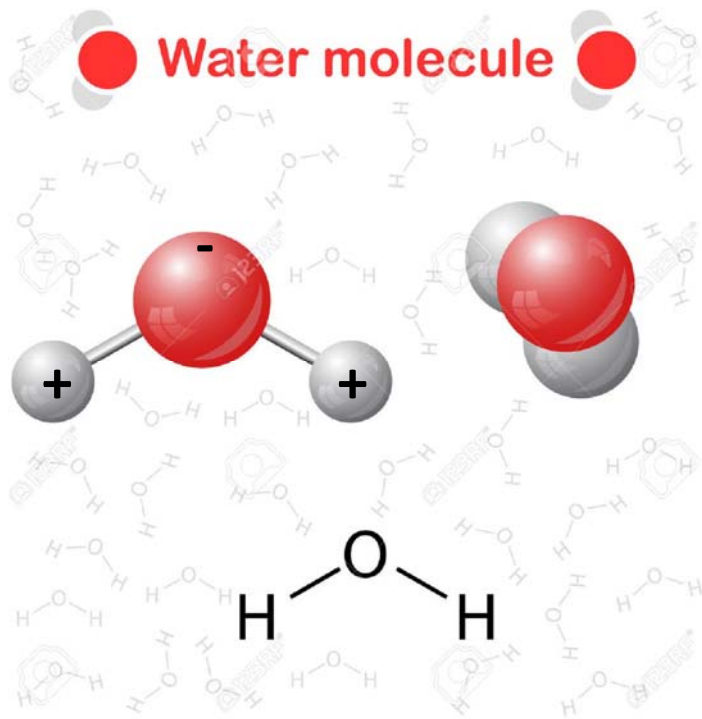


Water

UCI – Environmental Science 101

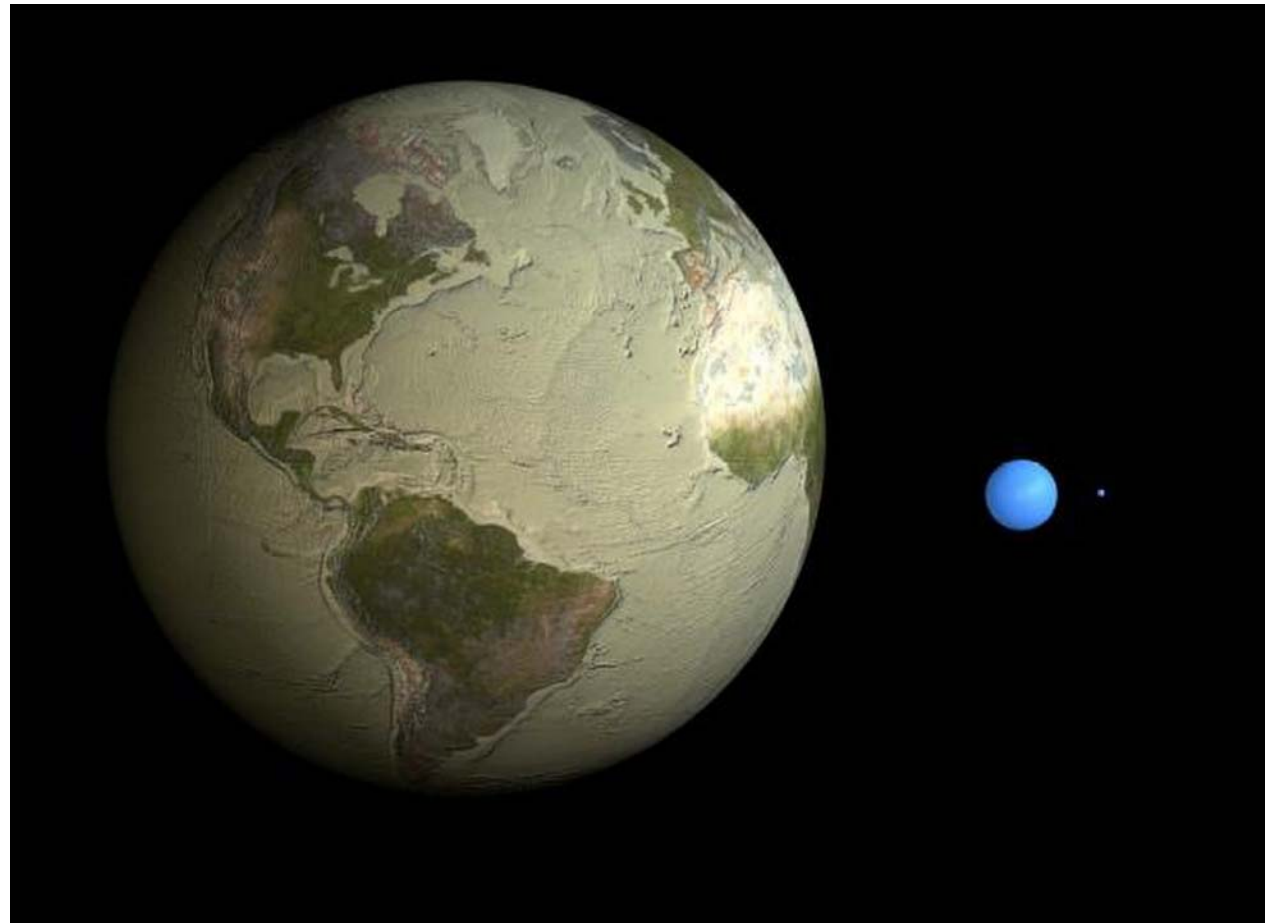
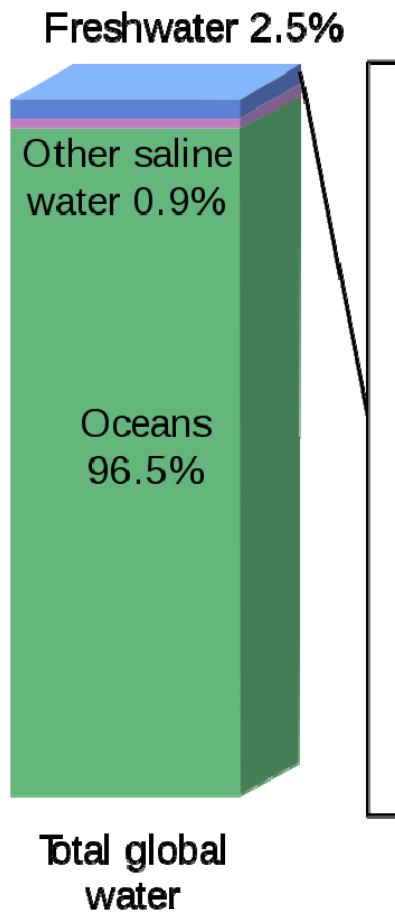
July 2018

Water



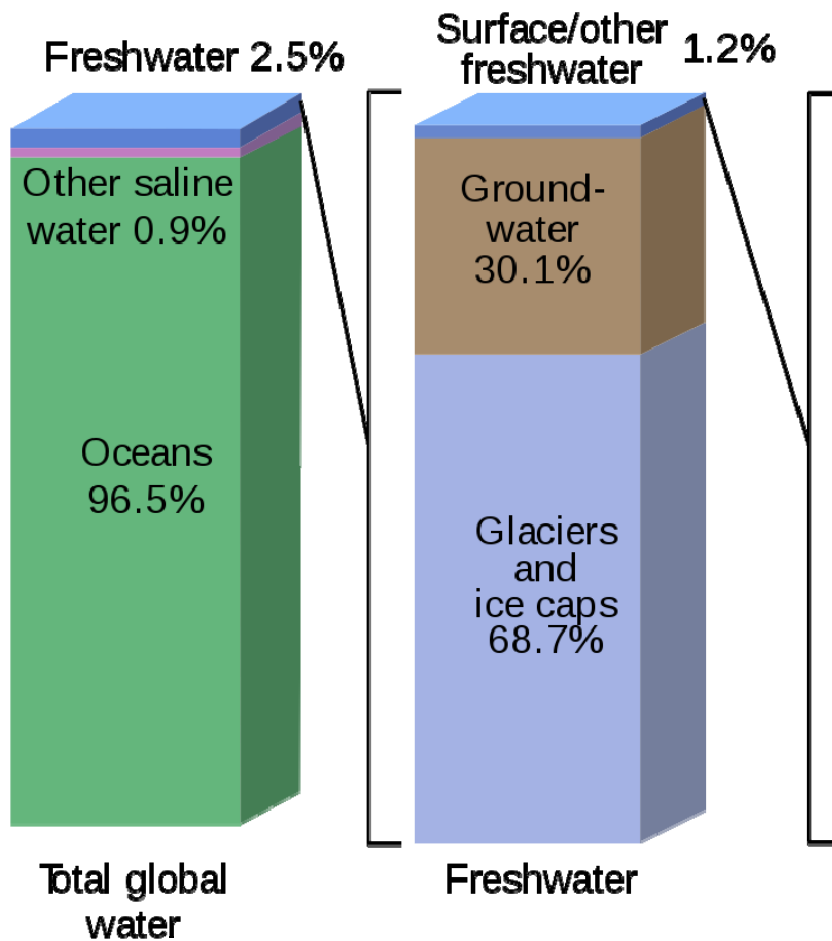
- Water can dissolve non-polar substances, making it the perfect medium for transmitting substances, e.g., phosphates or calcium ions, into and out of a cell
- Exists as solid, liquid and gas within a relatively narrow range of temperatures
- All known life uses water

Where is Earth's water?

