**ANSWER KEY**

**Topographic Map Study Questions**

The following maps include various karst terrains as well as various river- and glacially-modified landscapes and landforms. The following questions are not intended to be comprehensive, but are intended to provoke critical thinking and help improve your topographic map reading and interpretation skills.

**East Brownsville, TX**

1. What is the contour interval of this map? 5 feet
2. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Old age
3. Would you expect the USA-Mexico boundary to frequently change position over time? Why? Yes. The Rio Grande River is an old age river system that meanders frequently across the low-relief landscape, thus changing the position of the border between Mexico and the US.
4. What are the curved lakes found on this map called, and how do they form? Oxbow lakes. Oxbow lakes form when a meandering river erodes through a narrow neck of land, forming a new, shorter channel that abandons the old river bend.
5. In which direction would you expect to find the ocean (north, south, east, or west)? East

**Ennis, MT**

1. What is the contour interval of this map? 20 feet
2. Locate the Cedar Creek Alluvial Fan along the eastern edge of the map. In what type of climate/environment does this feature form? Dry, arid climate.
3. What topographic features would you expect to find east of the alluvial fan? Mountains.
4. Note the “V” shape of the contour lines where they intersect the streams draining from the alluvial fan. What does the “V” shape indicate about the stream flow direction? The apex of the V always points in the upstream (uphill) direction.
5. Calculate the approximate stream gradient of the alluvial fan. Answers may vary, but should be in the range of 200-300 feet per mile.
6. Locate the Madison River in the northwest portion of the map. What type of river pattern is shown here? Braided river channel

**Gainesville West, FL**

1. What is the contour interval of this map? 5 feet
2. Locate the interchange between Route 75 and Route 222 near the center of the map. Just east of the interchange and immediately north of Route 222 are several contours with hachure marks. What do these contours indicate? A topographic depression.
3. What type of feature is represented here? A solution valley (large sinkhole).
4. Locate Devils Millhopper State Geological Site on the map. What is the topographic feature that is represented here? How deep is it? Sinkhole. 120 feet deep.
5. Note the adjacent ponds and low-lying swamps surrounding the Devils Millhopper site. What would you estimate is the elevation of the groundwater table at this location? ~170 feet
6. Why do you think the depression at Devils Millhopper has not filled up with water to an elevation that approximates the surrounding groundwater table? There are additional fractures in this sinkhole that are draining the groundwater into deeper caverns.
7. What is the approximate elevation of the groundwater table at Hogtown Prairie? 57 feet.
8. Calculate the approximate groundwater gradient between the water table near Devils Millhopper and Hogtown Prairie. Answers may vary. Should be approximately 25 feet per mile.

**Lake Scott, KS**

1. Note the drainage patterns shown on the map. What type of drainage pattern is represented on this map? Dendritic
2. In which direction is the overland drainage flowing “off” the map (north, south, east, or west)? North
3. Is Lake Scott a natural or artificial lake? Artificial
4. Locate Ladder Creek, south of Lake Scott, on the map. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Maturity
5. How does the fluvial landscape development of Ladder Creek differ north of Lake Scott? Immediately north of Lake Scott, the dam has reduced river discharge and previous erosion rates, producing a fluvial landscape that lacks the developed floodplains south of the lake and restricts flow primarily to a narrow meander channel that predates the dam. Further north, a series of streams feed into Ladder Creek before flowing in a relatively straight path to the north through a V-shaped valley. South of Lake Scott, there is a wider and more developed floodplain with active meanders.

**Luray, VA**

1. What is the contour interval of this map? 20 feet
2. Locate the Shenandoah River on the map. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Rejuvenation.
3. How do the dotted contour lines on this map differ from the solid contour lines? Dotted lines represent 10-foot contours.
4. What does the surface topography of the Page Valley indicate about the underlying geology? How does this type of topography form? The Page Valley is a karst terrain underlain by limestone. This type of topography forms by dissolution producing sinkholes, underground drainage, and caves (e.g. Luray Caverns).

