Bicycles, Bentonite, and Botany: Spring 2023 Science Excursion to Cathedral Valley

Trip Guide

Phlox hoodii – A weedy semi shrub that is at home in the harsh desert environment of Cathedral Valley

Guide Index

Introduction

This guide serves as your reference for our journey through Cathedral Valley. Feel free to take notes on, add to, or subtract from this guide. The best way to use this guide is to keep it in your day pack and when you have a moment to glance at what will be coming along up ahead or later that day. The references and resources in this guide can come in handy if you find some interesting organism or if you are inspired by the stars or the geology around you. If you have any questions always feel free ask any of the folks on the trip.

Mile Guide (Approximate Miles)

DAY 1

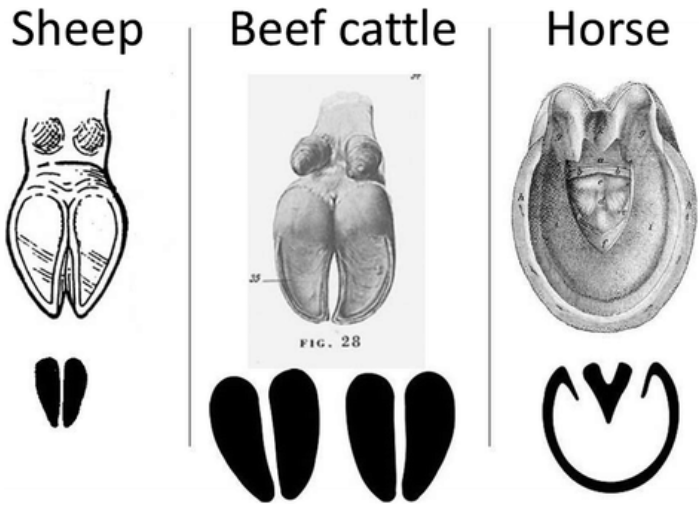
Mile 0: Fremont River

This river is fed by snow melt from the nearby Henry Mountains. This **Riparian Zone** is a critical oasis in the desert landscape we will be traveling over. It is one of the few areas where we will be seeing any sort of standing water. Notice the density and height of vegetation that can only exist in this zone. After exiting the riparian area we will join the Hartnett Road. These "Green Ribbons" are essential resources in this landscape.

Mile 6: Historic Well Drilling

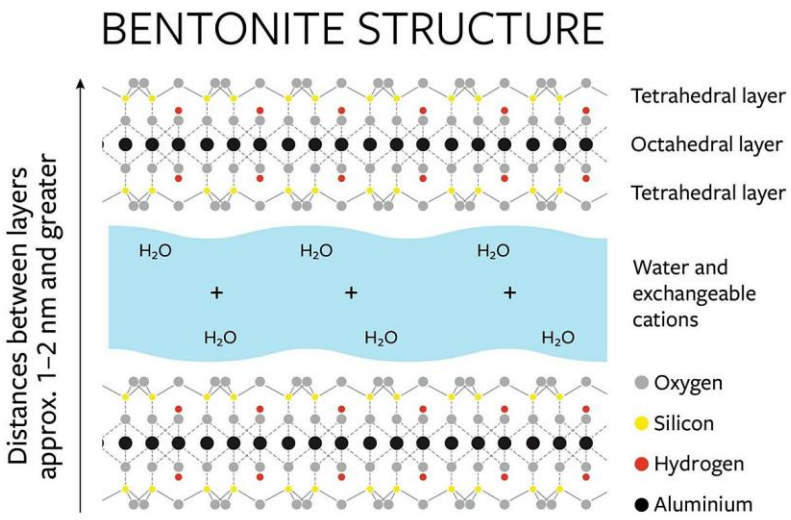
You may notice a small area of tamarisk that reveal a rusted old truck. The rarity of water in the area often drove early cattle ranchers to go to great lengths to maximize resources for their **cattle**. The **invasive tamarisk** has taken over this small spring and has pushed out other plants that would grow here.

You will notice that this area is severely degraded. Cattle hooves have compacted and marked up the soil and very little vegetation grows here. Cattle are stilled grazed on this land but are heavily subsidized and fed/ watered while in this "range".



Mile 8: Bentonite Hills

At this point we are entering a unique geological area known as the Bentonite Hills. These fun and unique colored hills are composed of clay and volcanic ash deposited during the Jurassic area (**Morrison Formation; Brushy Basin**). This formation is renowned for Jurassic era fossils (dinosaurs and plants). During this era a massive drought likely concentrated animals and plants in areas of remaining water which led to fossilization. Fossils may be found in this area.



Mile 12: Campsite #1

This area will also serve as our first overnight camp location. Bureau of Land Management (BLM) lands permit dispersed camping in the area. Tomorrow we will camp inside the park and must camp at a campground.

This area is dominated by rock outcrops and lots of micro-topography. We will do a small survey of this area looking at micro-topography. This micro-topography is a mix of boulder and pediment deposits (see Day 2 section on washes).

DAY 2

Mile 14: South Desert Overlook and Campsite #1

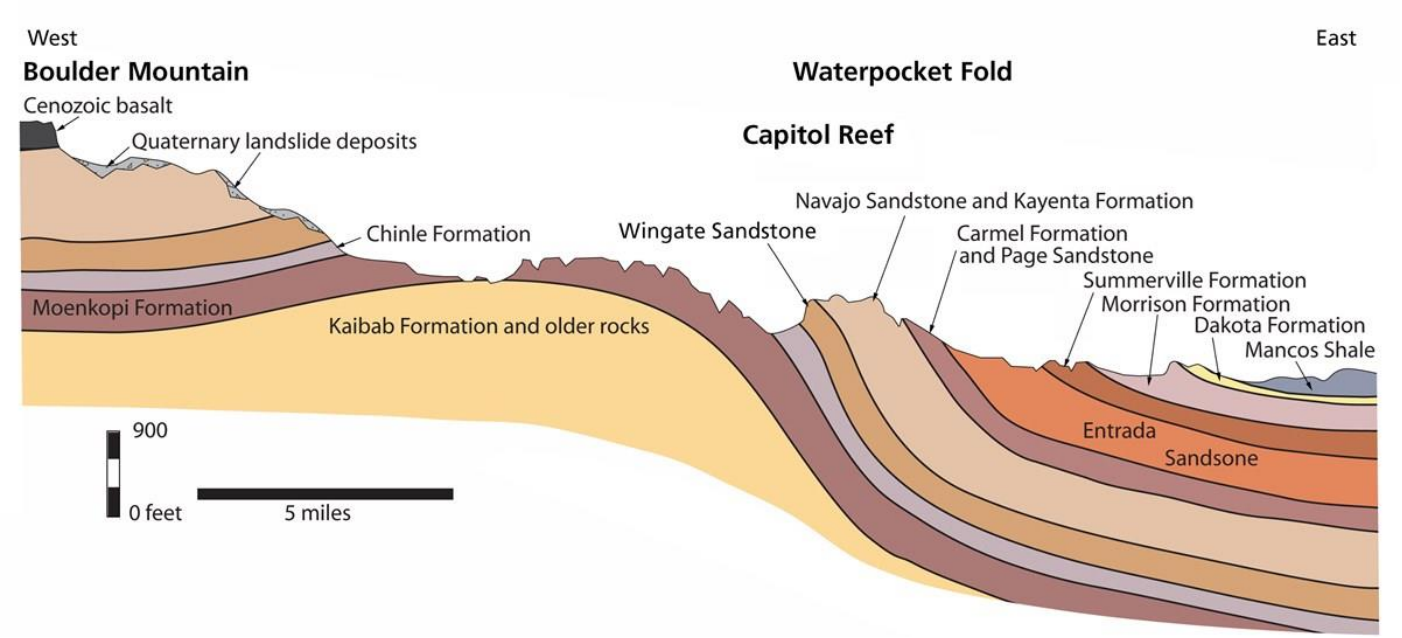
A short ¼ mile walk reveals the exciting scenery of the South Desert inside Capitol Reef National Park. This dry seemingly, deserted area has a long history of attempted cattle grazing. The Park is currently working to restore the area from years of unwise and intensive cattle ranching that resulted in little economic gain and a destroyed xeric grassland.

If time permits, we can walk further down this trail into the park. **Jailhouse rock** is capped with a faded grey-green layer. This sedimentary/ sandstone layer is known as the **Curtis Formation** and can also be found around the area. The "Bubbling" rocks in this area are composed of this formation. Below the grey-green Curtis formation is the bright orange **Entrada Sandstone.** This erodible material makes up most of the monolith formations in the area.

Mile 16: Park Boundary

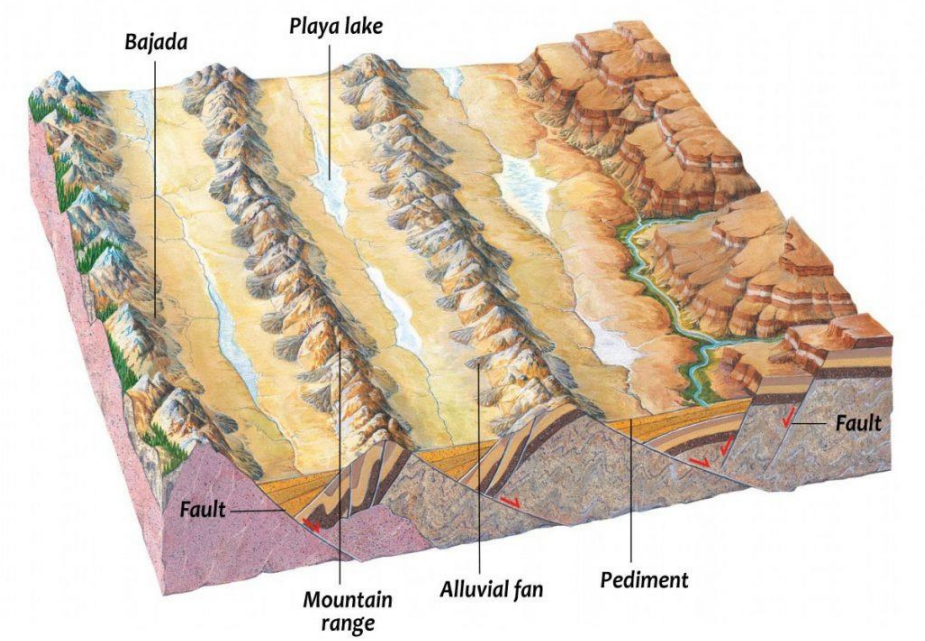
Welcome to Capitol Reef National Park. First preserved as a monument (in 1937) this park was established in 1971 primarily as way to protect and preserve the awesome geology of the **Waterpocket**

Fold formation (seen by the Field Station). Please no collecting of plants or rocks while on Park Service controlled land.



Mile 16.5- 19: Desert Wash's

This long slow sand stretch we will enter is known as a wash. In arid regions associated with topography these areas form as water moves from high to low elevations following the path of least resistance. This promotes water to channel and become concentrated. As most of the sediments are prone to erosion they have little water holding capacity and the water drains into aquifers, in areas with less erodible bedrock (such near faults) riparian areas can form. Sediments pushed out by washes are called pediment, evidence of the power of water when it is moved in large rain events.



Mile 27.1: Cathedral Valley Overlook

From here on out we will be passing several overlooks that give spectacular views of some of the monoliths in the park. This overlook here gives a good view of the Waterpocket Fold, the central geographic feature of Capitol Reef National Park.

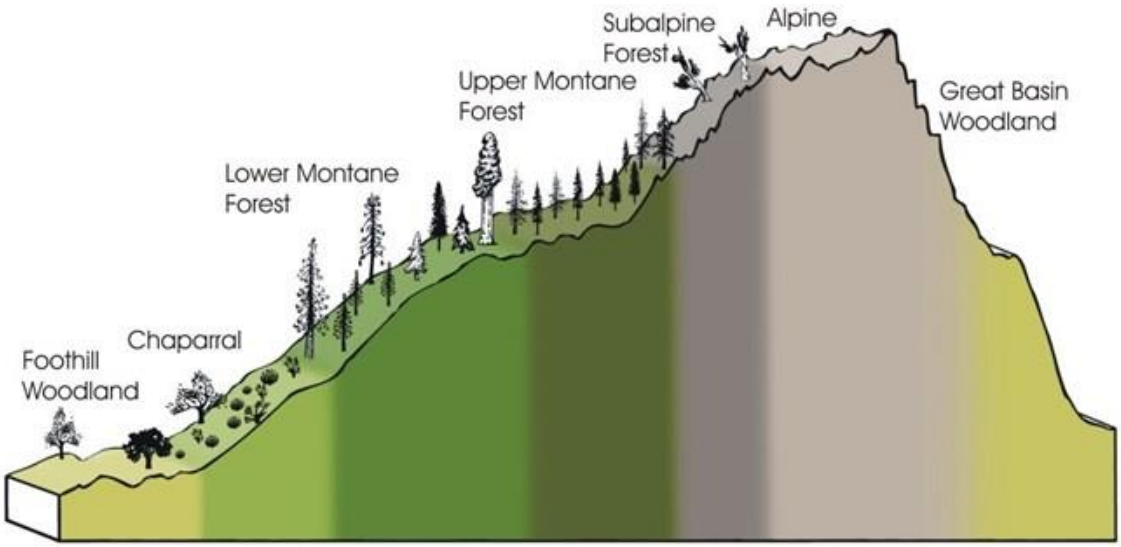
Mile 27.4: Cathedral Valley Campground

A junction gives us several options. We will take a right and head North up to Cathedral Valley. Here we will arrive at a small campground for the night. This area is in a small Juniper-Pinyon woodland. Juniper-Pinyon woodlands are areas with dispersed trees that at times seem barren but host a high level of plant diversity. The junipers are also important for much wildlife in the area through shade and as a food item. This area is also our highest elevation (6982 ft). We will spend some time exploring the dynamics of Juniper-Pinyon Woodlands.

