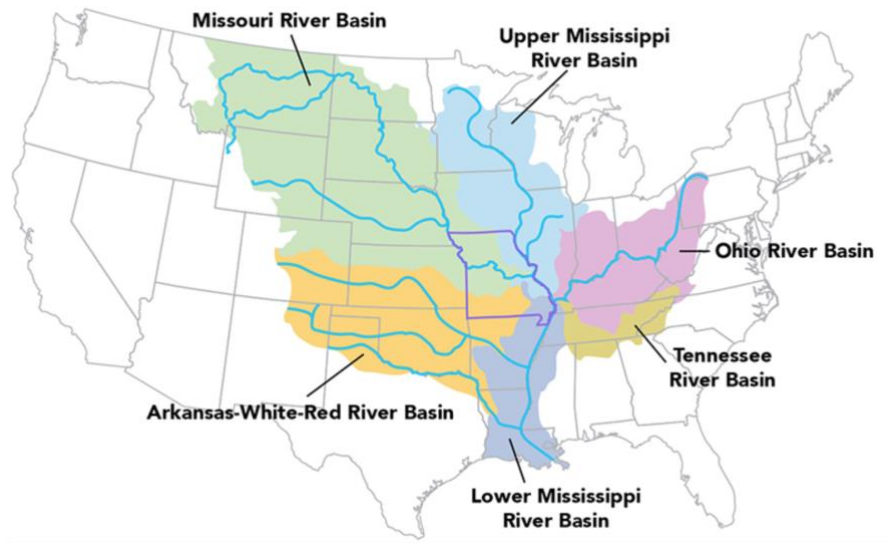


*** **Watersheds: Descriptions, Streams, Direction, Flow, & Floods:**

Coach files are a series of short lessons, each for a Road Scholar topic. Most started out as responses to questions from coaches. They are rough notes- maybe refined, maybe not. Questions and answers are from various events, both before and after the "Watershed & Flood " was in specs.

What's a Watershed?

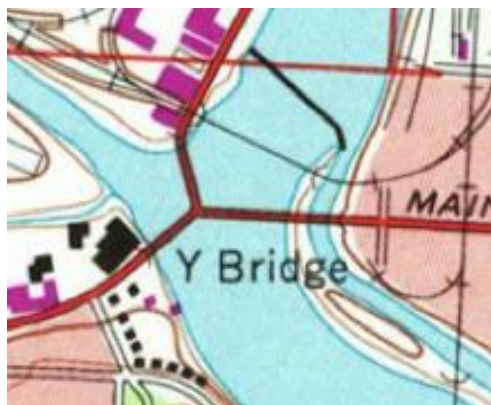
Rainwater or snowmelt runs downhill, either on the surface or as groundwater. It finds its way into bodies of water such as streams, rivers, lakes, etc. The entire area that has its water drain into a given body of water is that body's watershed. A large watershed such as the Mississippi River contains many smaller ones. Watersheds may also be called Basins.



Watershed Problems:

Story- *Zombies in Zanesville, OH (USGS Zanesville, OH 1961)*

Zanesville is located at the confluence, or junction, of the Muskingum and Licking Rivers. The Muskingum is the larger of the two, and flows North to South through this Mapscan



1. Rain and groundwater flow from the surrounding land into the Muskingum River, then travels downstream. What term is used to describe all the land area that drains into the Muskingum?

Muskingum Watershed

Watershed Boundaries:

Sometimes, Watershed boundaries are clearly marked. Otherwise the highest point between two watersheds can be located on USGS topo maps.



Story- Pirates in Yellowstone: (AAA Yellowstone Park Road Map)

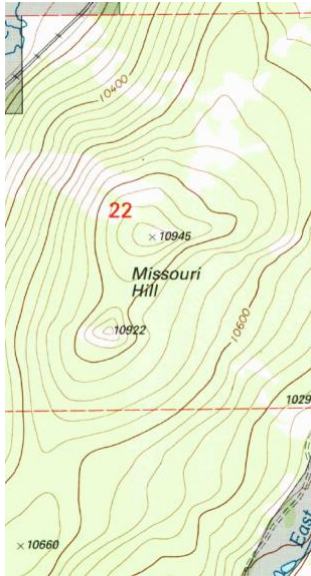
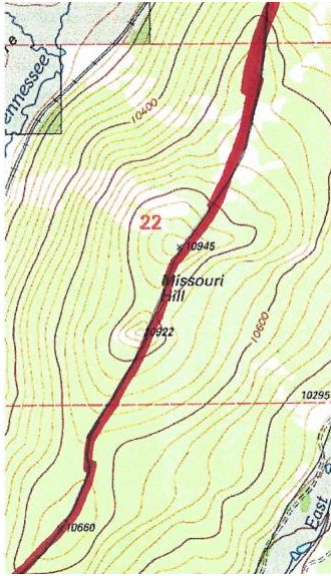
I sees the Continental Divide on me map. I likes the sound of that, and I knows it's got to do with water. So I finds a log exactly right on the Divide, and opens me two bottles of water. I pours the water on either side of the log. Argh!

