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Name: _____ Period: _____

6.1 Principles of Evolution

Case Study: A Tail of Two Squirrels

Northern Arizona is well known for the Grand Canyon. This expansive canyon is 18 miles wide at its widest and up to a mile deep. The canyon winds through the forested region of northwestern Arizona for 277 miles. Scientists estimate that the canyon began its formation 5-6 million years ago. The Colorado River originates in the central Rocky Mountains flowing downward across the Colorado Plateau in to the Colorado River Basin. In the basin, the river began to slowly erode the soft sandstone, limestone, and shale rocky layers. Over time, ice ages increased the amount of water draining into the Colorado River causing the canyon to be cut wider and deeper. Over millions of years, the canyon has developed into what we know today, one of the largest canyons in the world (Figure 1).

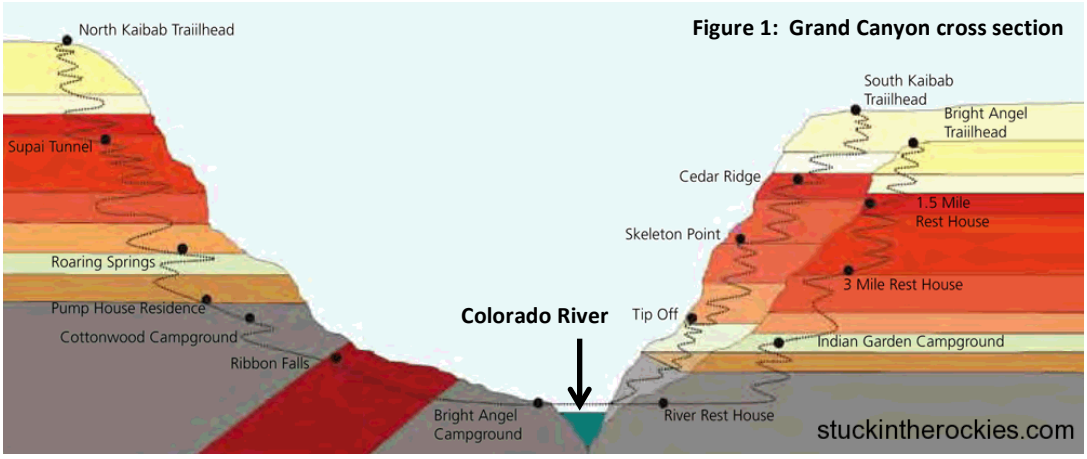

Figure 1: Grand Canyon cross section

Before the canyon became what we see today, the Colorado River Basin was teeming with wildlife, much like it is now. However, 6 million years ago the animals and ecosystem looked much different. The forest of the basin was full of ponderosa pine trees. Living off the seeds of the pine trees and using the needles for nests among the pine tree branches was an ancestor of the tassel-eared squirrel (Figure 2). These squirrels would mate in late spring and have baby squirrels in their tests by early summer.

Figure 2: Tassel-eared squirrel

The tassel-eared squirrels lived as a large population on both sides of the Colorado River. The squirrels would breed throughout the population, and they would cross the riverbed of the Colorado River during low drainage years to reproduce with squirrels on the opposite side. However, over the millions of years the Colorado River spent cutting through the Colorado River Basin, the river became wider and deeper. The shallow riverbeds became steep rock faces as the river cut deeper into the soft rock layers.

As the river widened, two unique populations of tassel-eared squirrels arose: a north population and a south population. These two populations became separated so that they no longer were able to reproduce due to a physical barrier. The physical separation became so significant, that the north side of the Colorado River (now the North Rim of the Grand Canyon) became a slightly different environment from the south side (now the South Rim of the Grand Canyon). The north rim has a slightly higher elevation creating cooler temperatures year-round and shorter summers to raise young.

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After the millions of years from the formation of Grand Canyon, these two tassel-eared squirrel populations have diverged or separated from each other into two different types of squirrel that are incapable of reproducing with each other, also called two different species. The division of these two species is estimated at about 10,000 years ago. The two species are now called the Kaibab squirrel of the North Rim and the Abert squirrel of the South Rim.

Figure 3: Kaibab squirrel

The Kaibab squirrel (Figure 3) relies almost exclusively on the ponderosa pines for nesting material and seeds for food. In addition, they eat mushrooms that grow at the base of the ponderosa pine. The Kaibab squirrel mate in the earlier spring, March to April, to allow for plenty of time to raise young in the warmer weather of the shortened summer in the higher elevations. The Kaibab squirrel differs in appearance by a red-brown stripe down its back and a whitened tail, compared to the Abert squirrel.

Figure 4: Abert squirrel

The Abert squirrel (Figure 4) is similar to the ancestral tassel-eared squirrel. It has a dark body, white belly, and a gray tail. The Abert squirrel also eats the seeds of the ponderosa pine but also the Mexican pinyon in areas further south from the Grand Canyon. The Abert squirrel mate later in the spring and have babies in their nests by late June.

Analysis Questions:

What caused the creation of these two species?

How are these two squirrels related?

What caused these two squirrels to become so different from each other?

If the Abert squirrel and the Kaibab squirrel populations were to meet, would they be able reproduce to make a hybrid squirrel? Why or why not?

What causes two organisms to be different species?