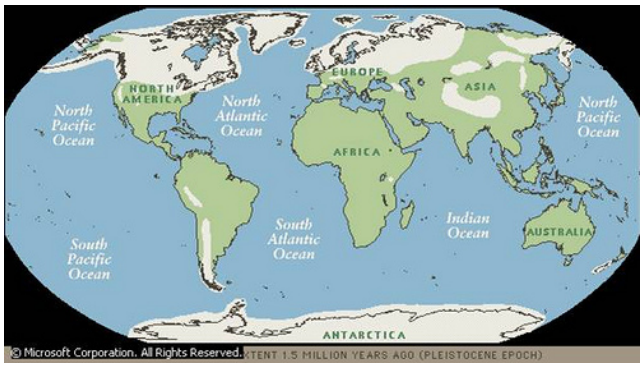
Oregon's Age of Fire & Ice

In this reading you will learn about the age of glaciers and volcanoes in Oregon and the Northwest region. You will learn what happened during this time, when and where the these volcanoes developed, and how they effected the landscape. For this activity read the material below, record three important things you learned about this geological period, and be prepared to discuss it with your class.

The Ice Age

The *Pleistocene epoch* or what is commonly called the Ice Age, happened between 2 million to 10,000 years ago. During this time the planet cooled drastically and glaciers spread from the north and south poles into the central regions of the planet. It is estimated that during the Pleistocene up to 30% of the Earth's surface was covered by ice. A permafrost zone also stretched beyond the ice into North America and Eurasia.



The maximum extent of glacial ice in the north polar area during the Pleistocene epoch.

The mean annual temperature at the edge of the ice would have been –6 °C (21 °F); at the edge of the permafrost the temperature was 0 °C (32 °F). To compare, today the mean annual temperature on earth is 15 °C (59 °F). In the area south of the ice sheets, large lakes formed because river outlets were blocked by ice and the cooler air slowed evaporation. In the Northwest, glaciers created towering ice dams like the one that formed Glacial Lake Missoula and caused the massive floods that scoured the landscape when the ice dam failed.

In Oregon, the *Pleistocene* is not just about ice and floods, it is also about fire. Before this period of time the Cascade mountains we know today did not exist. There was no Mt. Saint Helens, Mt. Jefferson, or Three Sisters. The Cascades Range was created during the *Pleistocene* by the fire of volcanoes while simultaneously being worn away by glaciers.

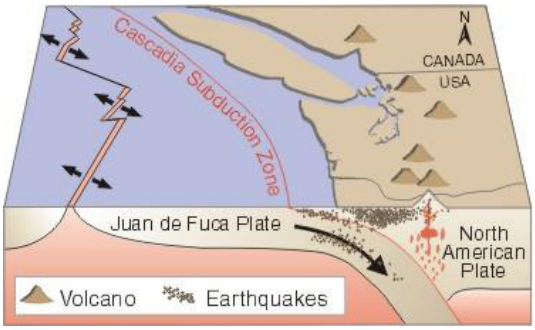
Oregon's Cascades

The Cascade Range is a 700 mile long chain of mountains and volcanoes. The range stretches from northern California, through Oregon and Washington up into southwest Canada. The width of the range varies from 50 miles wide in the southern and central parts, to 120 miles wide in the northern section. There are more than two dozen mountains and volcanoes in the Cascade Range. On average the mountains in the Cascades are about 5,000 feet above sea level.

When Plates Collide

The Cascades are part of an area called the Pacific Ring of Fire - a ring of volcanoes and mountains around the Pacific Ocean. All of the known historic eruptions in the contiguous U.S. have been from Cascade volcanoes. The most recent are Lassen Peak in 1914 and Mount St. Helen's in 1980 and again in 2006.

The Cascades were formed by two of the earth's tectonic plates pushing and rubbing together. These plates are the oceanic Plate of Juan de Fuca, located just off the Pacific coast, and the North American Continental Plate. The ocean plate is heavier and *subducts* (or moves under) the lighter continental plate. As this happens, enormous pressure is created and portions of basalt crust from the ocean plate melt with sediments from the ocean floor to form magma. As this magma vents to the surface it creates volcanoes.



Tectonic plates are sub-layers of the earth's crust that move, float and sometimes fracture creating earthquakes, volcanoes, mountains and ocean trenches. The image above illustrates how the plates moved to form the Cascades in the Northwest.

