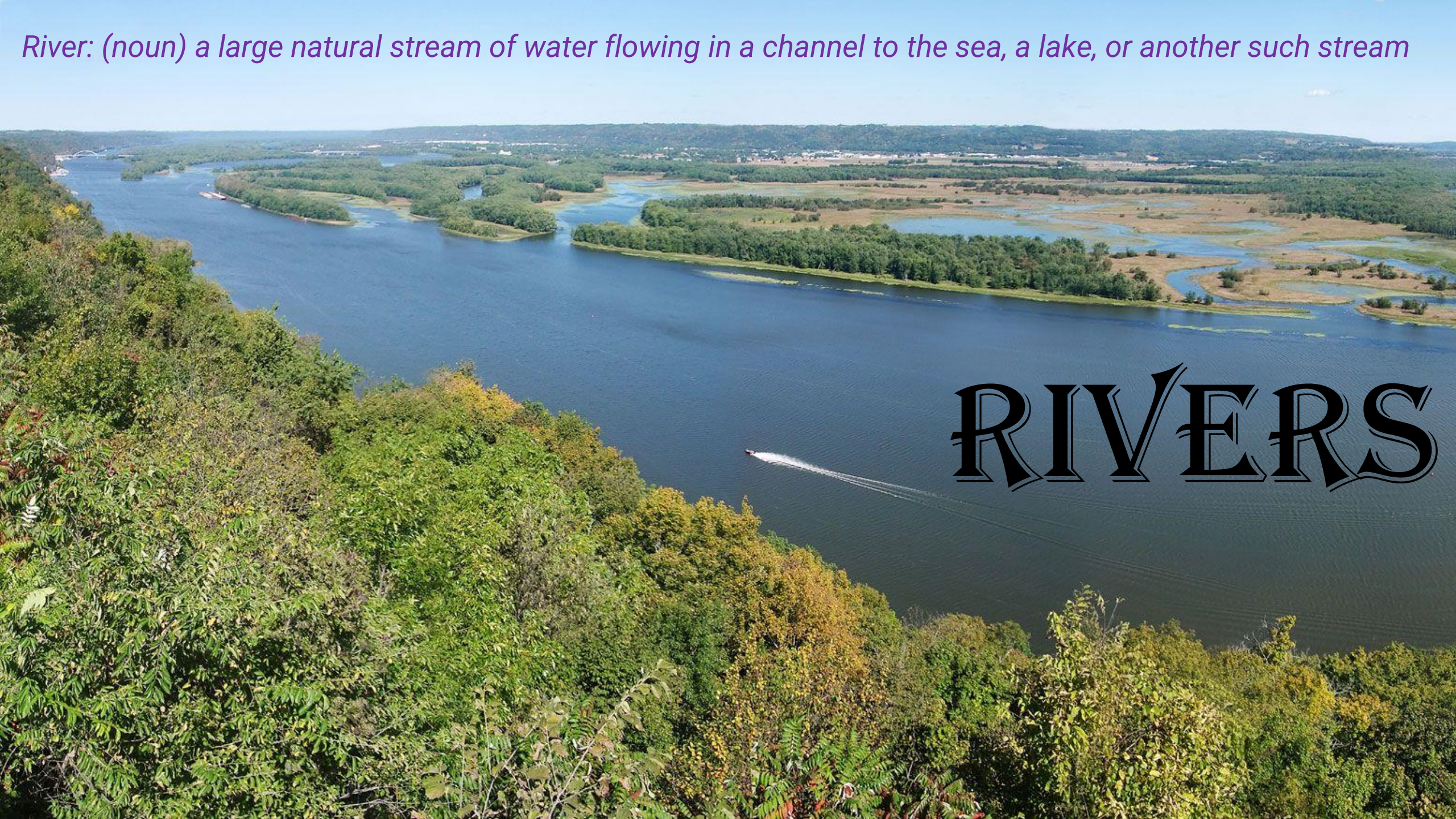
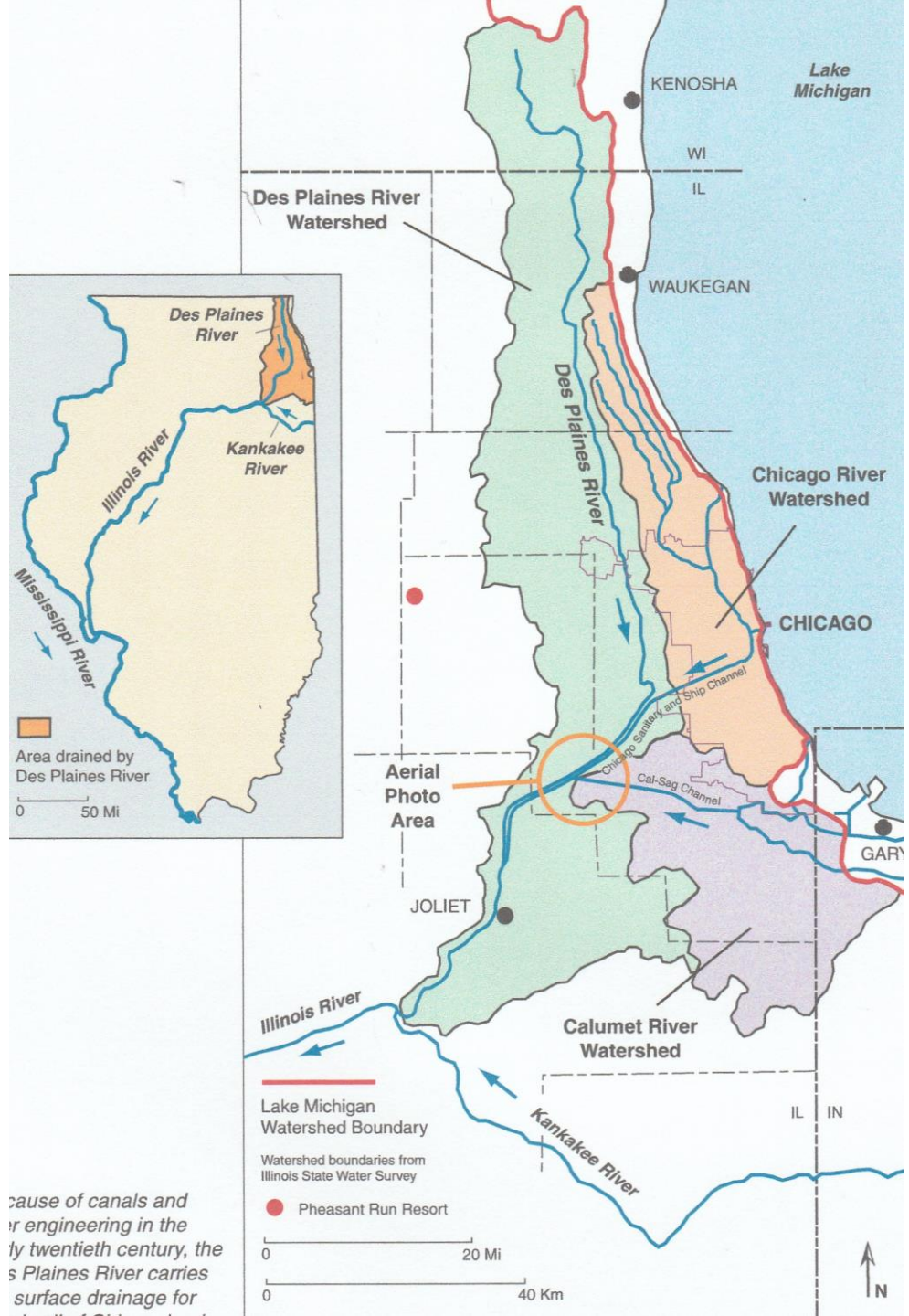
River: (noun) a large natural stream of water flowing in a channel to the sea, a lake, or another such stream





cause of canals and
r engineering in the
ly twentieth century, the
s Plaines River carries
surface drainage for


CANADA
Columbia River
Missouri River
Colorado River
Mississippi River
Hudson River
Rio Grande
MEXICO
Yukon River
CUBA