DAY 3

Mile 28: Descent into Cathedral Valley

Our first challenge on day 3 will be to navigate down into Cathedral Valley. The road has switch-backs and a few blind corners, use caution for oncoming cars. As we drop down into the valley today pay attention to changes in the vegetation. Vegetation takes it cues from elevation throughout the Colorado Plateau and even a change in 500ft can dramatically switch up the plant community. This pattern was influential on many early plant ecologists and became known as the elevational based “life zone” system.



Mile 31: Lake Creek

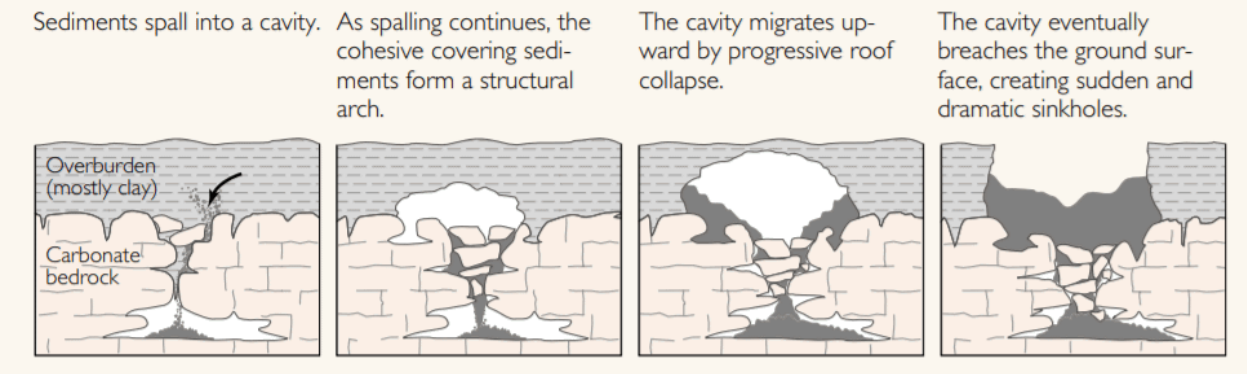
When water does come to Colorado Plateau it often comes in dramatic rain events. These events can produce a surge of water known as a “flash flood” and can often be triggered by distance rain events meaning little warning of a flash. At this point we cross a dry creek bed that only fills in the aftermath of these rain events. It’s a reminder to be safe when traveling in areas with little escape.

These areas can be important for annual plants that survive as seeds waiting for the perfect condition to live their short lives and reproduce before the area dries up again. Look for small, tiny plants in this area and if we had some rain we may even get lucky and find something flowering.

Mile 32.8: Baker Ranch and the Gypsum Sink Hole

At this point we have past several reminders of the old cattle days. As the area has been designated park land old cattle allotments have remained in some cases as they were given a grandfather clause. Many of these allotments have been abandoned but their scars will be present for years to come.

We can take a short 1 mile detour for a quick view of the Gypsum Sinkhole. Selenite (i.e. gypsum) is soluble to mildly acidic water. This has caused a collapse of the underlying structure resulting in a steep shaft into the ground as the selenite has been dissolved.

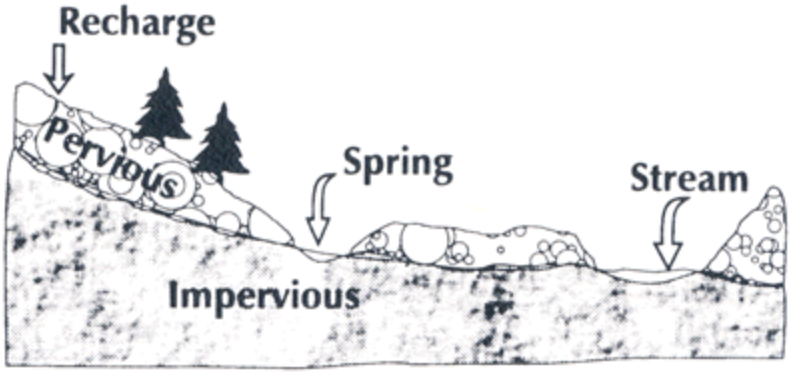


Mile 37: Leaving Capitol Reef and Intrusive volcanics

At this point we leave NPS land and arrive back into BLM managed land. Notice changes to the surrounding vegetation and the impacts that a few rules can have on the local landscape (we will briefly go into the park once more in a few miles). You will also see several veins of intrusive volcanics in the cliffs.

Mile 41.3: Campers Spring

Tamarisk has spread throughout western North America helped by mass plantings in the early 1900's in order to control erosion (caused by un-sustainable grazing and farming practices). Since then it has aggressively invaded waterways and water sources where it can cause increased evapotranspiration and drying of the areas it invades. Springs that once were productive are now reduced to areas of dense tamarisk stands.

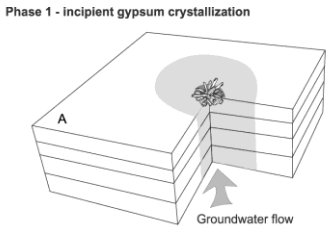


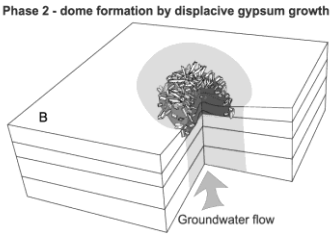
Mile 42.1: Temples of the Moon and the Sun

A quick venture (about 0.7 miles) gives us a close view of the two most imposing temples of Cathedral Valley. The first Europeans to make note of theses geological wonders was the crew of the Fremont led expedition in 1853. Although the names suggest deep rituals and spiritual meanings the geologic formations were given names more recently by Charles Kelly, the first superintendent of Capitol Reef, around 1938. If the Ute tribe or early Fremont cultures used this area for any spiritual or cultural use I have not been able to find any sources.

"The monoliths (large, freestanding rock formations) are composed of the earthy, buff-pink Entrada Sandstone. Deposited 160 million years ago in the Jurassic period, this fine-grained sandstone formed by the deposition of sand and silt in tidal flats. It crumbles easily to a fine sand which is rapidly removed by water; therefore, talus (debris) slopes do not form and Entrada cliffs tend to rise sheer from their base. Above the Entrada, the grayish-green sandstone and siltstone of the Curtis Sandstone forms a hard cap rock on some of the monoliths and higher cliffs and buttes, protecting them from erosion. Above the Curtis is the thinly-bedded, reddish-brown siltstone of the Summerville Formation."

-Geological Resources of Capitol Reef National Park





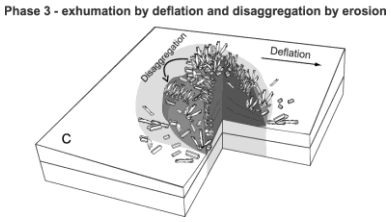
Mile 43: Glass Mountain

Near the temples we will see a pile of shard like rocks that have a mirror like surface. These are selenite crystals, like those at the bentonite hills. They have formed here as gypsum deposits get buried and are then pushed up forming a rounded mound. These are typically rare with only one other similar deposit in the area. This second Selenite Plug has been reduced to rubble by overzealous collectors. **Please no collecting inside of the park.**

Mile 44.8: Salt Wash and Camping

After the temples we will continue until we find a campsite for the night. The further we go the less time we will have in the saddle tomorrow.

We will go through "Salt Wash" a dry creek area that is prone to flash flooding. It will also likely be hardpacked as much of the eroded sand from the area is channeled down as silt during times of intense or sudden rain deposition.



DAY 4

Mile 46.7: Morrison Formation

Depending on how far we made it the previous night we will likely start the day by entering the Morrison Formation. From here on out we will be traveling downhill but the road may be rocky. Be careful of offroad vehicles operating at high and sometimes reckless speeds.

Mile 57.6: Route 24

Our adventure ends at the pavement. Here we will exit Cathedral Valley using the Caineville Wash.

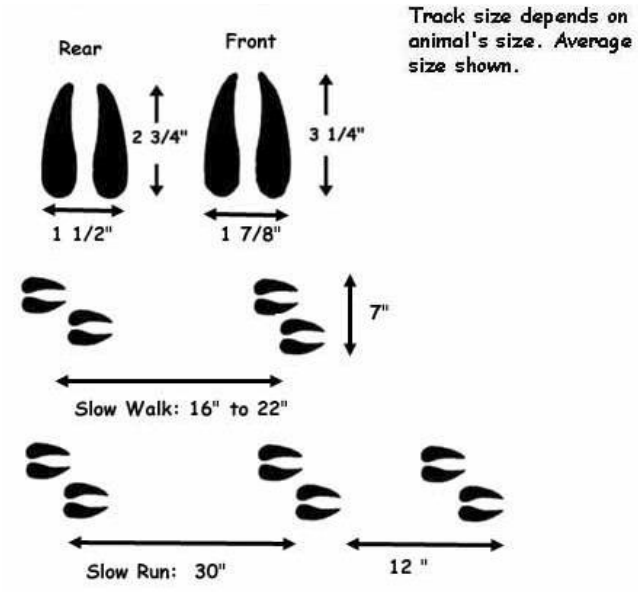
At this point we end our journey Here we will give each other high fives and get back to the real world. Make sure to ask Dr. Rotter for a special reward for your hard work.

Fauna of Cathedral Valley

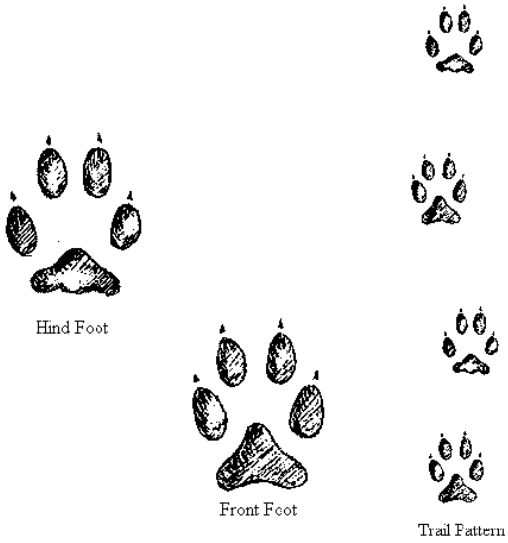
Mammals

Big Horn Sheep

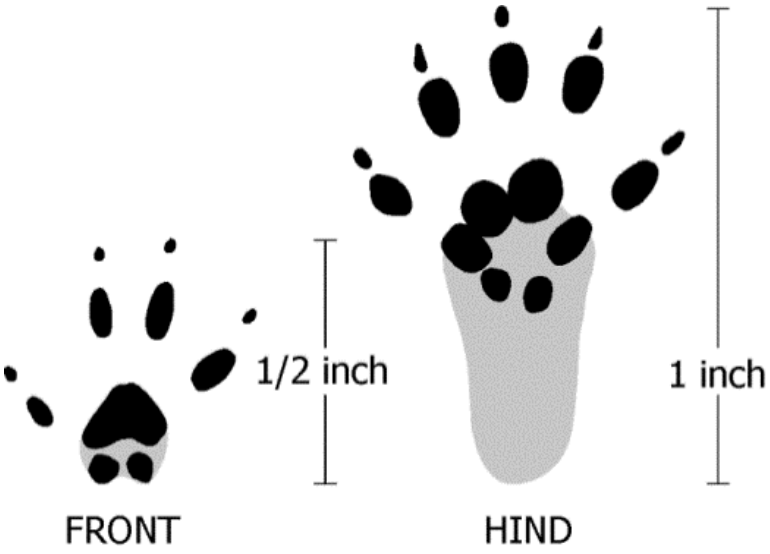
Mule Deer



Grey Fox*



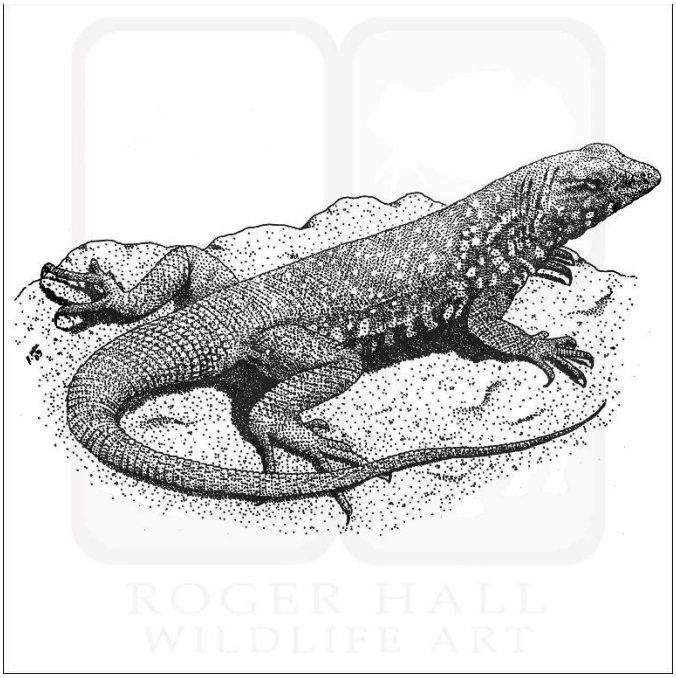
White-tailed antelope Squirrel



*Dog is typically larger and has a more prominent pad, track is not as uniform and meanders