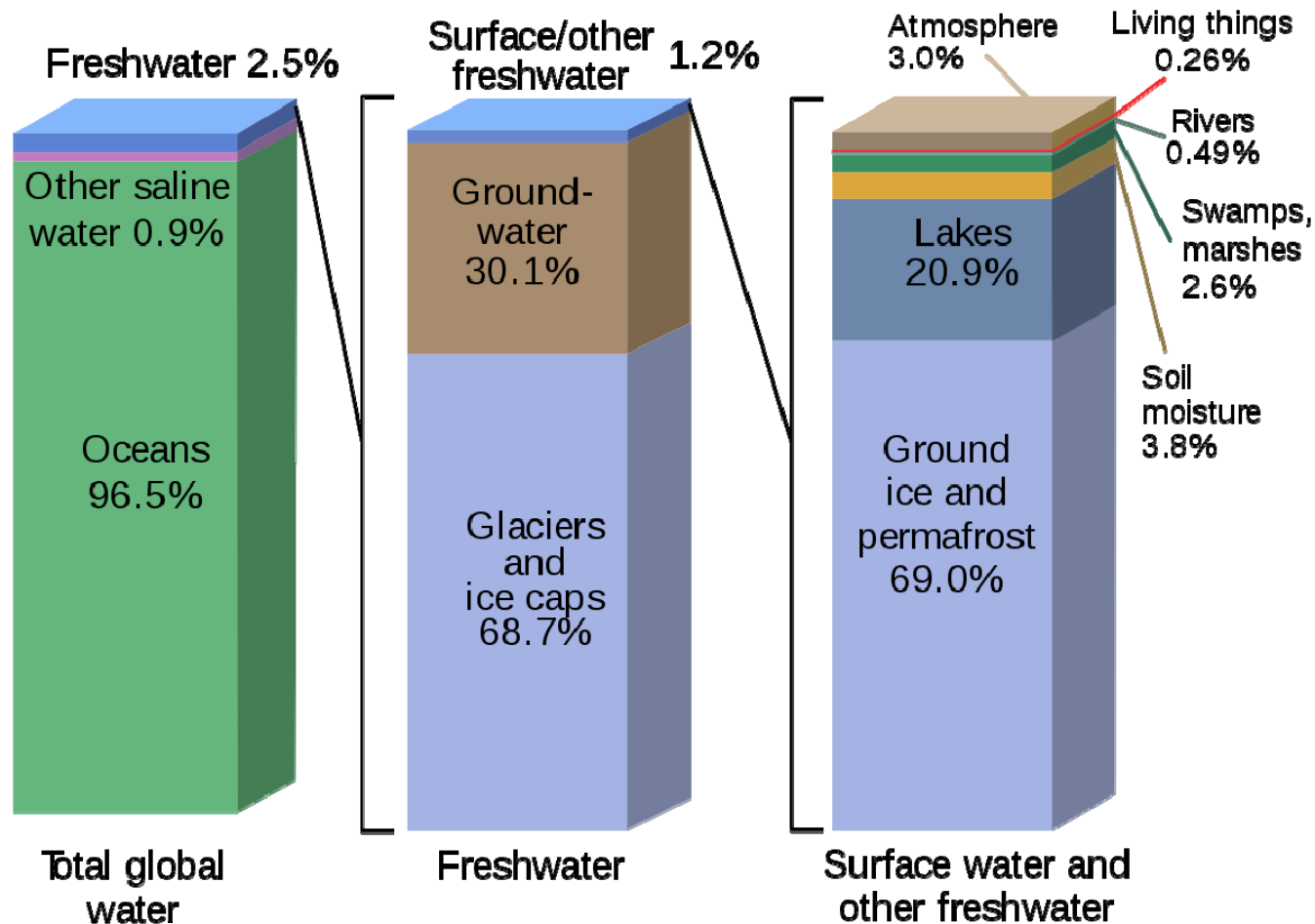


<https://www.livescience.com/29673-how-much-water-on-earth.html>

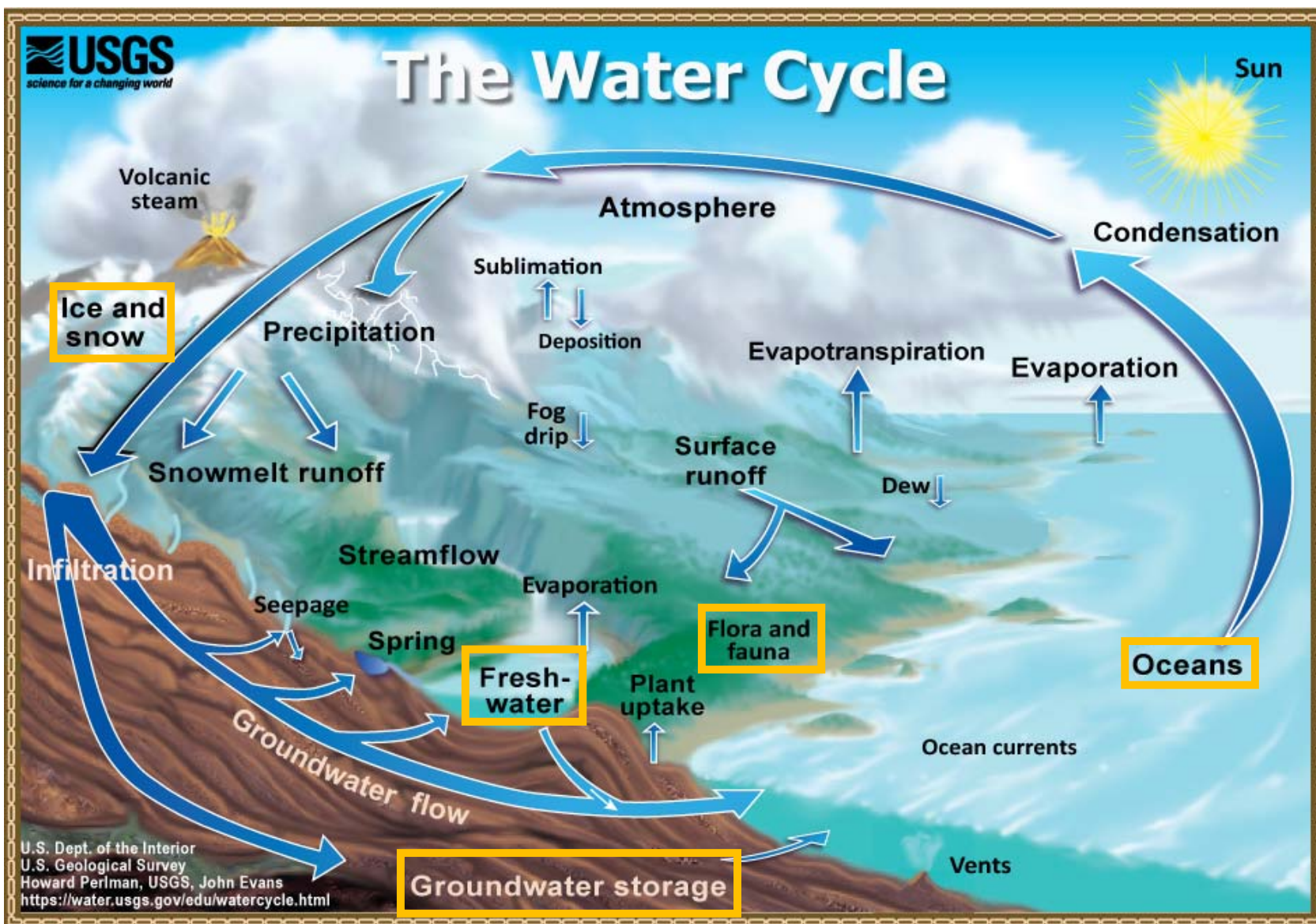
Where is Earth's water?



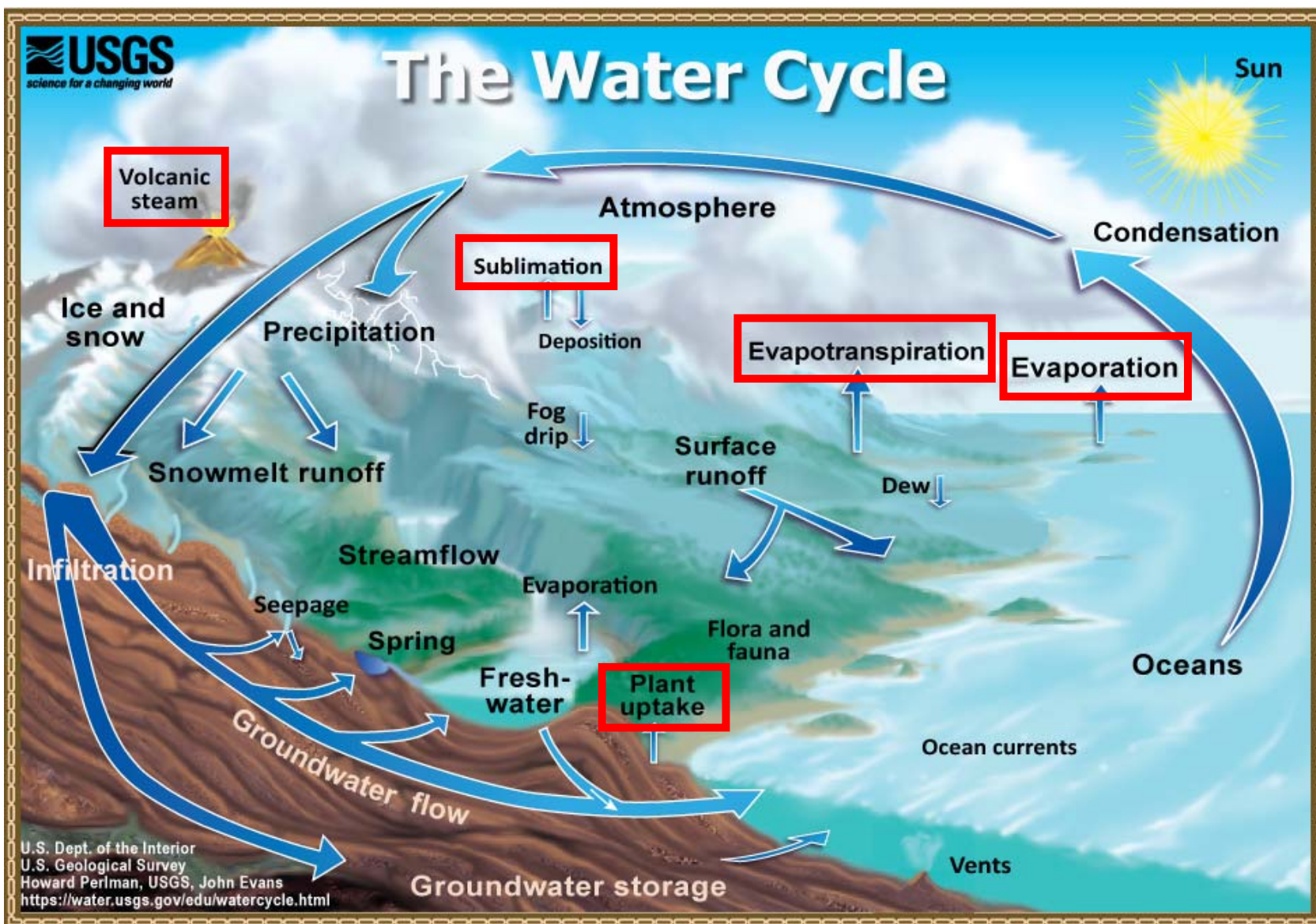
Where is Earth's water?