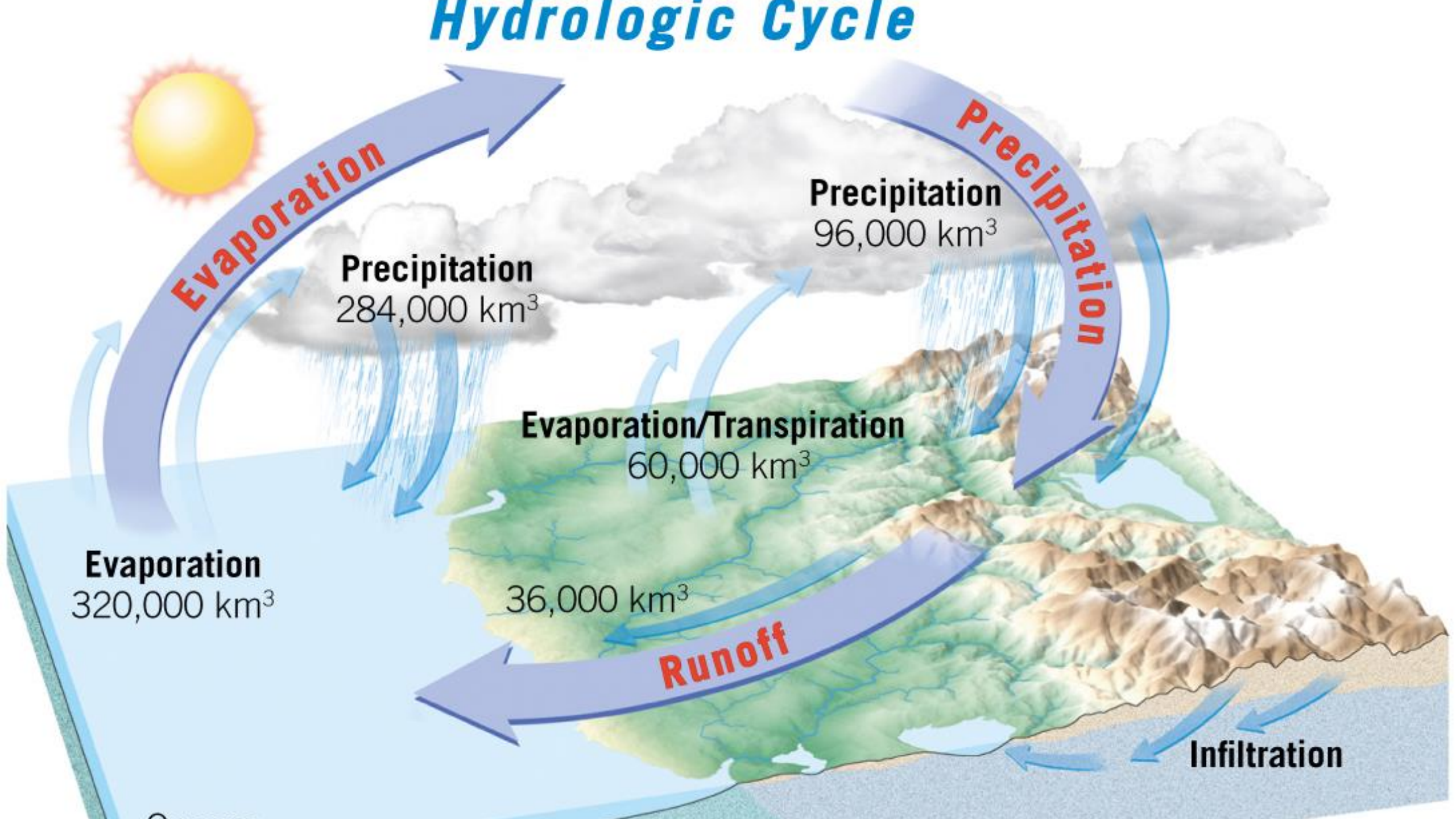
Continental Divide of North America

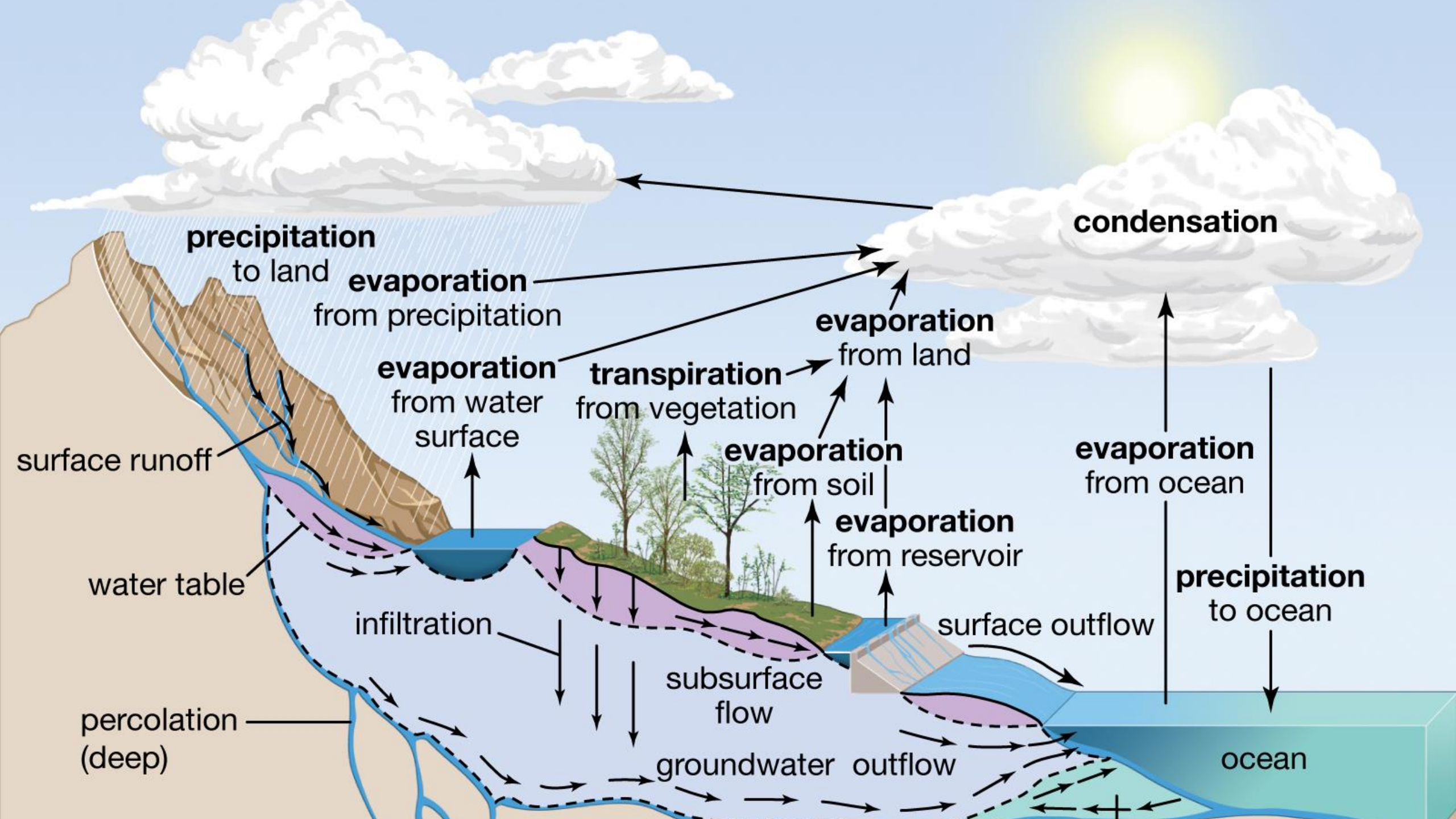

0 100 200 300 MILES
0 100 200 300 KILOMETERS
Base modified from U.S. Geological Survey data
WYOMING
Green River
Cheyenne
Yampa River
Salt Lake City
Green River
Colorado River
Denver
NEVADA
UTAH
UPPER BASIN
COLORADO
Glen Canyon Dam
Lees Ferry
San Juan River
Hoover Dam
Virgin R
Grand Canyon
CALIFORNIA
Las Vegas
Colorado R
Little Colorado R
Santa Fe
Albuquerque
LOWER BASIN
NEW MEXICO
ARIZONA
Los Angeles
All American Canal
Phoenix
Salt River
Gila River
San Diego
Gila River
Santa Cruz R
San Pedro R
Yuma
Tucson
PACIFIC OCEAN
Gulf of California
MEXICO

River	Continent	Length (miles to source of longest tributary, approx.)	Discharge (cu. meters per second)	Distinction
Nile	Africa	4,180	1,584	Egyptian agriculture depended on seasonal flooding.
Amazon	South America	3,920	180,000	Largest Discharge navigable for 2,000 miles
Yangtze (Chang Jiang)	Asia	3,964	35,000	the lifeline of China
Mississippi- - Missouri	North America	3,870	17,545	the longest river flowing southward

Hydrologic Cycle

Hydrologic Cycle




condensation
precipitation
to land
evaporation
from precipitation
evaporation
from water
surface
transpiration
from vegetation
evaporation
from land
evaporation
from soil
evaporation
from reservoir
evaporation
from ocean
precipitation
to ocean
surface runoff
water table
infiltration
surface outflow
subsurface
flow
percolation
(deep)
groundwater outflow
ocean

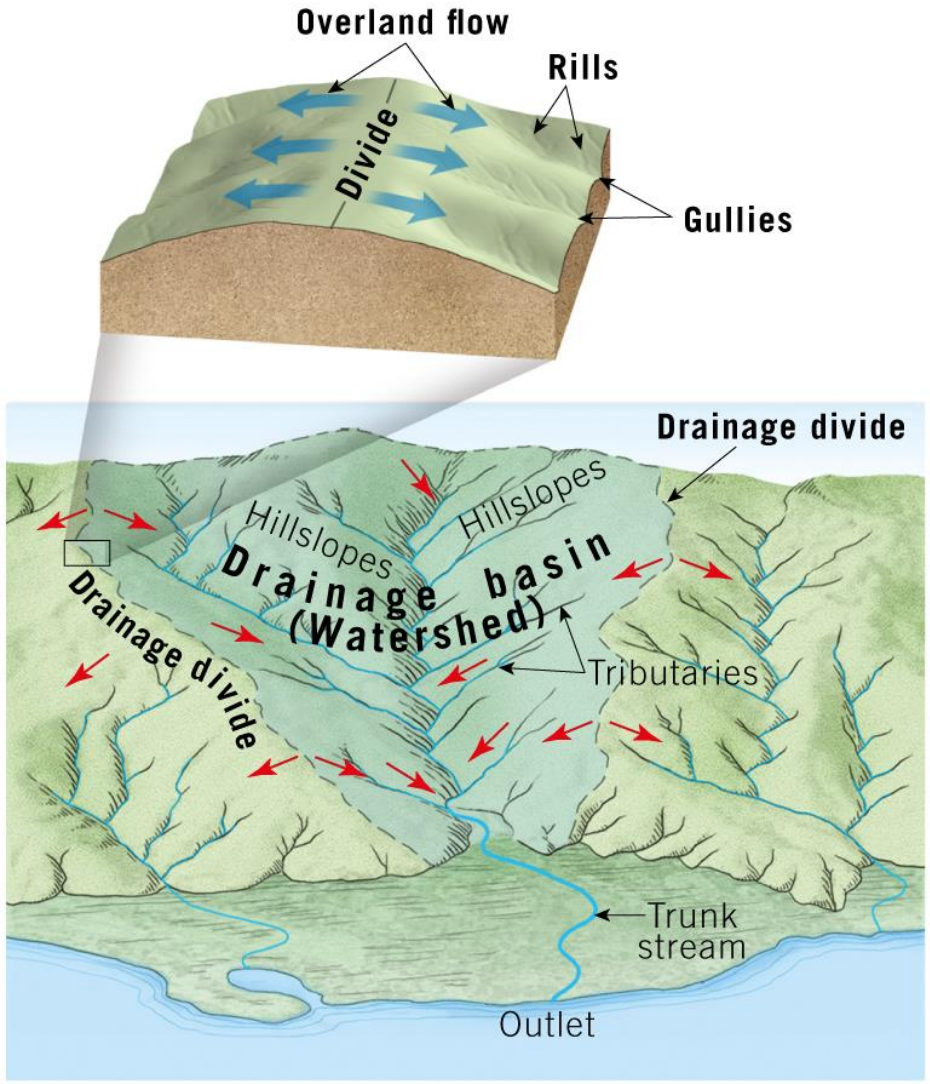
Hydrologic Cycle

- Precipitation Exceeds Evaporation Over Land
- Evaporation Exceeds Precipitation Over the Ocean
- Excess water that falls on land flows to the sea maintaining equilibrium.