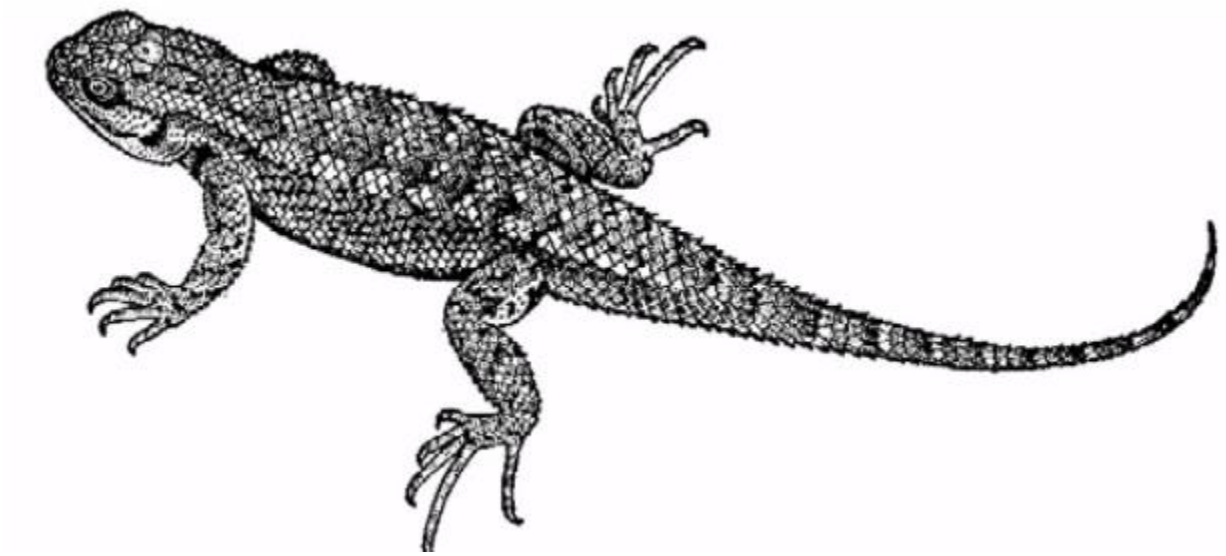
Reptiles

Side-blotched lizard



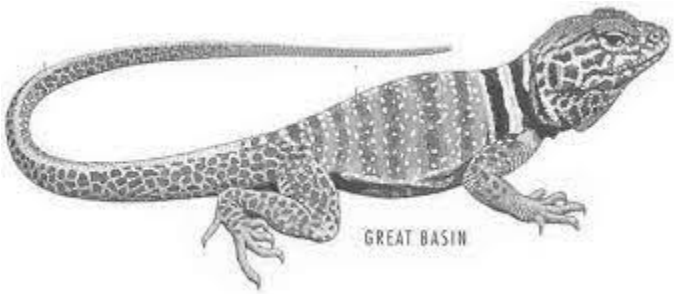
Desert spiny lizard

Common sagebrush lizard

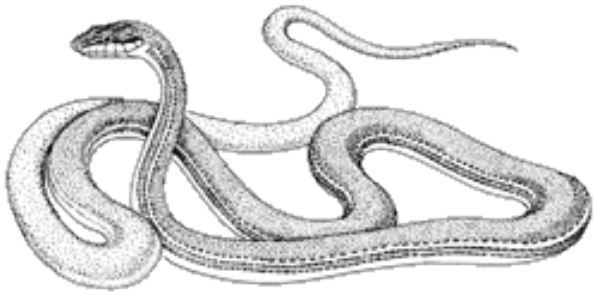


Western Whiptail

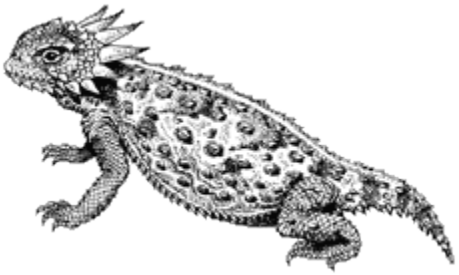
Great Basin Collared lizard



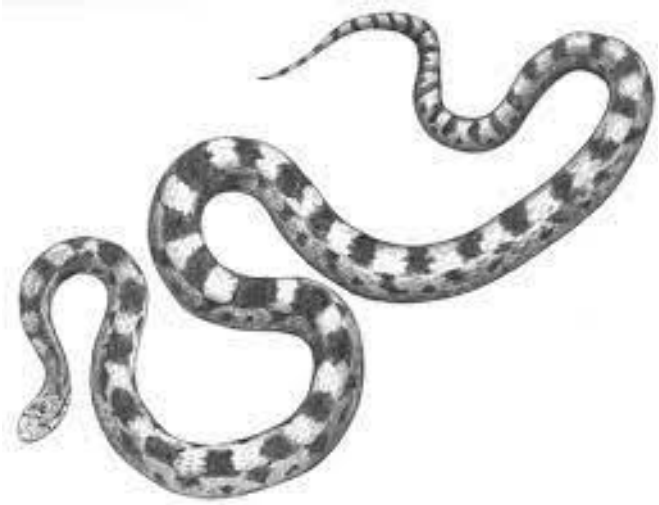
Striped whipsnake



Greater Short-horned Lizard



Gopher snake

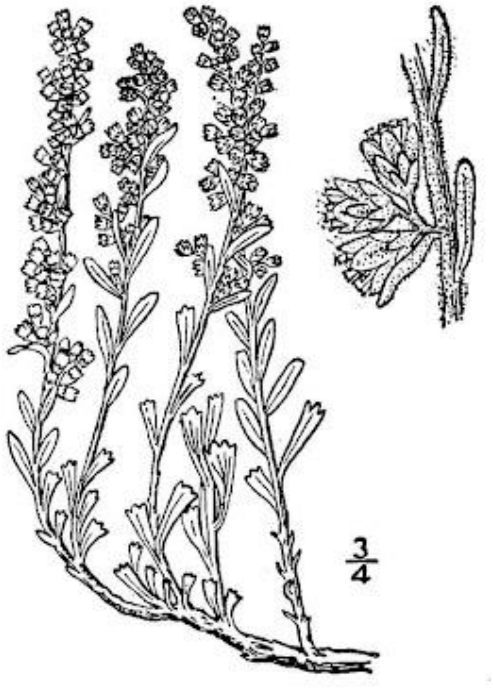


Midget faded rattlesnake

Flora of Cathedral Valley

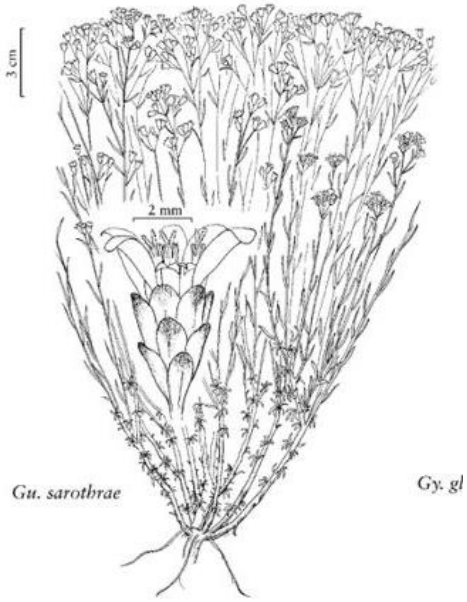
Common Plants of Cathedral Valley

Shrubs and Trees

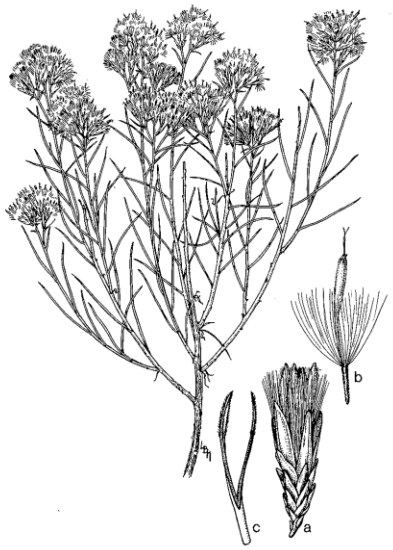


Flat Sagebrush – *Artemisia bigelovii*

Big Sagebrush – *Artemisia tridentata*

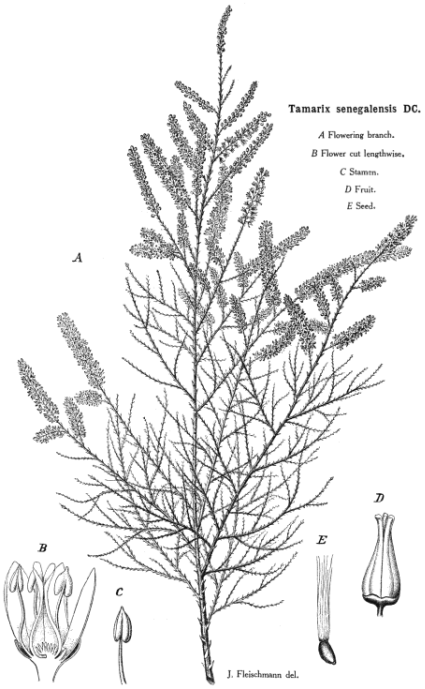


Broomweed – *Gutierrezia sarothrae*

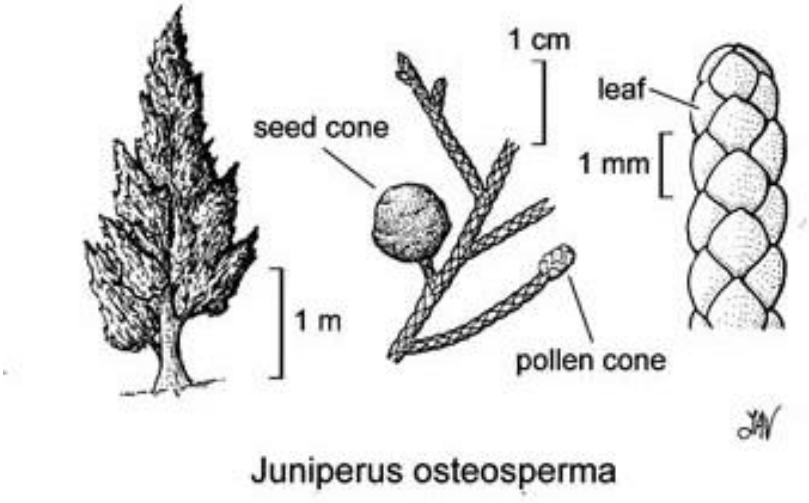


Rabbitbrush – *Ericameria nauseosus*

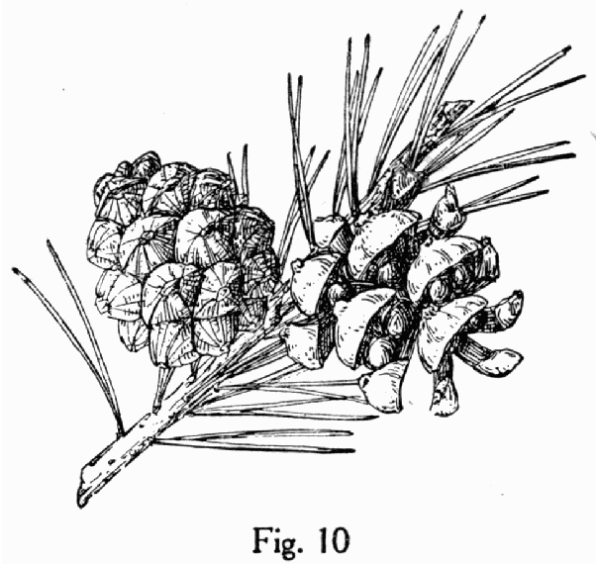
Saltbush – *Atriplex Canescens*



