Prospectors

In order to better understand our Earth and its importance in our everyday lives, it is vital to learn about rocks and geologic processes. Geology is the infrastructure of the Earth, and humans depend on it every day. Geologic events happen on such a grand timeline, relative to our human sense of time, that it can be difficult and humbling to understand. Rocks and minerals give us a gift: a portal into our earth's history.

"Rocks are records of events that took place at the time they formed. They are books. They have a different vocabulary, a different alphabet, but you learn how to read them."

- From *In Suspect Terrain,* by John McPhee

Prospectors

The Prospectors Discovery Group calls students' attention to the rocks around them by giving value to a relatively common mineral (quartz). Once the students have become excited about rocks, they are ready to learn about the geological forces which created those rocks. Similarly, once they begin to understand the reasons behind why we value certain minerals, prospecting for other riches (tangible or not) becomes exciting. The trip to the crystal beds or, on the all-day, to the copper mines or jasper pits, is always a highlight.

Activity	**Concept**
Quartz Rush	Rock & mineral definitions
Quartz Exchange	Recognition of different minerals Igneous rock identification & origins
Erosion Exploration	Forces of erosion
Rock Type Identification	3 types of rocks & identification Understanding of differences in rock types Minerals involved in different rocks
Contact Zone	Occurrence of crystals & rare minerals Bathlolith & pegmatite formation
Stagecoach Road	Mining & local history
Rock Cycle	How rocks change over time 3 types of rocks
Crystal Beds	Crystal structure Claim staking Variation in individual minerals
Impact of Rocks	Value of rocks Changing Earth over time
Stories & songs	Local mining history & lore
Mining Techniques	Mining history
Stagecoach Game	Local history
Copper Mines	Claim staking Copper refining process Uses of ore in everyday life Contact zones

Quartz Rush!

Counselors and HTOEC staff should run up to the stake dressed as prospectors, yelling *"We're gonna get rich!"* and asking the students to join. The instructors can wave a newspaper in the air, with a section describing a quartz rush, similar to the one below. They can then show the students the newspaper while dramatically reading or paraphrasing the text.

NATIONWIDE QUARTZ RUSH IN PROGRESS!

Scientists working on alternative energy sources have discovered that quartz is the source of a new type of nuclear fuel which is safe, economical, inexpensive and does not have dangerous by-products. Prospectors all over the country are searching for this precious mineral whose value has increased one hundred times over night.

HTOEC staff and counselors should introduce themselves as prospectors. Each person should have a new identity, and may provide a brief biography of their time as a prospector. One person can sneak a piece of pure quartz out of their pocket and show it to the prospectors group, taking care not to let any of the other groups see this valuable mineral. Explain that rich deposits of quartz are known to exist in the High Trails area. This is the break you've been waiting for - a chance to become prospectors and strike it rich!

Divide the students into mining companies, each led by a counselor, and ask them to choose a name for their company as they walk. They may also want to decide what they will do with their new riches. (Since one counselor will be waiting at Sunday Rocks as the Mad Assayer, you may want to assign companies after the Mad Assayer has rejoined the group).

Quartz Exchange

Upon arrival at the prospecting site at the base of Sunday Rocks, one of the counselors or teachers should appear from behind the rocks, insisting that this is their private claim. This person, the "Mad Assayer," should have scattered pieces of quartz around the base of the rocks before the students arrived. After eventually coming up with a goofy bargain with the Mad Assayer (i.e. 25% of the profits and a compliment for each piece of quartz in exchange for allowing prospectors on the claim and assessing the value of anything they find), the students may start collecting pieces of quartz.

***If students choose to go on top of Sunday Rocks, make sure they are supervised by HTOEC staff or a teacher.*

The Mad Assayer can use the shed to set up a trade-in station. The students can trade in their quartz in exchange for miniature marshmallows. After each student has traded in at least one piece of quartz, the group should reconvene to more closely discuss the Pikes Peak Granite and its constituent minerals. Students should share observations of the rock and instructors can use those observations as springboards to further discuss the granite.

What is quartz? A rock or a mineral? What is the difference between rocks and minerals?

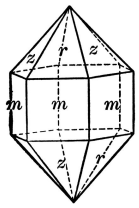
Quartz is a mineral. Rocks are made up of minerals, just as baked goods (such as a chocolate chip cookie) are made up of different ingredients. Some rocks are made up of only one mineral - for example, quartzite is a rock made up entirely of quartz - while most other rocks are made up of several minerals. Quartz can be found alone, and sometimes it can even be found in crystal form, but it is mostly found in rocks with other minerals.

What is the difference between quartz and crystals?

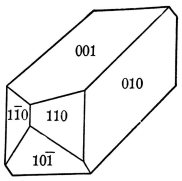
Quartz is a mineral, and all minerals can grow into a variety of different shapes. Generally, minerals are closely packed

<u>*Minerals and Common Crystal Shapes*</u>

Quartz



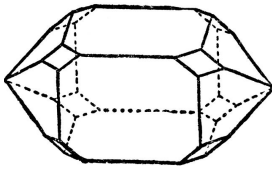
Feldspar



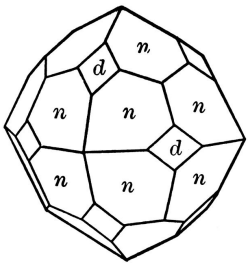
Calcite

together in a rock, which means that they form any random shape that fits the open space and fits together with the surrounding minerals (think of them like oddly shaped puzzle pieces). Given more space and time, a mineral could grow into a crystal form. Crystals are not a type of mineral; they are simply a specific shape a mineral may take. Every mineral assumes a different shape in its crystal form. In the case of quartz, a perfect quartz crystal will be a hexagonal prism capped with a triangle on each end (like a pencil). The crystal form is the shape that any given mineral will become if it is given enough space and time to grow.

Zircon



Garnet



What minerals exist in this rock, and how did it form?

This rock is the **Pikes Peak Granite**. It is about 1 billion years old and formed when a giant magma body (a huge area of molten rock) formed several miles under the surface. As that magma body started to move closer to the surface, after the layers above it eroded away, the rock cooled and minerals began to form. These minerals include quartz (*translucent gray*), mica (*black shiny grains*), and feldspar (*pink, coarse grains*). Just looking closely at the rock, you should be able to see all of those individual minerals. Today, the Pikes Peak Granite extends across much of Colorado and forms Pikes Peak.

What type of rock is it, and how can you tell?

Granite is an **igneous** rock, meaning that it was entirely melted at one point in time. You can often identify igneous rocks because all the minerals are jumbled together. If you think of the magma as a soup of elements that will eventually come together to form minerals, you can picture how the soup ingredients are all mixed up. If you were to flash freeze that soup, you would still have all the ingredients mixed up (peas next to carrots next to chicken or tomatoes). Igneous rocks are like that - there are not generally specific layers of one mineral; rather, all the minerals are mixed up.

Erosion Exploration

Since quartz pieces are combined with feldspar and mica in granite, why are there some pieces of just quartz lying around? What happened to break these pieces apart?

See how many examples the students can find of forces that might break the granite apart. Give the students a few minutes to climb around the rocks and compile a list of natural erosion forces that they can see on Sunday Rocks. The assayer can offer to "buy" ideas for natural "crushers" from the companies and award marshmallows at the end of the activity. Below are some examples of forces that catalyze weathering (*breaking down the rock*) and therefore erosion (*transportation of rock pieces away from the parent rock*):

- **Lichen:** lichen secretes a small amount of acid, which helps to break down rocks.
- **Other plants:** if plants manage to find a spot (often a crack in the rock) where they can grow, their roots can help to wedge pieces of the rock apart.
- **Ice/water:** when water collects in cracks in the rock and freezes, it expands, thus expanding the cracks as well. When water just runs across the rock, it can pull small pieces of the rock away with it and/or can pull particles across the rest of the rock, sanding away some more pieces and washing them away from the main rock.
- **Wind:** wind can sometimes blow loose grains away from the rock; it can also pick up pieces of soil and slam them into the rock, thus wearing down the existing rock.
- **Humans:** humans walking or sliding on rocks pull away small particles (there is almost always at least one student who can be an example of this, and reaching up to rub parts of Sunday Rocks will make loose feldspar grains fall off).

As prospectors we know that the purest ore is most valuable at the assay office. Some large pieces of granite contain a lot of quartz, but how will we get at it?

All of these erosion forces work on long timescales, removing only a few grains at a time. Since prospectors usually want instant results, they tend to rely on machines, blasting, and chemicals to break rock apart. For us, today, that seems like a lot of work, especially since this quartz is in a rock and not in crystal form; since we know of other quartz claims in the area, it might make more sense to move on and try our luck somewhere else rather than staying to try to break this rock apart (that also sounds expensive, and we don't want to waste our riches).

