Science Behind the Scenes Video Script
Air Quality

Hello, I'm Karl Cordova, a biologist at Rocky Mountain National Park.

One of the experiences we all appreciate about visiting the park is the stunning views. Katherine Lee Bates wrote "America the Beautiful" after standing on Pikes Peak 120 miles to the south of here. Her words about "spacious skies" and "purple mountain majesties" are evocative of the magnificent views one can here see at Rocky Mountain. Here the mountains can seem etched in the sky.

Under good conditions, views of up to 200 miles are possible, a heritage the National Park Service is charged with protecting. Under the Clean Air Act, the National Park Service works with the State of Colorado and the Environmental Protection Agency to safeguard park air. Rocky Mountain National Park is a Class 1 Air Quality Area. This means that the park has the highest level of air quality protection afforded by law.

During the next few minutes I'm going take you behind the scenes to see how air quality is monitored here in the park and why it matters to the visitors that come here and the plants and animals that live here.

The first monitoring station on our tour is hidden away under Trail Ridge Road. It's called a transmissometer. This part of the equipment transmits a very bright beam of light to a receiver approximately three miles away.
This is what that beam of light looks like three miles away where a receiver measures the amount of light received and records the information digitally. By comparing the amount of light that is transmitted under different atmospheric conditions and different pollution levels, air quality experts are able to quantify how visibility varies.

The bad news is that current visibility seldom matches natural historical conditions, estimated on good days to be around 200 miles. Under these historical conditions, it was common on a clear day to see Pikes Peak from Longs Peak. However, there is good news: changes made in vehicle exhaust systems and in treating industrial emission in our country,
have helped to compensate for increasing population and the number of cars along the Front Range.

While the transmissometer measures visibility, these instruments at Loch Vale measure pollutants that fall to the ground as rain or snow – what scientists call wet deposition. This site is one of two hundred and twenty sites nationwide that form the National Atmospheric Deposition Program. The large can-like receptacle collects and weighs precipitation then automatically records the amount of moisture collected. The instrument right next door features two buckets and a moisture sensor. When the sensor is triggered, for instance when it is raining a collection bucket is opened.
After it stops raining or snowing, the sensor signals the mechanism to replace the cover on the sampling bucket.

Every Tuesday for more than twenty years, a park service employee has come to this site to change out these buckets. They follow a strict set of instructions to be sure not to contaminate the sample with body oils or dust. There technicians measure hydrogen ions, sulfate, nitrate, ammonia, and chloride –all chemicals that can alter sensitive soils, waters, plants, and animals.

While some air analysis inevitably takes place in laboratories remote from park resources, other studies happen right here with the park serving as a laboratory where measurements are made. For example, the Loch Vale watershed is a high elevation site in the park where impacts of pollutants have been studied for over twenty years.

Scientists initially wanted to know how chemicals that are deposited with precipitation move through the surrounding rocky talus slopes, forest soil, lakes and streams and more recently they have looked at how deposition affects the chemistry of those systems.

If you've spent time in the park hiking or driving, you've probably noticed the large amount of rock. Through natural processes these soils develop from this rock and these soils are low in nutrients. The native plants and trees here have adjusted over thousands of years to these low nutrient soils. The clear water of these park lakes is a result of these natural conditions. With few nutrients and cold temperatures, algae growth is minimal. Chemicals brought here by rain and snow have a potentially significant impact on the park's ecosystems.

Atmospheric deposition sites show that precipitation coming to the park has elevated levels of sulfur and nitrogen, levels that are among the highest in the Rocky Mountains. In addition, nitrogen concentrations in precipitation have been increasing over the past twenty years.

How do these pollutants affect the ecosystems? Independent, peer reviewed lake sediment core studies show that the kinds of algae and the amount of algae have changed in the park lakes due to these unnatural inputs. Pollutants are also contributing to acid conditions that are potentially damaging to aquatic life such as fish eggs, frog larvae, and other life forms. Fortunately, published studies show that despite inputs from precipitation-borne pollutants, acid conditions have not yet been reached in park waters. However, as the ability of the rocks and soils to counteract acid ion inputs is used up, there is a risk that park waters could acidify in the future.

In addition to the changes in aquatic systems, soil chemistry and the balance of nutrients in plants themselves have also been altered in a way that is potentially harmful. The Environmental Protection Agency and the park are working together to develop strategies to reverse these trends in atmospheric deposition so that park ecosystems will be better protected in the future.

Now that we've seen visibility and wet deposition monitoring equipment, the last stop on our tour is here at the base of Longs Peak at a set of small buildings that look like overgrown outhouses. This building houses not just one piece of equipment but rather an array of sensors. Here weather such as wind speed and direction, humidity, barometric pressure. This combination of equipment samples what is in the air at a particular point in time.
We combine these data with other information to help us estimate where the pollutants are coming from.

One pollutant of special concern measured here is ozone, a colorless gas that can damage human lung tissue and affect plant health. Ozone forms when nitrogen oxide gasses and volatile organic compounds combine in the presence of sunlight. Moderate levels of ozone are hazardous to humans with respiratory problems such as asthma or emphysema. High levels of ozone are hazardous to anyone, regardless of their health status, who is exercising vigorously.

Unfortunately as the number of cars and other air pollution sources along the Front Range have increased over the last decade, there has been an upward trend in the number of days at the park when the ozone health standard is exceeded. Upslope winds can make ozone as serious a problem in the park as it is in nearby cities. Air quality agencies are working to reduce ozone levels in the park and in other parts of Colorado where they are considered too high.

I just mentioned upslope winds and it is this regional weather pattern
that is at the heart of concerns about park air quality. Although some pollutants are carried long distances by air masses, some come from relatively close here in Colorado. Local storm events follow an upslope pattern. Air warms and rises over the plains. This rising air sweeps agricultural chemicals, gasses from animal waste, industrial pollution, and car exhaust up with it. When the rising air cools over the mountains,
falling precipitation deposits pollutants in the park. The proximity of the park to Front Range communities makes it an ideal getaway for literally millions of people. However, its proximity to urban and agricultural sources also makes it vulnerable to air pollution.

This has been a brief overview of air quality monitoring of visibility, wet deposition, and ozone. The results of this monitoring relate directly to plants, animals, and the visitors of Rocky Mountain National Park.
Efforts over the last several decades in the United States have shown that we can protect water and air quality if we work together to be energy efficient and are willing to invest in technologies that can help control pollutants.

If you choose to walk or ride when you are doing errands, or when you use public transportation or conserve energy in other ways, you will make a small but important contribution to improved air quality.

When we protect the air quality of purple mountain majesties and spacious skies we also protect the air that we breathe. The National Park Service cares for special places saved by the American people so that all may experience our heritage.

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