

(Drinking) Water Sources

How much water is there in the world?

3.7×10^{20} gallons, 1.4×10^{21} kg

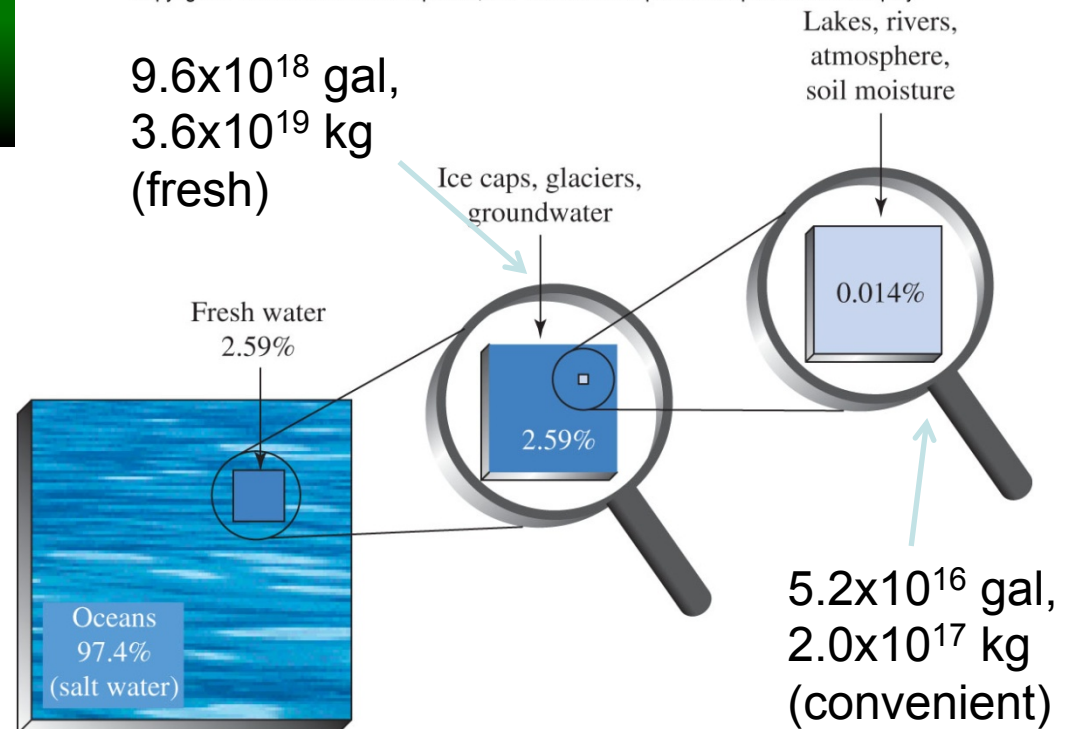
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Ogallala Aquifer

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9.6×10^{18} gal,
 3.6×10^{19} kg
(fresh)



Surface water: lakes, rivers, reservoirs
drinking H₂O source for most major cities