Rock Types

As you depart from Sunday Rocks, refer back to Pikes Peak Granite as an example of **igneous** rock. From the base of Little Blue, there is a good view of Pikes Peak. Point out that the top of the mountain is pinkish, just like Sunday Rocks - they are the same type of rock. Review how the Pikes Peak Granite formed and how to recognize an igneous rock, then ask students to keep their eyes open for a new type of rock as you head over the cattle guard and up Little Blue.

Eventually you will begin to see pieces of **biotite-sillimanite schist**, a **metamorphic** rock. Students may see that it has many of the same colors as the Pikes Peak Granite, but that it is layered with a different texture.

Using the rock samples in the tubs and the surrounding rocks, have each group discuss and look at an example of each rock type. One way to do this can be to hand out three rock samples (one of each type) to each mining company and ask them to decide which type is which and why. Each company can then present their decisions and reasoning to the rest of the group; the companies not presenting should then show their own examples of that rock type and discuss with the group any salient qualities of the sample. Basalt samples can be a challenge, but just remind the students that igneous rocks are ones without any layers, even if they are very fine-grained and it is hard to see individual minerals.

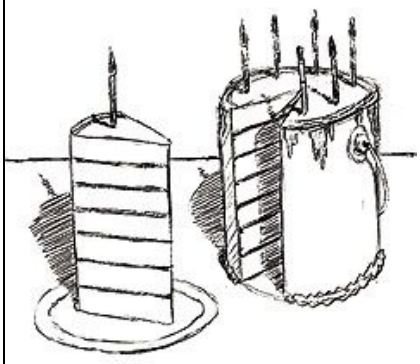
What type of rock is this and how do you know?

This rock is a **biotite-sillimanite schist.** The biotite is a type of mica and the sillimanite is another mineral (sillimanite forms the gray ridges in the rock - pointing that out can be a good way to link back to erosion, as sillimanite is less prone to erosion than the other minerals present in this rock). This particular rock is 1.8 billion years old, so you just walked 800 million years further into the past.

Biotite-sillimanite schist is a metamorphic rock that formed when eroded sediments were buried several miles under the surface. Unlike igneous rocks, metamorphic rocks never fully melt (although this one came pretty close - it's about as metamorphosed as possible before becoming igneous). The heat and pressure placed on this rock when it was underground "squished" it. You can have all of the students huddle up and ask the interior students how they felt under the heat and pressure.

The heat allowed each specific type of mineral to move around and find other like minerals. That created layering in the rock. Most metamorphic rocks have layers, but those layers are not nice and flat like a layer cake; they swirl around a little more and sometimes one layer pinches out while another forms.

What other types of rock are there?



The last main rock type is **sedimentary**. Sedimentary rocks form when soils are compacted. They are not under as much heat and pressure as a metamorphic rock, and they certainly never melt; they are just pressed together until the soil compacts enough to be a rock. Sedimentary rocks have layers, but, unlike metamorphic rocks, their layers are not wispy. Sedimentary rock layers look more like a layer cake with flat, continuous bands of former soils (which are often slightly different colours).

How can you tell the types of rock apart?

The easiest way to tell the types of rock apart is to think back to how they formed and how that might affect their appearance. Igneous rocks formed from something that melted, so they have all the minerals jumbled up in no obvious order (sometimes it's hard to see the individual grains, but the different minerals will still be scattered randomly). Metamorphic rocks formed under lots of heat and pressure, so the whole rock was basically squished and the minerals formed wispy, uneven layers. Sedimentary rocks formed when soil was compressed, so they have flat, even looking layers, like a layer cake.

Why should prospectors care about rock types?

Prospectors really need to understand the rock cycle and rock types in order to look for valuable minerals. For example: sedimentary rocks generally do not get hot enough or have enough space and time to grow quartz crystals, so we are unlikely to find crystals around sedimentary rocks.

Rock Cycle

The rock cycle can also run in this order: **magma → cooling/crystallization → igneous rock → heat & pressure → metamorphic rock → erosion → sediments → compaction/cementing → sedimentary rock → melting → magma.**

Parts of the Rock Cycle, explained -

Magma:

Magma is molten rock. It is called magma until it reaches the surface, at which point it is known as lava. This cycle begins and ends with magma.

Cooling/crystallization:

As magma moves towards the surface, it slowly begins to cool down. In the case of *plutonic* rocks such as granite, this magma slowly rises until it cools enough to begin forming crystals (freezing). This process is slow enough that individual mineral grains are usually fairly large, because they have had a considerable amount of time to form and grow.

In the case of *volcanic* rocks like basalt, the magma rises into a volcano's magma chamber and is eventually erupted. When it hits the air, forming a lava flow, the lava cools very rapidly, giving mineral grains very little time to grow. Therefore, volcanic rocks tend to be very fine-grained.

Igneous Rock:

Igneous rocks include a variety of volcanic and plutonic rocks, such as basalt, granite, rhyolite, welded tuff, and andesite. They are linked by the fact that all igneous rocks formed directly from molten material (magma or lava). Due to this fact, igneous rocks tend to have all of their minerals evenly mixed throughout the rock, rather than in discrete layers.

Erosion:

Weathering and erosion are the main processes that break down rocks into gravels, sands, clays, or other sediments. Weathering is the process that actually breaks the original rock apart; erosion is the process that transports those sediments away from the original rock and usually breaks them down more as they are transported.

Sediments:

Sediments are anything ranging from boulders to clay particles. They are pieces of larger rocks that have been broken off the main rock and generally transported into valleys, rivers, or other low-lying areas.

Compaction/cementing:

Compaction and cementing are the processes that turn sediments into a sedimentary rock. Unlike metamorphism, there is a negligible amount of heat involved (not enough to grow new minerals or significantly change the structures of the sediments). Sediments are basically pressed together hard enough to form a layered rock. Sometimes, calcite, quartz, or other minerals dissolved in solution may be precipitated out into the sediments, helping to glue them together.

Sedimentary Rock:

Sedimentary rocks range from conglomerate to sandstone, limestone, mudstone, shale, or siltstone. The naming scheme of the sedimentary rocks is based on the size of the sediments incorporated in them - conglomerate is a mix of sediment sizes, while sandstones are made of predominantly sand-sized sediments.

Heat & pressure:

Heat and pressure drive the process of metamorphism. When either igneous or sedimentary rocks are put under high levels of heat and pressure (but not enough to melt them), like minerals will come together, forming layers. The heat and pressure can often catalyze the growth of new, metamorphic-specific minerals, such as garnet or kyanite. Importantly, the heat and pressure may not melt the original rock - if they did, the new rock would be igneous, rather than metamorphic.

Metamorphic Rock:

There is a wide variety of metamorphic rock types, including schist, gneiss, phyllite, slate, marble, and quartzite. Metamorphic rocks are often identified by the degree of metamorphism and the minerals present in them (in the case of Little Blue, schist is a higher grade of metamorphism than phyllite or shale, and the prominent minerals in that rock are biotite and sillimanite).

Melting: when a rock is buried deeply enough under the crust, it will begin to melt, eventually transforming back into magma.

Rock Cycle Games

The rock cycle can be taught in conjunction with the rock types activities, or you might spread things out so that the students are not being overloaded with information at one time. If you choose to break them up, the top of the meadow just before the crystal beds provides a good open area to have a group discussion or game. A few activities to help teach the rock cycle are included below.

Paper rock cycle assembly:

- ★ Hand each group a color-coded set of papers that will eventually represent the rock cycle. (Counselors may look at the cheat sheet that is included in the bag.)

- ★ Explain that you are currently prospecting for knowledge, and that you do not want any workers who cannot prove their knowledge. If you are going to trust anyone to work on your claim, they must know what they are doing and you need to know that they will recognize anything of value. Therefore, you are going to ask each company to work together to assemble the rock cycle correctly.

- ★ Make it a race: the first company to properly assemble the cycle will stake the first claim within your claim.

Running rock cycle game:

- ★ Modify tag or sharks & minnows, with designated areas for different rock types and a safe zone for whichever rock type you yell out (or, if the whole group is fairly athletic, it's a race to get to the correct rock type; a few stragglers each time get out).

- ★ To make it more challenging, yell out rock formation processes (cooling & crystallization; heat & pressure; compaction) instead of a specific rock type.

Circle rock cycle game:

- ★ One person stands in the middle, points at someone, and yells a rock type.

- ★ If the rock type is sedimentary, the person being pointed at must say "the layered look, the layered look" (or whatever the group chooses for sedimentary) while pantomiming flat layers with their arms. For metamorphic, the people on either side of the person being pointed at should lean into that person and say "heat and pressure, heat and pressure." For igneous rock, whoever is being pointed at can melt, be a volcano, etc.

★ If someone does not react quickly enough or makes a mistake, they become the new middle person. If you are in the middle, you can mix it up (like in the game above) by listing processes rather than rock types.