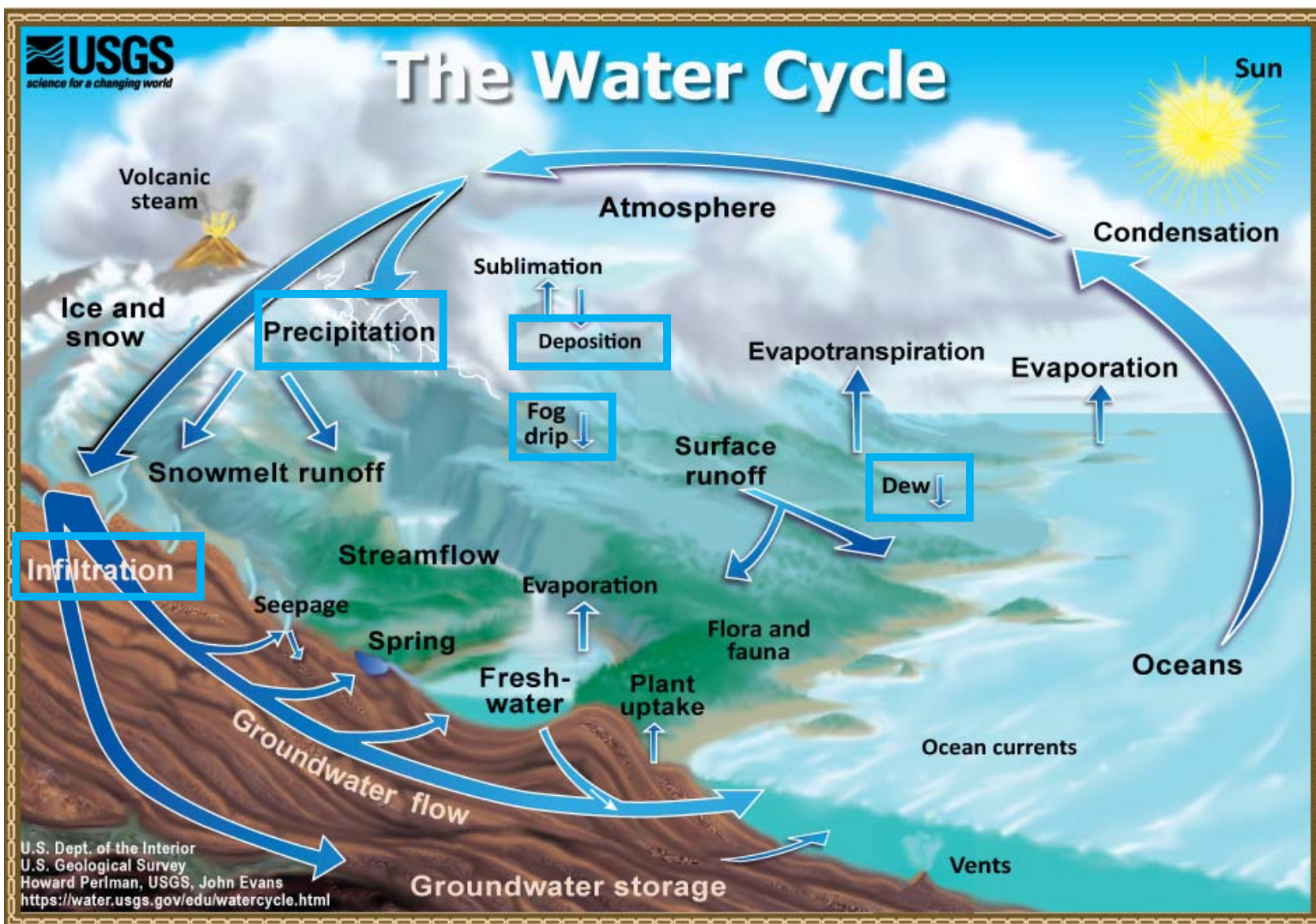
The Water Cycle



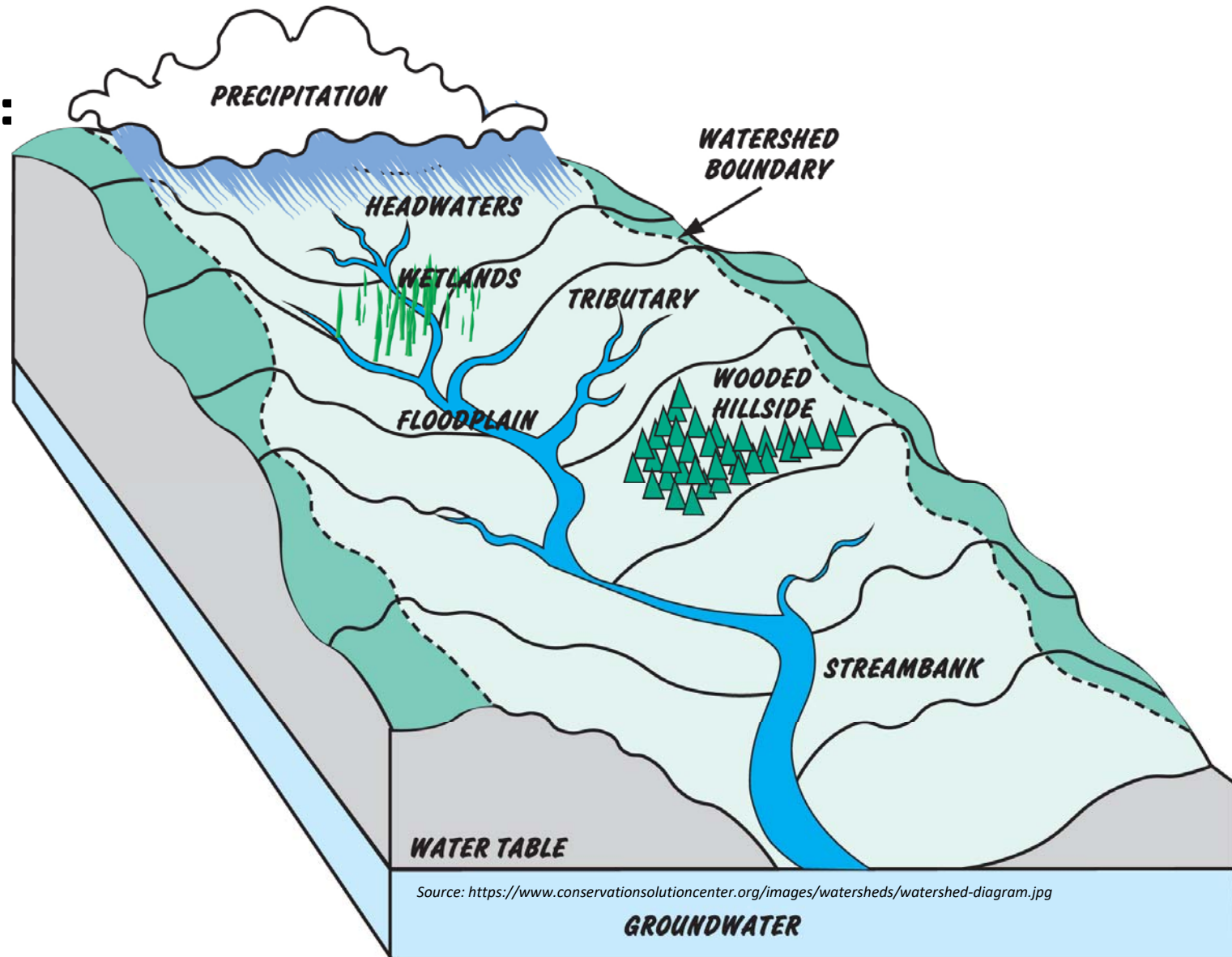
The Water Cycle



The Water Cycle



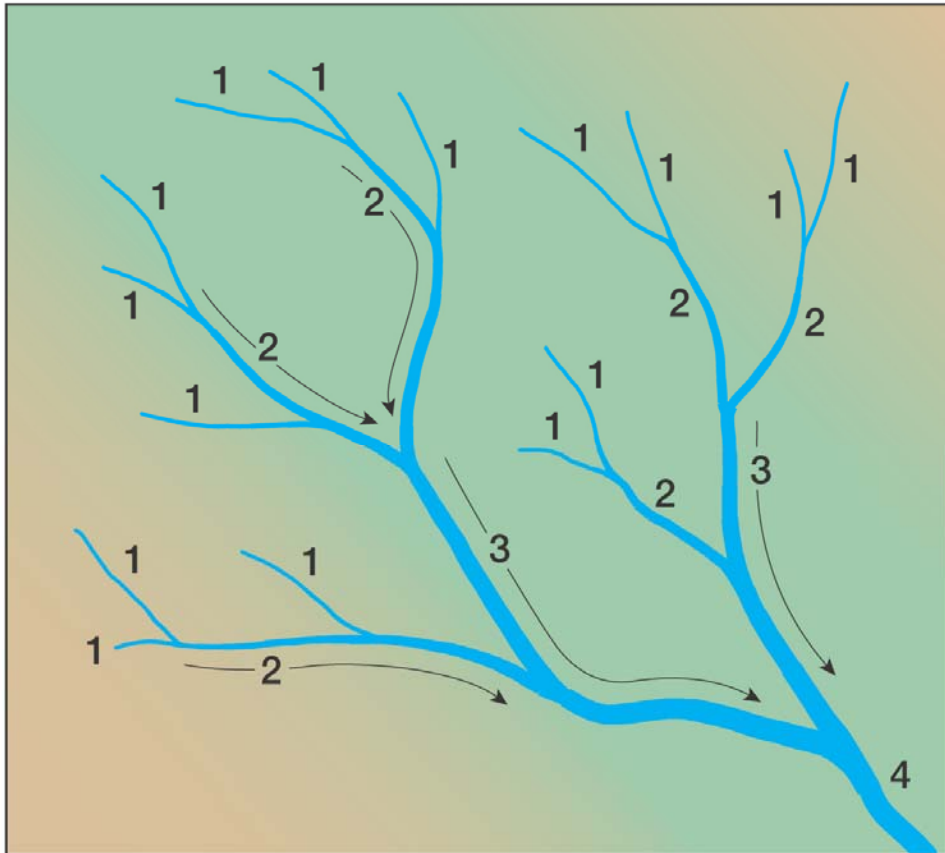
Watershed : Drainage network