Amount of Runoff Depends On…

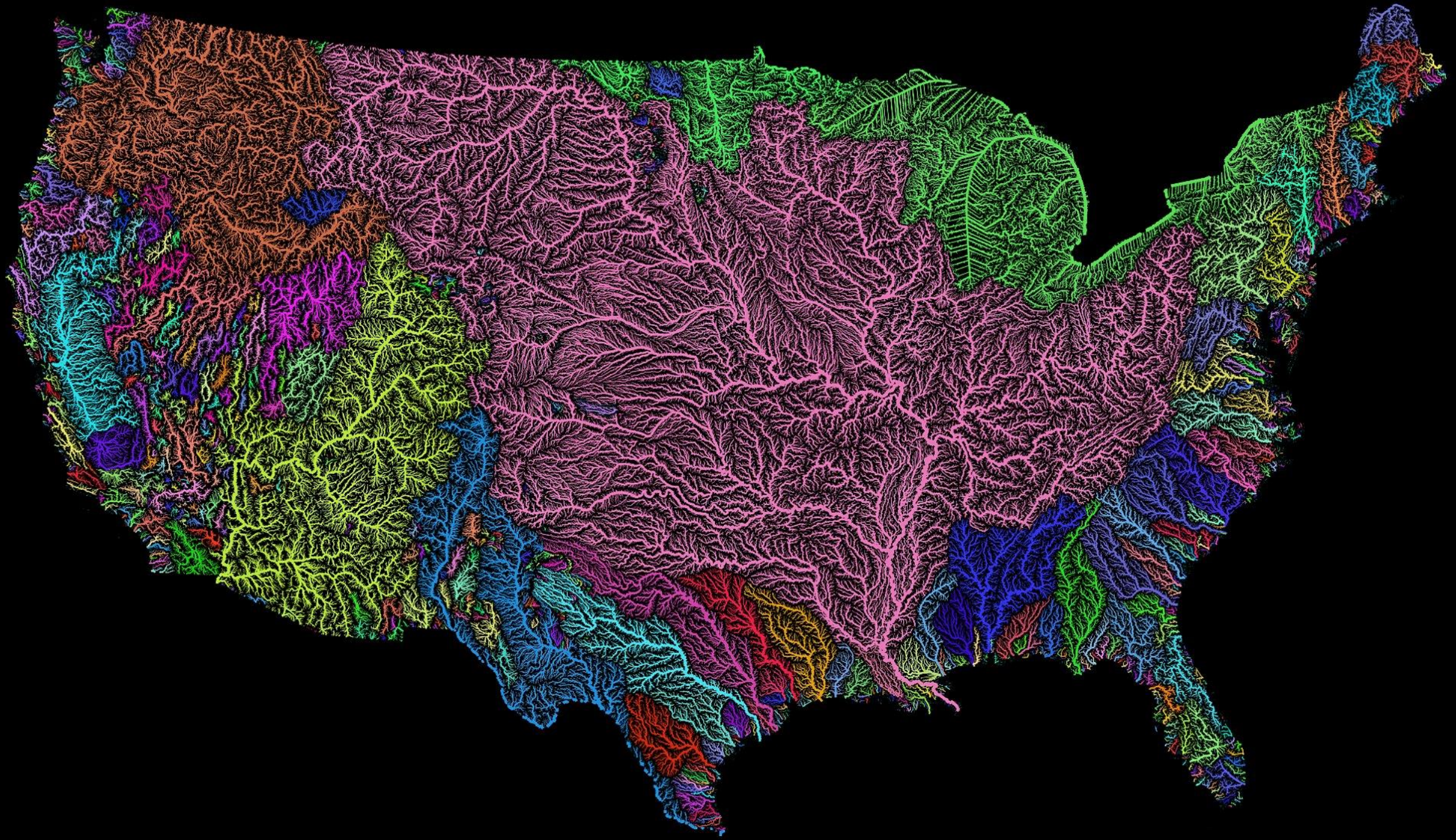
- Intensity and duration of rainfall
- Amount of water already in the soil
- Nature of the surface material
- Slope of the land
- Extent and type of vegetation

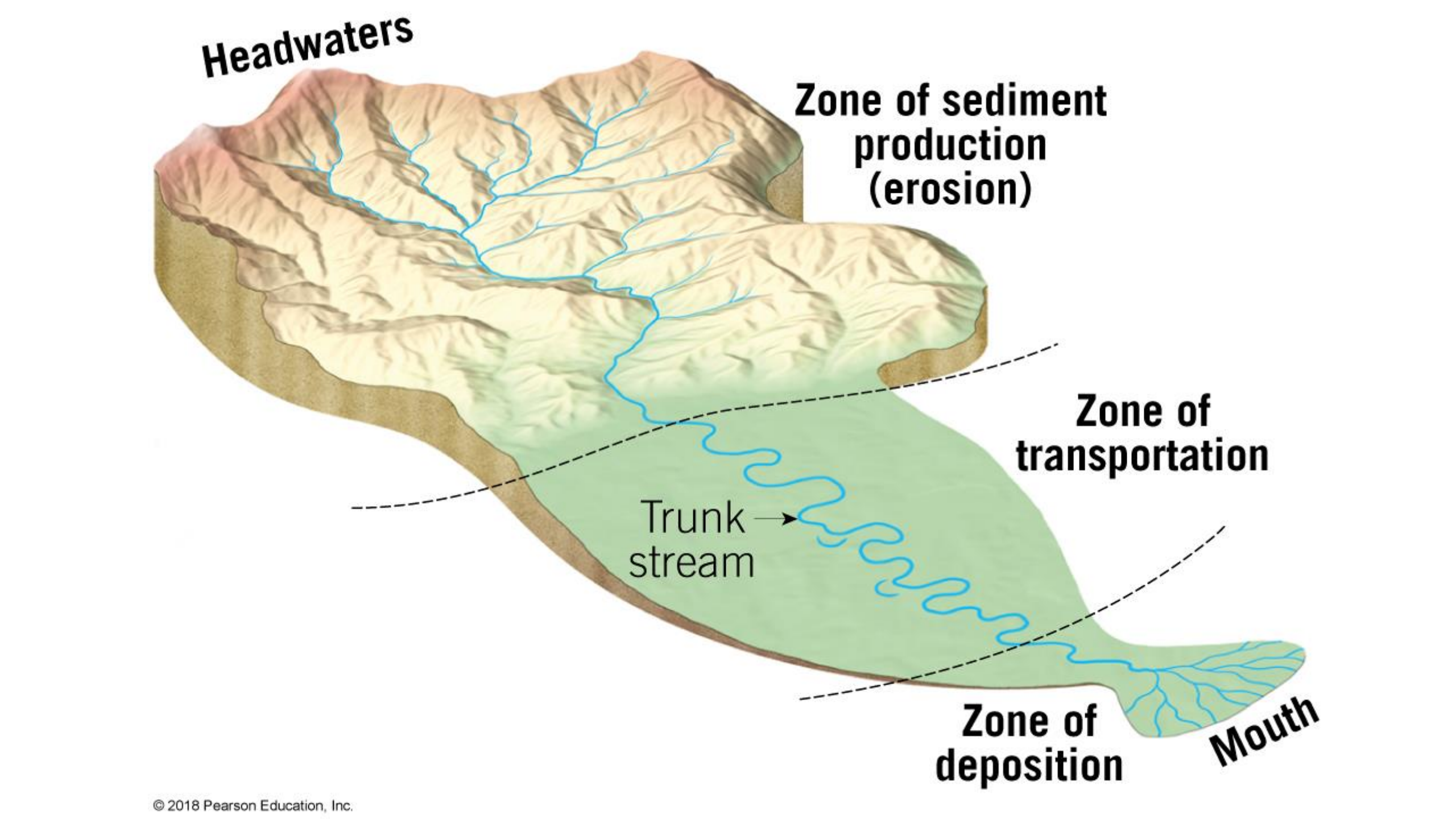
Divides and Basins

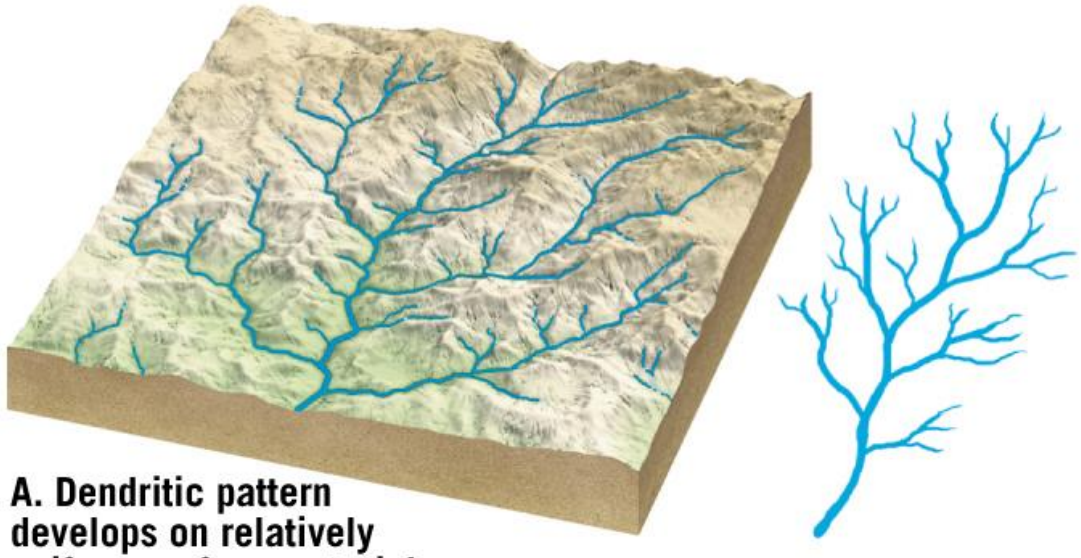



Calgary
Winnipeg
Vancouver
Surrey City Hall
Seattle
Portland
Minneapolis
Saint Paul
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
Toronto
Hamilton
Buffalo
Milwaukee
Detroit
Chicago
Toledo
Cleveland
Omaha
Lincoln
Denver
Aurora
Colorado Springs
Kansas City
St. Louis
Indianapolis
Columbus
Cincinnati
Pittsburgh
Louisville
Lexington
Wichita
Sacramento
Stockton
San Francisco
Oakland
San José
Fresno
Las Vegas
Henderson
Bakersfield
Albuquerque
Amarillo
Tulsa
Oklahoma City
Nashville
Memphis
Greensboro
Raleigh
Charlotte
Atlanta
Los Angeles
Santa Ana
Anaheim
San Diego
Chula Vista
Phoenix
Mesa
Tucson
Ciudad Juárez
El Paso
Plano
Dallas
Fort Worth
Austin
San Antonio
Houston
New Orleans
Jacksonville
Tampa
Hermosillo
Chihuahua
Ciudad Obregón
Corpus Christi
Nuevo Laredo