At this stop and throughout the rest of the day, be sure that you are being very specific in the terminology you use when referring to the rock types. This will make any rock cycle activities much easier for the students. If you are assembling the rock cycle from papers, make sure that you are being very careful to discuss rock type formation and changes using the vocabulary on those sheets of paper.

Leaving this stop by about one hour after the discovery group began will afford you enough time to stop at the crystal beds. If you choose to do a rock cycle activity here, leave by about an hour and fifteen minutes after the group began.

Bonus - The Pegmatite Game

This game further illustrates the concept of crystals forming in contact zones along the edges of batholiths.

Batholith: giant molten pools of magma that become granite

★ Have all the students stand within a circle drawn on the ground. This circle represents the boundaries of the granite batholith.

★ Designate 3 students as quartz and one student each as gold, silver, and copper.

★ With the remaining students, assign each student to be either feldspar, quartz, or mica (there should be even numbers of feldspar and mica, with 3 extra students as quartz). All the students together represent the molten mass of magma which cooled to form Pikes Peak granite.

★ Now have the granite cool: feldspar, mica, and quartz students should try to get together. Once one feldspar has joined with one quartz and one mica, this trio should join hands, push as close to the center of the circle as they can, and stop moving. They have become granite.

★ When all the possible granite combinations are formed there should be only 6 students still moving: 3 quartz, and the gold, silver and copper. They should hopefully be on the outer edges of the granite, near what would be a contact zone and with plenty of extra space to grow.

Contact Zone

As you walk along Stagecoach Road at the base of Little Blue, there is a boulder off to the left of the road that can be a great illustration of what certain contact zones look like. Look closely and you will notice that the majority of the rock looks similar to a fine-grained Pikes Peak Granite, but there are also darker stripes through the rocks. These darker stripes are closer in composition to parts of the schist (the metamorphic rock that makes up Little Blue) than they are to Pikes Peak Granite. You are almost looking at two rock types in one! Having the students pass around one of the smaller rocks or gather around the boulder and share their observations is a good way to begin this discussion.

What is going on with these rocks?
These rocks look almost splotchy, with several different rock colors and textures incorporated in them. If you look carefully, you will see that some sections of the rocks look like Sunday Rocks, while other parts look more like the rock we just saw. You are looking at a contact zone where two rock types come together.

How did this contact zone form?
The metamorphic rock here is 1.8 billion years old, while the Pikes Peak Granite is only 1 billion years old. Therefore, imagine what would happen if the schist, after lying around for 800 million years, had a giant magma body, (soon to become the Pikes Peak Granite), come up next to it. What usually happens when a material is exposed to a really hot object or region? They often melt, which is exactly what the edges of the schist did; at the same time, the schist was a lot colder than the granite, so it sort of flash froze the granite. This sudden cooling is why the Pikes Peak Granite here has such small grains; the minerals had no time to grow. So, what you are seeing here is a few melted blobs of schist encased in a slightly modified version of the Pikes Peak Granite. Basically, chunks of the schist melted off and fell into the giant pool of magma as that magma was cooling.

Will there be good crystals in this contact zone?
What do you think? Remember that crystals need space and time to grow. Do you think that this contact zone, based on what you just saw, had a lot of space and/or time for crystals to grow? Since one rock was melting into another, there probably weren't a lot of empty spaces, so it is unlikely that there will be great crystals here. Let's move on and see if we can find a better claim!

Tic Track/Stagecoach Road

Crossing onto the tic track that cuts across Little Blue is a great opportunity to share some local history. This stagecoach road once ran between Cripple Creek and Florissant, which was a much larger town during the mining era. Ask the students what

sort of vehicles might have used the road, and what they carried. This road used to host stagecoaches full of materials and everyday supplies. Often, stagecoaches full of gold traveled this road, coming from Cripple Creek over to Florissant and eventually Colorado Springs. This can be a good place to tell the story of Shady Pete (see all-day activities) and to touch on the fact that, although prospecting can give us great riches, it can also have problematic effects on life in the towns that sprang up around booming mines.

What might be some of the advantages and disadvantages of prospecting?

As you continue up the trail towards the crystal beds, the spring tank provides a convenient stopping point for a water break and debrief of a walk & talk question. You might also use the spring tank to discuss what a prospector's life would have been like; water and other necessities could have been hard to come by. This forest (below or above the springtank) is a convenient place to discuss things surrounding the group that are prospected for by humans. These could include trees, rocks, water, clean air, animals or plants, and any other natural resources students see nearby.

Crystal Beds

The crystal beds are usually the most exciting part of the day for students; this is their chance to truly prospect and stake their own claim. Make sure each student knows they may keep **one** piece of quartz or other rock/mineral. This piece may not be larger than they can easily hold in one hand and fit in their own backpack for the walk back. Explaining this rule in character, making a point of the fact that you are already doing them a favor by letting them on your claim and that you don't want to be robbed or have all your riches disappear. Remind students of what different types of quartz and quartz crystals look like.

Show students a small, partial crystal and explaining that it is a good find, that most crystals will be very small, and that if you want a crystal you will need to be highly observant. The most

If you have time, talk with the group about the different minerals present and what they found. There are several types of quartz present (milky, clear, and possibly rose or smoky), along

fully formed crystals (although generally tiny) will be found in the upper part of the crystal beds, while students usually find the clearest quartz a little ways down the hill.

Pointing out to students that rocks are not the only thing we prospect for and that humans are constantly prospecting for tangible and intangible things is often a good way to end your time at the crystal beds.

with feldspars, mica, and hematite. Hematite is the purplish mineral - it is an iron oxide, so its presence means that the rock or minerals are rusting as they weather. Hematite is an important mineral in its own right, as it is a major iron ore and can also be a gemstone (as can quartz, depending on what type it is).

What do you prospect for, in your life?

Where are you most likely to find crystals?
Crystals need space and time to grow into a proper crystal shape. One place that crystals often have some time and space is in contact zones, or areas where a few different types of rock come together. Rock types next to each other are not likely to fit together perfectly like a puzzle, so there will be some gaps or spots where crystals might have a little bit of extra space to form. Contact zones are also often places where random elements that haven't yet formed a specific mineral are floating around, so they can sometimes contain really valuable and unusual minerals (these chemical leftovers don't fit in any typical mineral, but they might fit in something like gold or copper or silver).

If there is even more extra time, explore the granite outcrop that is just South and a bit East of the main quartz boulder with mica. On its SE edge, you will see that the micas are almost in stripes and that the feldspar is much less pink than in the Pikes Peak Granite. This is another rock the students have not seen yet - it's another type of granite that might be slightly metamorphosed. Since this rock looks different, and since the Pikes Peak granite only has biotite mica (black mica, not the silver mica (muscovite) present here), you are in another contact zone. This makes sense, given that contact zones can be a good place to find crystals and rare minerals.

There are three main types of granite in the Florissant area. Two of them (the two that are not Pikes Peak Granite) meet at the crystal beds, and the only place in the area where all three of them meet is the Cripple Creek & Victor gold mine, a great example of a contact zone with valuable minerals.

Impact of Rocks on the Earth & Humans

Just before you arrive back at High Trails, find a good place to sit (the rocks on the side of B-Bluff, an aspen grove, etc.) and read this story to wrap up the day and give students a little more perspective on the importance of rocks to their everyday life.

Let's go on a journey way back through time, all the way out into the darkness of space, before our universe formed. Through the darkness, a little speck that is our universe began with the Big Bang, and as the hydrogen and helium gases started to cool down and condense into stars, the first minerals began to appear. New minerals formed as the earth solidified, and they provided a surface for the first plants and other lifeforms to grow. These life forms became more complex, and the minerals evolved (changed) along with them; new minerals formed in different environments, and new environments were made possible because of these new minerals. Rocks and life evolved together, eventually working their way towards today, where most of what we do on a daily basis depends on the rocks and minerals around us. We travel on roads made from rocks, look out windows made of the same material as melted down quartz, feel the warmth of ancient plants when we burn coal, which is a sedimentary rock, communicate with each other through devices that depend on rare earth minerals to function, and walk across the bedrock of our earth. Everything around us sprang from rock, and we continue to prospect for even more minerals to build our steel buildings, make beautiful jewelry, and keep us warm, comfortable, and connected.

Ending the day with an exit ticket or group discussion that moves the definition of prospecting beyond just rocks is a great way to keep the students thinking and curious.

All-Day Activities

The Prospectors All-Day may either go to the jasper pits or the copper mines. Teachers and often students tend to prefer the copper mines, as the hike is a bit shorter than the jasper pits hike with fewer hills. The copper mines also usually have a higher number of interesting rock specimens to work with. For these reasons, this packet focuses heavily on the copper mines option, with only background information on the jasper pits. In either case, realize that it will be a long hike, so budget time accordingly but take frequent water breaks as well.

