

# Grand Canyon Microclimatology: Plant Stresses

⚠ This is a preview of the published version of the quiz

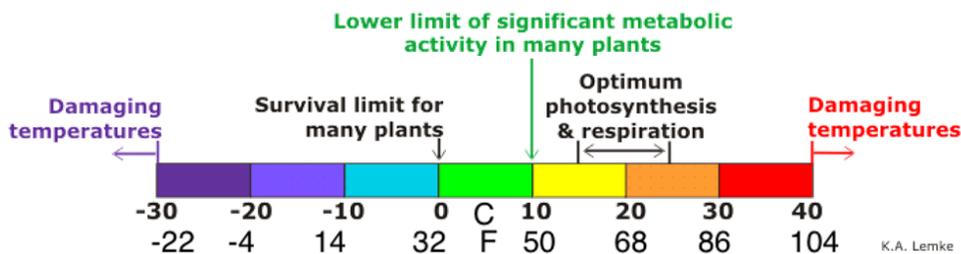
Started: May 18 at 4:39pm

## Quiz Instructions

The highest elevations around the Grand Canyon have spruce trees that are not very sensitive to very cold temperatures. They can survive at temperatures of  $-22^{\circ}\text{F}$  ( $-30^{\circ}\text{C}$ ) where other plants cannot.

Juniper trees (e.g. Utah Juniper), in contrast, cannot survive super cold temperatures. They also cannot survive super hot temperatures for very long. Still, they very hardy. They can tolerate freezing and  $100^{\circ}\text{F}$  temperatures—just not the extremes found around the Grand Canyon.

The graphic below made by Professor Lemke gives a snapshot of some of the temperature issues associated with different types of plants.



While the graphic above was made for air temperature measurements (e.g. meteorological stations), the ground temperature information in the geovisualization still applies. Extreme cold and extreme heat can influence whether a particular type of plant can survive. For your reference, this is the key for ground temperatures seen in the geovisualization.

-6.7 °C	20 °F	26.6 °C	80 °F
1.7 °C	35 °F	35 °C	95 °F
10 °C	50 °F	43.3 °C	110 °F
18.3 °C	65 °F	51.6 °C	125 °F
26.6 °C	80 °F	60 °C	140 °F

There are dozens of ways that microclimates can develop and influence plants. The ways vary at different spatial scales. For example, on the scale of tens of centimeters, the orientation of a boulder can influence whether precipitation is channeled to a spot where a tree might or might not germinate.

The temperature data in the geovisualization is at the highest resolution available at the present time – at least for the coverage of the entire Grand Canyon. Thus, this investigation is limited to the resolution of about a 30 m pixel.

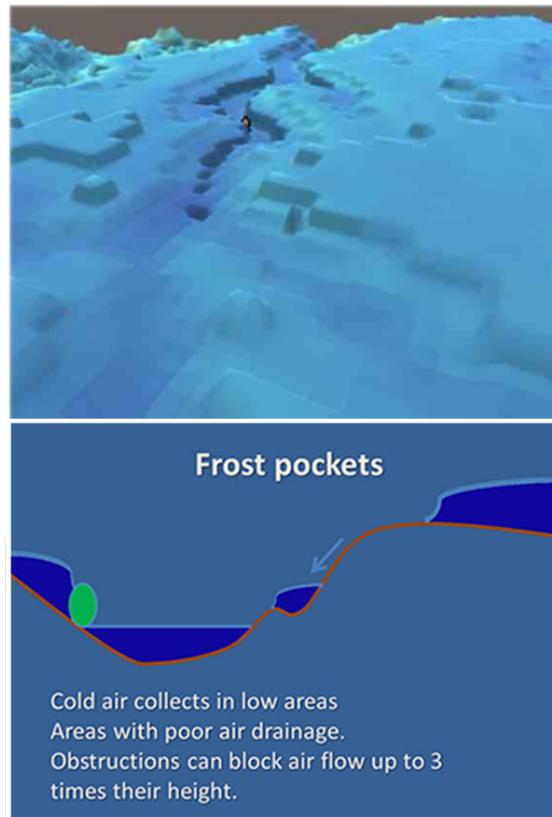
Those are the squares seen in the geovisualization for winter and summer ground temperatures. At this scale, you can investigate/analyze six connections between topography and temperature that are presented below.

**Diurnal effect of the 10am time of data acquisition**  
– explaining why east-facing slopes are often warmer than west-facing slopes.

The satellite gathering the temperature data images at about 10am in the morning. Thus, the east facing slopes have accumulated more insolation than the west-facing slopes.