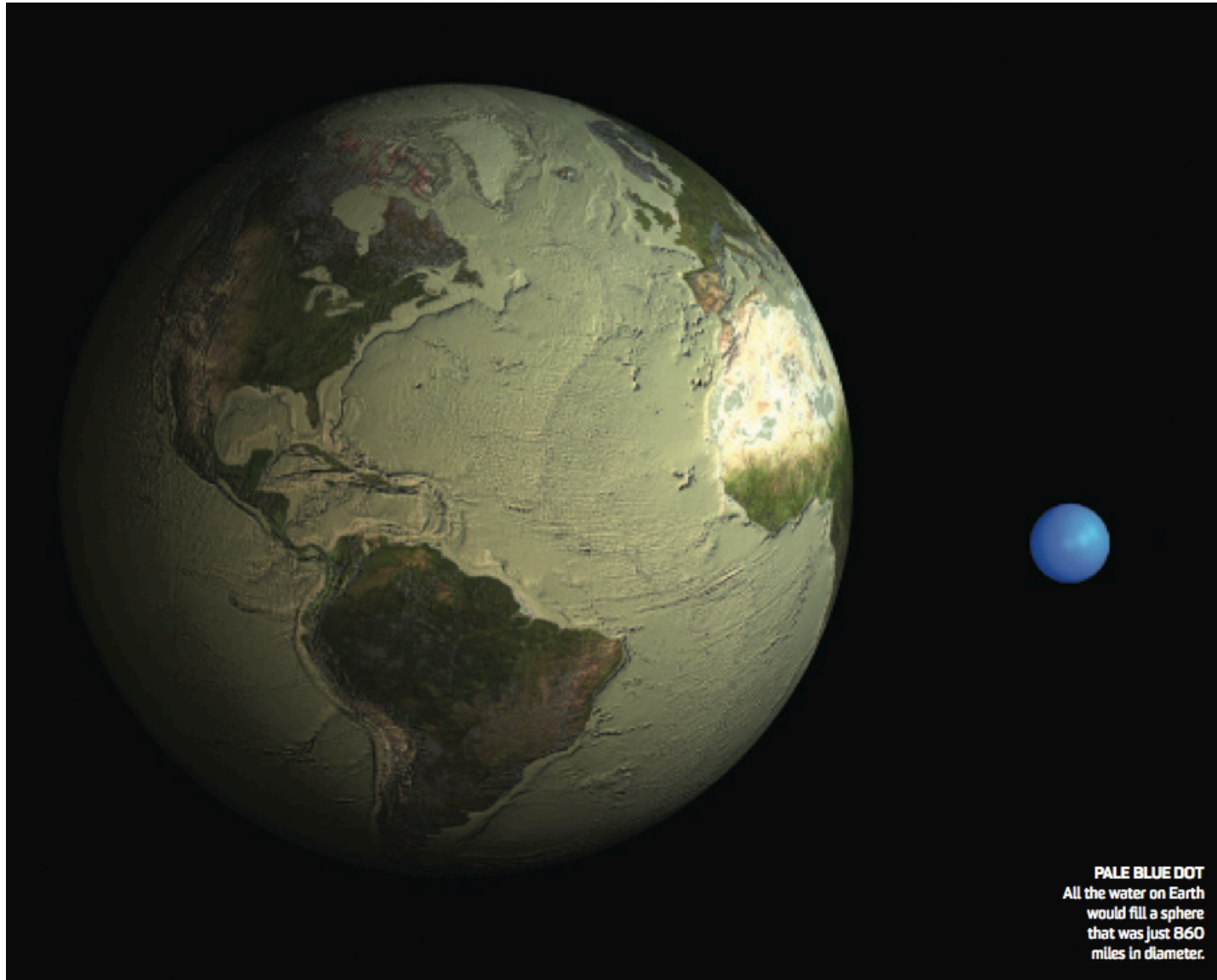
Ground water: aquifers
drinking H₂O source for most rural areas

US water usage (10^9 gallons/day) in 2000:

194 thermal electric power, 137 irrigation
43 domestic, 19 industrial, 14 miscellaneous

World's Water

Elizabeth Royte
POPULAR SCIENCE
July 2012, p52-53



The 750Gt Carbon in the atmosphere would fill a sphere $\frac{1}{2}$ mile in diameter as a liquid¹⁶

Protecting our Drinking Water

Maximum contaminant level goal (**MCLG**):

maximum level of a contaminant in drinking water at which there is no known adverse effect on humans

Maximum contaminant level (**MCL**):

sets the legal limit for concentration of a contaminant

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Table 5.10

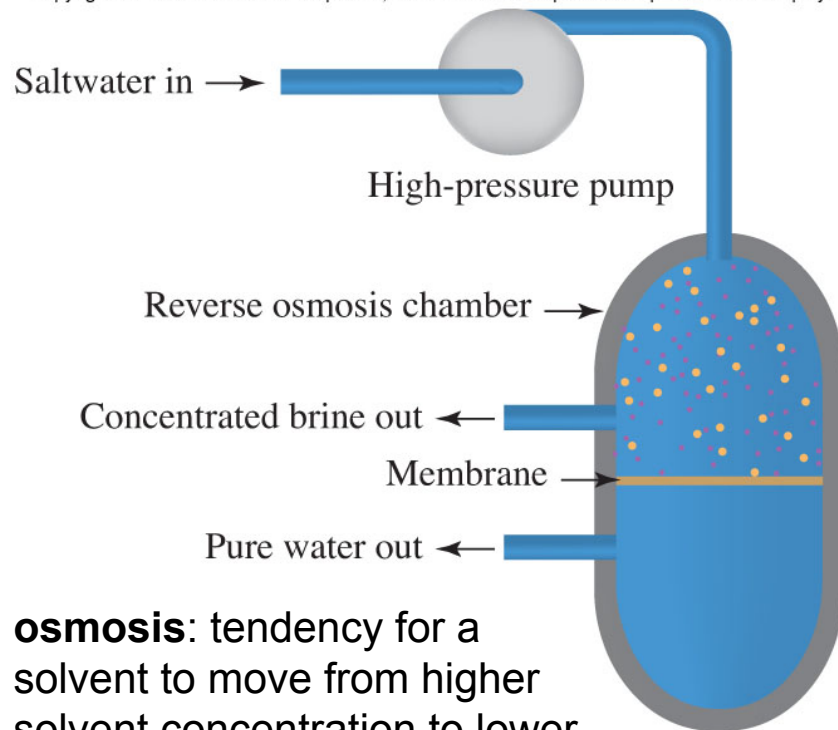
MCLGs and MCLs (in ppm) for Drinking Water