The All-Day begins in the same fashion as the half-day. Once you reach the base of Little Blue, take a right and walk out to the copper mines or continue on to the jasper pits, rather than heading to the crystal beds. The copper mines and jasper pits have the same collecting rules as the crystal beds; each student may only take one rock of a reasonable size. *If you are doing the reverse route, coordinate with the other person on prospectors but plan to start at the crystal beds and head to the jasper pits or copper mines either once you reach the stagecoach road or once you have discussed the rock types.*

Activities for the Hike

This is a long hike, so most activities that you do should be active and moving forward or just long enough to form the background of a water break. Scavenger hunts for prospectable natural resources and other activities help to keep students interested and focused on the discovery group throughout the hike. The following are a few options of activities and conversation topics.

Shady Pete:

A fun story (especially for the way back; great motivation to keep walking, as the kids will want to look at every stump), and also a good opportunity to talk about some of the negative impacts of prospecting. Feel free to modify or dramatize as you see fit. Rick Sanborn does insist that a stagecoach really was robbed in an ambush just off Top of the World (about half a mile from the Crystal Beds), although no one really knows.

In the late 1890's, the stagecoach running between Florissant and Cripple Creek carried primarily passengers and supplies, but occasionally it carried another cargo shrouded in secrecy. The passengers on these special days were not normal passengers-though they appeared to be at first glance. Under their coats they carried revolvers and their eyes were watchful and suspicious. The cargo on these days was

gold worth hundreds of thousands of dollars being carried from the world's richest mining camp.

Hanging around Cripple Creek at that time was a shadowy figure called Shady Pete by the locals. Rumors had it that he had killed half a dozen men and pulled off so many bank robberies that sheriffs in 10 states were looking for him. But Shady Pete didn't cause any trouble in Cripple Creek. He was always just around - watching and listening from the shadows.

And then, one day, the stagecoach left Cripple Creek with the biggest load of gold ever carried. No one knew about it at the time except the mine owner, the guards, and a strange quiet figure standing in the shadows. They journey went just fine until the stage approached that stretch of the road that lies where High Trails is today. It was a misty, eerie day and the drivers had lit their lanterns in order to see the road ahead.

Then suddenly as the stage rounded a turn, a figure flew out of the mist with blazing guns. The dazed guards could only stare in amazement as Shady Pete grabbed the gold and disappeared again into the mist.

Pete didn't get far with the gold, however. It was heavy and he knew he would be followed soon, so he stopped and buried it at the base of an old gnarled tree. Because the day was misty it was hard to get exact bearings, so to be sure he would not lose the spot, he plunged his knife deep into the tree.

A couple of days later, Pete showed up in Colorado City in a jolly mood. He spent much time in the bars and spent money like a millionaire. He was having such a good time, in fact, that he didn't notice the intense stranger who entered the bar. The stranger's eyes, however, immediately found Pete through the smoke and noise, for he had been one of the guards on the stagecoach. A shot ran out, Pete crumpled to the floor, and the stranger disappeared in the midnight gloom. As Pete lay dying on the floor a companion knelt to hear his words: "Stagecoach gold-buried under tree-my knife." These were Pete's last words.

*(**Alternate version:** Pete went to jail for life and told one of the other inmates that he had buried the gold under a tree with his knife stuck in it. When this inmate got out of prison, after Pete had died, he looked for it for a long time and finally shared the secret after having no luck, hoping that someone else might at least share the gold.)*

The word spread fast that there was a fortune in gold buried under a tree and fortune seekers combed the area. But none had any luck and it was finally agreed that Pete's dying words had been no more than a final joke.

It was about 30 years later when an old man was running logs through the sawmill at High Trails/Florissant. As one of the logs went through the saw, however, the saw clanked against something that sounded like metal and refused to cut any deeper into

the tree. The old man stopped the saw and looked for the offending piece of metal. Slowly he drew it out of the tree until he could plainly see that it was the blade of a knife. And clearly embedded on the blade were the initials S.P.

The old man remembered the story of Shady Pete and his hidden gold and knew that he would be wealthy if only he could find the stump of this tree. So he carefully measured the base of the tree (diameter 30 inches) and counted the rings (108) and set off to find the right stump. The old man told no one of his discovery but spent the rest of his life looking for the right stump.

Before the old man died, he told his son of the buried treasure, but the son did not believe in Shady Pete or the buried treasure. After the old man's death he talked freely about his father's discovery. Some have looked for the treasure since that time but none have found it.)

Prospecting songs:

There are plenty of options, but the following (a screenshot from https://mineralseducationcoalition.org/wp-content/uploads/2_2013_homeontherangestory.pdf) is one that many students may know. Whether this song or "Home on the Range" came first is unclear. You may need to edit out some verses (of most prospecting songs).

COLORADO HOME

PROSPECTORS' SONG

The Original of "Home on the Range"

Oh, give me a home where the buffalo roam,
And the deer and the antelope play;
Where seldom is heard a discouraging word,
And the sky is not cloudy all day.

Oh, give me the hill and the ring of the drill,
In the rich silver ore in the ground;
And give me the gulch, where the miners can sluice,
And the bright yellow gold can be found.

Oh give me the gleam of the swift mountain stream,
And the place where no hurricanes blow;
And give me the park with the prairie dog bark,
And the mountains all covered with snow.

Oh, give me the mines where the prospector finds,
The gold in its own native land;
With the hot springs below, where the sick people go,
And camp on the banks of the Grand.

Oh, show me the camp where the prospectors tramp,
And business is always alive;
Where dance halls come first and fare banks burst,
And every saloon is a dive.

Chorus

A home, a home, Where the deer and the antelope play;
Where seldom is heard a discouraging word,
And the sky is not cloudy all day.

Claim staking games:

This can work really well as a quick game to play while water bottles are being refilled at the archery range.

- Hand out three or four small pieces of paper to each student (hand them out from behind your back or randomly in some other way).
- Explain that each piece of paper is going to represent a claim on a specific type of mineral. For example, yellow might be a gold claim. Each mineral is worth a certain number of points (see resources section), and their points will be totalled at the end of the game.
- When the game starts, they will have 5 minutes to conceal their claims within a certain area. Claims may not be buried or covered (after all, you couldn't bury or totally cover all evidence of a mine), but they can be artfully placed to blend in with their surroundings or placed behind a tree or something like that. They must, however, be readily visible if you were to look in the correct place. Also, students need to remember where they put their claims, as they will be able to gain points later in the game by relocating their own claims.
- Once the 5 minutes is over, tell students they must drop any unhidden claims where they are and start looking for the claims of OTHER students. After 5 minutes of searching, tell them the search is over and ask them to go back and see if any of their own claims are still in their original location. If yes, they should pick them up and those will count towards their own total.
- Tally up the points and do a quick debrief to tie this back to prospecting.

How did it feel to come back and see that your claim was gone? Why do you think prospectors might have had to leave their claims unguarded? (weather/seasons, to go fill out a claim registration, etc.) How did it feel to find a gold claim? A copper one?

Mining Techniques:

Shaft mining: one of the simplest mining techniques. Prospectors find an ore body or a vein of a specific mineral and dig a tunnel, following that vein (horizontally or vertically) or digging into that ore body. These tunnels were sometimes reinforced with timbers or more solid rock, but they were still dangerous and could easily collapse or fill with carbon dioxide. Ore can be removed by ore buckets on pulleys, or, in the horizontal shafts, by cars on a rail. Shaft mines are still fairly common in this area today, although many of them have been mined enough that most of the valuable minerals are gone.

Strip mining: generally used for minerals or rocks that form in relatively horizontal veins close to the surface. All of the covering rock is stripped off, and the mine itself is basically a terraced gigantic hole in the ground. The current Cripple Creek & Victor mine is mainly a strip mine. These mines take more effort to build, but you can extract huge quantities of rock fairly easily. A strip mining site can permanently alter the landscape.

Placer mining: Many times the forces of weathering have already completed the task of digging ore from the earth, and the broken rock has been deposited as gravel in stream beds. Some of the earliest gold mines in Colorado were placer mines along streams where sluice boxes or large scale gold panning methods extracted valuable metals from the stream gravels. This mining method works best when you are working with high-grade or almost pure ore, as it is more recognizable and easier to pan out based on density than low-grade ore.

Stagecoach Game:

This game can engage students on the hike back towards Little Blue/High Trails. Two counselor groups become the "Stagecoach" and two counselor groups are the "robbers." The stagecoach team is given several packets representing the things of value a stagecoach would carry (see resource section). The members of the stagecoach team try to carry these items safely to their destination (wherever you want the game to end) while members of the "robber" team try to steal the packets by tagging players from the stagecoach team. Any player on the stagecoach team who is tagged while carrying a packet must turn it over to the tagging "robber". Members of the stagecoach team may pass the packets among one another.