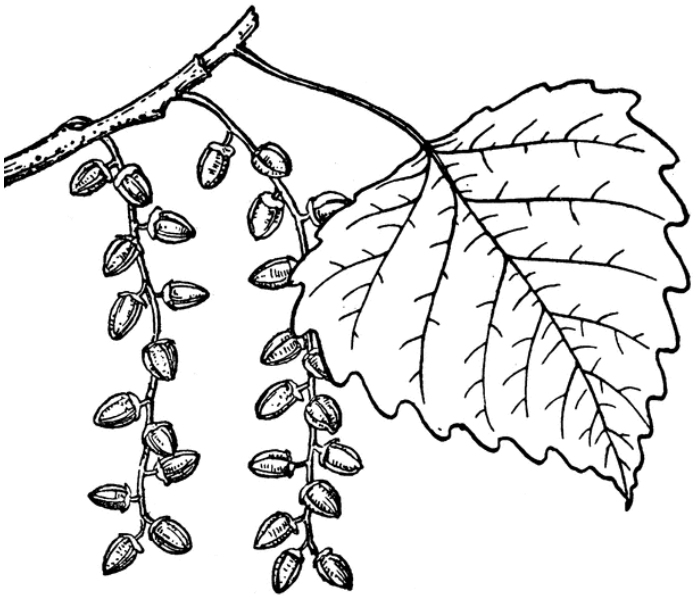
Tamarisk – *Tamarix chinensis*



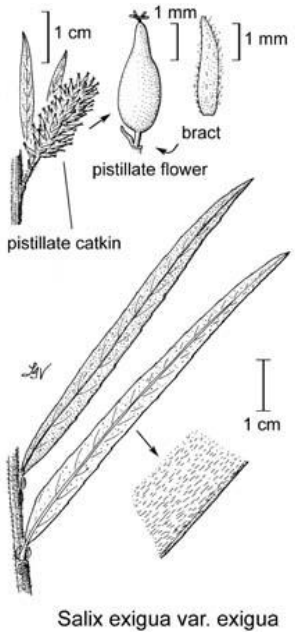
Boneseed Juniper – *Juniperus osteosperma*



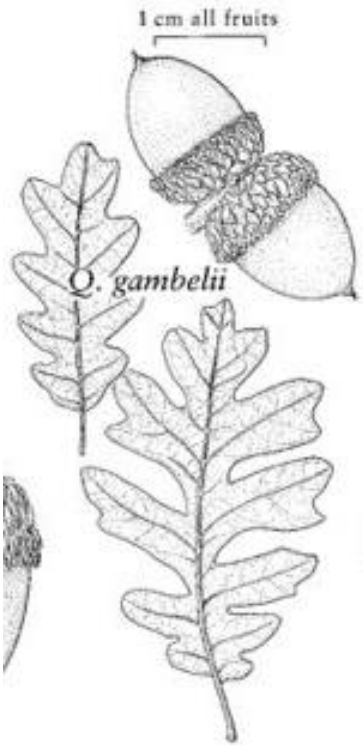
Pinyon Pine – *Pinus edulis*



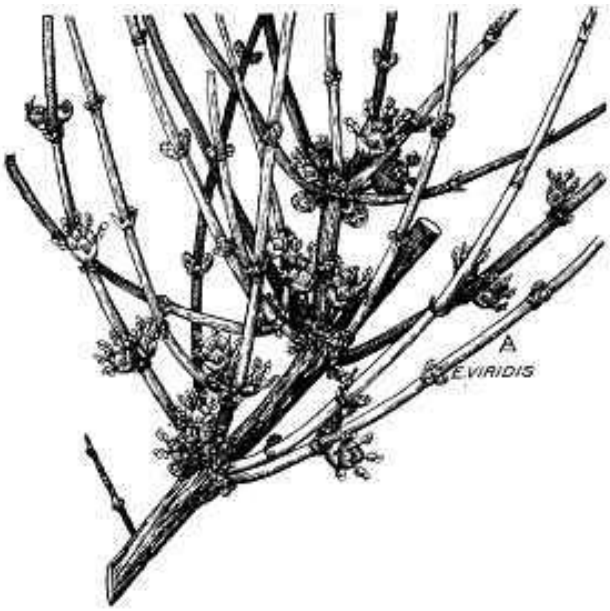
Cottonwood – *Populus fremontii*



Willow – *Salix spp.*

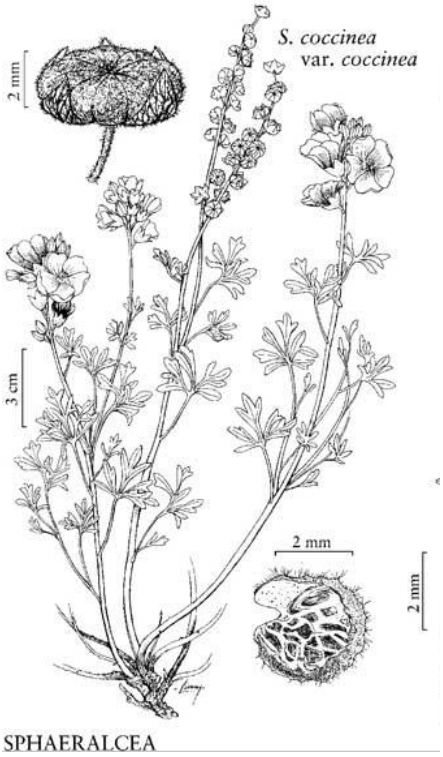


Gamble Oak – *Quercus gambellii*



Green Ephedra – *Ephedra viridis*

Herbs

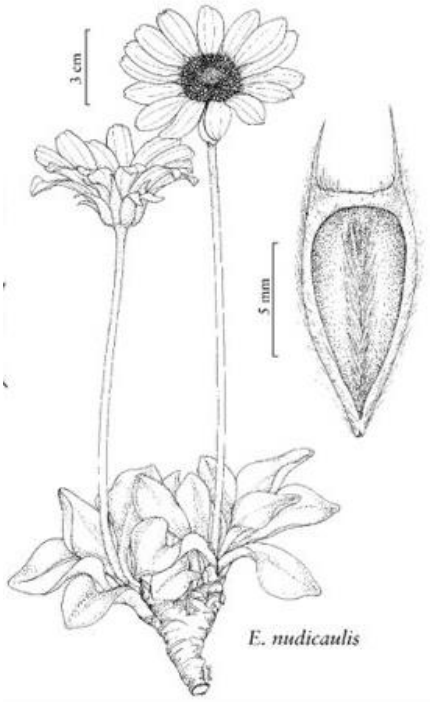


Common Globemallow – *Sphaeralcea coccinea*

Small-leaved Globemallow – *Sphaeralcea parvifolia*

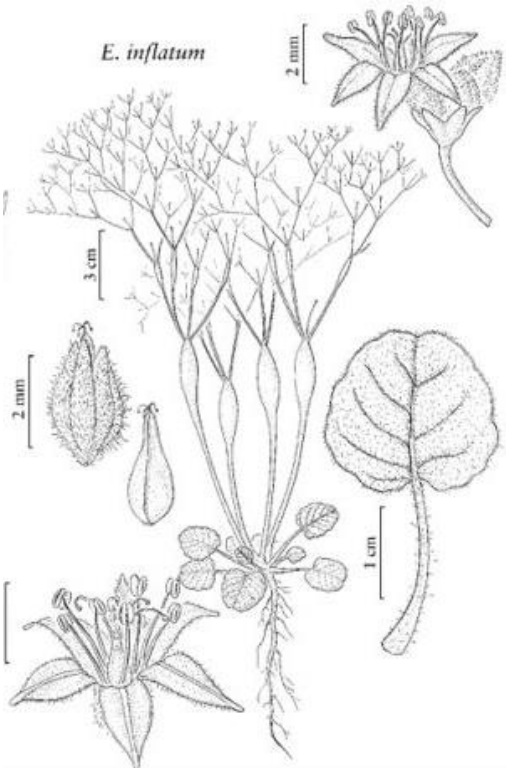
Penstemon – *Penstemon sp.*

Cats Paw Flower – *Cryptantha* sp.

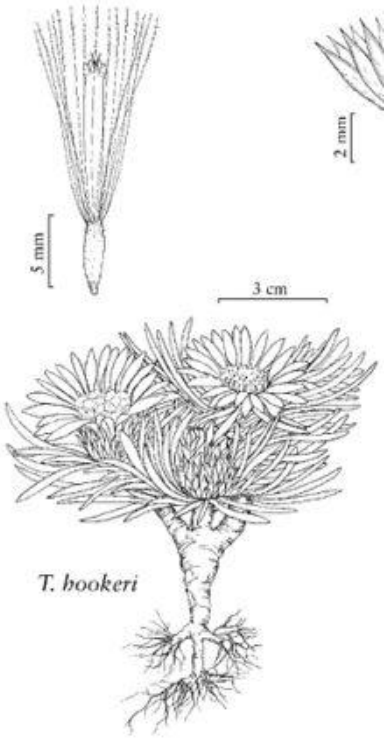


Sunrays – *Enceliopsis nudicaulis*

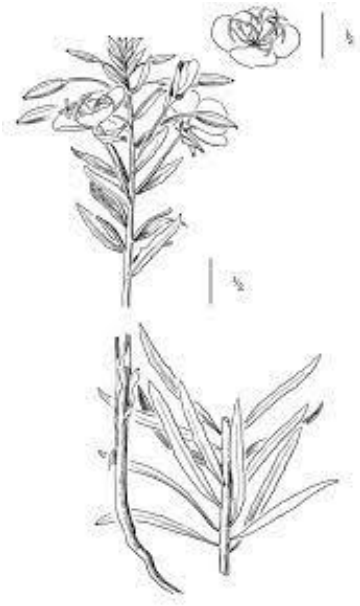
Prince's Plume – *Stanleya pinnata*



Inflated hairy knees - *Eriogonum inflatum*

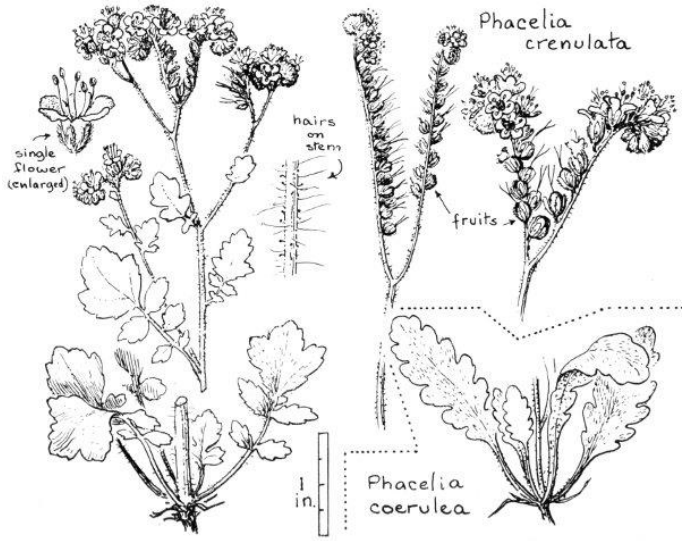


Townsendia – *Townsendia sp*.