There are two parts to the Cascade Range – the old Cascades on the west side and new Cascades on the east side. The west side was formed between 40 and 5 million years ago as the two plates pushed together. Over time there was a change in the angle that the ocean plate pushed against the continental plate. As a result the volcanic activity in the Cascades moved farther east and formed a new mountain range.

The volcanoes in the Cascades are *stratovolcanoes*, also known as composite volcanos. They are typically tall and cone-shaped and have periodic explosive eruptions. They are built up by many layers (*strata*) of hardened lava, tephra, pumice, and volcanic ash. Stratovolcanoes are commonly found in subduction zones and form in chains along the plate tectonic boundaries where an oceanic crust is drawn under a continental crust.

Above, the Three Sisters is one of three potentially active volcanic centers that lie close to rapidly growing communities and resort areas in central Oregon. Below, Crater Lake is what remains of one of the largest stratovolcanoes to have ever formed in the Cascades.

Mt. Mazama

During the Pleistocene, Mt. Mazama was one of Oregon's largest stratovolcanoes with peaks 12,000 feet high. It was taller than Mt. Hood and wider than Mt. Jefferson.

Mt. Mazama was destroyed by a volcanic eruption 7,700 years ago. During this major eruption, an estimated 12 cubic miles of rock and debris exploded in a single day. Winds carried ash across much of the Northwest and parts of southern Canada. Lava flows partially filled the valleys around Mount Mazama with up to 300 feet of pumice and ash. So much magma erupted that the volcano collapse in on itself. When the dust settled it revealed a volcanic depression called a *caldera*. The caldera was five miles in diameter and one mile deep. Today, this area as is called Crater Lake, the seventh deepest fresh water lake in the world (1,943 feet deep) and Oregon's only National Park. Because of the long history of volcanic activity around Crater Lake, scientists believe this volcanic center will erupt again.

Before

After

Image of Crater

Mount Saint Helen's

Mount Saint Helen is the most recent Cascade volcano to erupt. In 1980 an earthquake triggered an eruption and caused the entire north face of the volcano to slide away. The eruption column rose 80,000 feet and deposited ash in 11 U.S. states. At the same time, snow, ice and several entire glaciers on the volcano melted, forming a series of large *lahars* (volcanic mud slides) that reached as far as the Columbia River, nearly 50 miles away.

In total, 57 people and thousands of animals were killed. Hundreds of square miles were reduced to wasteland, causing over a billion dollars in damage. Mount Saint Helen was left with a crater on its north side. The U.S. Forest Service has preserved the area by creating the Mount Saint Helen's National Volcanic Monument.

Mount Saint Helen erupting in 1980. A smaller eruption occurred in 2006.

Carved by Ice

Unlike the midwestern United States, Oregon did not have huge ice sheets covering the landscape. There were, however, ice caps on the highest parts of the region. A massive glacier covered the Cascades about 170 miles from Mt. Hood to Mt. McLoughlin. At its deepest, it was a half mile thick. Other Oregon mountains ranges also had extensive glaciers or ice caps including the Strawberry, Elkhorn and Wallowa Mountains in eastern and northeastern Oregon and the Klamath and Steen Mountains in southern Oregon.

In many areas the glaciers created near perfect u-shaped mountain valleys like those found in the Steen Mountains. The Steen Mountain Range in southeastern Oregon is one of the largest single fault uplifts in North America. Glaciers eroded sections of this area into gentle slopes.

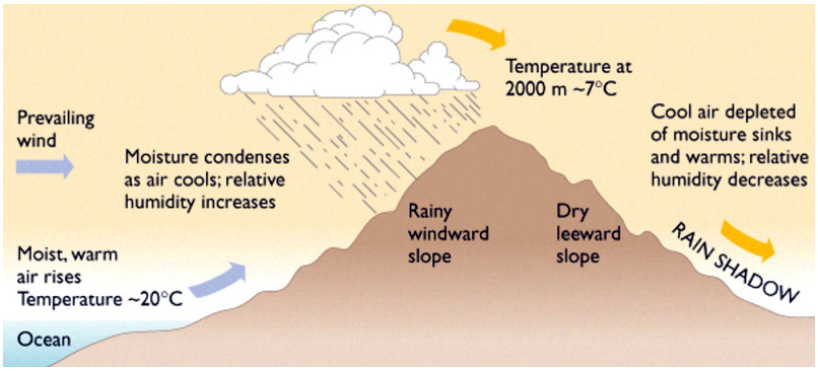
This perfectly U-shaped valley in the Steens Mountains of southeastern Oregon was created by glaciers.