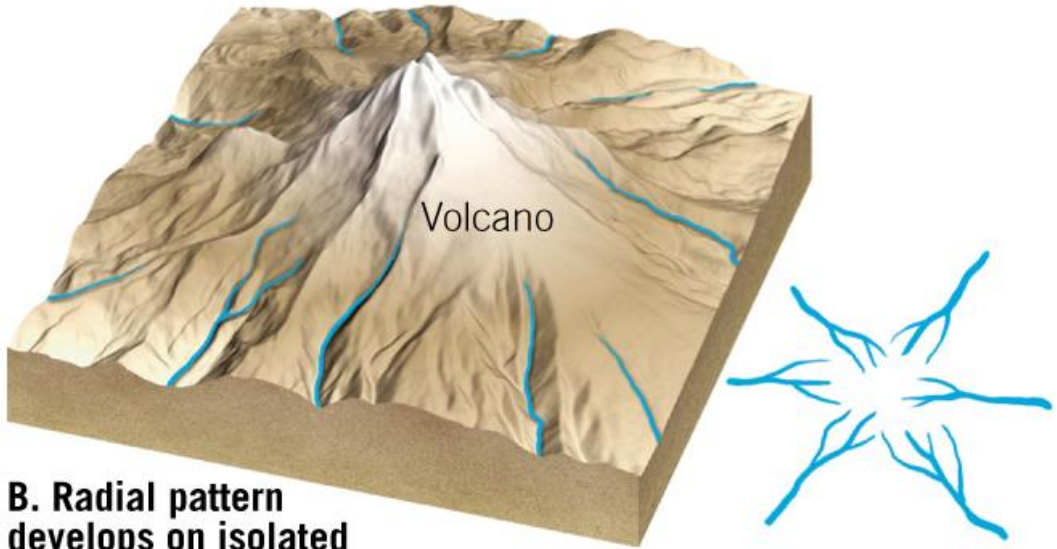

HOOSIER PASS
ELEVATION 11,539 FEET
CONTINENTAL DIVIDE
ATLANTIC OCEAN
PACIFIC OCEAN
PIKE
National Forest
WHITE RIVER
National Forest
U S
FOREST SERVICE
DEPARTMENT OF AGRICULTURE



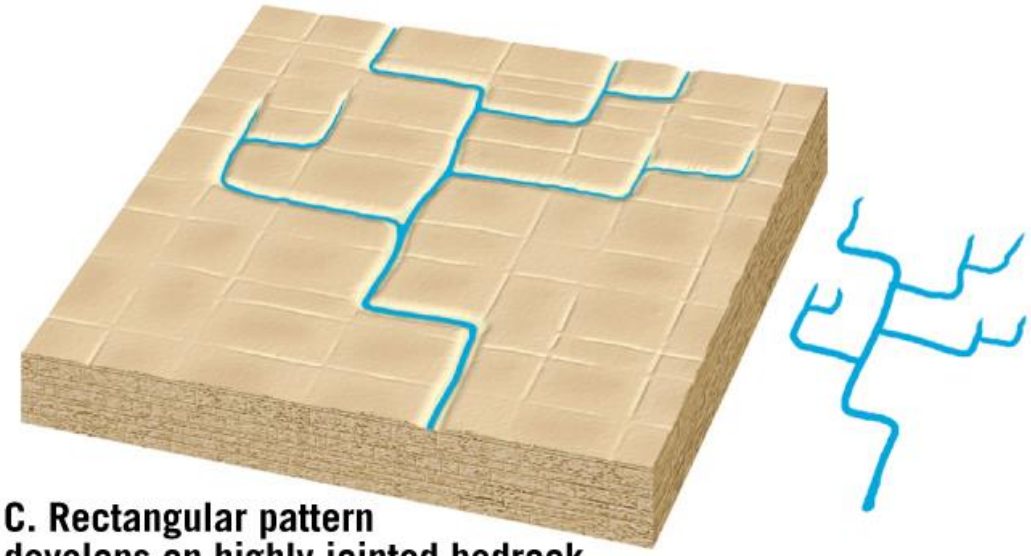




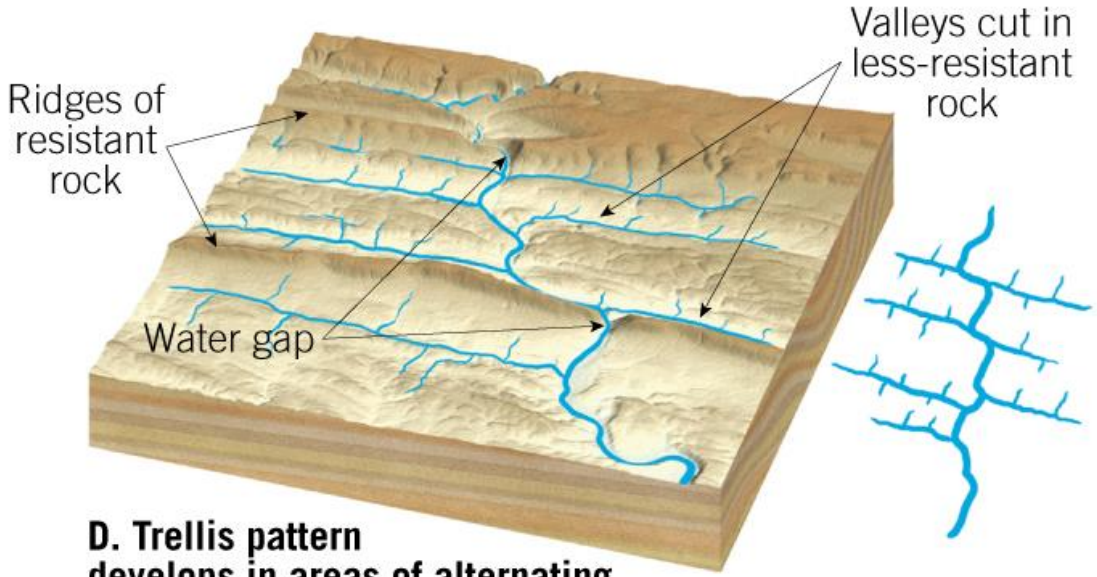
A. Dendritic pattern develops on relatively uniform surface materials



B. Radial pattern develops on isolated volcanic cones or domes



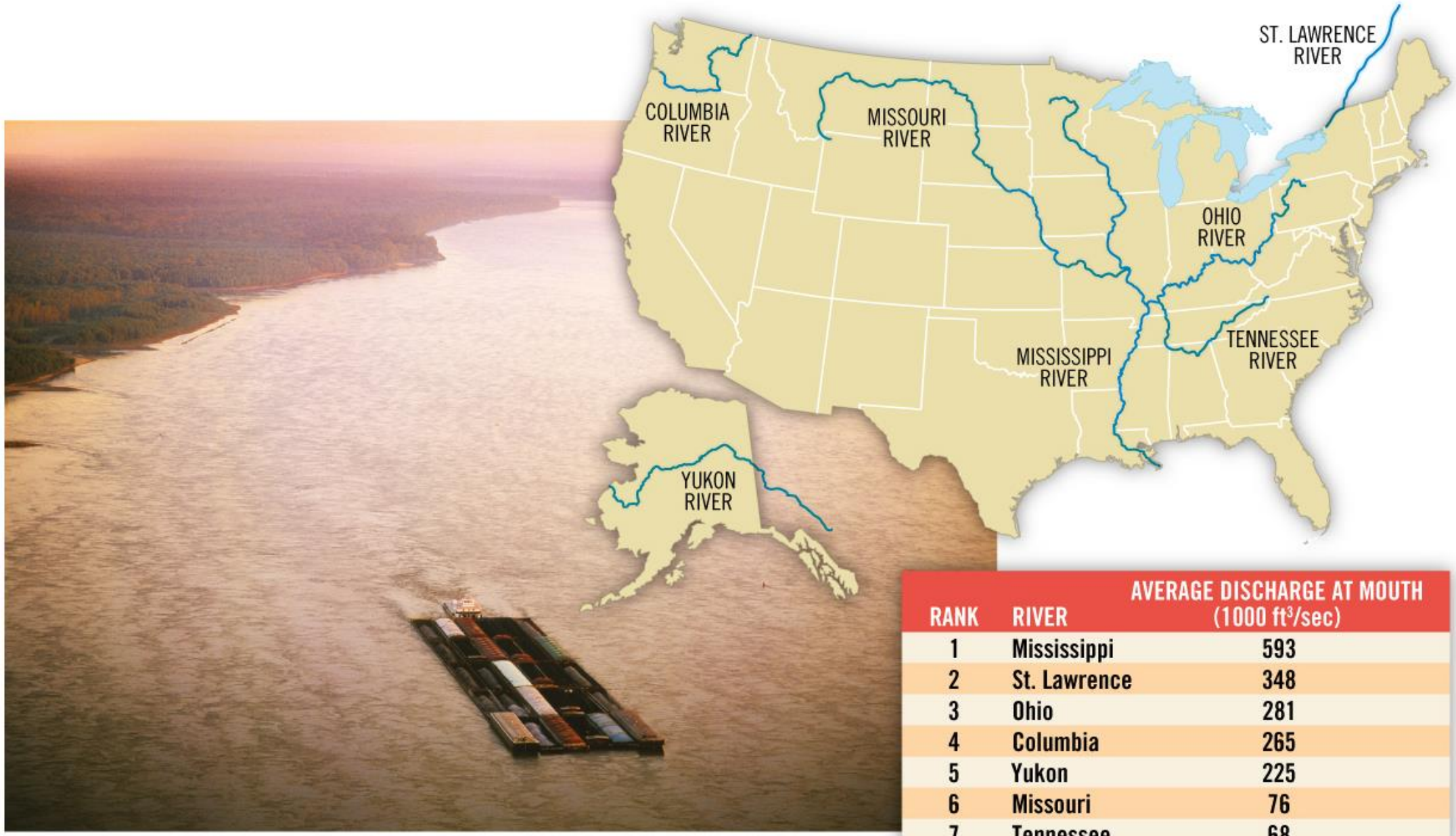
C. Rectangular pattern develops on highly jointed bedrock



