welcome to watch this space I'm NASA Administrator Jim Bridenstine and NASA is going forward to the moon this time recently NASA announced nine commercial partners that will take NASA payloads to the surface of the Moon these are highlights from that recent announcement not only are we announcing today a number of very innovative companies that are going to go to the moon for the first time commercially in other words we're going
to buy the service we're not going to

purchase own and operate the hardware

we're gonna buy the service but we're

also announcing a change that I think is

important for NASA and that is this is a

response to the science community who

has for a long time decided that we

needed to do science on the surface of

the Moon and yet NASA for a long time

has focused the moon within the human

exploration and operations Mission

Directorate and not the science Mission

but now we're changing that

we believe there is a lot of amazing
science that we can do on the surface of the Moon in fact science that we can't do anywhere other than the surface of the Moon we want multiple providers that are competing on cost and innovation so that we as NASA can do more than we've ever been able to do before and advance the human spirit science and human exploration go together and we should not be surprised that I'm standing here as a scientist really excited about exploring this celestial body right next door to us the moon like any other body in the solar system the moon is full of...
secrets that we don't know yet for

example if you really want to decide

what the h's of the solar system just

like you look at the rings of a tree

when you cut it if you want to learn

that you go to the moon and you analyze

the samples that are there

today we are at the Jet Propulsion

Laboratory the Charles elachi Mission

Control Center where we had the

opportunity to participate in the Mars

insight Lander I am here with Emily

manor Chapman who is an instrument

engineer on the Mars insight Lander and

of course today we've had a very
exciting day and in fact a very successful day her part in this was the development of instruments that have been you know not just engineered but built and now delivered to the surface of Mars so congratulations on a wonderful day thank you so much definitely so exciting today that's so great tell me what is the instrument package that you worked on I work with what we call the auxiliary payload sensor suite which is a collection of environmental or weather sensors oh so we have a sensor that can measure air
temperature, wind speed, atmospheric pressure, and also a magnetometer that can measure the magnetic field at Mars.

So tell us are we gonna get like continuous updates on the weather you know on Mars we will starting this week.

We'll do a short check out with the instrument just to make sure everything is working correctly after landing if that's successful then we'll turn on the instrument and it basically stays on almost continuously at that point so we will get a full Sol's worth of weather.

data every Saul how long is it going to
take before there's a number of instruments here and of course your package is one of many instruments that's right there's a seismometer on the mars insight Lander and there's something called the mole let's talk about the seismometer first what is that gonna help us understand so the seismometer will measure quakes on Mars or Mars quakes as we call them okay and by looking at the type of seismic activity on Mars will tell us something about how Mars formed and what it's made of so scientists can look at
the waves and data picked up by the

instrument tell us about how do seismic

waves move through the material on Mars

and looking at how they move what

and I've been told that it can even pick

even micro meteor

meteorites that actually hit the surface

of Mars even on the other side of the

planet yeah that's correct we think

we'll be able to detect those as well

wow that's fantastic so okay the mole

tell me about the mole so the purpose of

the mole is to measure how heat changes

and moves around inside of Mars so the

mole is kind of a big nail about the
size of my forearm and it can actually

hammer itself underneath the surface of

Mars and so with the mole we're gonna go

deeper underneath the surface of Mars

and any other mission has before will go

down - up to about 15 feet and trailing

behind that mole will be a series of

temperature sensors and so it will be

able to take temperature over time and

again see how the heat is moving around

how is it changing inside Mars and again

that tells us something about how Mars

formed and what it's made of

amazing tell me what do you know about
the core of Mars well first if you look at our core here on earth we know that we have a kind of molten metallic core and that core is what drives the magnetic field that we have here at Earth and so as you said we don't see that mobile magnetic field anymore at Mars so we want to find out is the core liquid or is it solid and what does it made of because if we see something it's like maybe it's a solid core so you don't have that dynamo action in the center of the planet like we do your hair so we don't have anything to drive
that magnetic field of Earth and so