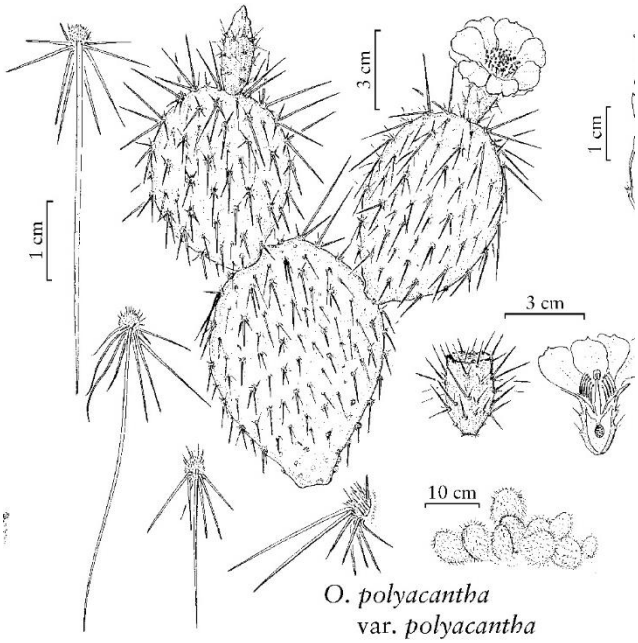
Evening Primrose – *Oentheria pallida*

Milkweed – *Asclepias sp*.

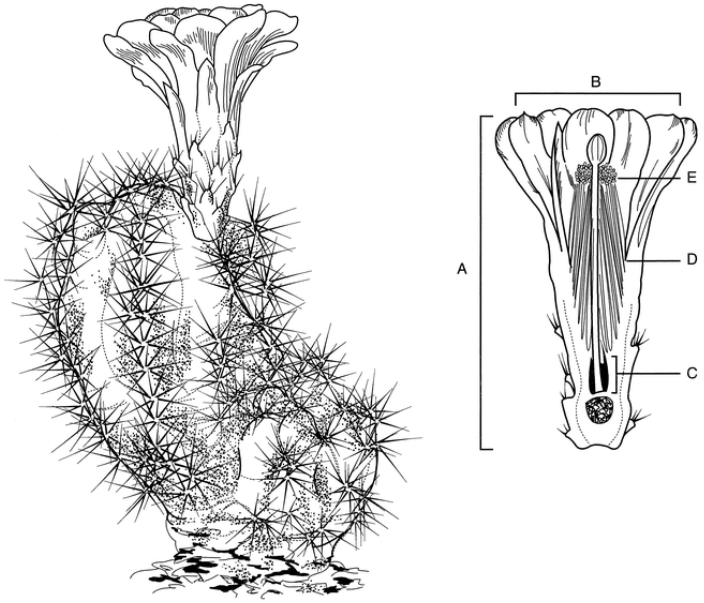


Scorpion weed- *Phacelia sp.*

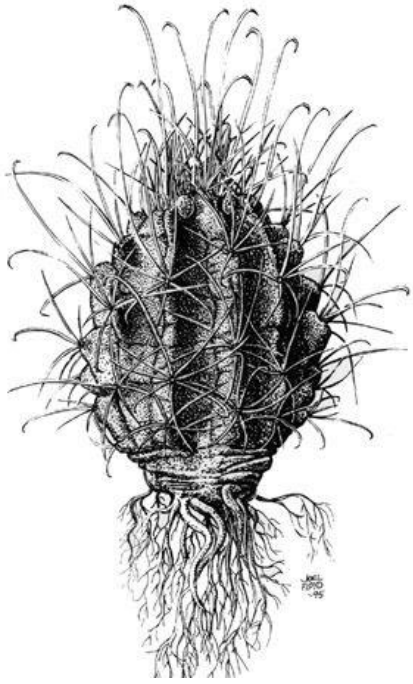
Cacti and Yucca



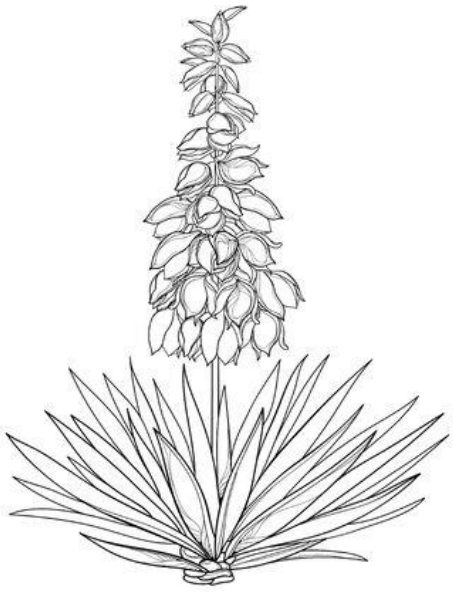
Prickly Pear – *Opuntia sp.*



Claret Cup - *Echinocereus triglochidiatus*



Fishhook Cactus - *Sclerocactus whipplei*



Yucca - *Yucca harrimaniae*

Geology of Cathedral Valley and the Colorado Plateau

Cathedral Valley is part of the **Colorado Plateau**, an area of higher elevation plateaus (nothing under 5000 ft) situated around the four corners region. These plateaus are interspaced by steep canyons and striking “badlands” formations caused primarily by erosion. Many of these eroded cliffs and terraced like areas reveal underlying formations of Mesozoic (Dinosaur times) and Tertiary origins. The geographic variation is diverse on the Colorado Plateau. This variation is primarily driven by elevation and erosion stages.

The **Cathedral Valley** is known for its large monoliths (or cathedrals). These have been shaped out of erosion to mudstone, siltstone, and sandstone that compose the **Entrada Sandstone**. Some of the monoliths are capped by a resistant gray-green sandstone known as the **Curtis Formation.** Along the southwest wall of the valley you can see rock towers that will be stranded through erosion creating future monoliths.

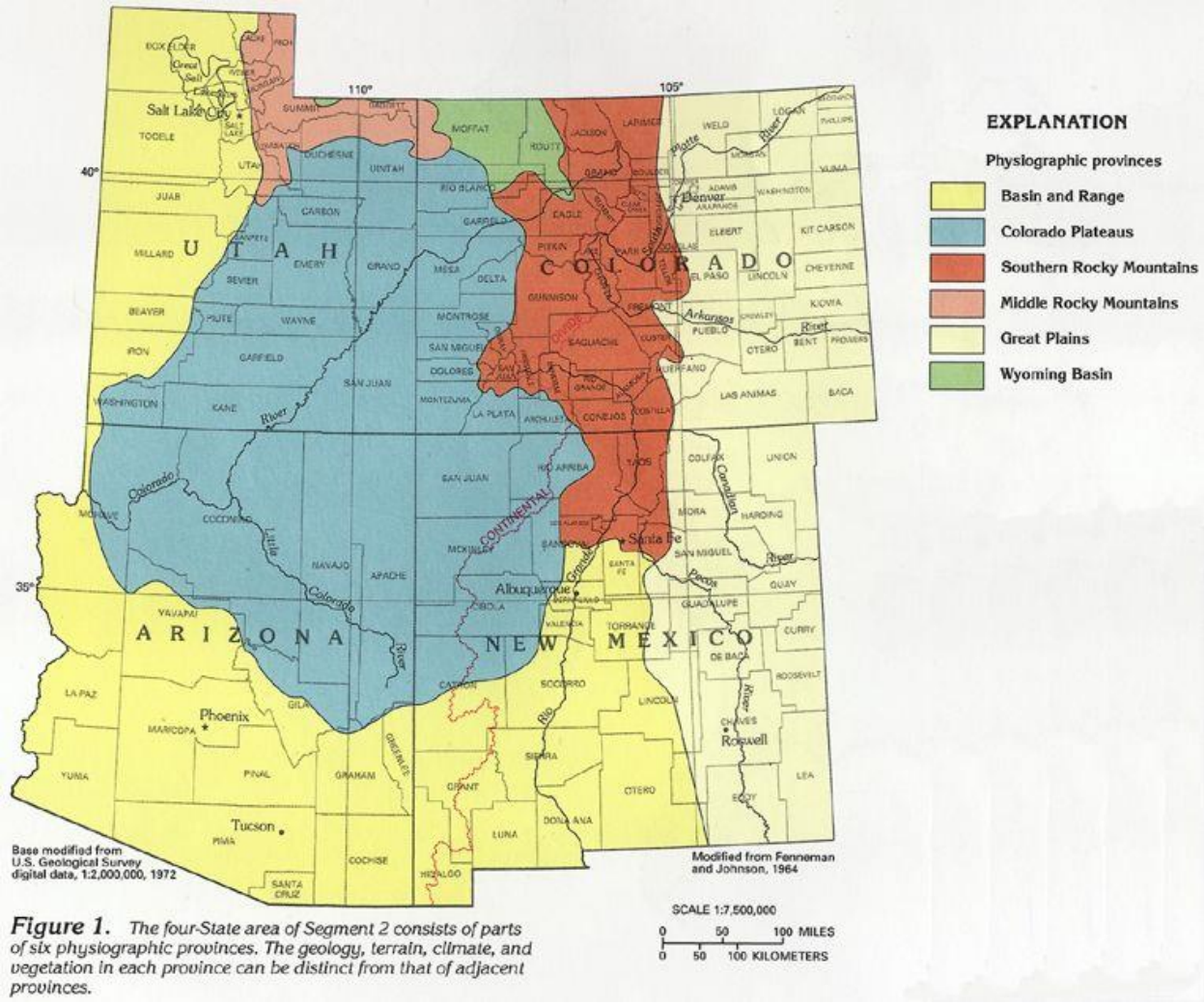
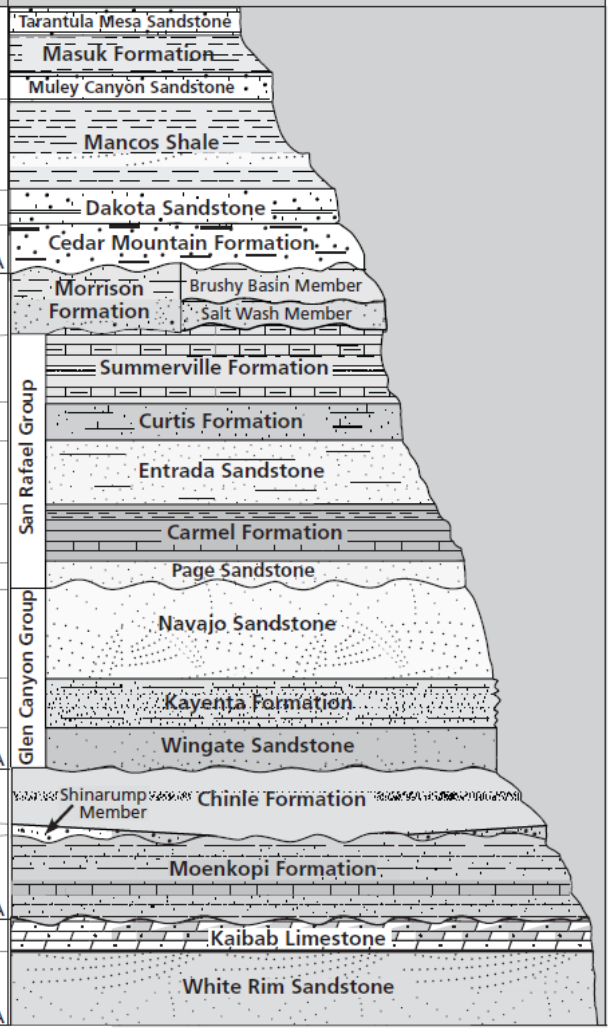


Figure 1. *The four-State area of Segment 2 consists of parts of six physiographic provinces. The geology, terrain, climate, and vegetation in each province can be distinct from that of adjacent provinces.*