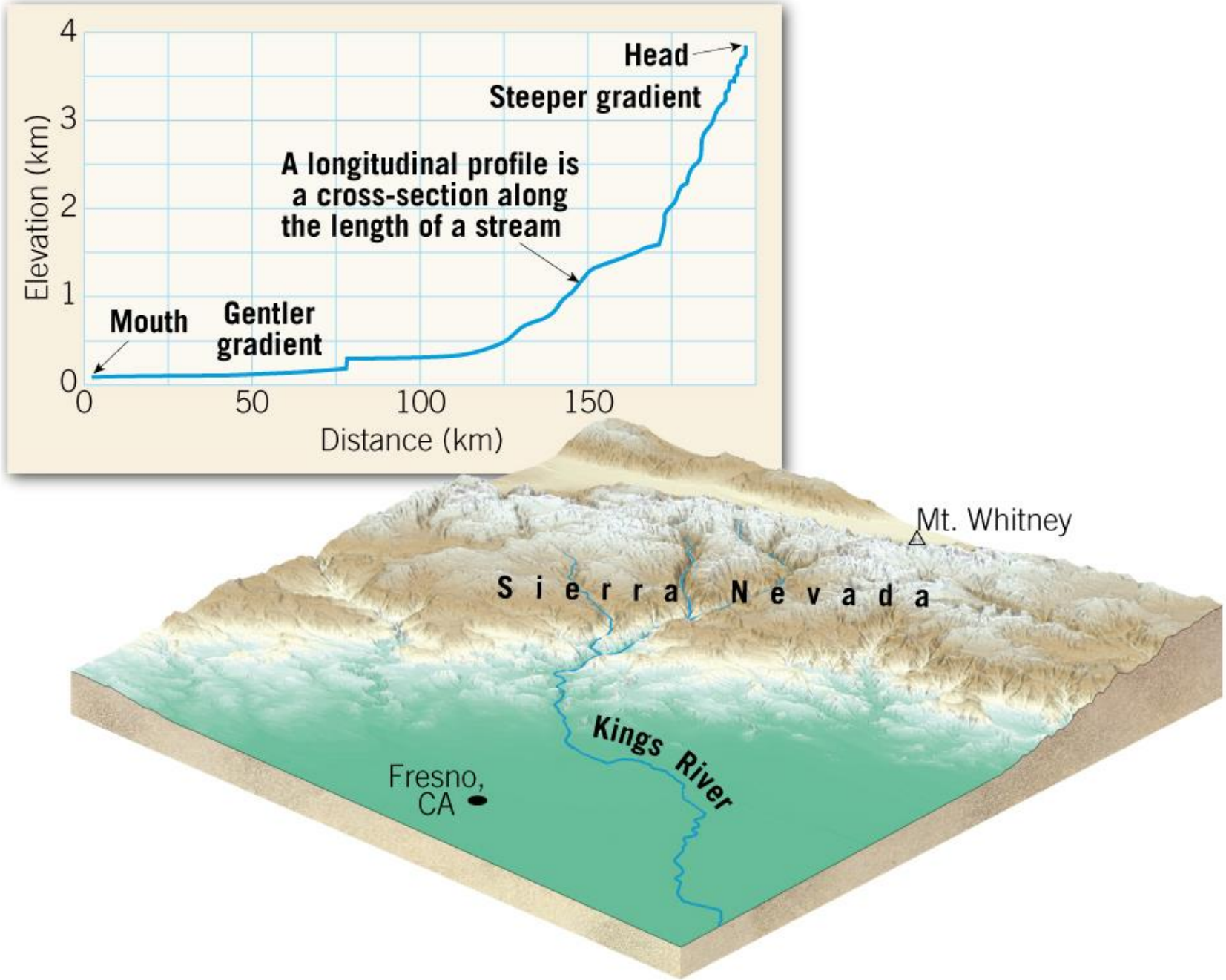
D. Trellis pattern develops in areas of alternating weak and resistant bedrock

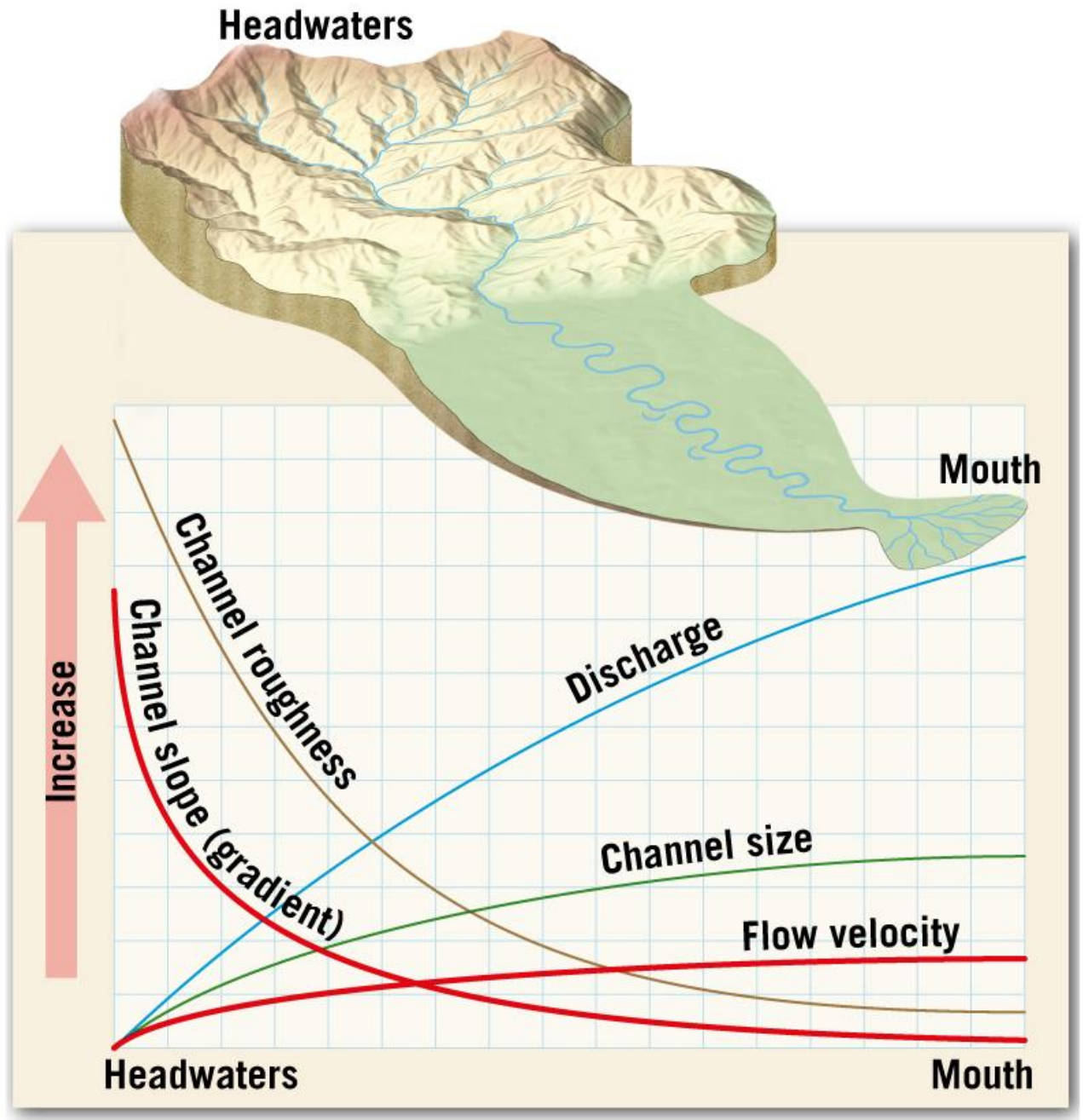
Streamflow

- Gradient or slope
- Channel characteristics
  - Shape
  - Size
  - Roughness
- Discharge – volume of water flowing in the stream (cubic feet per second)

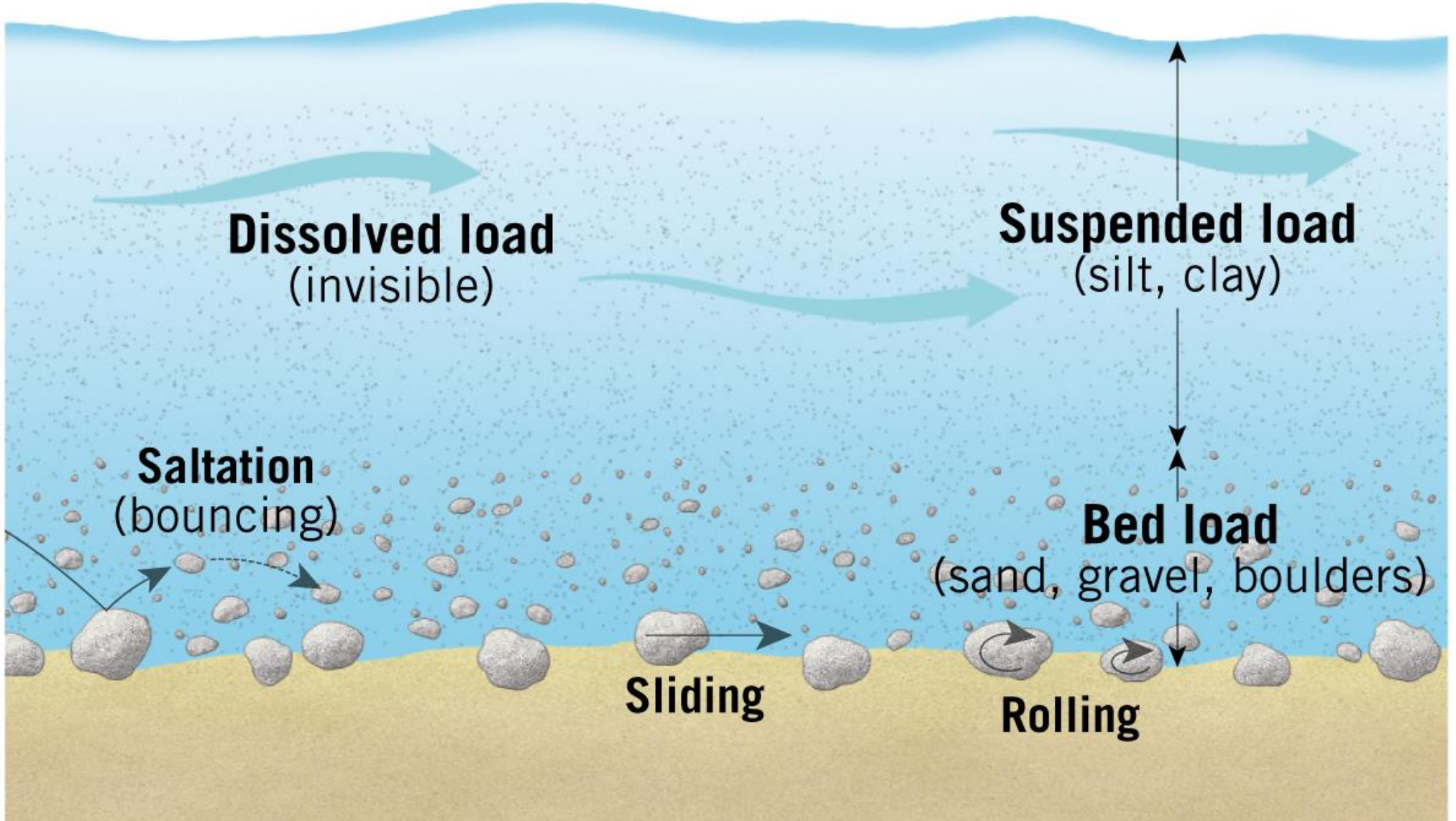


RANK	RIVER	AVERAGE DISCHARGE AT MOUTH (1000 ft^3/sec)
1	Mississippi	593
2	St. Lawrence	348
3	Ohio	281
4	Columbia	265
5	Yukon	225
6	Missouri	76
7	Tennessee	68