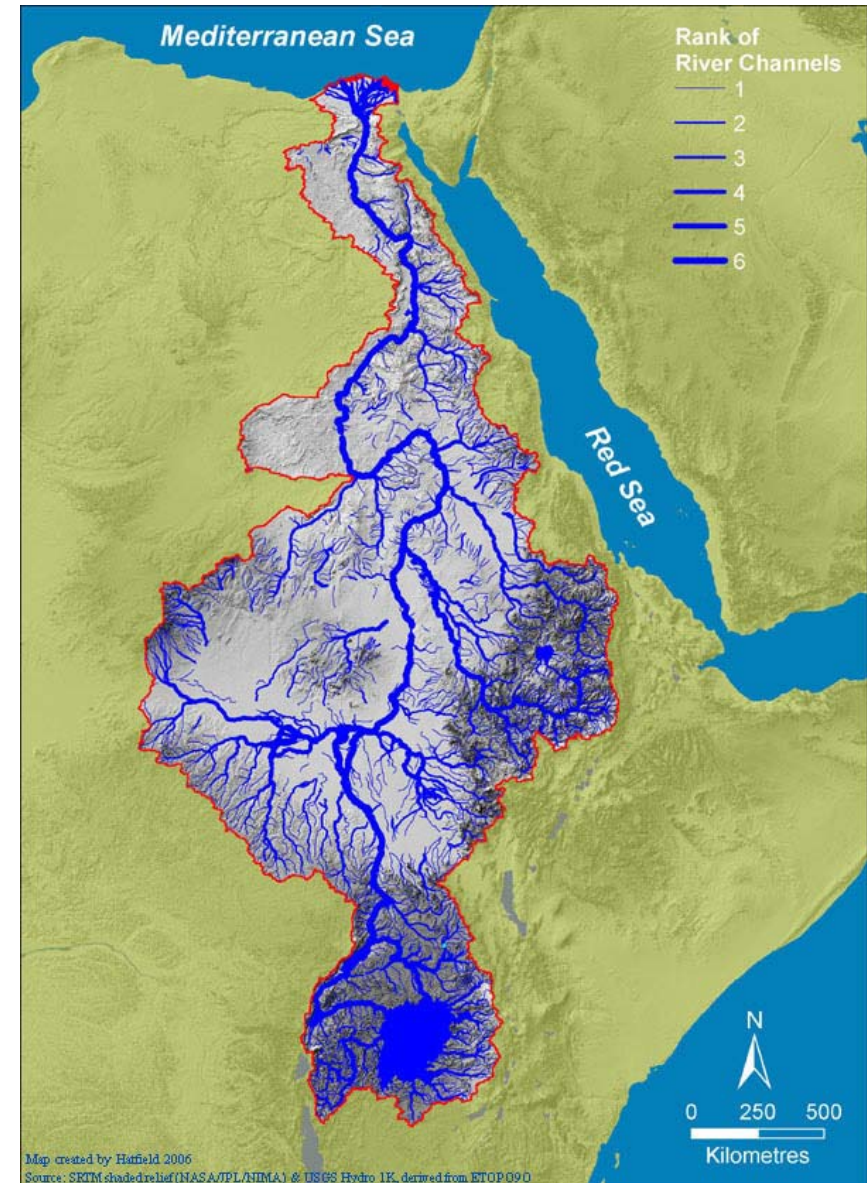
Do you live in a watershed?

Are we currently in a watershed?

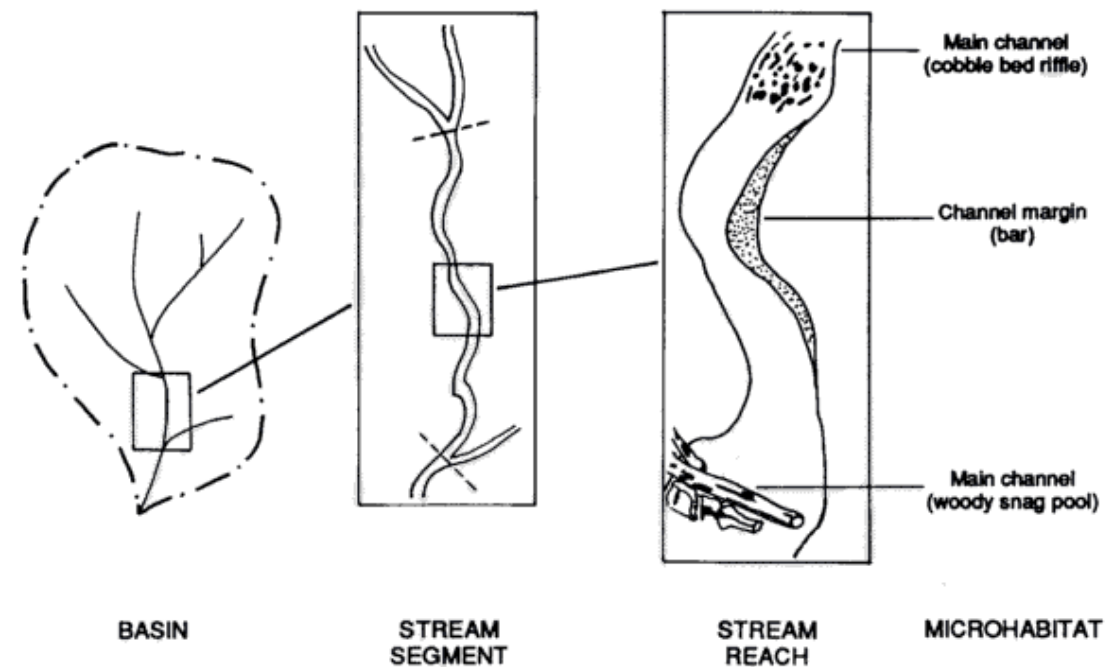
Stream order



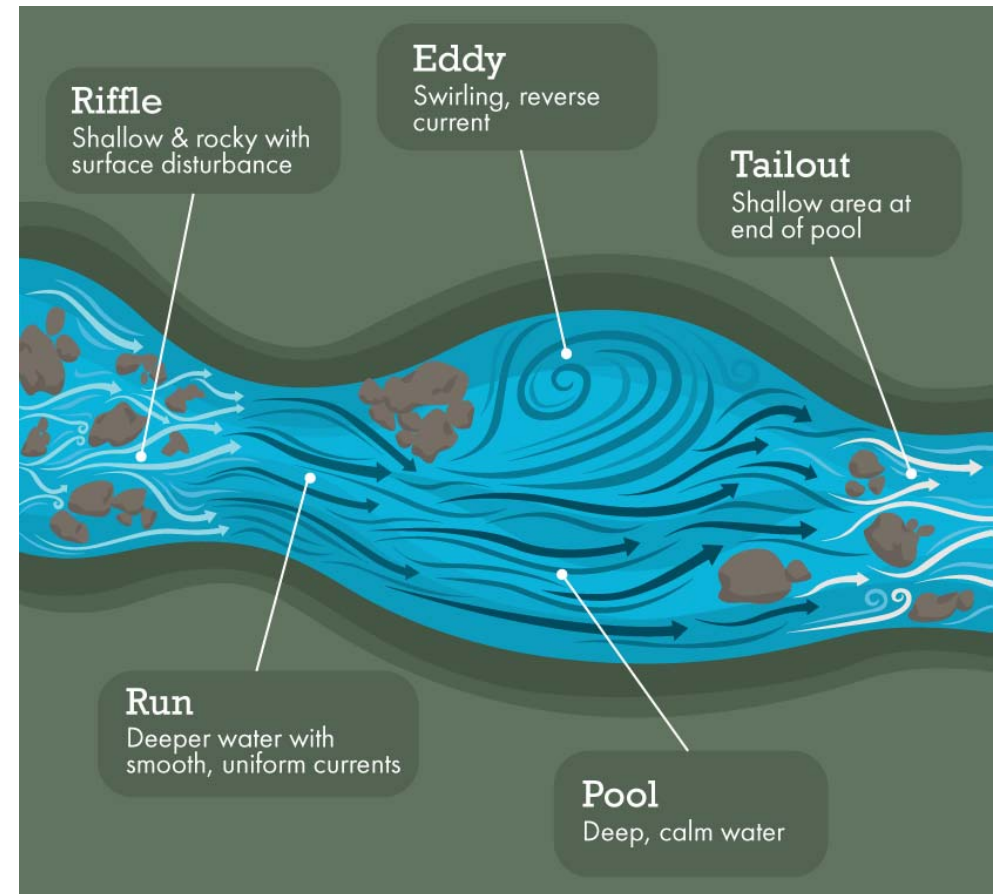
Copyright © 2005 Pearson Prentice Hall, Inc.