The teams must stay together and with their counselors throughout the game. If at any time the teacher or staff member feels that the teams are getting too strung out, they may declare a "town", or temporary safe base. The game ends when all of the players have reached the destination. Points on the cards in the possession of each team are then tallied to determine the winning team.

Copper Mines

Budget about half an hour of walking time (including water breaks) from the base of Little Blue to the Big Spring archery range and another half hour to the copper mines. Lunch is usually dropped off at the archery range, and where you choose to eat it is entirely up to you. One option: snack at the archery range on the way out, and eat the rest of lunch when you pass the range on your return trip. Students benefit from a food boost before the final part of the day, hiking the hill up to the Crystal Beds.

Discuss safety with students at the Copper Mines. The areas in which students most commonly find copper minerals are slippery sandy slopes, so students should not run up or down them, attempting to slide down them, or prospect directly above other students. One area has many logs and old boards in it; this is potentially dangerous due in part to these obstacles as well as the possible presence of a mineshaft underneath them. This is also not a good place to find copper minerals, so a blanket rule that

students should avoid this area is generally a good idea. If you see any mineshafts, students may not approach them and keep a good distance, as any mining relics in the area are probably not very stable.

About the copper mines: Upon arrival at the copper mines, show samples of the most common copper minerals in the area: **malachite** (green), **azurite** (bright blue), and **chalcopyrite** (gold). Talc, which is white and powdery, is also present. The copper mines are in the same basic contact zone as the one at the base of Little Blue; this is just the other side of Little Blue, but it is still near a contact zone between Pikes Peak Granite and older schist (the copper is mainly in the metamorphic rocks). This can be a good way to further discuss or introduce contact zones. There is a larger copper prospecting area by Big Blue, also in the metamorphics near a contact zone.

These rocks don't look like copper. Why?
These are not pure copper; they are minerals made up of the element copper as well as other elements. Therefore, if you were to heat and otherwise treat these minerals in a specific way, they would yield some pure copper and some other material. Malachite's chemical formula is $Cu_2CO_3(OH)_2$, and the chemical formula of azurite is $Cu_3(CO_3)_2(OH)_2$. Both of these minerals can also be used in jewelry, in addition to their uses as copper ores. Malachite should yield about 57% pure copper, and azurite should yield about 36.5% pure copper (both of these calculations are for these reactions occurring in a perfect world).

Who lived here or who dug the holes?
These holes were probably dug in the early 1900's and were abandoned because they didn't pay off. Think about the amount of work it would take to turn all of these copper minerals into pure copper (and remember, at best, you would only end up with about half as much copper as original malachite or azurite). That would be a lot of work, time, and energy, especially if you factor in needing to heat all the rock up enough to separate out the copper. The prospectors may have been unable to do that on site, needing to take their minerals somewhere else for processing. No one is sure exactly who lived here, but take a minute to imagine their life, especially if they were ever here in the winter!

What is copper used for, and why do we care about it? Both malachite and azurite can be used in jewelry or as decorative items - that is sometimes a more common use for them, since they do not yield a huge amount of pure copper. Copper is used frequently in pipes and electrical wires or motors - it conducts heat and electricity well and is flexible. Copper is also in every US coin, since it is less expensive than actual gold or nickel or most other metals.

Jasper Pits

The Jasper Pits are out near Four Meadows, NW of the spring tank and up the hill (East & North of the fire pit). The pits themselves are fairly impressive, especially the one furthest from the spring tank; it looks like a real, timbered vertical mineshaft. Students need to be mindful of their surroundings. Like the copper mines, the jasper pits have a considerable amount of loose stone and sand. The first and shallowest pit is fairly safe for students to explore; the second one should not be closely approached; and the third, timbered one is not safe to explore.

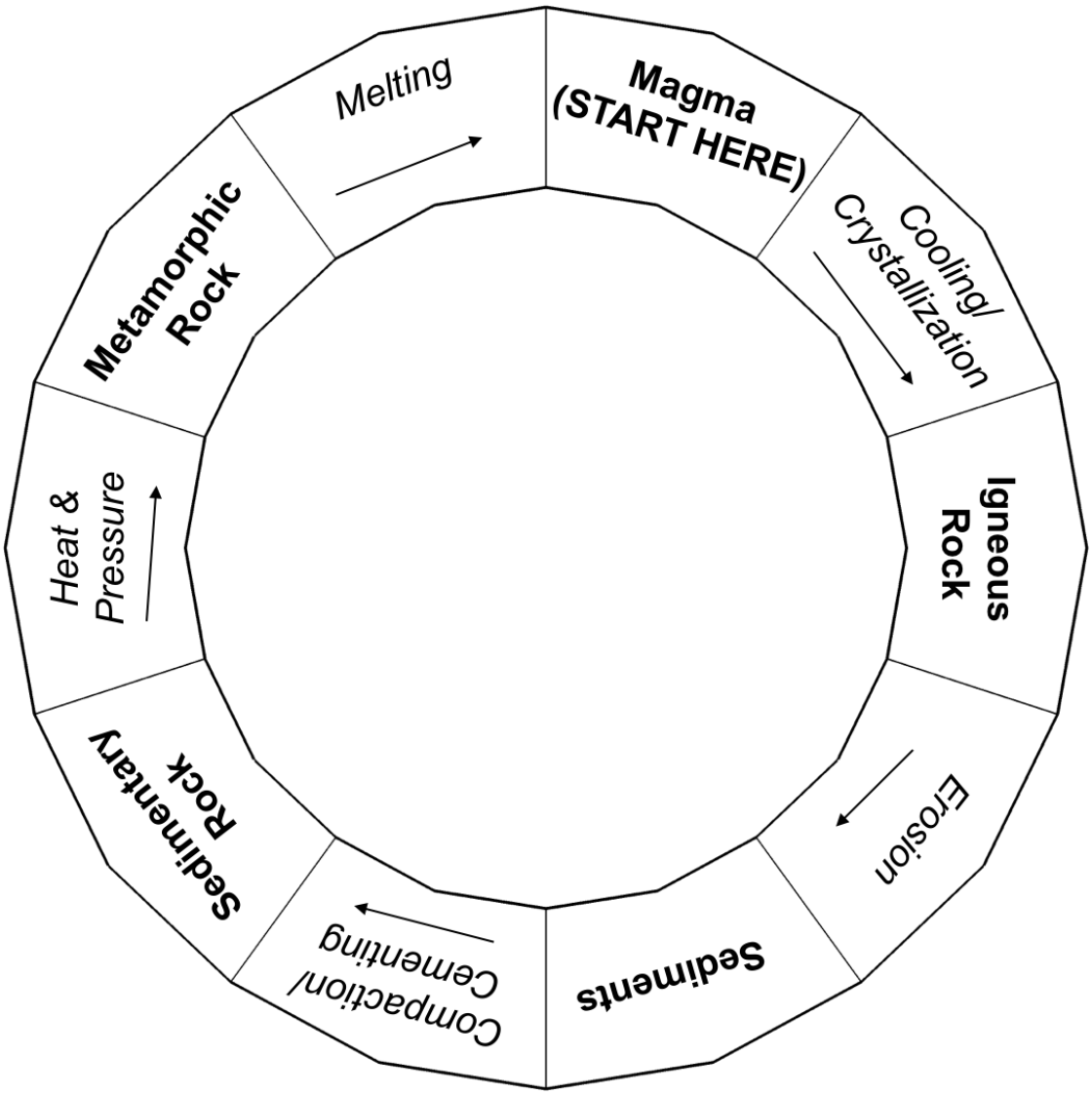
The jasper pits have likely been a destination for a long time; many arrowheads or partial arrowheads have been found in the area surrounding them. While it is unclear exactly why the jasper pits were first prospected by Europeans, it seems likely that this happened at about the same time as the Pikes Peak gold rush. During that period of time, the phrase "volcanic rocks near Cripple Creek" was more or less synonymous with "gold." The jasper pits are in volcanic rock (the 37-million-year-old Wall Mountain Tuff), and near Cripple Creek. Therefore, it is quite probable that someone advertised the jasper pits as having valuable minerals, being in volcanic rock, and being near Cripple Creek. Sandy Sanborn said that speculators sold stock in the Eastern part of the US based on the jasper pits. This would explain why they are so deep and carefully timbered.

The Wall Mountain Tuff is a rock that originated as a "glowing avalanche" of a pyroclastic flow, released by the eruption of a caldera out near present-day Mt. Princeton. This superheated volcanic flow raced across much of Colorado, vapourizing basically everything in its path and preferentially running down valleys. Many of these former valleys are now preserved as hills or ridges, since the Wall Mountain Tuff is more erosion-resistant than the underlying rock, which has since eroded away. The volcanic rocks at the Cripple Creek & Victor gold mine are not Wall Mountain Tuff.
Jasper itself is technically a variety of quartz. It is microcrystalline (so instead of having an obvious crystal structure like quartz does, it has miniature crystals and can appear to not be crystalline at all) and one of its distinguishing features is its opacity. Unlike other varieties of microcrystalline quartz, jasper is not translucent. It comes in a variety of colours; the most commonly found at the jasper pits include green, brown, white, and red. Jasper, chert, agate, and chalcedony are all variations of microcrystalline quartz, which can make identification of jasper fairly confusing.