TRANSPORT

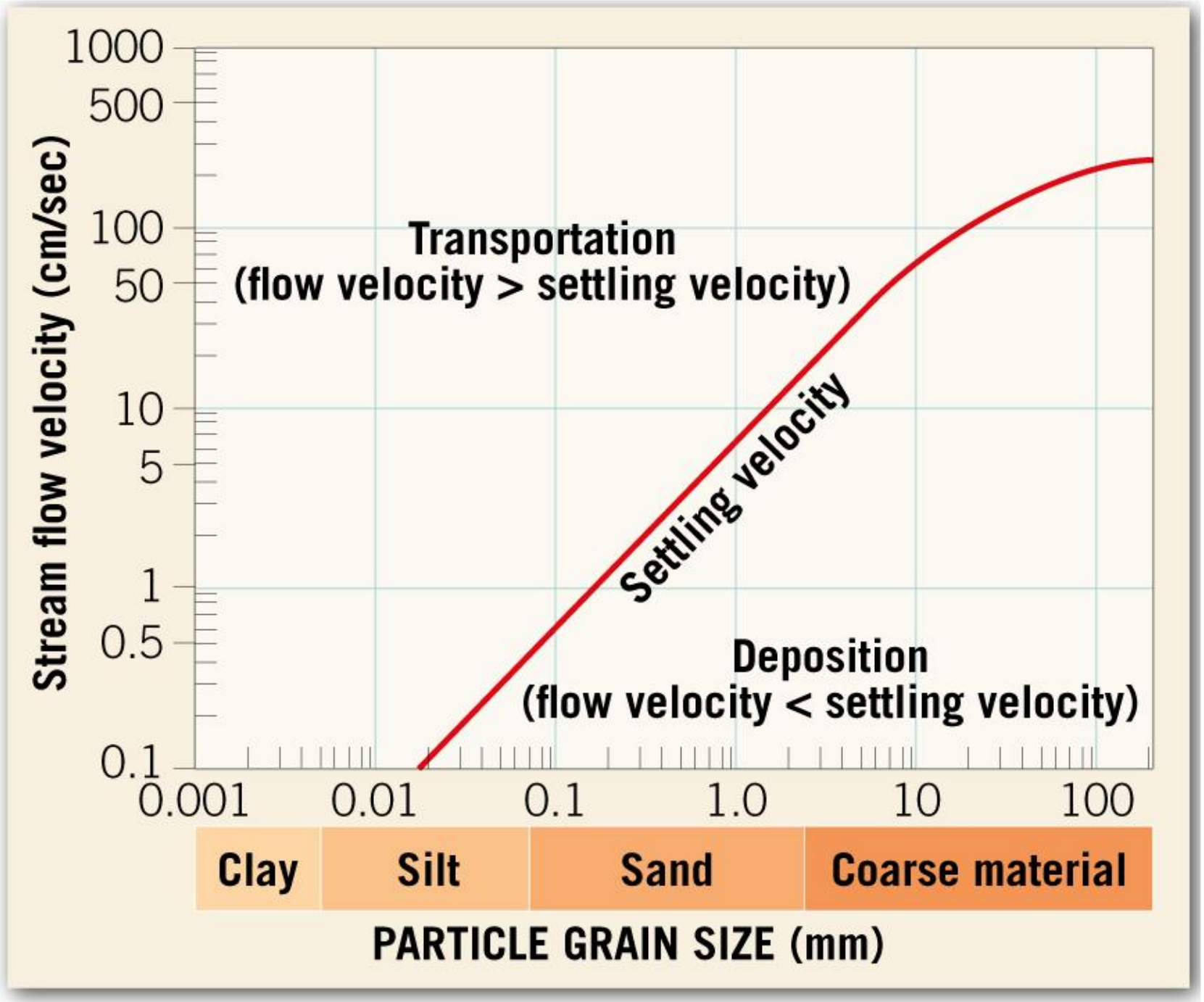

Dissolved load
(invisible)
Suspended load
(silt, clay)
Saltation
(bouncing)
Bed load
(sand, gravel, boulders)
Sliding
Rolling