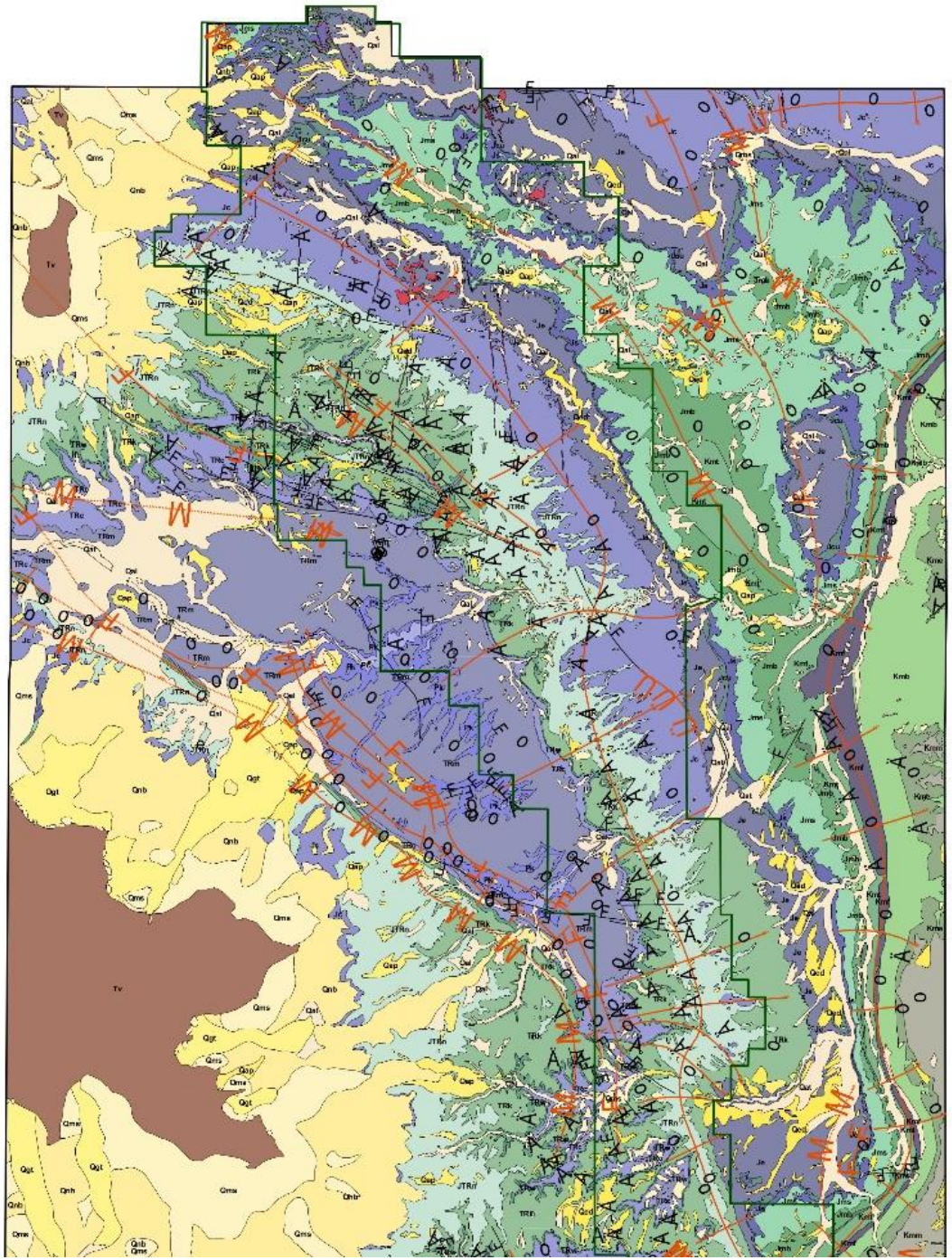
Thickness	Rock Type	Paleo-environment	Location / Remarks	Landforms	Age
1200-1450 feet (combined)	Shale interlayered with sandstone	Floodplains, coastal areas, and marine	West side of Henry Mtns., east of Strike Valley		65 MYA
2000-3000 feet	Mostly dark gray shale interlayered with sandstone	Shallow sea that bisected North America	Factory Butte and badlands near Caineville		Cretaceous
0-50 feet	Tan sandstone, oyster shell fossils	Coastal	Oyster Shell Reef; locally absent		
0-100 feet	Conglomerate and mudstone layers	Rivers and Floodplains	North and east of the Hartnet Road river ford		144 MYA
180-700 feet	White crossbedded sandstone (Salt Wash) & candy-striped mudstone (Brushy Basin)	Vast river systems; bentonite clays from altered volcanic ash	Bentonite Hills; along Notom-Bullfrog Road north of Burr Trail		
150-300 feet	Thinly-bedded, reddish siltstone; thick, wavy gypsum on top	Tidal flats	Cliffs at east park entrance		
0-80 feet	Grayish-green sandstone & siltstone	Marine	Caps cathedrals of Cathedral Valley		
450-750 feet	Earthy, red, very fine-grained sandstone & gypsum	Transition between tidal flats and dune fields	Cathedrals of Cathedral Valley		Jurassic
300-100 feet	Interlayered red sandstone, siltstone, & gypsum	Shallow marine, tidal flats, & sabkhas (sandy salt flats)	Forms red V-shaped chevrons on east side of Waterpocket Fold		
50-100 feet	Tan sandstone	Sand dunes	Cap of Golden Throne		
800-1100 feet	White crossbedded sandstone	Vast region of sand dunes	Capitol Dome, Navajo Dome, & Grand Wash Narrows		
350 feet	Interlayered white sandstone & red siltstone	West-flowing rivers	Top, ledgy portion of Fruita Cliffs; Hickman Bridge		
350 feet	Sandstone, often stained dark red	Sand dunes	Fruita Cliffs & Circle Cliffs		206 MYA
350-550 feet	Interlayered sandstone, siltstone, & bentonitic mudstone	Forested basin with rivers, swamps, & lakes	Slopes below Fruita Cliffs; contains petrified wood & uranium		Triassic
0-90 feet	White sandstone	River channels	Discontinuous; cap of Chimney Rock		
500-1000 feet	Mostly dark red siltstone & mudstone; minor yellowish limestone	Gently sloping coastal plain, fluctuating sea level	Miners Mountain, Egyptian Temple, & base of Chimney Rock		248 MYA
70-100 feet	Gray dolomitic limestone	Marine	Fremont River Gorge		Permian
400+ feet	White crossbedded sandstone	Beach & dune sands	Fremont River Gorge & Goosenecks of Sulphur Creek		290 MYA



MYA = Million Years Ago

Geological Time Scale

ERA	PERIOD	EPOCH / AGE	Million Years Ago	EVENTS
CENOZOIC *Age of Mammals* 65.5 mya – present day	*Quaternary*	*Holocene*	*Today*	Ice Age ends Humans are dominant
		Pleistocene	*0.01*	Earliest Humans appear Ice Age begins
	Tertiary	*Pliocene*	*1.6*	Hominids (human ancestors) appear
		Miocene	*5.3*	Grass becomes widespread
		Oligocene	*23.7*	Mammals are dominant
		Eocene	*36.6*	Eocene – Oligocene extinction event
		Paleocene	*57.8*	First large mammals appear
MESOZOIC *Age of Reptiles* 245 mya – 65.5 mya	*Cretaceous*	*Extinction of Dinosaurs*	*65.5*	K-T extinction event Earth looks closer to present-day Flowering plants appear
	Jurassic		*144*	First Birds appear Pangaea splits into Laurasia, Gondwanna Dinosaurs are dominant
	Triassic	*First Dinosaurs*	*208*	Pangaea cracks First mammals appear Reptiles are dominant
PALEOZOIC 570 mya – 245 mya	*Permian*	*Age of Amphibians*	*245*	Permian – Triassic extinction event Pangaea forms
	Carboniferous		*286*	First reptiles appear First large cartilaginous fishes appear
	Devonian	*Age of Fishes*	*360*	Late Devonian extinction event First land animals appear First amphibians appear
	Silurian		*408*	First land plants appear First jawed fishes appear First insects appear
	Ordovician	*Age of Invertebrates*	*438*	Ordovician – Silurian extinction event First vertebrates appear
	Cambrian		*505*	End Botomian extinction event First fungi appear Trilobites are dominant
PRECAMBRIAN 4600 mya – 570 mya	*Proterozoic Eon*		*570*	First soft-bodied animals appear First multicellular life appear
	Achean Eon		*2500*	Photosynthesizing cyanobacteria appear First unicellular life appear
	Hadean Eon	*Priscoan Period*	*3800*	Atmosphere and oceans form Oldest rocks form as Earth cools
Formation of Earth			*4600*	