Resources

Rock Cycle

This circle is a good way to have students assemble the rock cycle. If you print several versions on different coloured paper, then you can give each group a colour-coded set. Each group should begin with magma and work through the rest of the options. After igneous rock, the process could alternately be heat & pressure, then metamorphic rock, then erosion, sediments, compacting/cementing, sedimentary rock, melting, and back to magma. Either way works, and there could be many shortcuts across the circle throughout the life of a rock.



Claim Staking Game

This template works well for color coding the claim staking game. All of the minerals listed are related to Colorado (and this area of Colorado) in some way, and many of them are best known for occurring in Colorado.

Gold (yellow) = 5 points

Gold is a valuable mineral used in electrical, dental, and many other applications. It is easy to work with and does not tarnish, meaning that it has a myriad of uses beyond the well-known ones in jewelry, ranging from technology to architecture to telescope mirrors or surgical tools.

Aquamarine (blue) = 4 points

The state gemstone of Colorado, aquamarine is mainly valued for its uses in jewelry. The best-known place to find aquamarine is near the summit of Mount Antero. Aquamarine is one of many minerals that are varieties of beryl – emerald is another famous type of beryl.

Rhodochrosite (pink) = 3 points

Rhodochrosite is the state mineral of Colorado. The best specimens of rhodochrosite found in Colorado have almost all come from the Sweet Home Mine, which is located in Buckskin Gulch near Alma. Like aquamarine, rhodochrosite is often used in jewelry.

Amazonite (purple) = 3 points

Amazonite is actually a turquoise colour, not purple. Colorado is well known for its amazonite collecting localities, and much of the best amazonite (often with smoky quartz) is found near Crystal Peak in Florissant. Mineral collectors and some jewelers work with amazonite.

Copper (green) = 2 points

Copper is an extremely important element but copper minerals are more common than any other minerals listed here. Copper is, like gold, used in a wide variety of ways. It can be used in jewelry, electrical work, carpentry, the automotive industry, and many other areas.

Stagecoach Game

These are a few potential item cards with which you could play the stagecoach game.

Mail **+10**	***Checks*** **+50**	***Legal papers*** **+40**	***Jewelry*** **+10**	***Flint*** **+5**	***Horse escape*** **-50**
Tools **+10**	***1st aid supplies*** **+50**	***Water jugs*** **+30**	***Food spill*** **-10**	***Maps*** **+30**	***Coach schedule*** **+20**
Illness **-50**	***Coach damage*** **-40**	***Extra harness*** **+5**	***Injury*** **-50**	***Shelter*** **+40**	***Warm layers*** **+40**
Money **+50**	***Horses*** **+100**	***Weapons*** **+15**	***Gold*** **+100**	***Food*** **+20**	***Trading supplies*** **+15**

Other prospecting stories:

There are plenty of good prospecting stories around. These are just a few examples, quoted from local (CC&V district) prospectors who told their stories at the 2017 "Stories at the Strong" event in Victor. The Strong Mine is a mine in Victor, just outside the town. Its original design (from the late 1800s) is a story in itself - the shaft was a two-compartment setup until about 700 feet down, at which point the rock became easier to excavate and so it was widened out to three compartments. At the top, though, one compartment was for anything being hoisted up or down, while the other was for a combination of the hoist counterweight (a good ton or more) and humans. Imagine climbing a ladder in a few-foot-square space, with a several ton weight whistling up and down immediately behind you. As the Strong Mine people said, you learned early to keep your elbows in while you were climbing. Today, they are restoring the Strong Mine, but one place that they chose to ignore the historical footprint of the mine was in that first 700 feet; the Strong Mine main shaft is now 3 compartments all the way down. The Strong Mine is named after Sam Strong, an infamous Cripple Creek resident in the late 1800s. In 1894, there was a labor strike and the Strong Mine was blown up. It was rebuilt and produced valuable ore, but its owner continued his adventures. In 1901, Strong was involved in an argument in the Newport Saloon's over Strong's gambling debts. He was killed during this argument, and the city of Cripple Creek subsequently outlawed both guns and gambling.

Jim:
We'd always come by the Independence [Mine] and play on those foundations - why, it was the greatest playground in the world for kids because you could always find something to do (anything you wanted or could think of). We even had our own swimming pool - an old metal water tank that was laid upside down, and in the summertime the sun would heat that water. We would slide down the shady side of the metal part, but anyway we'd swim in that and play until we were just wore out and lie out on the concrete foundations until we were dried out. Then everyone would tell us how great our suntans were - we didn't want to tell them it was just rust.

Randall:
He worked in mining in the CC&V district 1973-79, but this story is from 1972: *I was working for Golden Cycle Gold on a survey crew. It was my 4th year of college, went back behind the Ajax. Our shift had basically finished, and we were heading back to town, and we had to go by the Ajax. The mine superintendent, supervisor, and the shift boss were all hanging around by the Ajax, and there was this flatbed truck backed up to the collar and mounted on it was an A-frame, and at the top of the A-frame was a pulley. They had a wire cable and a winch that went through the pulley and on the far end of the cable was a small wooden plank. So we stopped by and said "hey guys, what's up?" "we're looking for a volunteer." I was 21, I was invincible, what did I know, but I eventually realized that I was volunteering to sit on this plank and be lowered down the Ajax. And the Ajax is 3100 feet deep. Now they said "once you get*

down there a little ways, not too far, we won't be able to hear you, so if you get in trouble you're going to have to signal with your lamp - flash it back and forth, and when we see that light a-flashing we'll stop, we'll yell." So my job was to inspect the shaft - what shape was the thing in? Well, the last time it was actively mined was 1962 or somewhere around in there, this is 1972, so nobody'd been down that thing for a while, I guess. Well, the wire rope is twisted, so it didn't go straight down - went in a circle. So I'm on this plank, death grip on the two pieces of wire rope, and I'm looking at the wood that's in the shaft as I'm going down, twisting around. And I'm noticing every now and then there's a timber missing and the shaft is just soaking wet - not a dry piece of wood around. And I'm looking and looking, not sure how far down I got, probably about 150 feet, and I'm still looking, and my knees got caught on one of the timbers from above that was crossways in the shaft. Now of course that caught my attention and I immediately started flashing but it didn't do much good because I kept going down, and then just as my ankles are on the edge of that timber, I'm not kidding, I come to a stop. Now I thought that was great, and I slowly start to go back up. I still have a death grip on the two pieces of wire rope and somehow manage to land my butt back on that plank. Well, after that they retimbered that puppy, from the top, and they hung it all the way down 3100 feet.

1974-9175: I can't remember the level of the Ajax that you had to go down to, but whatever it was you'd end up in the Roosevelt Tunnel level, which was the equivalent of the Cresson 17. And of course the Cresson was this unbelievable mine, unbelievably rich. Anyway, my job was to take a crew of new guys down the Roosevelt Tunnel and one of them was around 6'4" and put that hardhat on him, put some mining boots on him, he's getting pretty close to 7'. And so we's walking down the drift, down the tunnel, and he kept having to dodge, duck his head. One time, bam, he just ran smack into the back. So our job was to go through the Cresson 17 back to some place called the Dante. So after you went around the big stope and the vug, you'd go down a little incline and then you'd go back up where the Dante was. Well up here, on a heavy air day, it's colder - it's more dense air, so it keeps the CO_2 suppressed. But here in Colorado, weather can change, and so we went underground and thankfully we had a naptha lantern because you didn't have a canary. And so the idea was that you watched the naptha lamp and if it started to go out, well CO_2 was coming in and the oxygen was being pushed out. Well, we're back there in the Dante and the naptha lamp goes out. So we relight it and it's about knee level, and I say "guys, we've got to get out of here." So we leave the rocks there, but we have to go back and remember we had to go down that 10 feet, so I told them "look, don't take a breath when we're down below there because if you're dead, I'm not carrying you out of here." And so we did get back to the Roosevelt Tunnel finally. I kept relighting the naptha lamp and I was the shortest guy and by the time that we got to the Tunnel, the CO_2 was at my shoulder. I came really close to dying but the Roosevelt Tunnel's a wind tunnel, because the air would come in from the Portland, the Ajax, and who knows how many mines up here, so that was good pressure, it didn't matter how much CO_2 was around.