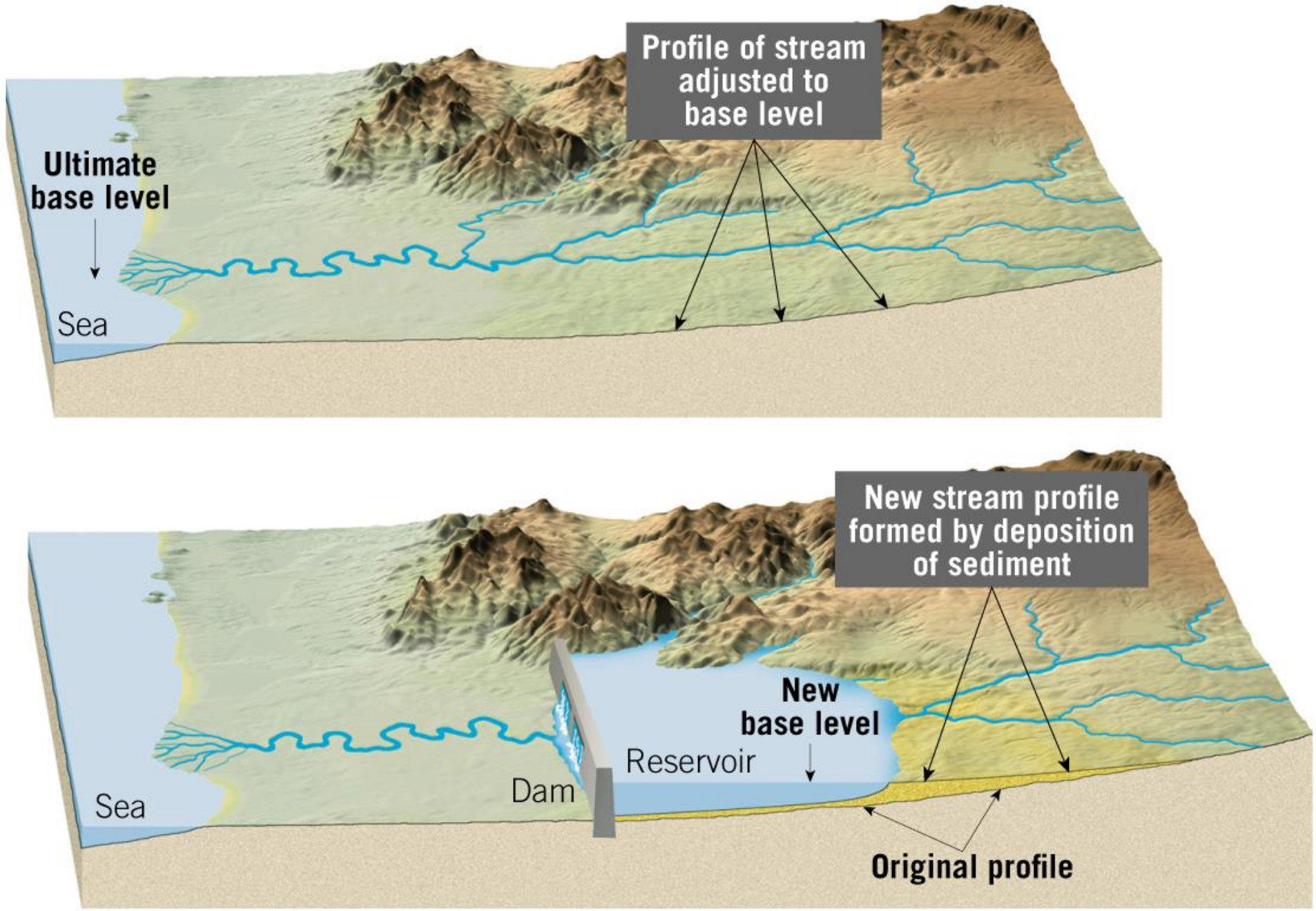
Competence vs Capacity

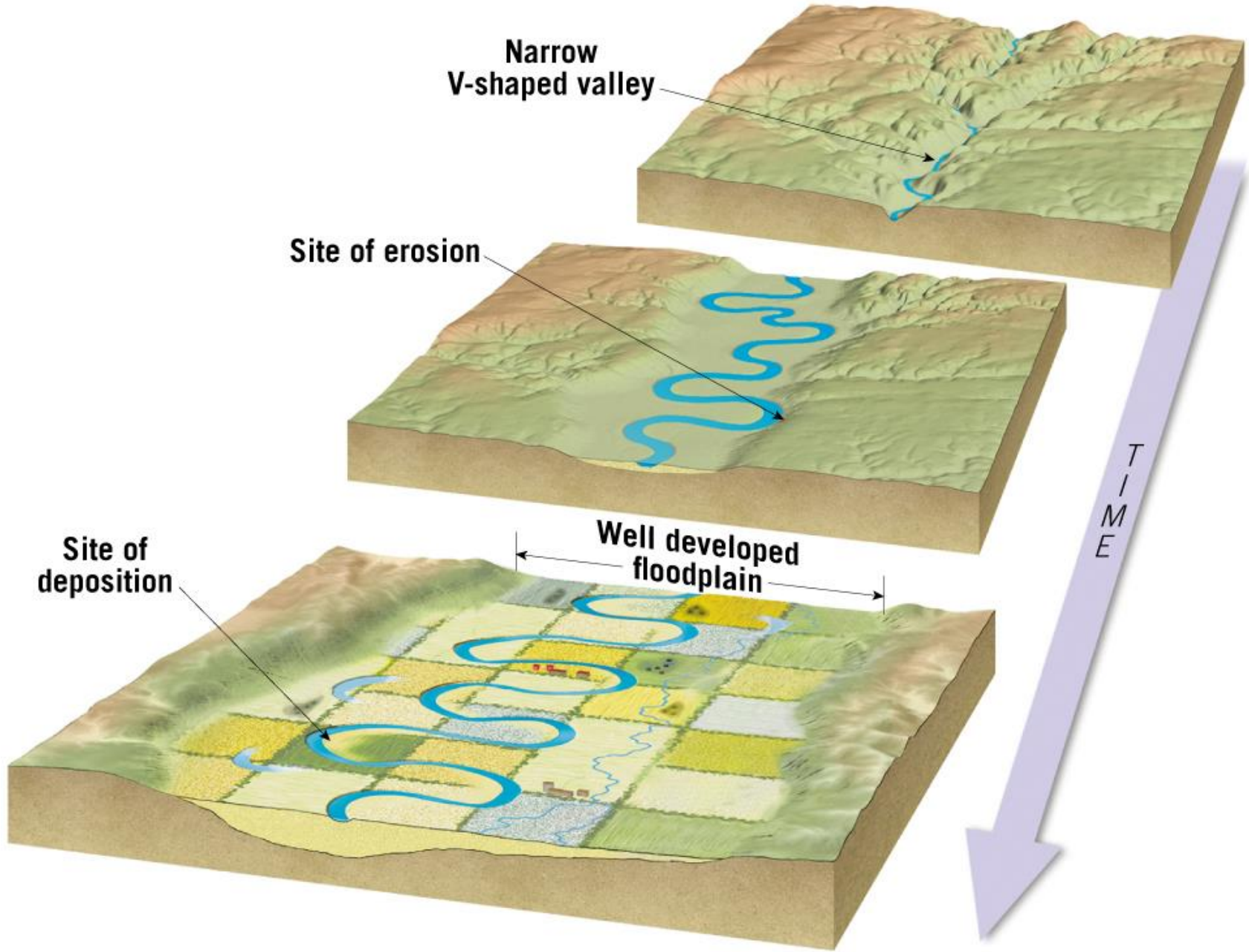
Competence is the **largest particle** a river can carry

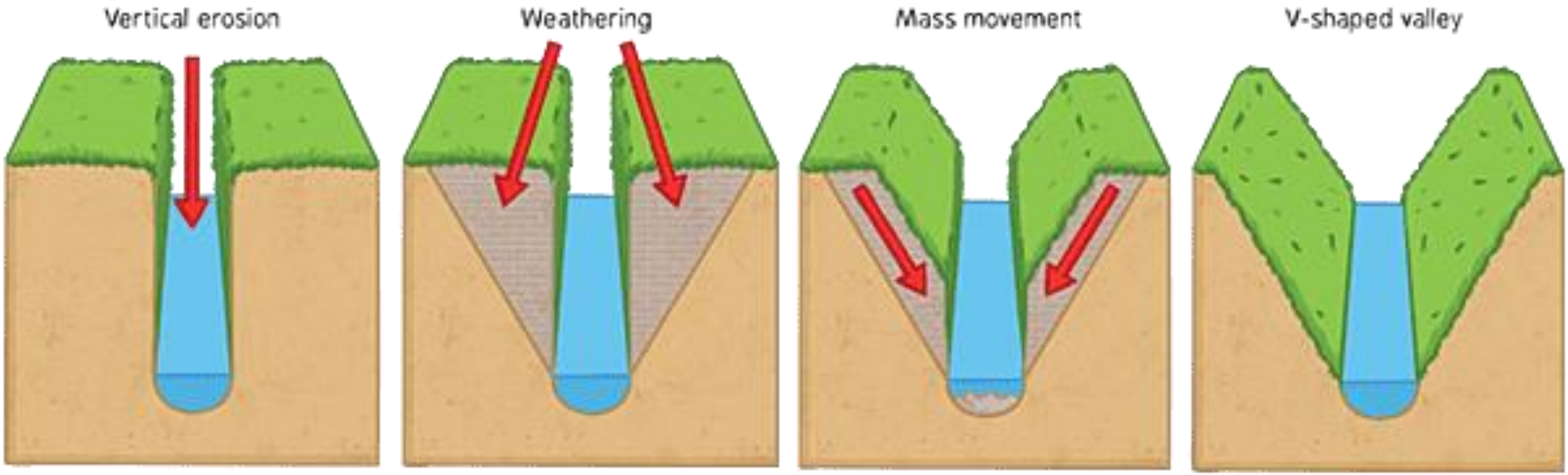
Capacity is the **TOTAL LOAD** a river can carry

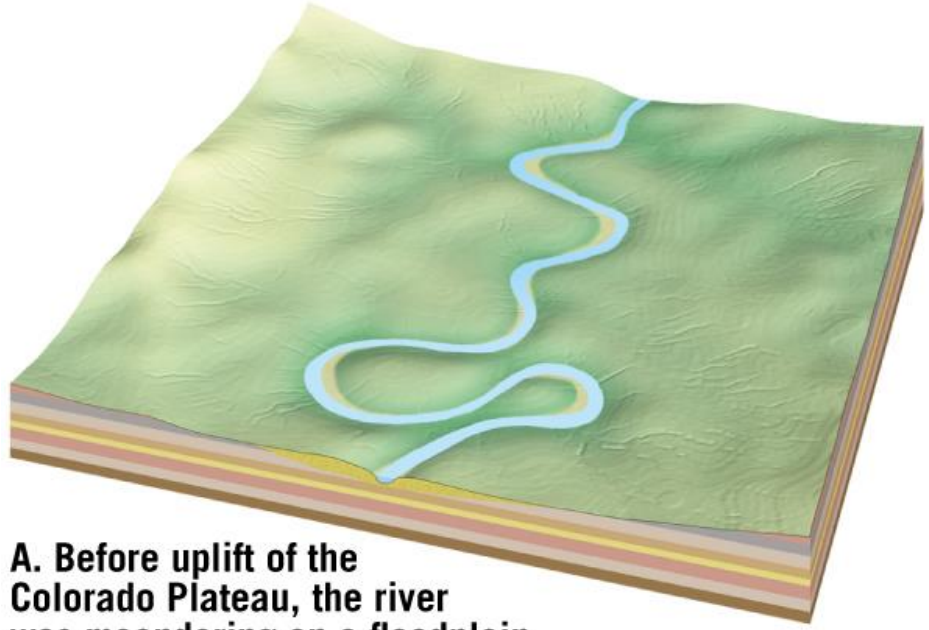
Rivers deposit alluvium. Alluvium is sorted according to size. The particles settle out by size when the velocity of the river decreases. A decrease in velocity causes competence to decrease.


Stream flow velocity (cm/sec)
1000
500
100
50
10
5
1
0.5
0.1
Transportation
(flow velocity > settling velocity)
Settling velocity
Deposition
(flow velocity < settling velocity)
0.001
0.01
0.1
1.0
10
100
Clay
Silt
Sand
Coarse material
PARTICLE GRAIN SIZE (mm)