2. What is different about the way water from the two bottles will run off the land at this exact spot? (Express yer answer in a sentence. Assume no water is absorbed by the soil, and all of it runs downhill.)



One bottle will flow to the Atlantic Ocean, the other to the Pacific.

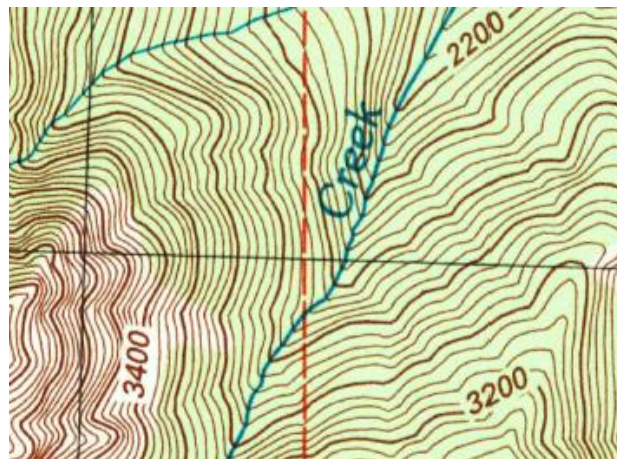
3. On the Left Mapscan shown here, water on the Eastern slope will flow to the East, and Water from the Western slope will flow West. On the Right Mapscan, draw a line (straight or curved) to show the boundary of the two watersheds. (from USGS Leadville North)

Question	Answer
	

Water Flow Direction

In any steep slope, the direction of water flow in a stream can be deduced from the contour lines. Stream flow causes erosion into the slope, resulting in a V-shaped pattern that points upstream. Coastal rivers can have strong tidal influences and may reverse the direction of flow with tides.

4. In what compass direction does this Creek flow?



North or Northeast. Erosion cuts into the slope, causing "V" shaped contours that point upstream.

Measuring Water Flow: Stream Gages

The USGS maintains a network of stream gages around the country. On topo maps, stream gages are shown by the symbol below:

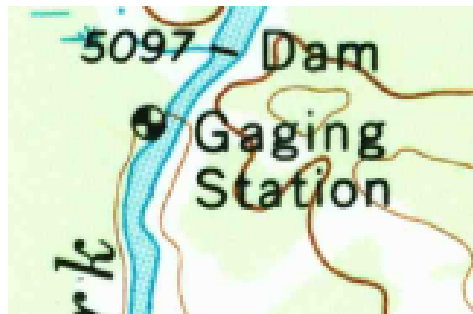


Since this symbol is easy to recognize, gages are frequent targets for latitude /longitude questions. Stream gages continuously record water depth in the stream. USGS Stream Gages are generally solar powered and data uploads to satellites for remote access. The amount of water flowing through a stream is important for everything downstream from the gage from irrigation to shipping, and essential to predict floods. Data from a specific gage can be found on usgs.gov or <https://waterdata.usgs.gov/nwis/rt>, usually as a graphic read out.



Stream Gage Problems - (USGS McCall, ID 1987)

Using both the topo map and stream gage readout: Little Payette lake is upstream from this Gaging Station.



NF Payette River at McCall ID - 13239000

January 28, 2023 - January 28, 2024
Gage height, feet



5. If the water Level in Little Payette Lake Exceeds the dam height, how will the stream gage respond?

A) it will rise from increased flow B) it will fall from decreased flow C) it will not change

A) it will rise from increased flow

6. In what month do people downstream from the Gaging Station shown above have to be concerned about flooding?

May or June

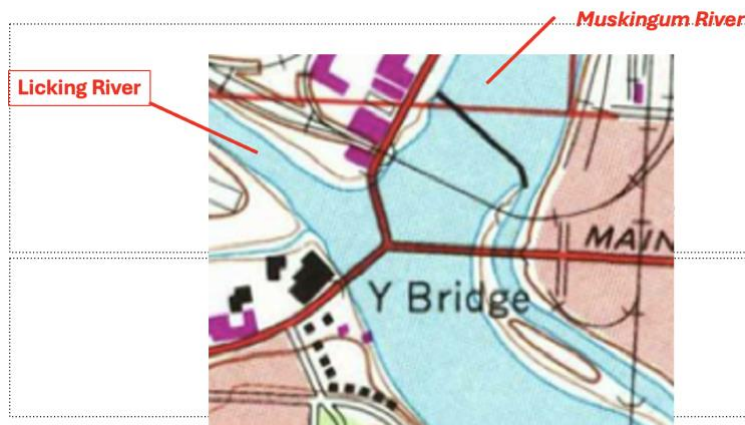
7. An inspection of the McCall, ID topo map shows that this is a mountainous, high altitude area. What is a probable reason for the higher Stream levels in certain months?

Snowmelt

Watershed and Stream Flow Problems

Story- *Zombies in Zanesville* (USGS Zanesville, OH 1961)

Zanesville is located at the confluence, or junction, of the Muskingum and Licking Rivers. The Muskingum is the larger of the two. It flows North to South through this Mapscan.