Former miner speaking about Cripple Creek characters:

Dale Weaver - *boy what a character. You'll never meet a character like him. I remember up in the Amanda mine, we'd all come out after work except for Dale - we didn't know where Dale was. So I went back down there looking for him and couldn't find him and called "Dale! Dale!" and I heard this voice down in the stope and I shined my light down there and here's Dale, upside down with his one leg caught in a rung. And I said "Dale, what are you doing!?" and he looks up, calm as can be, and says "just hanging around."*

Eddie Roy - *there wasn't a man who could handle a jackleg or drive drift any better than Eddie Roy.*

Edward Pickett Sr. - *just a fantastic worker; you didn't want to get near him when he was working, because he was dangerous, and anything he used usually broke down; you'd have to come behind him and fix it, but what a guy - loyal, faithful, he would go through anything to get the job done for you.*

Nippy/George Carter - *he was working up, either the Gold Cycle or Vindicator. He was mucking with his dad - he was on one side of the trip car, and his dad was on the other, and he went to pick up a rock, and when he turned back around to put the rock in the car, he was looking at a rock wall. There was a roof-fall, and his dad was under it. He became the postmaster here in town for many years.*

Mel Anderson *- he had great stories (some of the ones listed above may have come from him)*

Gary:
I*f you're up here in the wintertime, you'll see a lot of the shafts and whatnot and a lot of the ground kinda steaming. And that's upgas - the Ajax is a perfect example of upgassed shaft, where all the heat is coming from down below and heading out. Well, I worked on the Nevins in '77-'78 - we started retimbering that shaft, over by the El Paso mine, and that was a downcast shaft. It was basically plugged off; we were retimbering the whole shaft, and what would happen in the wintertime was it would ice up, and not just ice up but it would be glacial. And that happens overnight, so it was a daily occurrence where we took a sinking bucket and one guy would have to climb in the sinking bucket and we'd hang it underneath the skiff, and as you went down, you'd have an axe in your hand, and the idea was to chip the ice off the guides. Well, the guide ice was thick as heck, and the bucket was spinning the whole time and you're trying to chop the ice and it would take about 2 hours for us to get down to where we could actually put in a set of timber. And boy was it cold and wet.*

Rich:
2006 onward in Victor. Had visited summer of '66. Now working at the Strong mine.
The first time I was working with this crew, we were over at Tenderfoot, widening the

tunnel with the Sangre de Cristo mine, and also doing razebore work. We were putting 10-inch pilot holes from the surface down (about 500 foot depth), and this one was perfectly placed. So what we do there, is after the hole is punched through, we take the 4-foot cutter head and attach it to the drill steel and pull it up [so the hole was being widened from the bottom up]. Meanwhile, we were doing a crosscut in the tunnel and occasionally as the cuttings would fall, they'd make a big pile. And the ceiling is 8 feet, 9 feet high, so we'd have to check and make sure that those muddy wet cuttings don't plug up the end of the hole, so we'd muck it out occasionally. A couple times we were a little late, and the cuttings got up into the hole and got it a little plugged. Now the first time, we dug it out and we were fine, but the second time, we obviously didn't know how much it was plugged up into that hole. So we're on the pile, shoveling it and trying to clear it and let it run out. And of course we're listening for any movement we might hear. Keep digging, and we're wearing boots - rubber boots - and it's mud, so it's not like running on the surface. And we realize it's going, so Andy ran, and I tried to but got stuck. This whole pile flushes (20 ft high), and I manage to get my feet free and swim on top, and I call it mudsurfing. I probably rode that thing 30 feet. Andy was ahead of me, and I stayed on top and got out, but to this day if you go into the Sangre de Cristo tunnel, you can see the mud line on the ribs.

Carl:
Meanwhile, in 1963, there's a mine over near Victor called the Silver Stake - and the partners in it told me "we want somebody to sink that shaft 50 feet and drive a crosscut." And my dad and my uncles say "go after it, go after it," so I sign the contract. So anyway my brother Everett and I have a motor on a hoist, and it was a rinky dink outfit. So my sister Irene was running the hoist, and we was down in the ground - we rode the muck run ore bucket down - so Everett spits the round; 6 foot rounds; and we had all the fuses together, and he says "give Irene 3 bells; tell her to be ready." So meanwhile, we've tied the ladder up, probably about shoulder height, and so we got the igniter cord out, we spit that round, I gave Irene 3 bells (3, 1 means hoist; 3 bells means man on and 1 bell hoist). We set that round, look around, and the bucket's going up the shaft. All I can think of is "we're dead." But Everett was there and this is what happens when adrenaline starts flowing. He says he felt something hit the top of his shoulder, and I swear I jumped probably that far, and caught the bottom rung of the ladder and I'm out of there. He's screaming at me, still stuck down there, and I have to go up and loosen the ladder and let it down, and we get halfway up and the round went. I mean boy, my sister was screaming when we got to the top because she knew we weren't in the bucket and that she'd hoisted early. But that's just one experience.

Miners also have a sense of humor:

Andy:
We take every precaution we can. You have a full harness on and you're always tied off to something. We're on the floor working, we're tied off. One day, I'm down working with my sidekick and we didn't know where bottom was. It's getting close,

because you drop a rock and you can hear that drummy sound. So I say we're getting close, this could flush at any time, and we've got a lead rope hanging down, and Josh is tied off to that, and I'm tied off to the bucket. I'm down on my hands and knees, shoveling away, trying to get the timber out, and we fill the bucket. So I tell Josh "unhook me, hook me up to the tether line, and then send this bucket out so it can get empty," and I hear an "okay." So I go right back to my shoveling, and I'm down on my knees trying to shovel out this timber when all of a sudden I'm sucked up off the floor and I'm going up the shaft from a loop on my back. Evidently somebody heard "bring the bucket up" but conveniently did not hear "untie me first." So there I am, yelling, on my way up, and somebody else is dying of laughter on the floor. I'm hoping the bucket is going to spin around and get me close to the bell cord, and I'm yelling to stop. I think somebody eventually stopped laughing long enough when I was about 15 foot up and rung me back down to the floor.
"That's what you get for locking me in the port-a-john!" (From Josh in the back row). We do end up having a good bit of fun here.

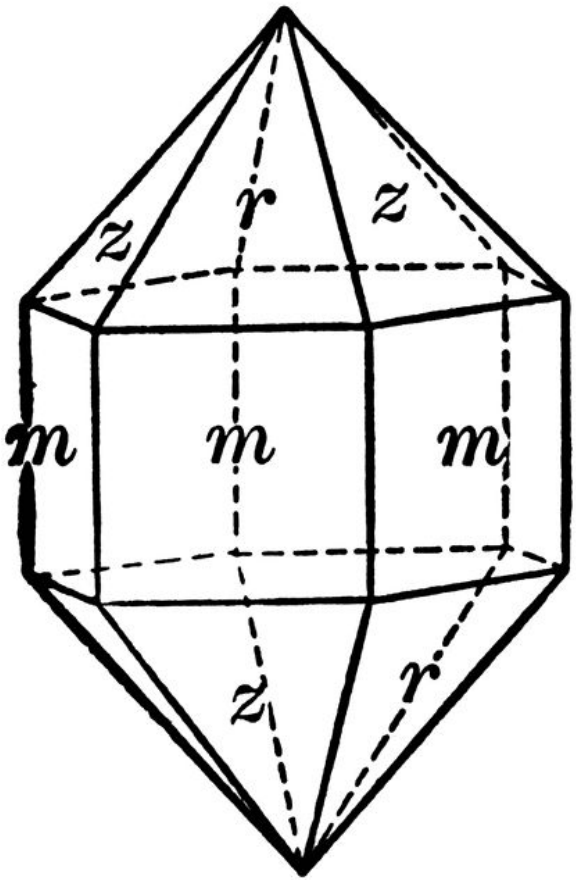
I don't know what it is, but everybody who's not a miner, why you think us miners know what rocks are. I had a lady bring me a rock and ask me at church if I could tell her what that was. Well, you see, a rock is a rock - I mean, you hand me a gold bar, I'll take that, but otherwise it's just a rock. So she goes and she says "well, you're a miner, can you tell me what this is?" So I take it and I say "oh boy, you got a really nice piece of leaverite here." And that means "leave it right here." What I've found out since then is she was impressed, and she took my word for it, and she's told everyone in Cripple Creek "this is a great specimen of leaverite."