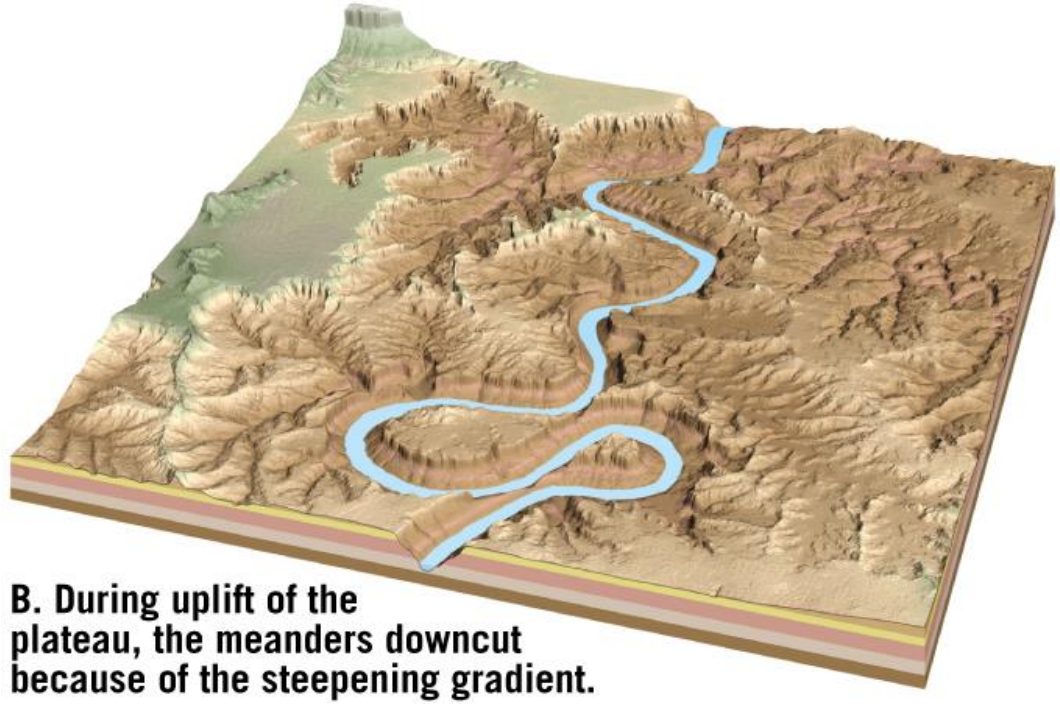




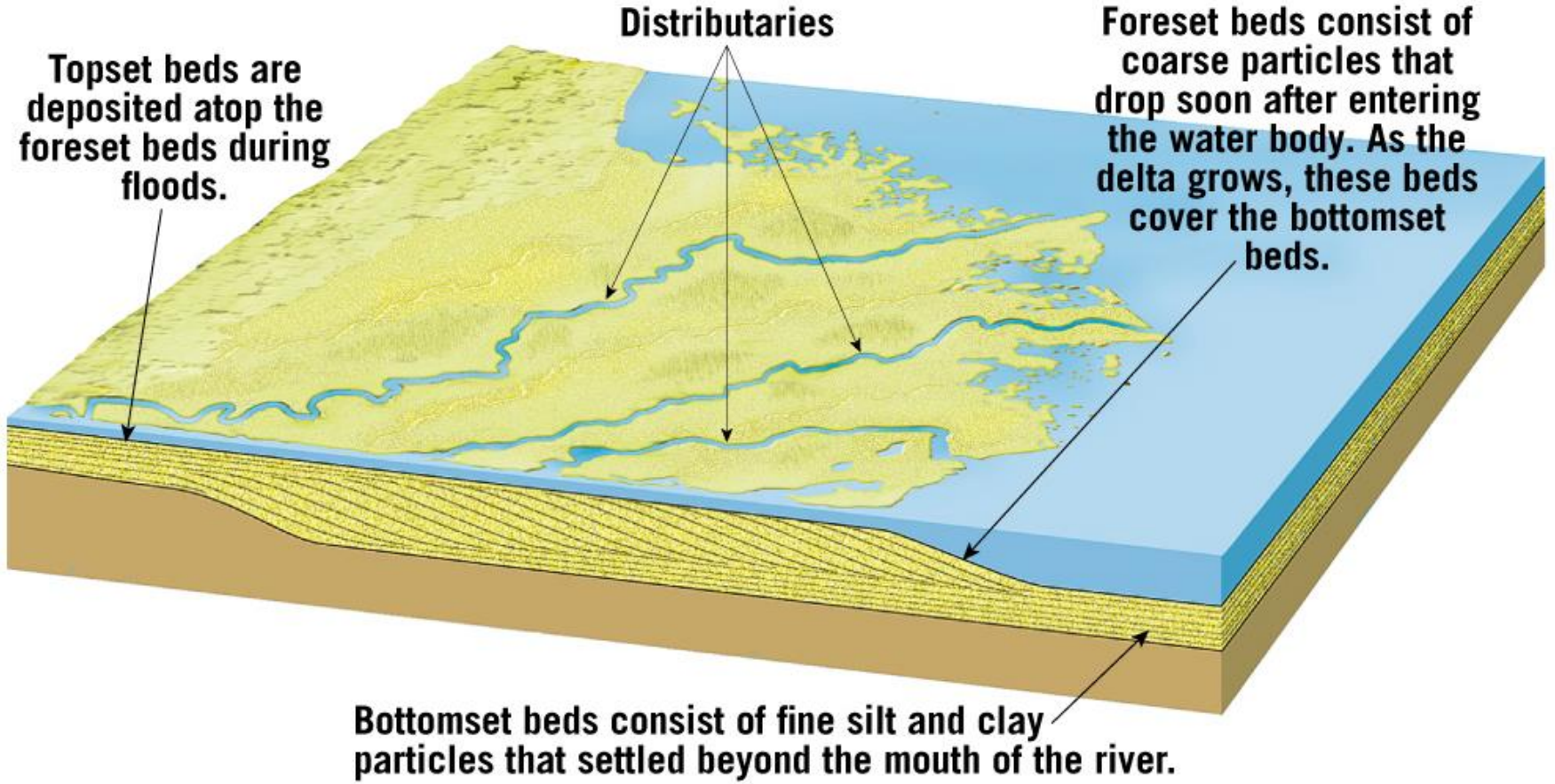

Vertical erosion
Weathering
Mass movement
V-shaped valley

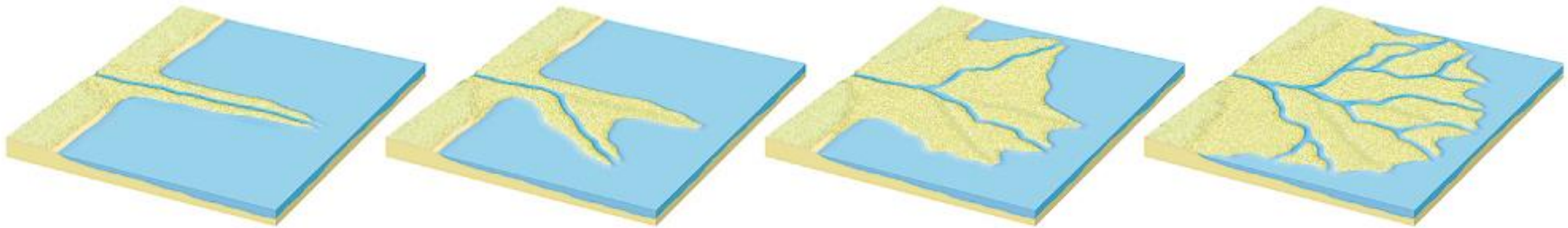


A. Before uplift of the Colorado Plateau, the river was meandering on a floodplain.

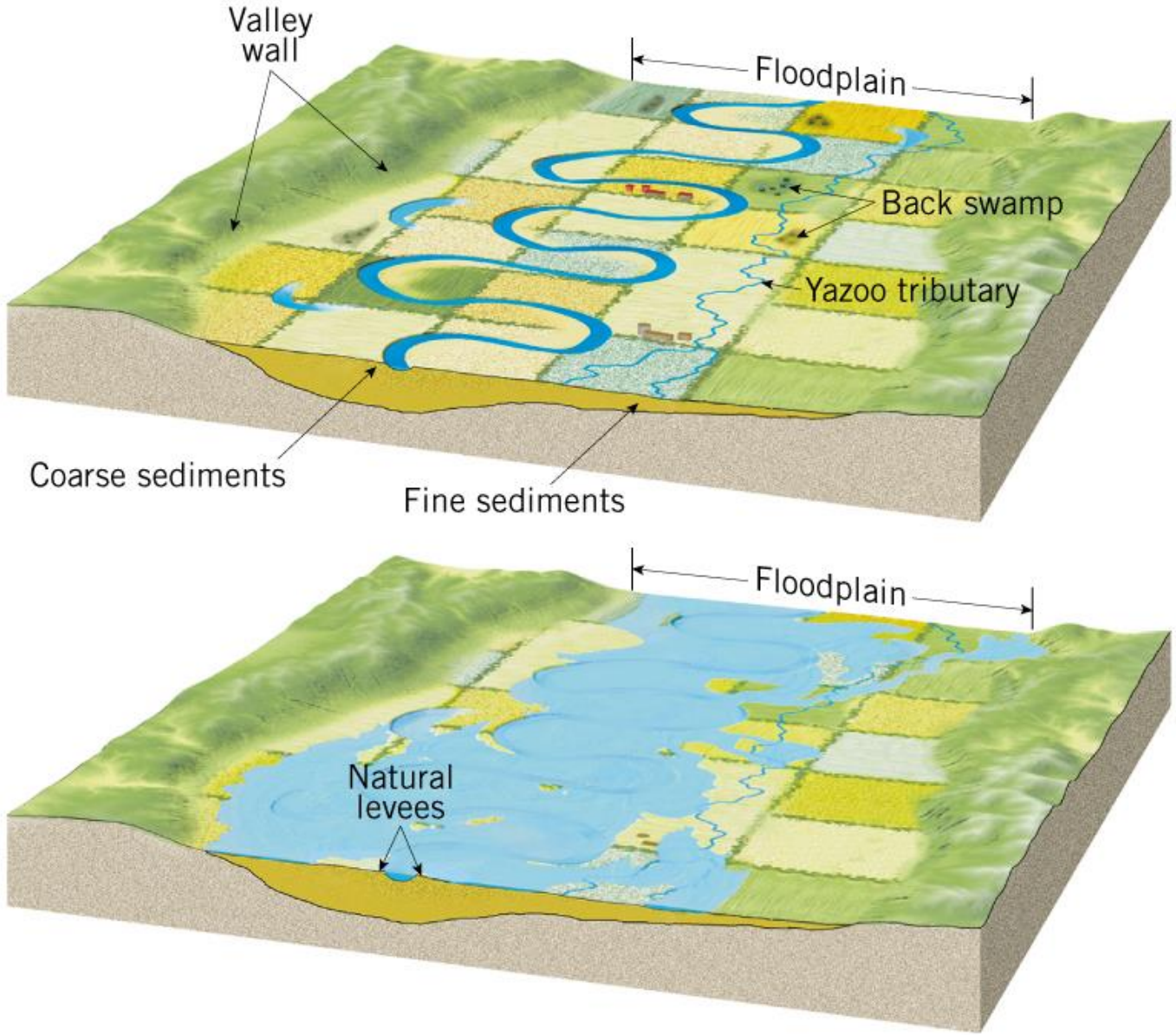


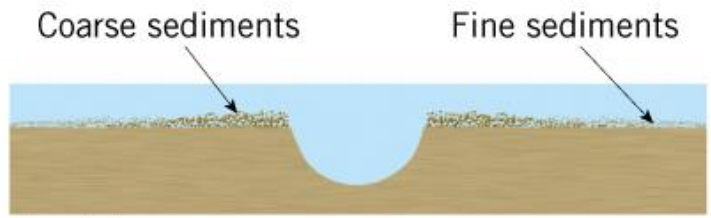
B. During uplift of the plateau, the meanders downcut because of the steepening gradient.



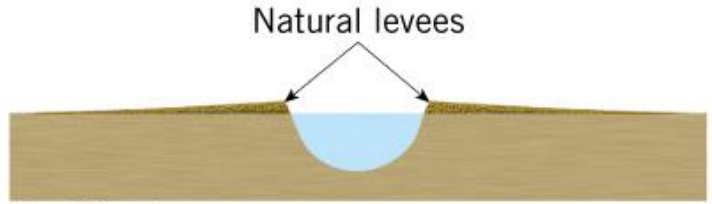


As the stream extends its channel, the gradient is reduced. During flood stage some of the flow is diverted to a shorter, higher-gradient route forming a new distributary.

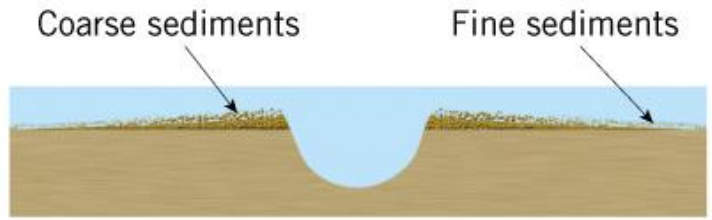




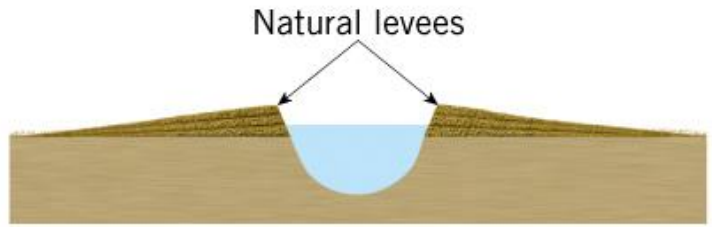
Floodstage



Post flood



Floodstage



Natural levee after numerous floods

Vocabulary

alluvium	back swamp	base level	bed load
capacity	competence	delta	discharge
dissolved load	divide	drainage basin	entrenched meander
floodplain	gradient	incised meander	meander
natural levee	oxbow lake	precipitation	rejuvenation
saltation	suspended load	transpiration	water cycle