Stream hierarchy and anatomy

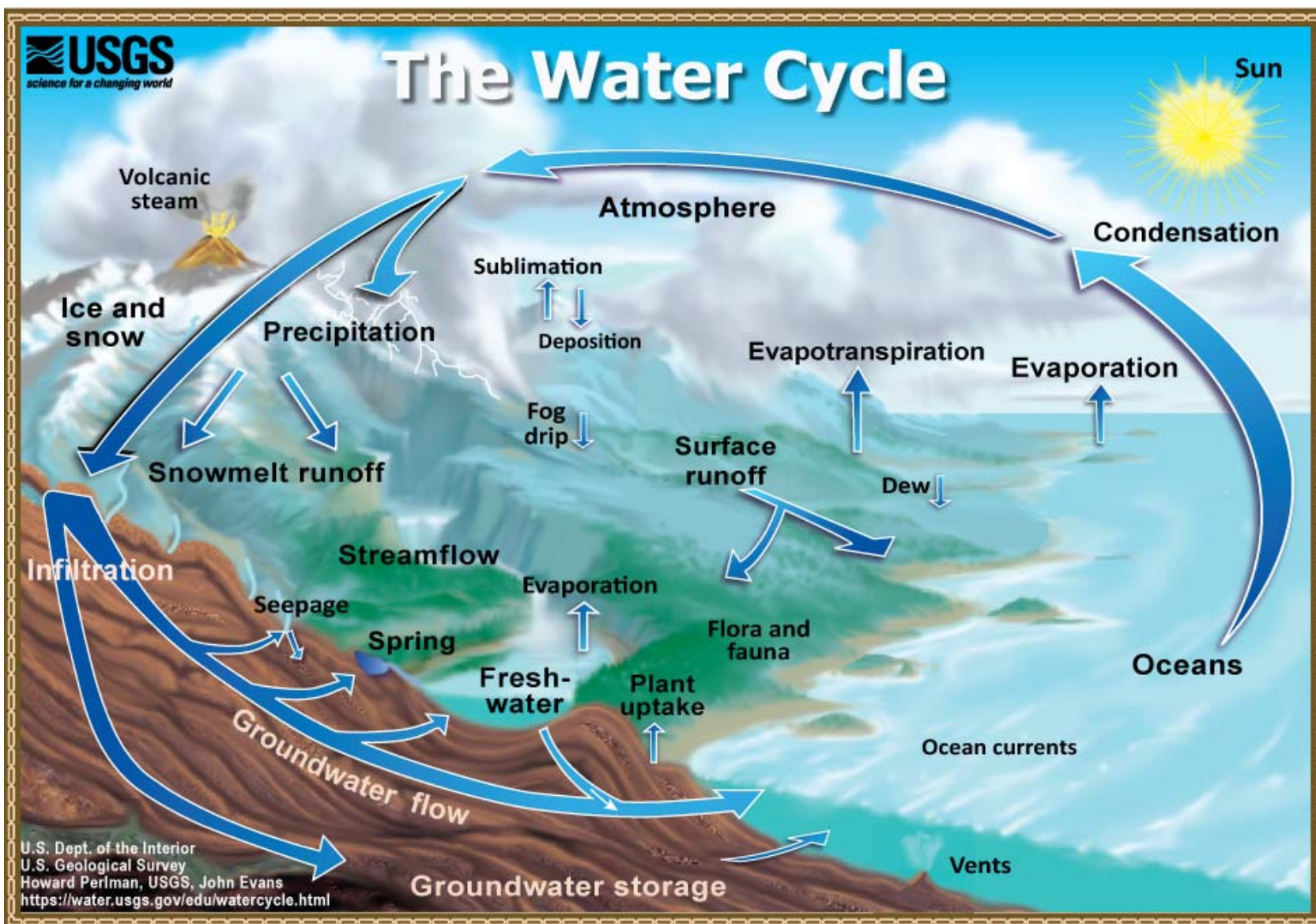


Source: <https://water.usgs.gov/nawqa/protocols/OFR-93-408/page5.gif>



Source: <https://www.fix.com/assets/content/15548/river-sections.png>

The Water Cycle



Where does stream flow come from?

Where does stream flow come from?

$$\text{Precipitation} + \text{Groundwater}_{\text{in}} = \text{Discharge} + \text{Evapotranspiration} + \text{Groundwater}_{\text{out}}$$

- Precipitation: frequency, magnitude, type
- Groundwater: influence of shallow aquifers on stream flows
- Evapotranspiration: $\approx 60\%$ of precipitation is transpired globally

Demo: Groundwater and aquifers

How would flows differ between these river channels?



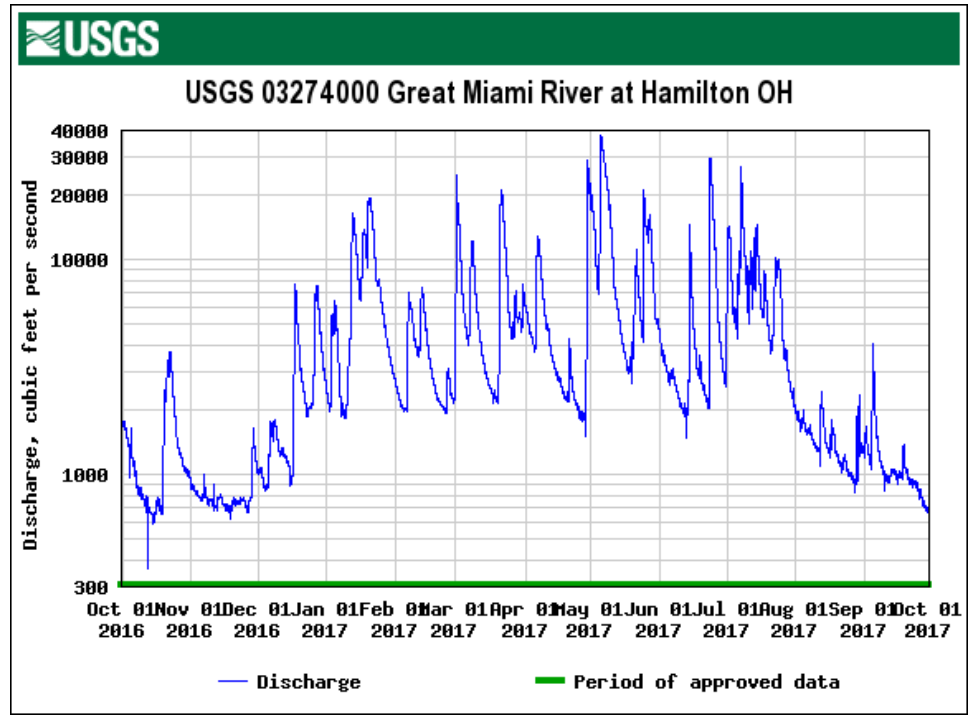
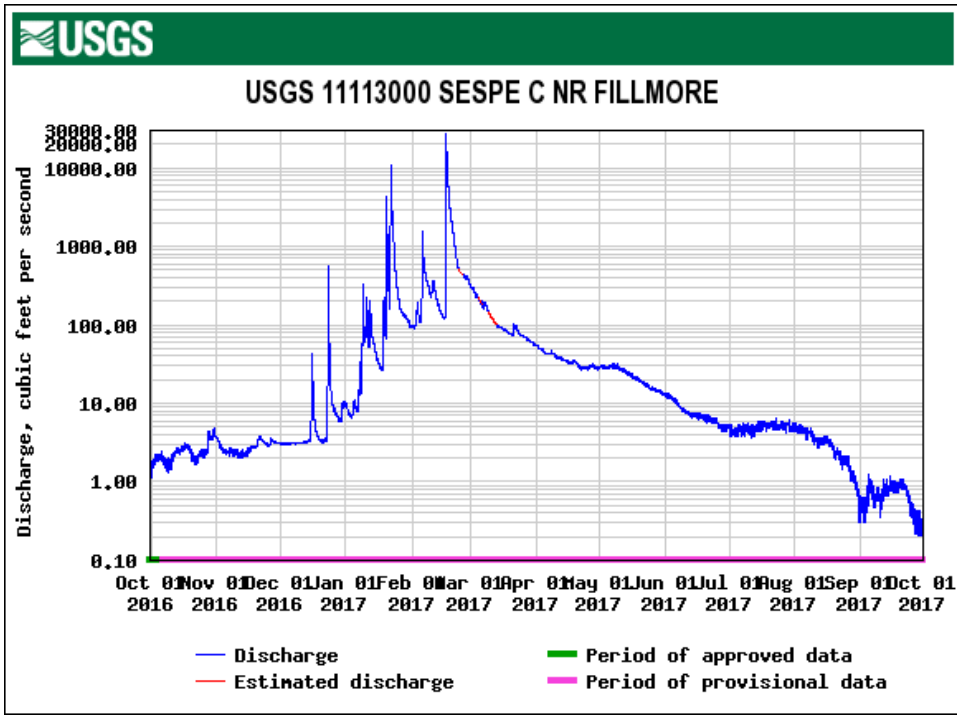
Surface water vs groundwater pathways

- **Infiltration capacity:** Percolation rate determined by soil type and saturation (slowest when grain size is small and soil is unsaturated)
- **Interflow:** Subsurface runoff down slopes
- **Overland flow:** flow in excess of depressional storage capacity
- Gaining and losing reaches are typically linked to groundwater inputs