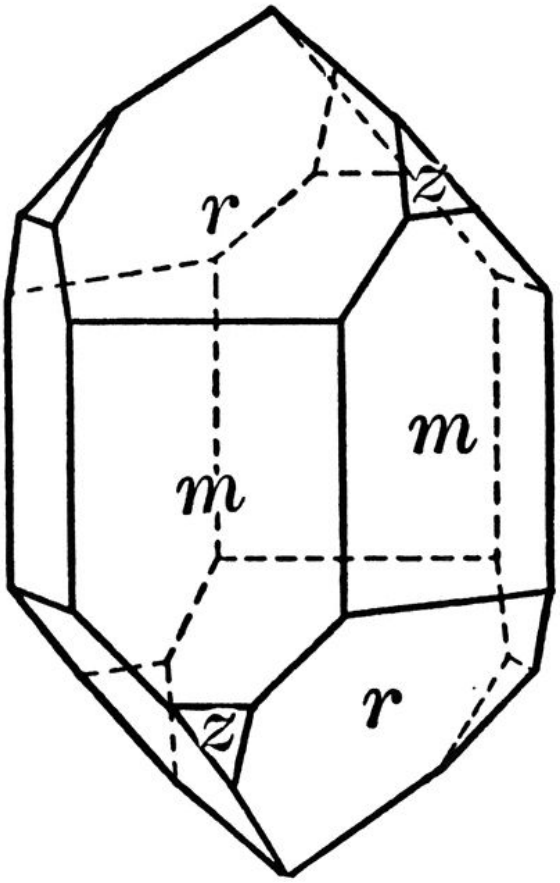
Crystal Types

All crystal illustrations here are from https://etc.usf.edu/clipart/ .

Quartz:

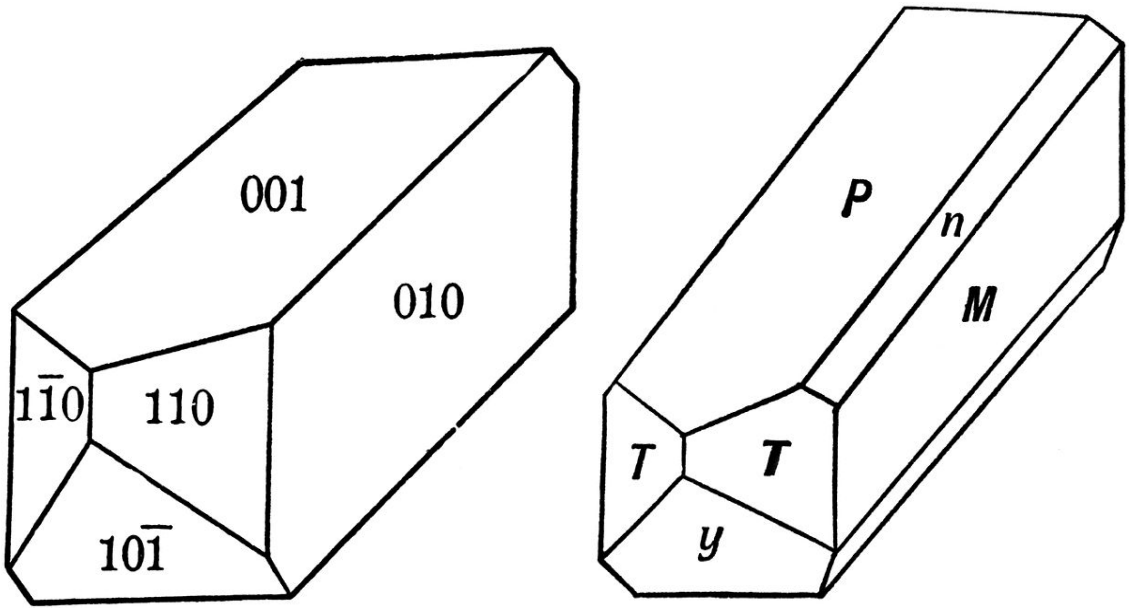
These are two example of quartz in its crystalline shape. Both have a hexagonal barrel with approximately triangular ends on either side of that hexagon. The first example is a more simplistic version; the second is a very well-formed and detailed crystal (one that has had a considerable amount of both space and time to form). At the crystal beds, it is unlikely that anyone will find a fully-formed crystal, unless that crystal is very small. More typical is someone finding a fragment of the hexagonal barrel. In this case, there would be a 120 degree angle between two or more very smooth surfaces. Sometimes, the entire hexagonal shape might be distinguishable.





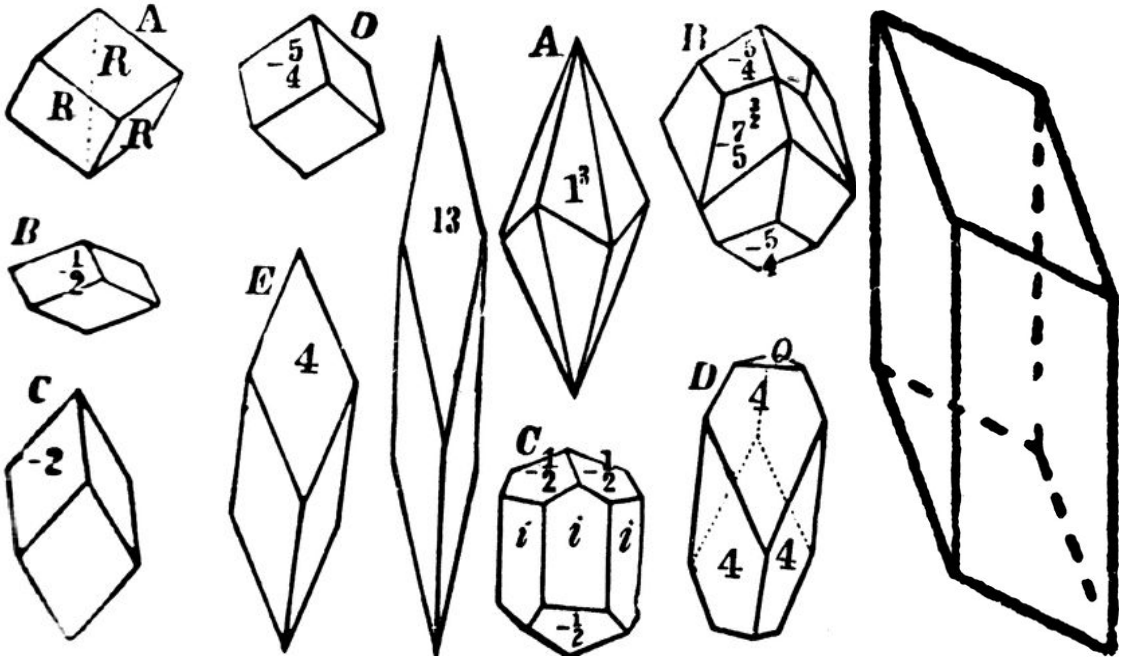
Feldspar:

Feldspar crystals are almost rectangular prisms. Feldspar of some kind is a major constituent of many rocks, including the Pikes Peak Granite (and most forms of granite).



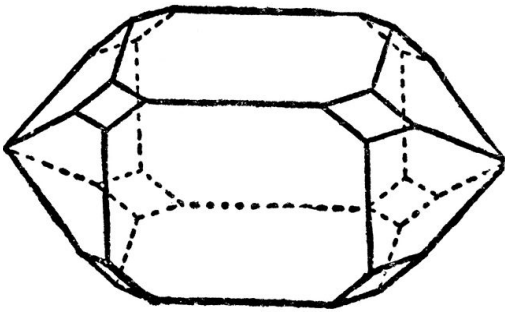
Calcite:

Calcite (calcium carbonate, which makes up limestone and many marbles) occurs in a wide variety of crystal shapes. The most common is the parallelogram-like prisms.



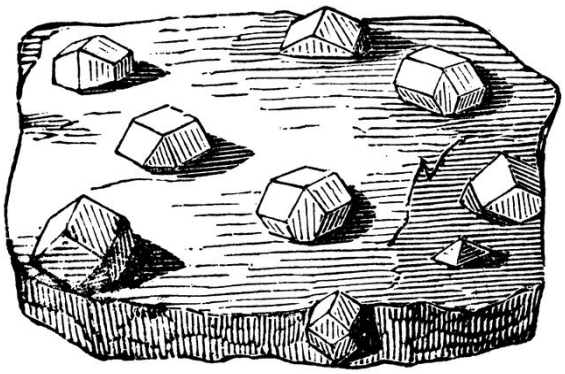
Zircon:

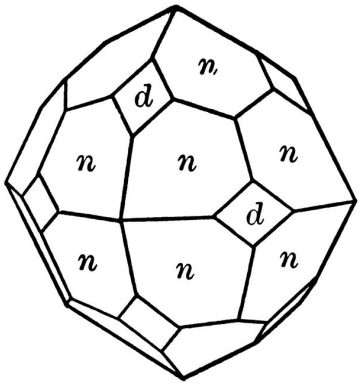
Zircon is a mineral that scientists often use to help determine the ages of specific rocks. Its crystal form is similar to that of quartz, except that is is not hexagonal.



Garnet:

Garnets are metamorphic minerals and often occur in their crystalline shape, even when they are incorporated within a rock. Garnet crystals are generally dodecahedrons.





Fluorite:

Fluorite is used in various industries and can also be a gemstone. Its crystal shape is basically a cube, although it sometimes forms more elaborate crystals.