**Mammoth Cave, KY**

1. Locate the Green River on the map. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Rejuvenation
2. What are these types of meanders called? Entrenched/incised meanders
3. Locate the Eaton Valley, Houchins Valley, and Doyel Valley on the map. What drainage pattern exists within these valleys that feed into the Green River? Dendritic
4. East of the Mammoth Cave National Park boundary is the Hamilton Valley. What features in this area would indicate that this is a karst terrain? Sinkholes/depressions; numerous small, rounded lakes/ponds

**Michigan Center, MI**

1. What is the contour interval of this map? 10 feet
2. The topography of this area has been shaped by continental glaciations (the last ice age) that began during the Pleistocene and ended approximately 12,000 years ago. Locate Blue Ridge on the map. This sinuous landform is composed primarily of well-sorted sand deposits. What is this landform and how did it form? Esker. An esker forms from the deposition of sand and gravel by a stream flowing in a tunnel beneath a glacier near its terminus.
3. Note that the area is riddled with small depressions and rounded lakes. What are they called and how did they form? Kettle lakes/holes. These depressions are created when blocks of ice become lodged in glacial deposits and subsequently melt.
4. Do you think Center Lake is a glacially formed lake? Why or why not? No. The shape of the lake is not indicative of glacial formation and the configuration around spillway 939 appears to indicate a dam is responsible for the lake.

**Mount Tom, CA**

1. What is the contour interval of this map? 40 feet
2. What is the NW-SE trending landform that also marks part of the boundary between Fresno and Inyo Counties? Arête
3. Steelhead Lake drains into three other lakes (L, Moon, and Elba). What are these glacially formed lakes called? Pater noster lakes
4. What type of glacially formed lake is Longley Lake? Tarn
5. The area where Pine Creek flows northeast out of the mountains has experienced glaciations in the past. Is it possible to determine how far the glacier extended down Pine Creek? If so, how do you know? Yes. The U-shaped glacial valley ends at Pine Lake and returns to a narrow and linear V-shaped valley.
6. What type of drainage pattern exists around Mount Tom? Radial

**North Palisade, CA**

1. What is the contour interval of this map? 40 feet
2. This area has been affected by alpine glaciations. What glacial landform also serves as the border between Fresno County and Inyo County? Arête
3. What type of glacial landform is Mount Agassiz? Horn
4. A series of bowl-shaped depressions marks the perimeter of the Dusy Basin. What are these glacial landforms called? Cirques
5. What are the glacially formed Rainbow Lakes called? Pater noster lakes
6. Locate the small lake at an elevation of 11,115 feet, below the letters “ON” at the end of the word “Canyon” in Kings Canyon National Park. What is this type of glacially formed lake called? Tarn
7. In which direction is the overland drainage from the streams and rivers of Fresno County flowing “off” the map (north, south, east, or west)? South
8. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Youth
9. What is the lowest elevation on the map? What is the highest elevation on the map? Lowest: 6400 feet. Highest: 14,242 feet.
10. What is the topographic relief of this map? 7,842 feet

**Paw Paw, WV**

1. Locate the Shenandoah River on the map. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Rejuvenation
2. Locate Reckley Flat and the town of Paw Paw in the southwest corner of the map. What former fluvial features are represented in these locations? The meander of the former river channel of the Shenandoah River that has been abandoned.
3. Would you expect a cutoff to develop anywhere along this stretch of the Shenandoah River shown on the map? If so, where might one form? The narrow strip of land at Beven Bend would appear to be the most likely location for a cutoff to develop. However, these are entrenched meanders. Look carefully at the contours at this location and recognize that there is approximately 60 feet of rock and soil that would need to be eroded! A cutoff may eventually form here, but it’s going to take a very long time.

**Voltaire, ND**

1. What is the contour interval of this map? 5 feet
2. Locate the Souris River on the map. What stage of fluvial landscape development is shown here (youth, maturity, old age, or rejuvenation)? Old age.
3. How did the depressions (hachured contours) in the Souris River floodplain form? Abandoned river channels and meanders
4. The terrain above the Souris River floodplain is composed primarily of glacial till deposited during the last ice age. What type of lakes are Stink Lake and Lake Hester? Kettle lakes
5. Locate the NW-SE trending ridges adjacent to these lakes. These ridges are also composed of varying amounts of glacial till that are wider at the NW end and taper to a narrower point at the SE end. What might this indicate about the direction of glacier flow? Glaciers were flowing toward the southeast
6. What might we call these ridge-like features? Drumlins

If you have any questions about these maps, the geology resources in the Science Learning Center, or a geology question that can’t be answered by someone available in the SLC, consider stopping by the geology lab prep room (CS 203) and ask for NOVA’s Geology Program Assistant, Jim Buecheler, who may be able to help.

Are any of the maps or other geology resources in the Science Learning Center missing or out of place? If so, please notify either Jim Buecheler or Science Learning Center coordinator Robin Rohrback.

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