DISCUSSION

Special task!!!

Katty, Jun Hien, and Yingshan are going to be bad to the environment between 11:30am and 2pm.

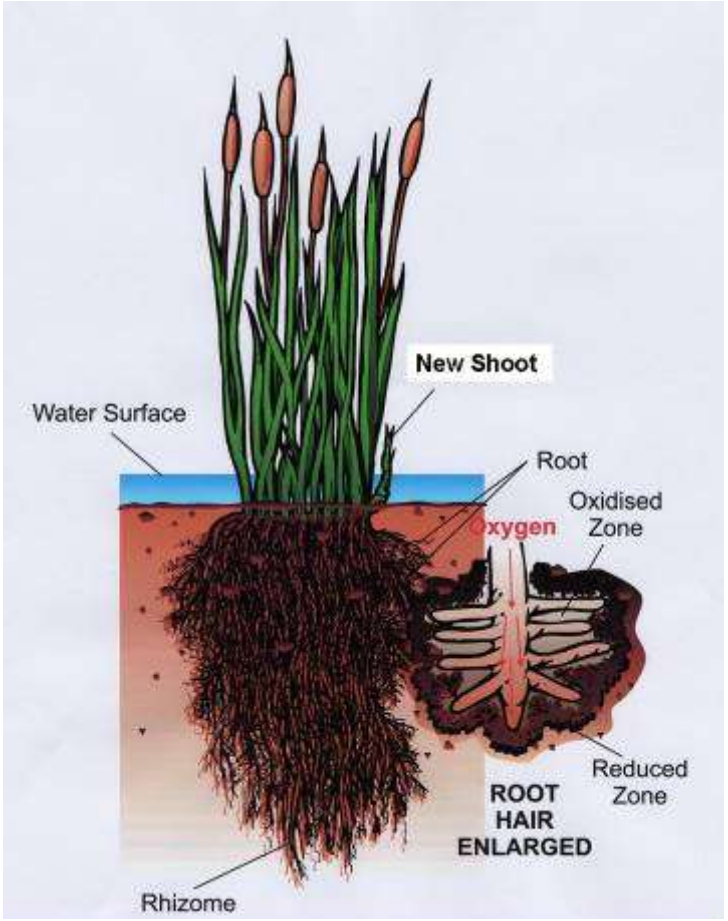
Please identify their bad behavior and correct them.

What are wetlands?

http://en.wikipedia.org

http://en.wikipedia.org/wiki/File:L%C3%BCtt-Witt_Moor-2.jpg

How do wetland plants improve water quality?

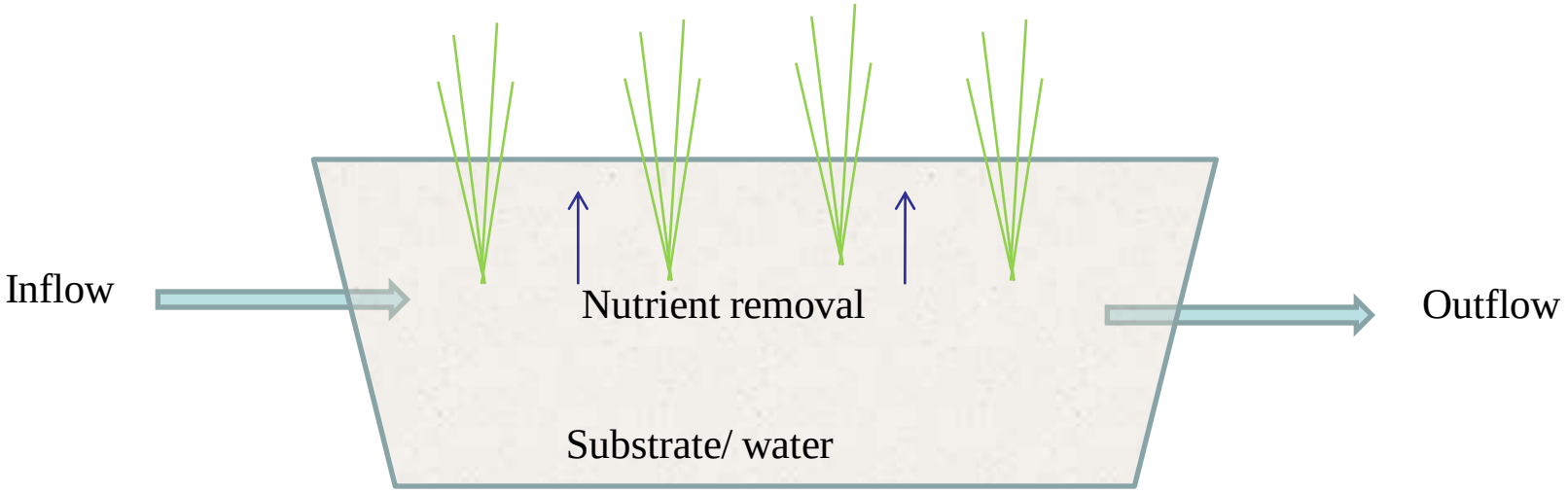


- Plants take up nutrients for growth
- Root systems provide large surface area for microbial growth
- The microbes help to break down pollutants and absorb nutrients

Constructed wetlands

- Created from a non-wetland area, designed to imitate functions of a natural wetland

- Main functions:
  - Water quality improvement
  - Flood control
  - Habitat creation
  - Education and aesthetic purposes



Types of constructed wetlands

Floating wetland

Surface flow wetland

Floating aquatic plant wetland

Sub-surface flow wetland

(Courtesy of ET's photo Homes' photostream)