Carbon dioxide is a very, very important gas and it's building up rapidly in our atmosphere.

We're tipping towards warmer conditions. So buildup of carbon dioxide in the atmosphere, buildup of greenhouse gases in the atmosphere, is going to lead to a warmer world.

There is quite a lot of urgency to see what we can get from a satellite like OCO-2.

Take a breath.

As you exhale, you're releasing carbon dioxide into the air around you. On a small scale, you've just demonstrated a process that's repeated, every moment, around the world.

Natural and manmade sources pour carbon dioxide into the atmosphere, while plants and the ocean absorb it... and sometimes release a portion of it back into the air.

This is the "global carbon cycle." The Earth itself is breathing.

NASA's Orbiting Carbon Observatory-2, or OCO-2, is designed to study this process from a whole...
new perspective.

OCO-2 is based on the original Orbiting Carbon Observatory mission launched in February 2009.

However, that mission ended before it even began, as a launch vehicle failure resulted in the loss of the satellite shortly after liftoff.

But by the time the sun rose the next morning, we had already started to formulate plans to restart the mission; that turned out to be a very long process.

The restart became OCO-2, which is nearly identical to the lost OCO satellite.

The body of the spacecraft -- called the "bus" -- is a hexagon-shaped cylinder measuring about three by six-and-a-half feet. A pair of 10-foot-long solar array wings generate power for OCO-2's systems.

The satellite carries one very important instrument designed to peer down through the atmosphere and precisely measure the quantity of carbon dioxide it finds there.
CO2 is a colorless, odorless gas that's formed when one carbon molecule binds to two oxygen molecules. It's a greenhouse gas, meaning it absorbs and then traps radiation that's reflected from the Earth's surface.

The mission's scientific instrument features a trio of high-resolution spectrometers that will break this reflected light into its component colors.

So you can literally measure the brightness of the light in these colors carbon dioxide absorbs, and count the number of molecules throughout the atmospheric column from the top to the bottom.

Earth's plants and oceans absorb carbon dioxide, and also emit it back into the atmosphere.

This give-and-take is a natural process -- and has taken place as long as there's been life on the planet.

But that balance began to shift with the dawn of the Industrial Age. That's when human activities began to influence the carbon cycle.
began to pump more and more carbon dioxide into the atmosphere.

But the amazing thing is that half of that buildup has occurred since 1980. And one quarter of that buildup has happened since 2001. So the rates of buildup of carbon dioxide in our atmosphere, mainly from burning fossil fuels and other human activities, is growing faster and faster as time goes on.

From its vantage point in orbit, OCO-2 will be able to track Earth's atmospheric carbon dioxide around the globe -- about twice a month, through every season, for at least two years.

Although humans have been adding significant amounts of carbon dioxide to the atmosphere over the past two centuries, it also appears that Earth's plants and oceans have been absorbing more than usual.

Where this additional carbon dioxide is going is one of the big mysteries scientists hope
As the chlorophyll in plants absorbs sunlight and carbon dioxide to create carbohydrates through photosynthesis,

they re-emit small fractions of this energy as fluorescence.

The instrument on board OCO-2 will be able to detect this "chlorophyll florescence,"

allowing scientists to see where plants are actively growing -- and whether there's a response in atmospheric CO2.

And the two in combination, carbon dioxide in the atmosphere AND an indicator of how effective plants are at taking CO2 out of the atmosphere -- it's just an impossibly brilliant combination from a science point of view.

OCO-2 will circle Earth every 99 minutes. As it sweeps from south to north, across the sunlit hemisphere.

It will pass overhead around 1:30 in the afternoon, local time.
us the opportunity to map out the whole Earth a couple of times a month.

But first, OCO-2 has to get into the right place in Earth orbit. The spacecraft will get its boost into orbit from a Delta II rocket, a reliable vehicle with a "workhorse" reputation.

NASA's Launch Services Program ensures the spacecraft and rocket are ready to fly, and manages the countdown and liftoff, working in tandem with rocket provider United Launch Alliance.

The NASA Launch Services Program team has been preparing for the OCO-2 mission for almost two years now. This will be our first Delta II launch in just over two and a half years, and we've been very focused on integrating the OCO-2 spacecraft onto the Delta II.

The launch team is based at the Kennedy Space Center in Florida, but they travel frequently to Vandenberg Air Force Base to make sure everything's on track.
OCO-2 has to launch from the California site in order to accomplish its mission.

The OCO-2 mission requires a polar orbit. That’s an orbit that would cross the north and south poles, and covers a tremendous amount of area of the surface of the Earth. And the only way to achieve a polar orbit from U.S. soil is from Vandenberg Air Force Base in California.

Months before launch, the Delta II was transported from the manufacturing facility in Decatur, Alabama to Vandenberg, where the stages were stacked together at Space Launch Complex 2.

When everything’s checked out, they’ll start building the rocket on the pad, kind of like a LEGO system. So you’ll start with the first stage, and then the second stage, which will be the top part of the rocket. You attach the solid motors on the outside, which are the three, white little motors that are attached to the base of the rocket. And then just check it out and make sure, as a whole, that it works.
The spacecraft was assembled by Orbital Sciences Corporation and tested at its facility in Gilbert, Arizona, then trucked to the launch site for final checkouts and functional tests.

After the satellite is installed atop the rocket, it's enclosed in the fairing that will protect it during the first minutes of its climb to orbit.

Once the countdown begins, the launch team will spend the night at their consoles, monitoring the health of the Delta II rocket and the OCO-2 spacecraft.

OCO-2 is going to be launching just before 3 o'clock in the morning so we will be arriving on console approximately 10 o'clock at night. And on launch day it's really a joy to sit back and watch our NASA team work hand in hand with our contractor team from United Launch Alliance.

and also with our fellow government team from the U.S. Air Force at Vandenberg Air Force Base, and see this whole team pulling all their components together that are required for the launch vehicle, the spacecraft and...
the range, so that we're all ready for liftoff

96
00:07:58,178 --> 00:07:59,238
at T-0.

97
00:07:59,720 --> 00:08:05,440
After years of careful planning, the Orbiting Carbon Observatory-2 mission finally is about

98
00:08:05,449 --> 00:08:06,860
to begin.

99
00:08:06,860 --> 00:08:11,259
This is the most exciting period of any project life cycle. You're counting down the days

100
00:08:11,259 --> 00:08:16,110
to get ready for launch. And then hopefully, if everything goes successfully, you start

101
00:08:16,110 --> 00:08:23,110
seeing that data come back, and all the work -- which is many, many years of work -- come
to fruition.
If you look at the big scheme of where we

102
00:08:23,288 --> 00:08:27,509
are in understanding climate change, the impact of increasing greenhouse gases in the atmosphere,

103
00:08:27,509 --> 00:08:34,500
this is really important.

104
00:08:34,500 --> 00:08:35,788
We're expecting it to give us a real breakthrough and a real step forward.