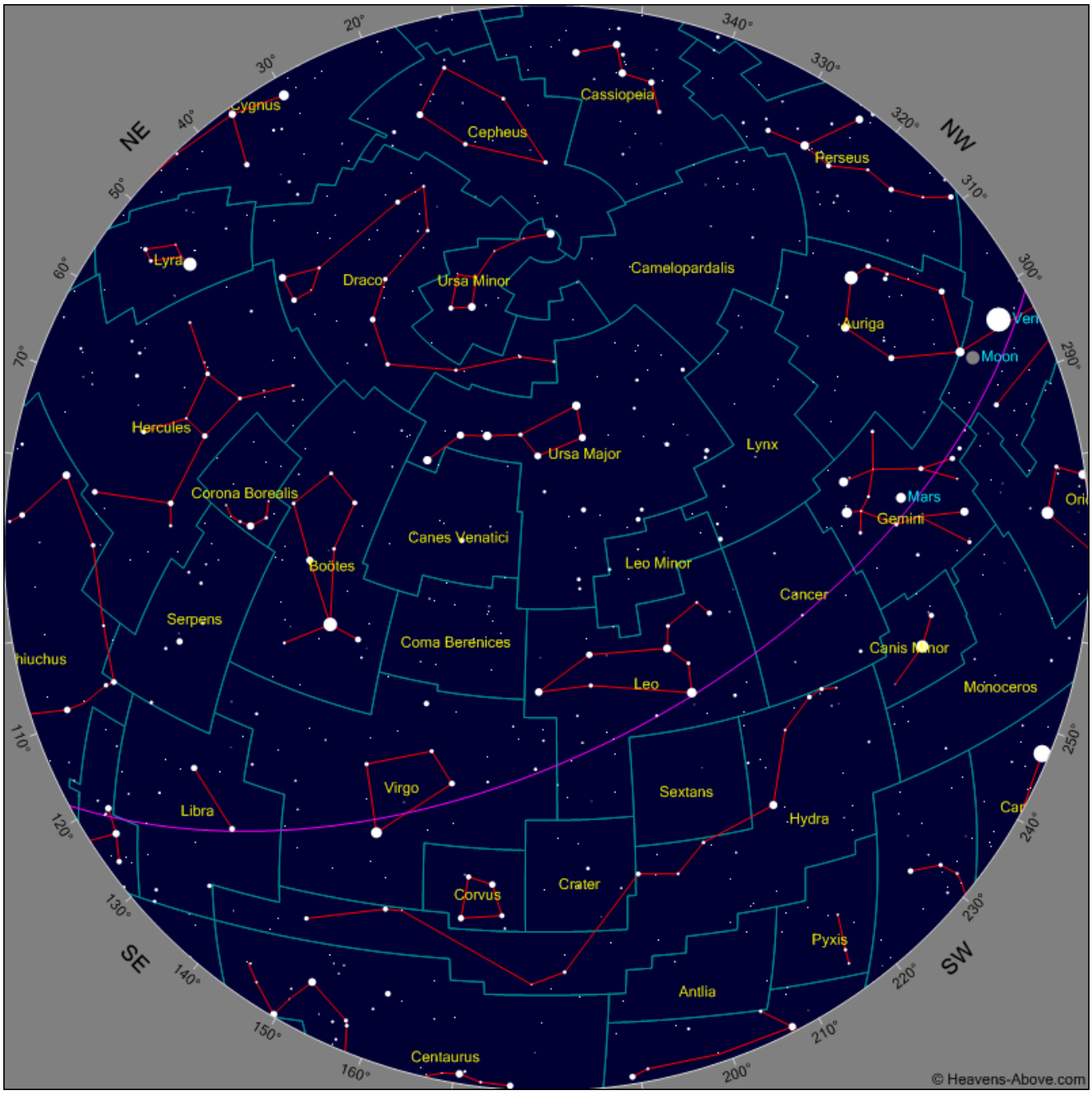


Geologic Units

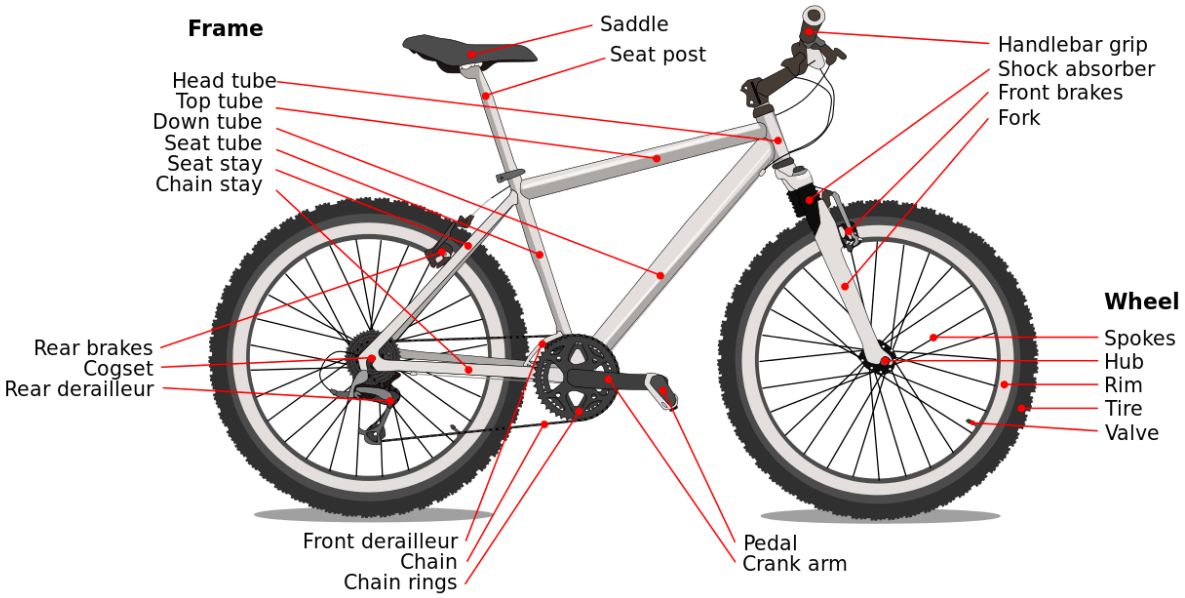
- Qal - alluvial deposits
- Qed - eolian deposits
- Qmr - rock glacier deposits
- Qms - colluvial deposits
- Qat - terrace gravel deposits
- Qap - pediment deposits
- Qnb - boulder deposits
- Qgt - glacial till
- Tv - extrusive volcanics
- Tdp - Diorite Porphyry
- Ts - shattered sedimentary and igneous rocks
- Ti - intrusive volcanics
- Tf - Flagstaff Limestone
- Kmv - Mesa Verde Formation
- Kmm - Mancos Shale, Masuk Member
- Kme - Mancos Shale, Emery Member
- Kmb - Mancos Shale, Blue Gate Shale Member
- Kmf - Mancos Shale, Ferron Member
- Kmt - Mancos Shale, Tununk Shale Member
- Kd - Dakota Sandstone
- Kcm - Cedar Mountain Formation
- Jmb - Morrison Formation, Brushy Basin Member
- Jms - Morrison Formation, Salt Wash Member
- Js - Summerville Formation
- Jcu - Curtis Formation
- Je - Entrada Sandstone
- Jc - Carmel Formation
- JTRn - Navajo Sandstone
- TRk - Kayenta Formation
- TRw - Wingate Formation
- TRc - Chinle Formation
- TRm - Moenkopi Formation
- Pk - Kaibab Formation
- Pc - Cutler Group, undivided

Star Chart

4.24.2023, 11:00PM, Temple of the Moon



Bicycle Tips and Quick Fixes



Gears and chain (drive)

- Always try to go from gear to gear, don't jump from high to low quickly.
- Match your front cog with your back cog so the chain stays relatively straight, when in a low gear in the front chain ring be in a low gear in the cog set (back).
- If the chain falls off stop and lift the chain back on, the chain will likely be greasy.
- Lubricating the chain is important. Wipe down the chain (use a degreaser if possible) and then re-apply lube. Use as little lube as possible and only for the inner pins of the chain.
- When setting your bicycle down, make sure the rear derailleur is facing up.
- The rear derailleur is the most fragile part of the bike be careful when riding.

Brakes

- Check brakes every time you get on your bike before starting.
- Do not touch brake rotors or pads. Dirt and oils will contaminate them and reduce your stopping power. Brake rotors may also be extremely hot and can burn you.
- If your brake pads are rubbing likely we can make a quick adjustment.
- If braking power is low or not working let someone know immediately so we can fix it.

Tires and wheels

- Tires should be inflated within the recommended range (on the side wall of tire), they do not need to be at max, lower inflation can give more cushion but slow you down and could cause pinch flats to tubes
- Don't be scared to adjust tire pressure throughout the day depending on conditions

- Check to make sure the wheel is attached firmly to the frame throughout the day. Quick release levers should be tight and through axles should be tighten at the appropriate force.

Bags, racks, etc…

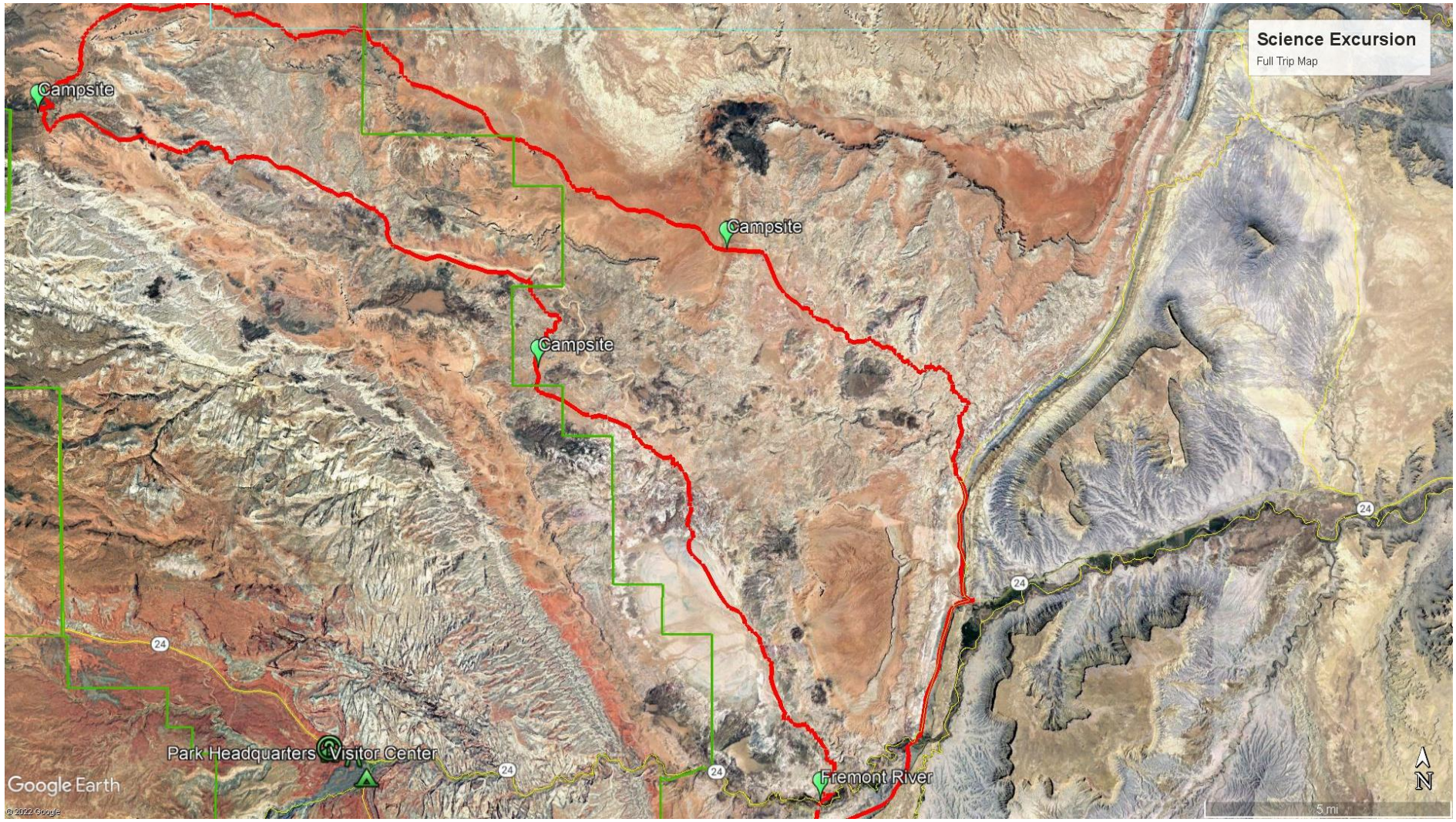
- Check bolts for any racks every day, you do not want a rack falling apart.
- Make sure bags are attached tightly to you so they don't shift and throw you around.
- If using straps make sure they are not loose and have no danger of going into wheels.
- Have water easily accessible so you can drink without stopping.

Riding

- Sand: Keep pedaling while in sand and shift your weight back so the rear wheel can dig in, try to ride in a straight line.
- Rocks: Try to avoid larger rocks and "pick a line" by thinking two moves ahead. Weave your front tire through the easiest path and keep track of your back tire. Watch out for hitting your pedal on down strokes.
- Downhill: When descending keep two to three fingers ready to gently pull the brake levers. Sit up and back and use your thighs to grab the saddle. This will give you better control at high speeds. Don't jam the brakes as you descend gently pump them to avoid wheel locks.
- Uphill: Anticipate each uphill and downshift with the rise of the hill as you go along. You can stand up and peddle if need be to give more power. Sometimes being in a much lower gear and sitting and peddling at a low speed, slow rolling, can be an easy way to ride.
- When you go up hill be careful on putting down a hard pedal during gear change. This can cross your chain causing your chain to derail or break.
- Hike-A-Bike: Sometimes it's too hard to ride. Don't feel bad about hiking your bike through an area.

Comfort

- Stay hydrated. Drink water in the morning and drink it continually throughout the day. If you run out, ask someone for more water.
- Eat salty foods. These will keep your electrolytes up as you drink lots of water.
- Each pedal stroke should have you fully extend your leg, if this is not the case move the seat post up.
- Switch up hand positions throughout the day. On easy stretches you may want to rest your hands on the inner bars of a mountain bike style handlebar.


Science Excursion
Full Trip Map
Campsite
Campsite
Campsite
Park Headquarters
Visitor Center
Fremont River
Google Earth
© 2022 Google
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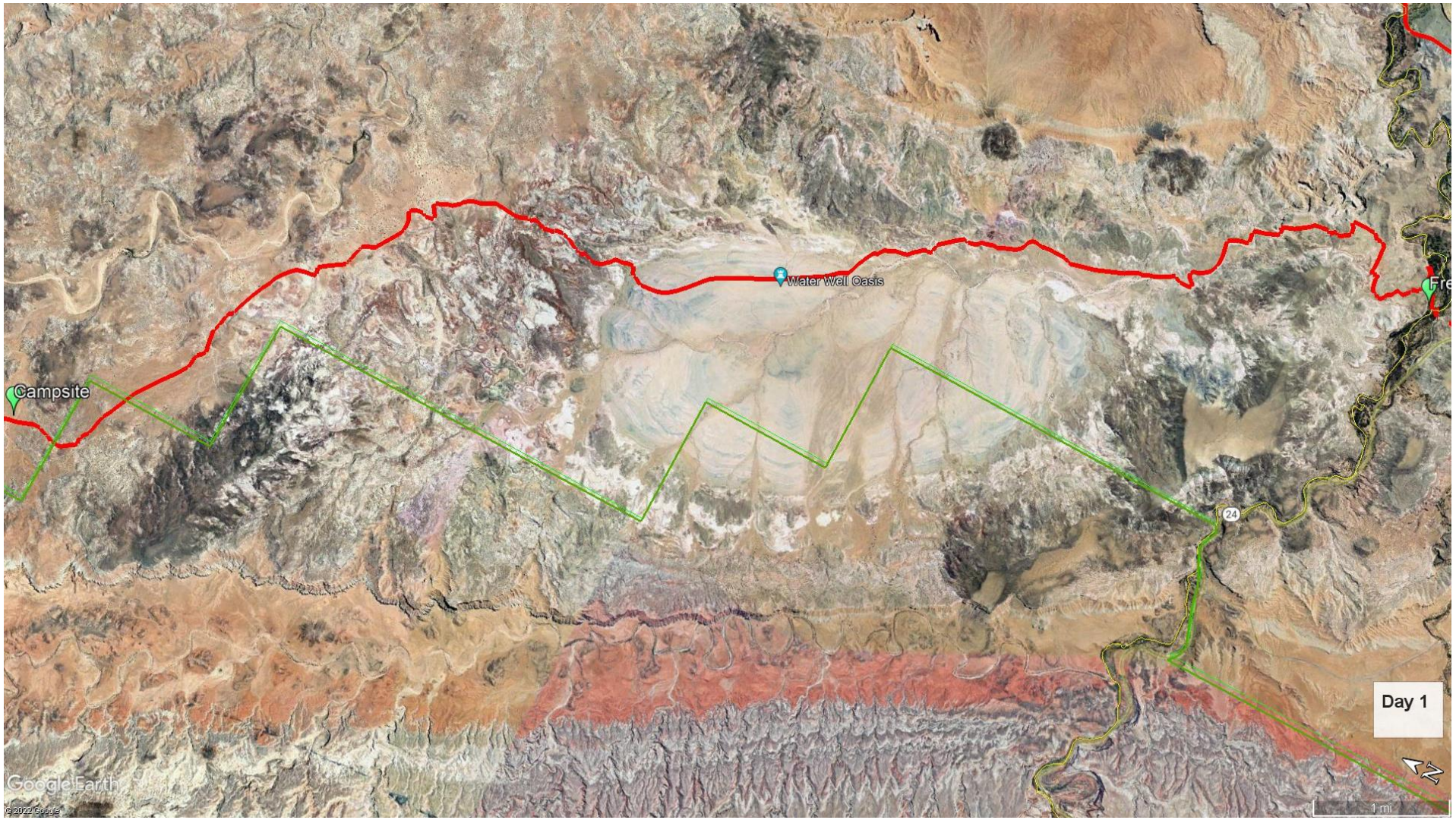
Water Well Oasis
Campsite
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Day 1
Google Earth
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1 mi