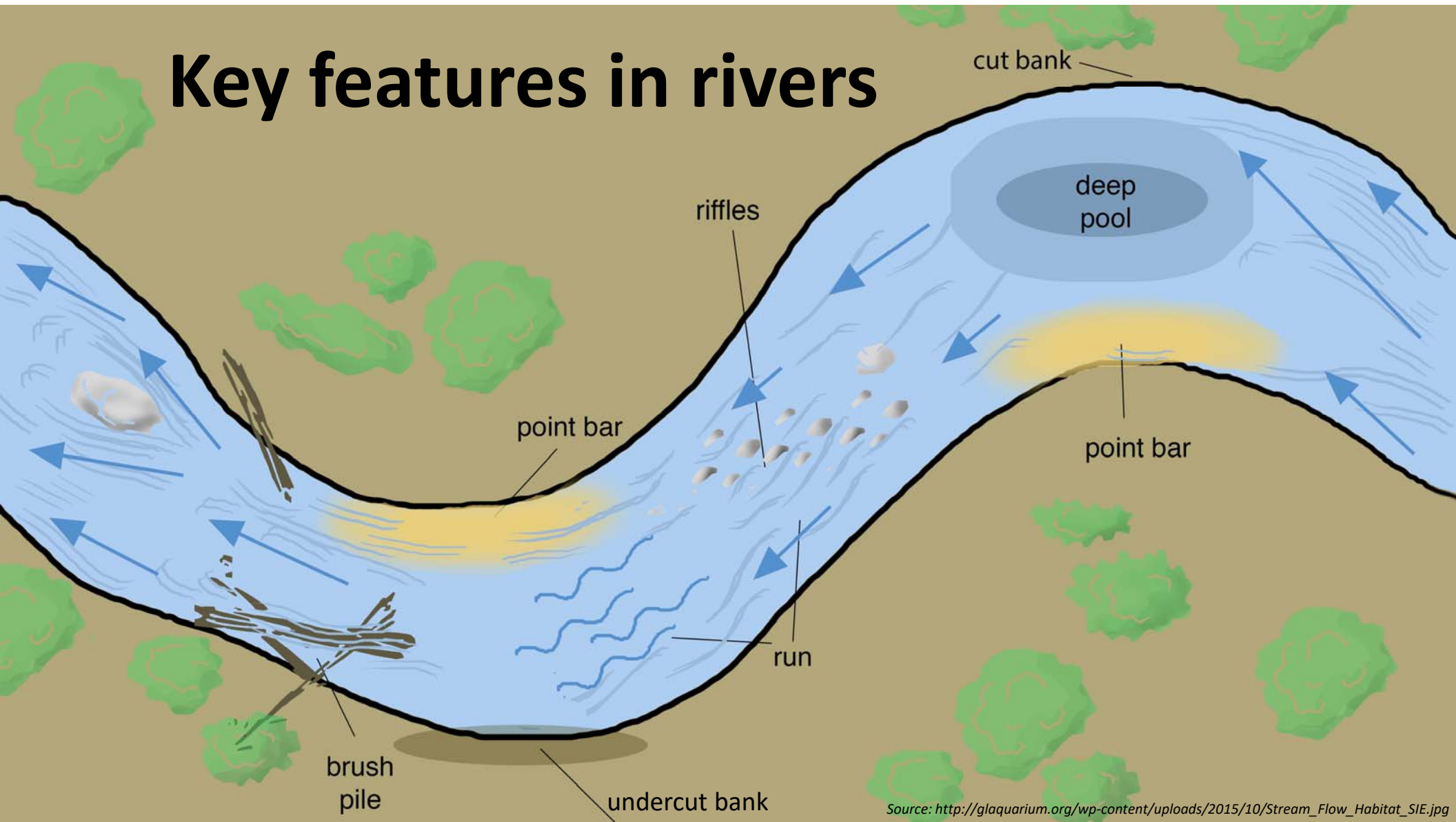
How much water is in a river?



Hydrographs = stream flow over time



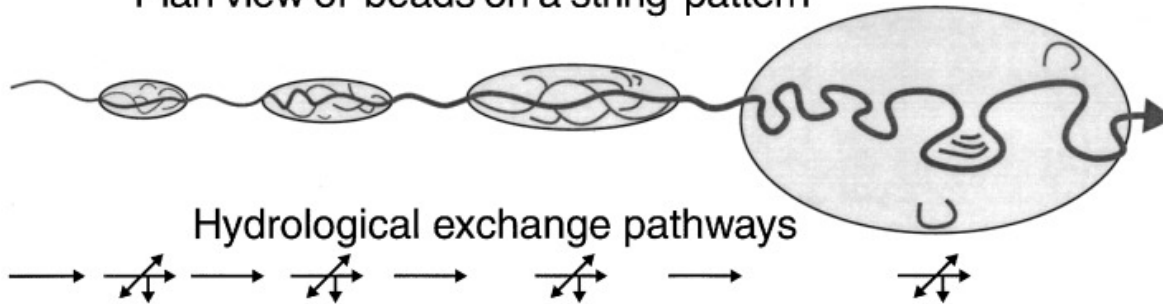
Key features in rivers



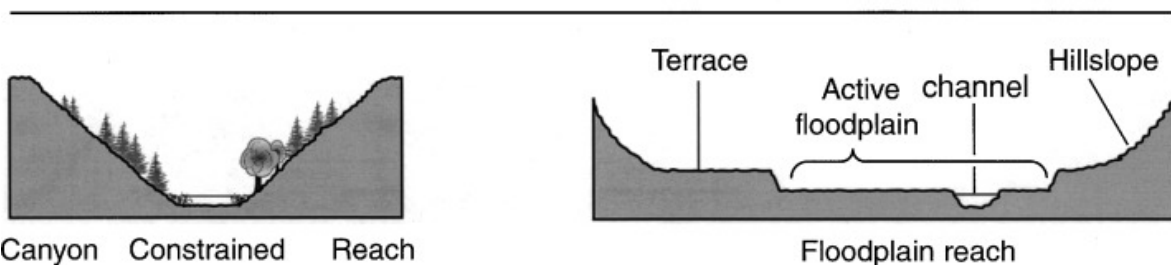
Source: http://glaquarium.org/wp-content/uploads/2015/10/Stream_Flow_Habitat_SIE.jpg

Floodplains and aquifers

Plan view of 'beads on a string' pattern



Longitudinal section of alluvial aquifers



- **Bankfull width:** level of the river when just overflowing banks
- Typically 1-2 yr recurrence interval
- River constructs a channel large enough to contain the most frequent flows

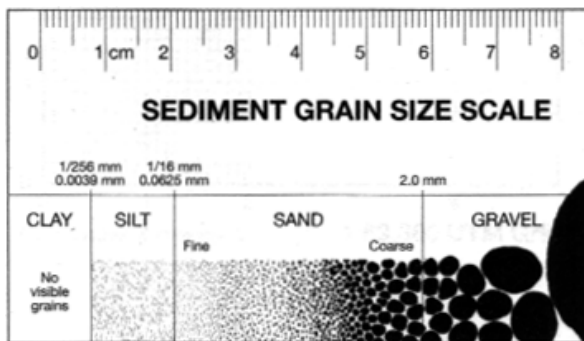
Source:
https://www.researchgate.net/profile/Klement_Tockner3/publication/227497608/figure/fig12/AS:267885788528740@1440880357913/Figure-1-Idealised-configuration-of-a-river-corridor-as-an-alternating-sequence-of.png

Transport and erosion

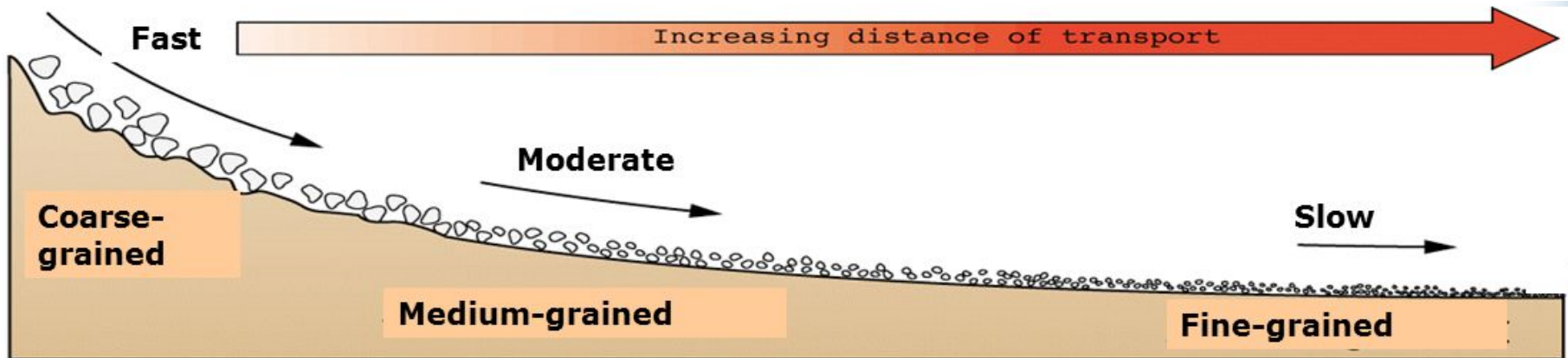
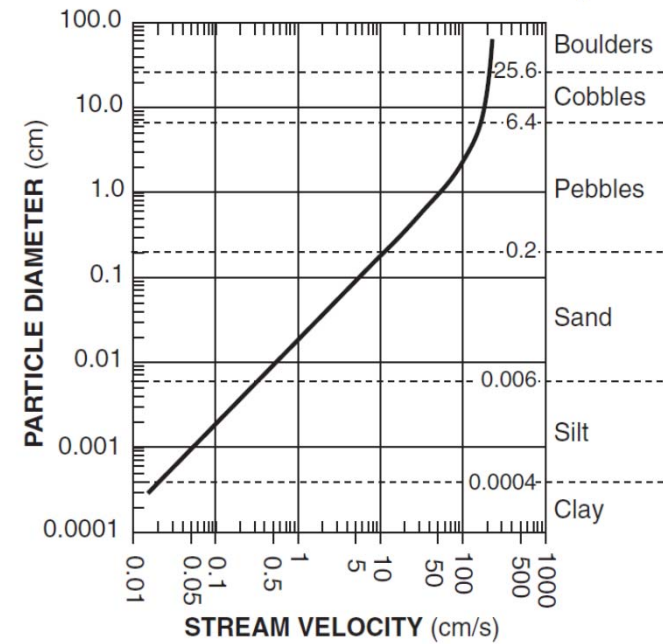


How does particle size relate to erosion?