8. If heavy rains raise the water level in the Licking River, what will happen to water levels in the Muskingum River?

- A) Levels at the Northernmost part of the Muskingum (in this Mapscan) will rise greatly
- B) Levels at the Y bridge will rise
- C) Levels at the Southernmost part of this Mapscan will fall
- D) Muskingum water levels will not change.

(B) Levels at the Y bridge will rise

Story: Orpheus and Eurydice: (USGS Leadville North, CO 1994)

We enter the map area at the Northern edge, headed Southbound. Just before we reach the Tennessee pass, we hit a strong stationary thunderstorm with tons of rain- it's pouring cats and dogs. As soon as we drive over the Pass. the sun comes out.



Remember that thunderstorm North of Tennessee Pass? It rained cats and dogs for an hour!

9. South of the pass, Eurydice points out the stream gaging station on the Arkansas River. In response to the thunderstorm, will the gage go up, down, or stay the same? Answer and explain your reasoning.

Rain North of the pass will flow North of Tennessee Pass will flow North- it is in a different watershed. This gaging station is South of the pass and will not change.

Flooding in watersheds- Graphics Problems:

Questions might be based on satellite images or Mapscans that are drawn on or shaded in like a coloring book to indicate flooded areas.

Story-A Fish named Wanda (USGS Columbus North, MS, 1987)

10. Look carefully at the enlarged Mapscan below, showing a section of the River below the Columbus dam. Suppose the water elevation above the Dam on a given day is measured at 160 ft. If the dam should fail, how high might the water rise below the dam?

On your answer sheet, color in the area likely to flood on Mapscan provided.



flooded area - at the 160 ft elevation contour-marked on answer sheet:



Stream Flow and Flooding within Watersheds- Satellite and topo map problems

Comparison of USGS topo and satellite images during a historic flood on the Raritan River, New Jersey , in 2021.

****Use Both Satellite Image and USGS New Brunswick, NJ Mapscan ****

Mapscan- USGS New Brunswick NJ, 2024 **10 ft contour interval



***Satellite Image- Flooding on Raritan River, NJ 2021 *** (courtesy storyfull.com).



11. The River channel, shown above, is 165 m across. How wide is the water in the flooded Image?
Range of 460- 530m. This tough question was a tie breaker on a highly competitive state event. Comparison of the image and topo map shows a line of trees marking the normal "left hand" river bank. This was measured as 165meters. By measuring the image and doing a proportion, the image yields a total water width of the width at high water of 460- 530m. Satellite image analysis frequently involves this type of comparison/proportion process.

12. In this image, all the flooding is on the left side of the River. Explain why the right side is not flooded.

topo map shows left bank is low (about 10 ft) but right bank is high (about 50 ft)

13. The heavy rainfall causing this flood was a "once in 1,000 year" event. According to ideas of climate change, how often is such an event likely to occur in the future? Answer as: once in ____ years.

A) 200 B) 950 C) 1,000 D) 1500 **A) 200**

Stream Flow Levels in Satellite Images

Mississippi River, 2021 and 2022. (Copernicus Sentinel-2 Imagery Courtesy European Union)

Note: water shows as blue-green , vegetation as green, fields as brown, and sand as white.

October 2021		October 2022
	14. What feature changed the most from 2021 to 2022? amount of sand 15. What effect does the change in water level have on the River's commercial shipping)? low water- less shipping	

16. Based on both images, what may be inferred about the weather upstream from this area between October 2021 and October 2022? Why do you think so? Express your answer in one or two complete sentences.

Images show a lowering of water level in the Mississippi River. This is most likely due to decreased rainfall in the upstream watershed.

17. What type of instrumentation allows commercial shipping companies on the Mississippi to predict the changes observed in these images?

Stream gages in upstream locations

How to get USGS topo maps:

To get free downloads of topo maps: go to [**www.usgs.gov**](http://www.usgs.gov)

To get USGS Topo maps from USGS site: (The USGS site changes constantly but these steps worked as of October 2024.) Example using Questa, NM 1:24000 map dated 1995 used in *Zombie Bedtime Rhymes* (full event posted on soinc.org; see Events→ B Events → Road Scholar → Resources

usgs.gov → products → topographic maps → get topo maps → historical topo map collection → (menu at right) search by map name → Enter "Questa" in search box Enter → click "24K" below search box → Slide date bar to about 1980 → Results should show :Questa, NM 1995" → pick "↓GEOPDF 17 MB" from menu. Download may take a while.

On your own computer: by adjusting "view" to actual size you will have the same map used in competitions. Save as file "USGS Questa NM 1995" and all your downloaded maps will be together. You can make measurements right on your screen. You cannot print a whole map on a standard printer, but you can screen grab one map sector at a time and print the entire map on nine standard sized sheets of paper. Note that "actual size" on your screen is probably different than the same setting on another screen.

These "Coach" files are a work in progress and may be rough in spots. If you have questions or want to suggest changes contact me at: ctsciencedirector@gmail.com

Brendan Herlihy