Google Earth
Campsite
Lower South Desert Overlook
Temple of the Sun
Campsite
Day 2
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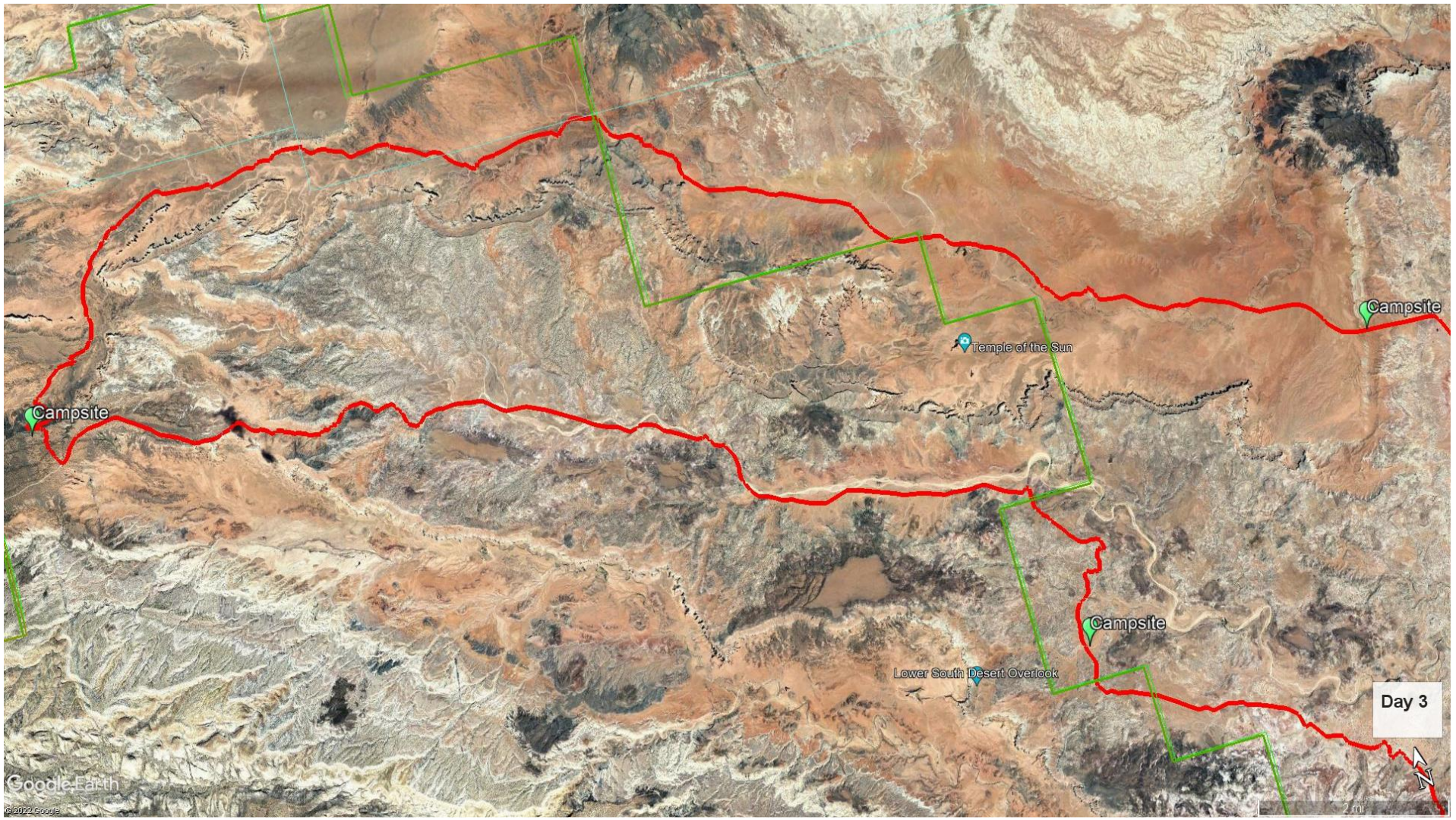
Campsite
Temple of the Sun
Campsite
Campsite
Lower South Desert Overlook
Day 3
Google Earth
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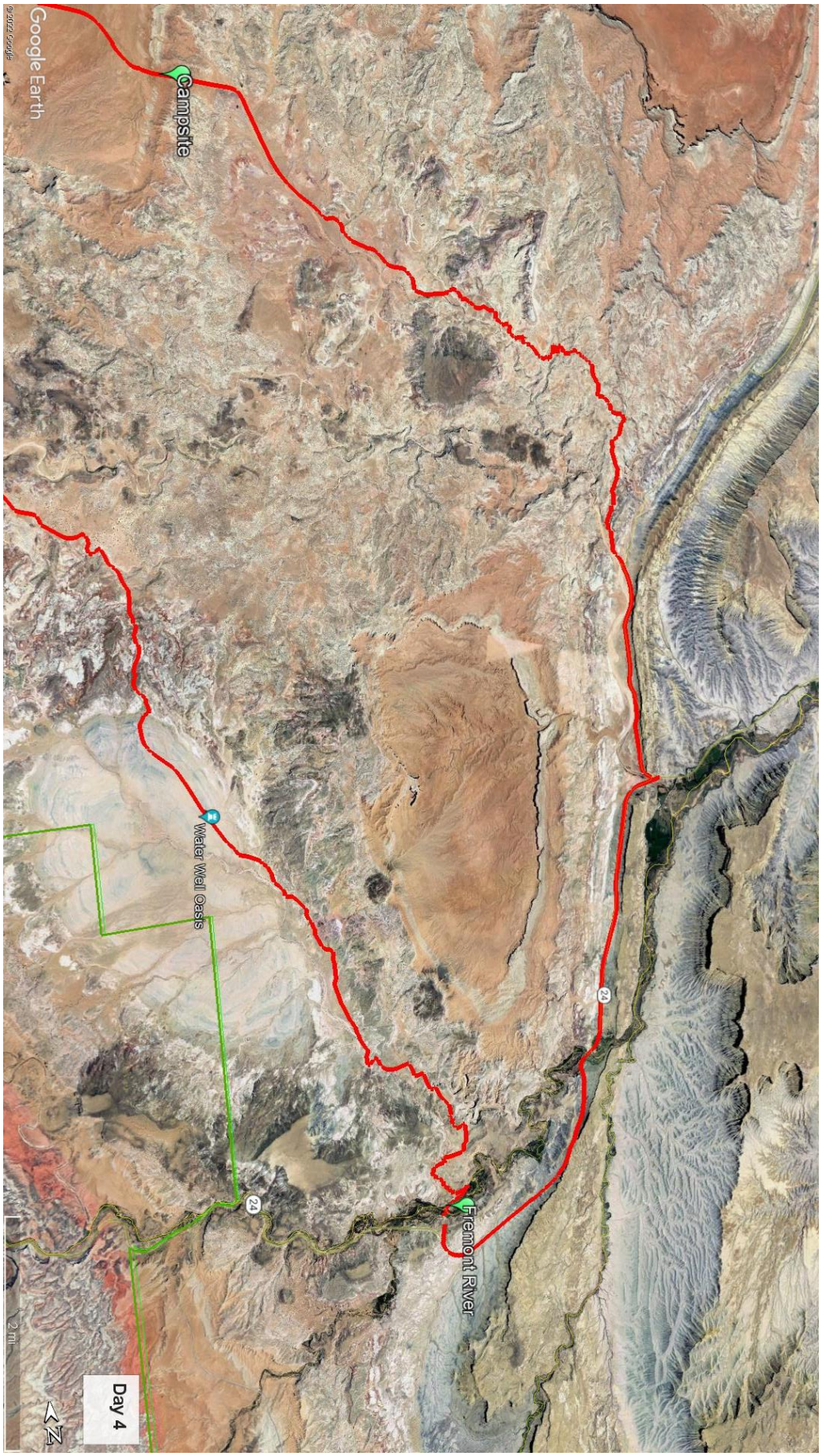
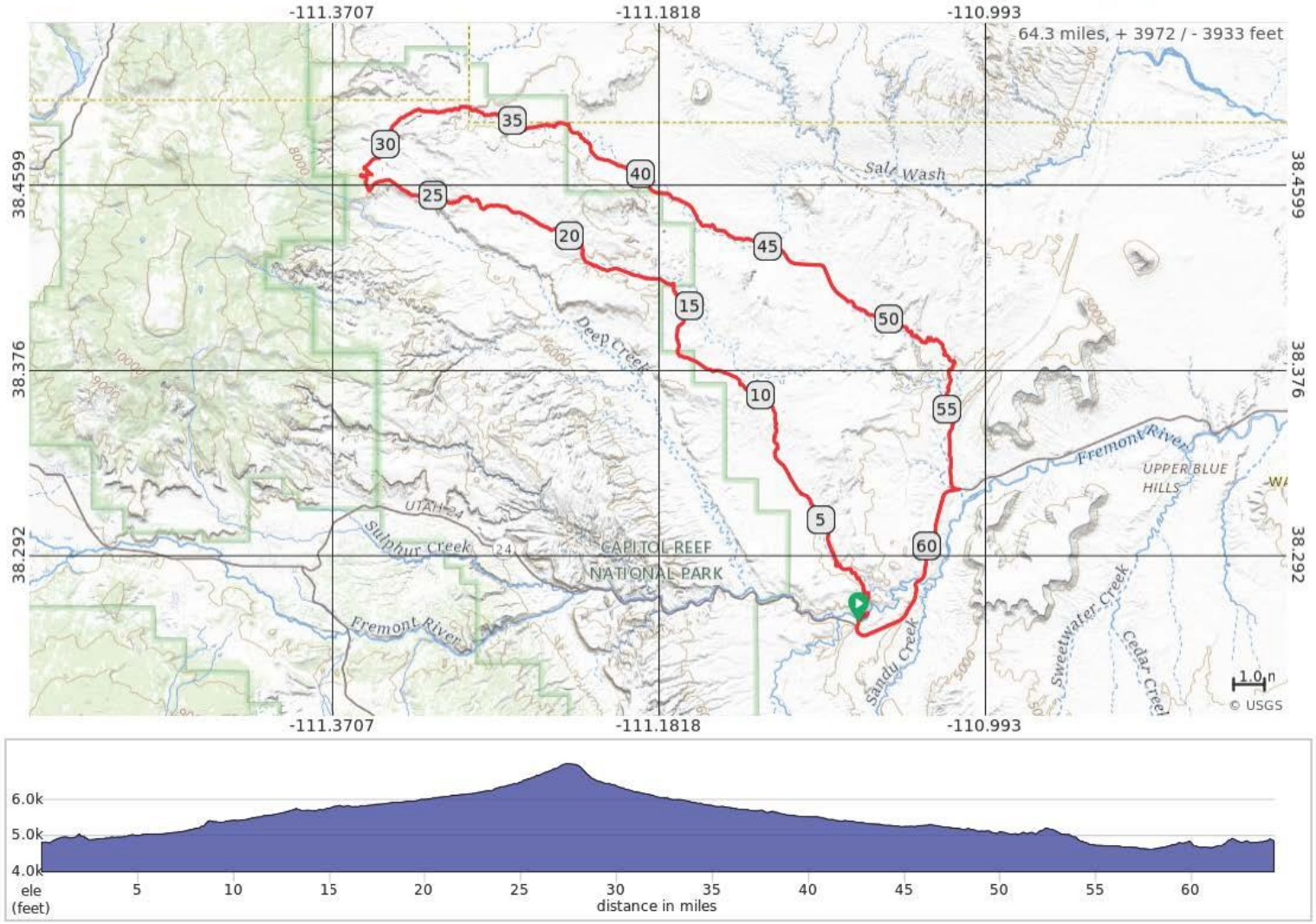

Google Earth
Campsite
Water Well Oasis
24
Fremont River
2 mi
Day 4

Bikes, Botany, and Bentonite Science Excursion



Notes and Camp Activities

Microsite Ecology

Lichen Species (#)	Aspect (Direction)	Coarseness (1-3)	Substrate Type	Notes

Juniper-Pinyon Ecology

Seedling: Height < 0.5m

Juvenile: Height 0.5m – 3m

Adult: Anything greater than 3m OR bearing reproductive structures

Seedling juniper	**Juvenile juniper**	**Adult juniper**	**Seedling pinyon**	**Juvenile pinyon**	**Adult pinyon**

Storytelling and mythologies