The Cascades Effects on Climate

The Cascade Range is so large it affects the climate of the Northwest United States and parts of Canada. In Oregon the Cascades are a substantial barrier between the east and west sides of the state. Historically, the Cascade Range has been a difficult barrier for people to cross. The only sea level route through the entire 700 mile-long range is the Columbia River Gorge.

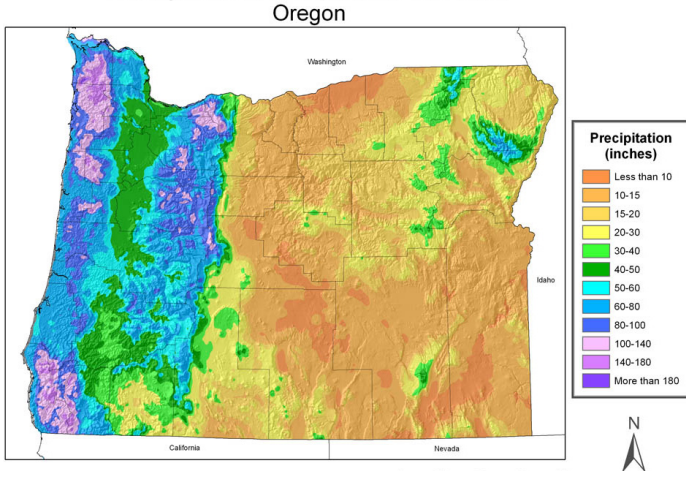
The climate on the eastern side of the Cascades is effected by a rain shadow. A *rain shadow* is a dry area on the *lee side* of a mountainous area. The mountains block rain-producing weather systems, casting a "shadow" of dryness

behind them. The diagram to the right shows how warm moist air is pulled by the prevailing winds over a mountain. The moist air condenses and precipitates, then the dry air moves forward leaving a rain shadow behind the mountain.



The east side of the Cascades is dry and desert like with anywhere from 9 - 20 inches of precipitation annually. It also has more extreme temperatures (hot and cold) then the west side of the range. The Willamette Valley on the west side of the Cascades is much wetter (averaging 50 inches of precipitation annually) and has a mild, temperate climate.

Average Annual Precipitation, 1971-2000
Oregon



Most of the Cascades peaks are white with snow and ice year-round. Because the Cascades are close to the Pacific Ocean, and the winds come primarily from the west, a tremendous amount of precipitation falls on the western slopes of the Cascades. About 150 inches of snow falls on average annually, and it is not uncommon for some areas in the Cascades to have over 200 inches of snow.

Cascade's Effect on Agriculture

In the Willamette Valley the wet, mild climate created by the Cascade Range is idea for agriculture. Willamette Valley farmers raise about 170 different plants and animals making it one of the most agriculturally diverse areas in the United States. Crops in the valley include greenhouse and nursery plants, grass seed, fruits, vegetables, Christmas trees, nuts and wheat, as well as dairy and beef cattle, sheep, other live stock. The western slopes of the Cascades are densely covered with Douglas-fir, Western Hemlock and Red Alder and have historically been one of the most active logging areas in the United States.

The dry climate on the eastern half of Cascades limits the agricultural diversity. The dry climate is more suited for cattle, wheat, and alfalfa and grass hay. Along the Columbia River farmers irrigate to raise fruit trees, melons, potatoes, onions and grapes.

Fertile Soils

Volcanoes obviously can cause damage and destruction, but in the long term they also benefit the soil. Volcanic ash blows over thousands of square miles of land adding nutrients and increasing the soil fertility of forests and agricultural land. Over thousands to millions of years, the breakdown and chemical weathering of volcanic rocks forms some of the most fertile soils on earth. Nearly everywhere volcanoes are located, people use the rich soil for farming.

The volcanic, Jory soils found in Oregon are ideally suited to produce world-class wines and fruits like pears and apples. They are also excellent for growing conifers. Jory soils are brick red, typically 4-6 feet in depth and consist of a silty, clay loam. The depth and quality of the soils is the reason for much of the agricultural bounty found in Oregon.