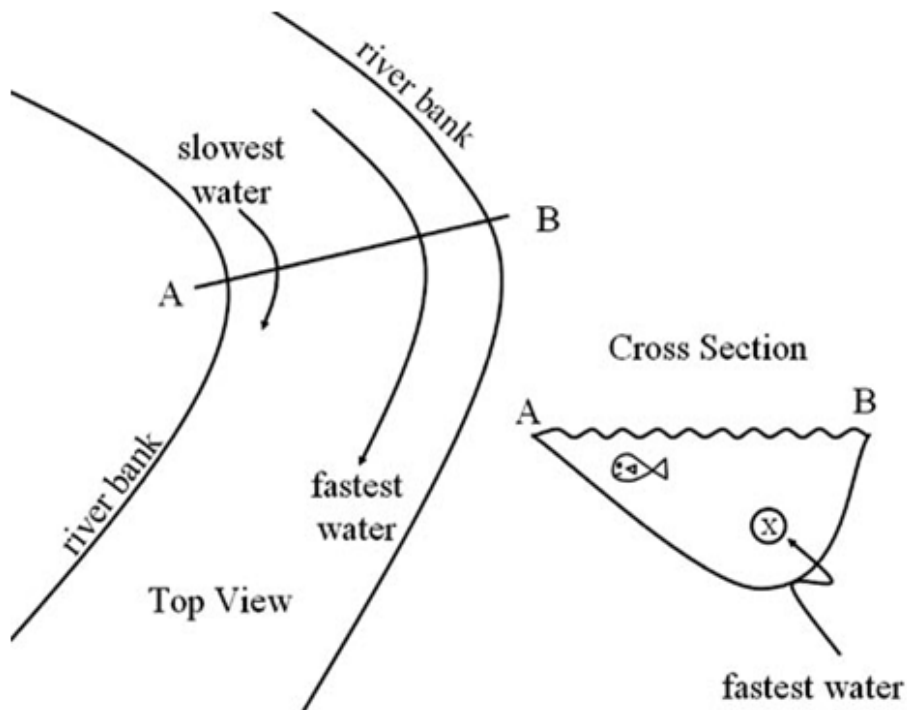
Sediment transport



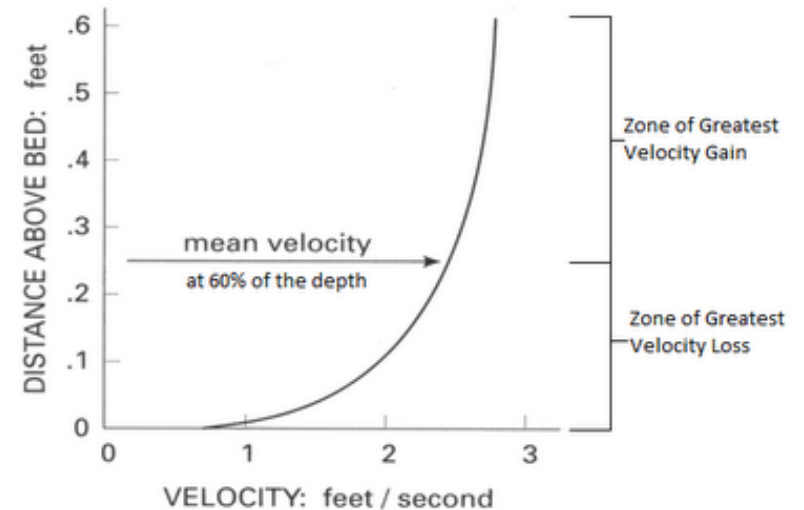
Relationship of Transported Particle Size to Water Velocity



Erosion and deposition



Depth vs. Velocity Profile

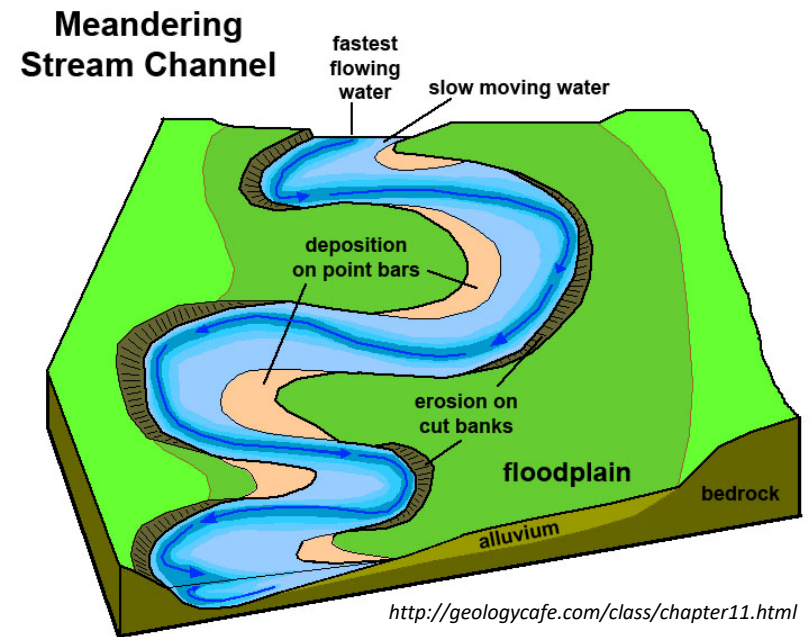


Source: <http://ksuweb.kennesaw.edu/~jdinber/limno/LecStream/velocity%20profile.png>

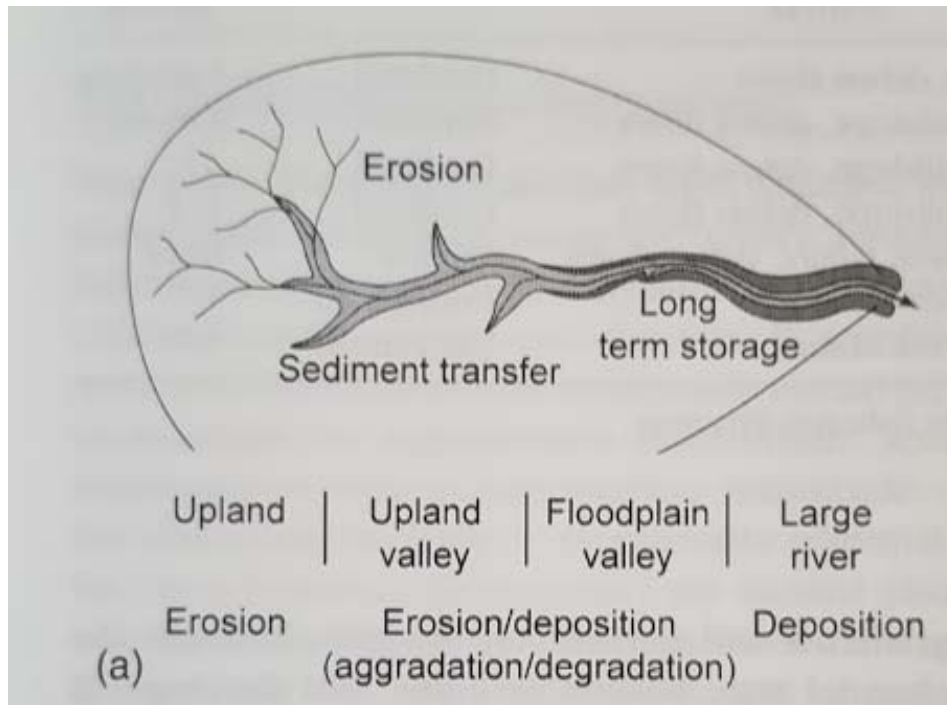
Erosion



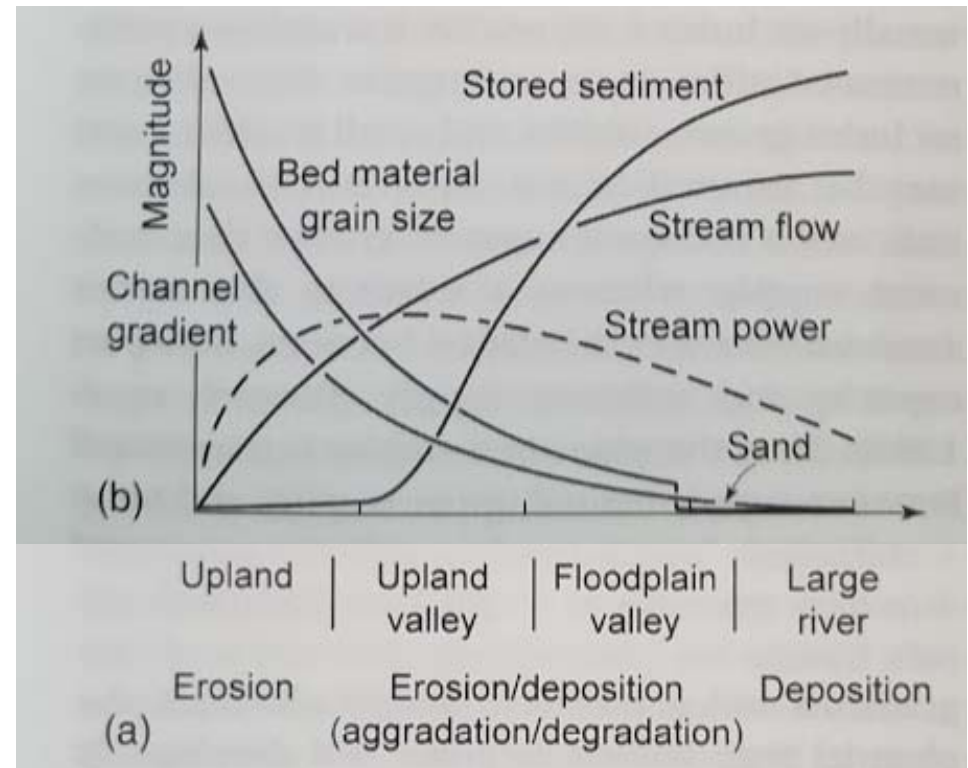
<https://conservationdistrict.org/tag/riparian>



