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Date: _____

Unit X
Geophysics
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X

Missouri Caves, Karst, and Springs – Cloze Exercise

Directions: Use the following words to complete the cloze passage below. Then complete the reading and answer the questions at the end.

ABOVE, ACID, AND, ARE, COMPOSITION, DETERMINE, DOLOMITES, ERODED, FORMS, INLAND, INSTEAD, IS, KARST, KARST, LAYERS, MANY, MIX, NAME, NOT, OZARKS, QUIET, REGION, ROCKS, SINKHOLES, SOLUBLE, SOME, TUNNELS, VEGETATION, WHERE, ZONES

There are many sorts of Karst. The _____ itself comes from the Karst _____ of Slovenia, along the Adriatic coast, _____ the landform was first noted. Karst _____ any terrain based on a layer of _____ bedrock, usually, though not always, of carbonate _____. In the American Midwest, _____ forms on limestones (calcium carbonate) and _____ (magnesium calcium carbonate.)

The precise erosional _____ that the karst takes depend on _____ variables. The mechanical structure and chemical _____ of the rock, the local climate _____ temperature range, and the amount of _____ and rainfall a region has all _____ how fast a carbonate landscape erodes. _____ along a seaside is quite different than that _____, and tropical karst does _____ resemble karst in temperate or sub-Arctic _____. Landforms in zones with earthquake activity _____ quite different than that in _____ zones, or places where mountain building have turned the _____ of carbonate rock on edge. _____ karst is formed as a result of sulfuric _____ welling up from below _____ of carbonic acid percolating down from _____. Some places in the American West are a _____ of the two processes.

But the karst of the Missouri _____ is almost textbook, and is characterized by well _____ rolling hills, deep hollows, springs, caves, _____, losing streams, natural bridges, and _____. A few definitions:

- ❖ A *spring* is a natural resurgence of groundwater, usually along a hillside or from a valley floor.
- ❖ A *cave* is an air-filled underground void, large enough to be examined in some way by man.
- ❖ A *sinkhole or sink* is a collapsed portion of bedrock above a void. Sinks may be a sheer vertical opening into a cave, or a shallow depression of many acres.
- ❖ A *losing stream* is one with a bed with allows water to flow directly into the groundwater system. There are many chert bottomed losing streams in the Ozarks.
- ❖ A *natural bridge or tunnel* is a void beneath still standing bedrock, usually of short extent, and allowing human passage from one end to the other, at least part of the time. A natural

bridge is somewhat shorter than a tunnel, and is more inclined to be air filled than partly water filled.

Missouri, especially south of the Missouri River, has all the natural resources to make, (in the words of Jerry Vineyard, one of our best known geologists and cavers) a wonderful cave factory. In order for temperate karst to form, there must be sufficient layers of carbonate rock (in Missouri, anywhere from none to thousands of feet thick); adequate rainfall (about 45 inches annually); a reasonable vegetative cover to provide humus and carbon plant debris (oak-hickory forest and grassland over much of the state); suitable entrances to the bedrock (faulting and dipping from the Ozark uplifts and seismic activity); and a variable climate (bored with our weather? Just wait a few minutes.)

Karst is formed when rainwater picks up carbon dioxide from the air, and dead plant debris in the soil, then percolates through cracks dissolving the rock. The bedrock becomes saturated with water at some level, and dissolving continues as the water moves sideways along bedding planes (horizontal cracks between rock layers) and joints (or fractures) in the rock itself. These conduits enlarge over time, and move the water, via a combination of gravity and hydraulic pressure, further enlarging the conduits through a combination of solution and abrasion of water on the surrounding rock.

Eventually, much of this water under pressure reaches the surface of the land as a spring. A spring may emerge high on a cliff, at the base of one, or even forced upward from below the level of the surrounding surface streams, depending on nature of the surrounding rock, and the altitude of the groundwater level, with respect to the base level of the controlling stream in a drainage area. Often in Missouri, springs have little relationship to surface drainage, because so much of our water movement is actually groundwater movement. In some areas of the Ozarks, more than 70% of all water goes underground via karst processes.

As groundwater levels in an area drop, more and more of the underground passage becomes air filled. When it is sufficiently air filled, springs become cave entrances, passable by humans. Other voids never develop a natural opening, and are intersected by drilling, notably of wells looking for water. At this point, due to changes in chemical equilibrium underground, the resulting caves begin to fill with dissolved mineral, called cave deposits or speleothems. Caves may refill with water or continue to dry out, or even cycle several times as water levels change.

Erosion continues underground, and eventually a cave hollows enough for the roof to thin, and the cave collapses. Such cave collapse may actually un-roof the cave if it is near enough to the surface, or simply form a slump in the level of the land. In either example, a sink forms. Natural bridges and tunnels can be formed as resistant remnants of a cave collapse, or independently, if a block of bedrock becomes cut off from the main land mass, and it is hollowed out by wind, ice wedging, and rain.

Many karst areas have poor soil, and do not retain water easily, allowing it to go directly underground. Sinks also act as "swallow holes" for rainwater; some sinks take water under certain conditions, and resurge it at others. These reversible sinks, called *estavelles*, are among the curiosities of karst. Some springs in the Ozarks are periodic, or "ebb and flow" springs, whose discharge can be measured to rise and fall independent of local rainfall. Many theories, but no one knows why, for sure. Another oddity of Missouri karst is the *karst window*, where one may look into a cave or water filled sink below, but getting down there is another matter entirely.