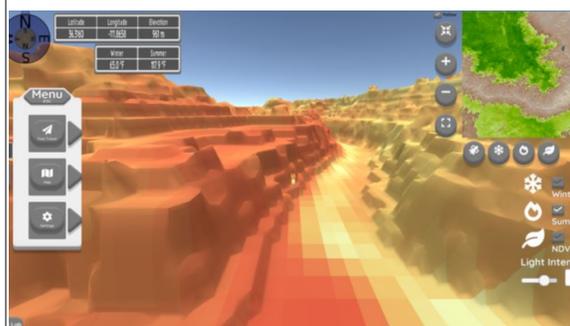


**Cold Air Drainage** especially in winter due to the low solar angle. The game screen on the right shows a small drainage on the Kaibab Plateau where cold air has collected. As cold air is more dense, it will sit there until significantly warmed or disturbed by wind. This sometimes happens on a much larger scale within the entire canyon, and with enough moisture can lead to cloud inversions, with clouds below the canyon rim.



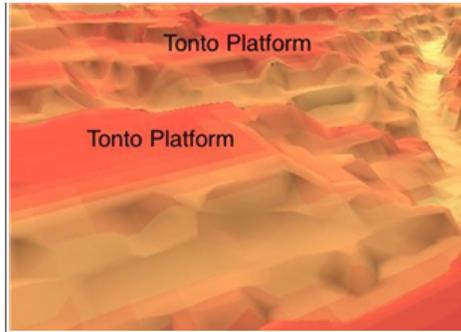
**Evaporative cooling** – In the summer temperature image, the Colorado River is able to exert a cooling effect on the 30 m pixels. This effect is often several pixels wide.

The effect of water evaporative cooling is not seen in the winter imagery around the Colorado River. The reason is that the surface temperatures around the river are sometimes colder or similar to the river itself.



**Flat treeless surfaces as heat accumulators.** Flat surfaces can accumulate a lot of energy in summer, when sun angles are high. Solar radiation starts the process. However, treeless surfaces with lots of

exposed rock play a big role in absorbing lots of the solar radiation. The result is that these are some of the hottest surfaces in and around the Grand Canyon



**North-facing slopes that are steeper than the angle of the sun at noon receive no solar radiation.**

This slope has an angle of 35°, and the rabbit is facing south, so the slope is facing north. Because the noon sun angle at winter solstice is only 30.5°, no sunlight hits this slope. The effect on plants is greatest in winter at high elevations, because the result can be severe cold temperatures.

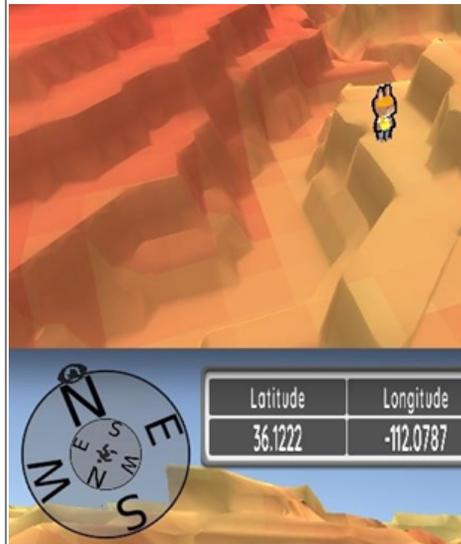


**Summertime north-south exposure contrasts.**

Wintertime temperatures in the lower desert portions of the Grand Canyon are not severe. Freezing rarely occurs, and only for a few hours in the morning. Maximum temperatures are not extreme.

In contrast, summer temperatures can cause great stress for plants, especially when air temperatures exceed 104° F and ground temperatures exceed 120° F.

Even though sun angles are much higher in summer, the contrast of south (warmer)-facing and north (cooler)facing slopes can influence plants. The rabbit is standing on the side of a river canyon that has facing north, where the sun's rays are not as direct. The hotter surface temperatures on the other side of the canyon are because those surfaces are facing south, and they are getting more direct sunlight.



**Question 1**

**3 pts**

Please fast travel to the locations presented in the question below. Each location also has the season (winter or summer) that you should investigate. Try to bring the game camera angle up higher, so that you can get an overview of the location and you can spin the view.

**Make the best matches between the temperatures you see for each location/season with the effect of topography on temperature.**

36.0923 -112.0034 in winter

[ Choose ] ▼

36.3225 -111.9995 in winter

36.3775 -112.2701 in winter

 **Question 2****3 pts**

Please fast travel to the locations presented in the question below. Each location also has the season (winter or summer) that you should investigate. Try to bring the game camera angle up higher, so that you can get an overview of the location and you can spin the view.

**Make the best matches between the temperatures you see for each location/season with the effect of topography on temperature.**

36.4303 -111.8494 in winter

36.1024 -112.0965 in summer

36.4381 -111.8161 in summer

Not saved