Sediment transport and storage

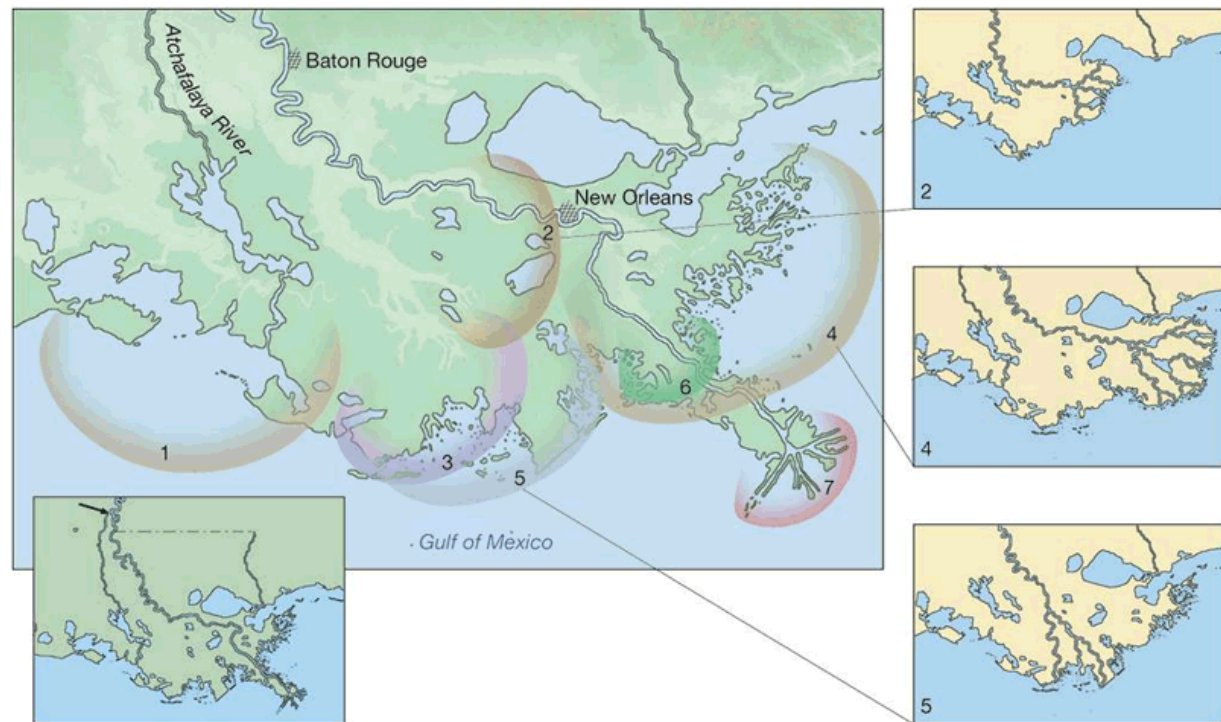
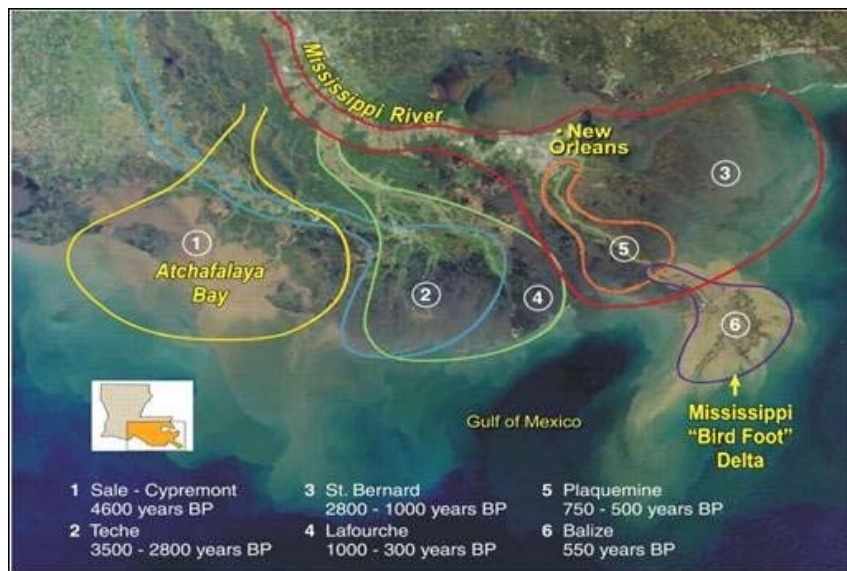


Source: Allan and Castillo 2008



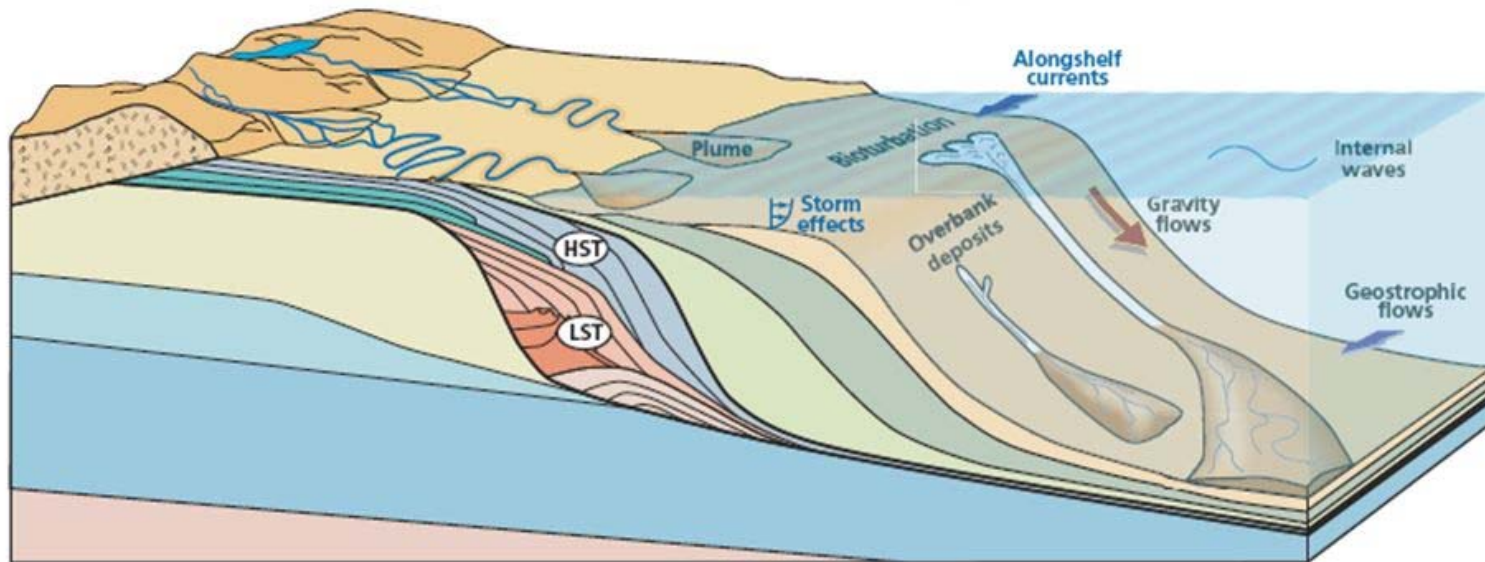
River deltas

River deltas



Sediment transport: headwaters to ocean

SOURCE-TO-SINK (S2S) CONCEPT



Source: <http://slideplayer.com/8935899/27/images/2/SOURCE-TO-SINK+%28S2S%29+CONCEPT.jpg>

What happens when a river is sediment “starved”?



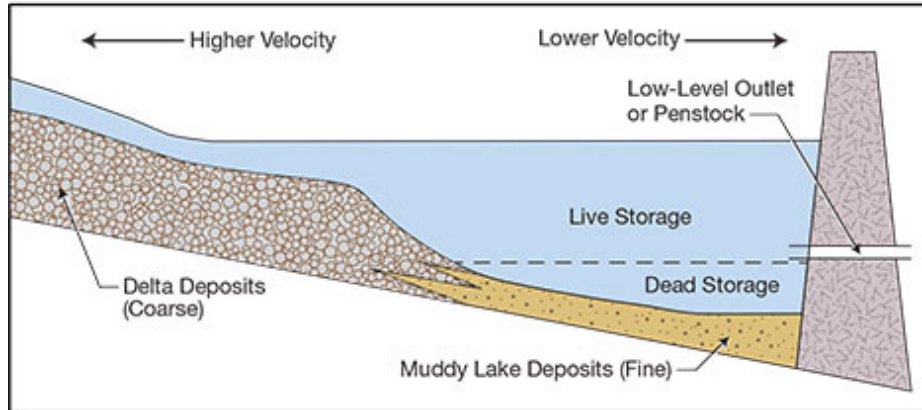
Source: <https://www.nps.gov/grca/learn/nature/images/Comparison2.jpg>



Source: http://www.azwater.gov/azdwr/images/Glen_Canyon_Dam_Contribute.jpg

What are the consequences for reservoirs?

Figure 1 — Typical Reservoir Sediment Profile*



Typically, sedimentation in the reservoir behind a dam takes the form of progressively finer materials being deposited as the flows approach the dam.

*Adapted from Morris, G.L. and J. Fan, *Reservoir Sedimentation Manual*, McGraw-Hill, New York, 1998.



1701HRWdon_z01

What else goes downstream?