Pollutant	MCLG	MCL
cadmium (Cd^{2+})	0.005	0.005
chromium (Cr^{3+} , CrO_4^{2-})	0.1	0.1
lead (Pb^{2+})	0	0.015
mercury (Hg^{2+})	0.002	0.002
nitrate (NO_3^-)	10	10
benzene (C_6H_6)	0	0.005
trihalomethanes (CHCl_3 , etc.)	0	0.080

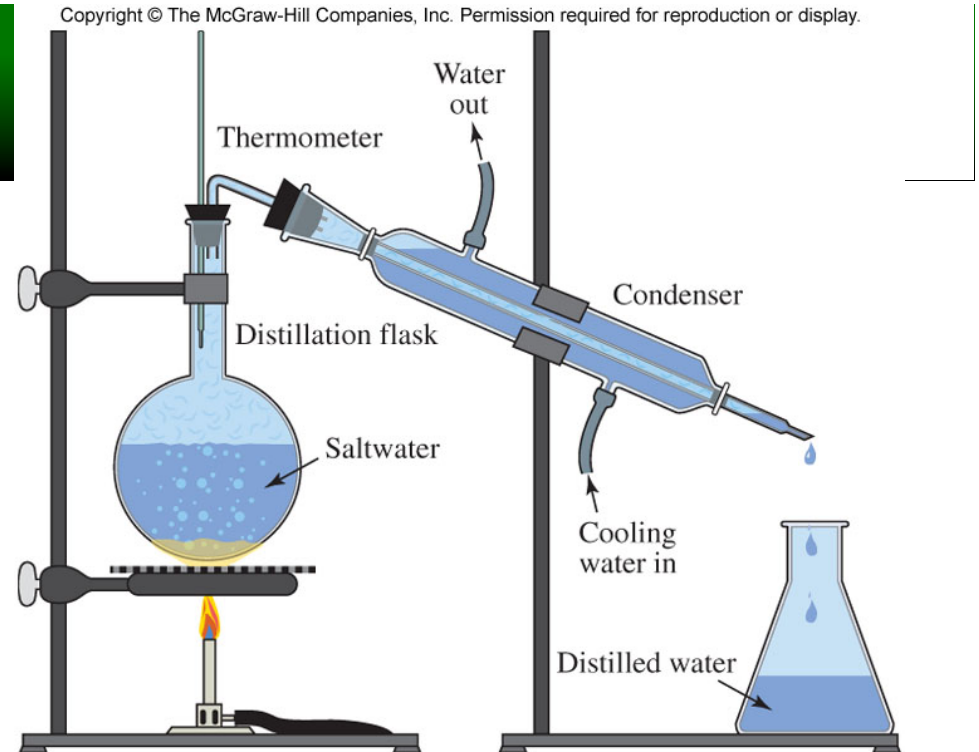
Desalination

Most (~98%) water is salt water. Water can be **desalinated** by **reverse osmosis** or **distillation** (but both require energy)

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osmosis: tendency for a solvent to move from higher solvent concentration to lower solvent concentration (why you can't live on seawater)



0.31 kJ/g to heat H₂O from 25°C to 100°C

2.26 kJ/g to boil H₂O

How much energy to distill 1 gallon of H₂O?
(need to break H-bonds)

$$1 \text{ gallon} \times \frac{3.785 \text{ L}}{1 \text{ gallon}} \times \frac{1000 \text{ g}}{1 \text{ L}} \times \frac{2.57 \text{ kJ}}{1 \text{ g}} = 9.7 \times 10^3 \text{ kJ}$$

43x10⁹ gal/day for domestic use (USA)

$$43 \times 10^9 \text{ gallons/day} \times \frac{9.7 \times 10^3 \text{ kJ}}{1 \text{ gallon}} \times \frac{365 \text{ days}}{1 \text{ year}} = 1.52 \times 10^{15} \text{ kJ/year}$$

=1.52 EJ/year (the total US annual energy use is 100 EJ/year)