we're actually gonna use radio signals

between a radio signal between the

lander on Mars and an antenna here on

earth looking at changes in that radio

signal will tell us about what the core

is made of is it solid or is it so how

long until we start getting some you

know really serious science data from

insight it will actually be about two to

three months because the next thing that

we need to do with insight is so we're

on the surface but as we when we landed

all of our science instruments are

on the surface but as we when we landed

all of our science instruments are
sitting up on top of the lander and we

00:05:56,529 --> 00:06:00,069
really want to get our seismometer onto

00:05:58,810 --> 00:06:01,569
the ground because it's gonna take much

00:06:00,069 --> 00:06:03,519
better data if it's actually in contact

00:06:01,569 --> 00:06:04,870
with the Martian surface and for our

00:06:03,519 --> 00:06:05,889
probe obviously it also needs to be on

00:06:04,870 --> 00:06:07,509
the ground cuz we wanted to hambar

00:06:05,889 --> 00:06:09,459
underneath the surface so the next two

00:06:07,509 --> 00:06:11,349
to three months we're gonna spend using

00:06:09,459 --> 00:06:12,430
the robotic arm and the robotic arm you

00:06:11,350 --> 00:06:14,320
could think of like one of those

00:06:12,430 --> 00:06:15,610
carnival games with the claw and you go

00:06:14,319 --> 00:06:16,899
and pick stuff up and put it on the

00:06:15,610 --> 00:06:18,580
ground and that's basically robotic arm

00:06:16,899 --> 00:06:19,810
has a have little claw and you go pick
up the instruments and set them onto the ground so

in the neck then the coming a couple weeks we're gonna be looking out where did B land taking lots of images to see

what's in front of the Lander picking where do we want to put the seismometer where do we want to put the mole and then actually start that process of using the robotic arm to pick up those instruments and get them onto the surface of Mars amazing well Emily thank you for your great work what an amazing accomplishment today we're all so proud
of you and your entire team here at the Jet Propulsion Laboratory and of course the insight team so thank you so much for your great work thank you absolutely well I'm here with Vivian son who is a systems engineer here at the Jet Propulsion Laboratory and she has been involved in picking the landing site for the Mars 2020 Rover which of course is a mission happening in 2020 and we're all very excited about that so tell us what goes into selecting a landing site on Mars for the 2020 Rover right so actually this process began several
years ago so it first started in 2013
when an open call was put out to the

Mars community basically saying that

anyone who wishes to propose a landing

site for this Mars 2020 mission can do

so and the only requirements are that

this landing site had to demonstrate

that there used to be liquid water at

this site and that this liquid water had

a chemistry that could have supported

life had it existed on Mars at that time

and so with those requirements the first

landing site workshop was held in 2013

and there were about 30 years so
landings like candidates that were put forth by different members of the community and so at the workshop we discussed the pros and cons of each site would each site had to offer what kind of samples we might collect at every site and so in this sort of fashion we've had several more landing site workshops we just concluded with the fourth and final one this past fall just about a month ago and throughout that process that initial list of 30 landing site candidates was eventually whittled down to the three that we had just a month ago which is of
course jezero crater northeast syrtis and Columbia Hills and so at the conclusion of the final landing site we discussed again the pros and cons of every location what a kind of mission might look like to each of those sites and then we came out with jezero crater you mentioned that the water was critically important as the the maybe the the type of chemicals that would have been in that water that may have been able to help support life and that's what went into this selection process so what we're actually going to
do is cache samples on the surface of Mars with the Mars 2020 Rover what we get when we cache samples why do we do that so the reason why we've really to cache samples with Mars 2020 and the reason why this is such a critical step for Mars sample return and understanding the history of Mars and its potential for ancient life the reason is because even though our Rovers are incredibly sophisticated on the surface of Mars they're still limited compared to the analyses that we could do here on earth
in our laboratories where we have access to the most state-of-the-art technologies and so to really look at them sample to look at a rock and be able to tell whether something is the true bio signature or whether it's something that was truly evidence for past life you really need to do that kind of analysis here on earth with our sophisticated labs yeah yeah so the idea is Mars 2020 just passes a sample then we have to do a Mars sample return mission which of course we don't have a date for yet but in my view we need to
do it as soon as possible to get those

samples back to earth and at the end of

it the goal is to discover whether or

not Mars is habitable or maybe at one

time was habitable or even today

could it have life is that the intent

here yeah so for sure we want to

understand whether the environments that

we're investigating were habitable or

not and from the satellite data or the

orbital data that we have we have pretty

good hints that there probably habitable

that they used to have water and that

that water had chemistry that could have

supported life if it existed there but
what we don't know is if there was life

that's one question if there was life do we have evidence that preserves for example fossils or other bio signatures
do we have that evidence that there was past life in any of these that's something that we can only figure out by returning those samples back okay

well Vivian I want to tell you we're grateful for your work we're looking forward to coming back 26 months from now and we have a a successful Mars 2020 landing on the surface of Mars and we'll we'll revisit this again and talk more
in depth about what the next steps are

so thank you so much and Mars is a wonderful place we need to learn more

thank you you bet we now have an opportunity to meet Mimi um who of course has been highly involved in what's called Mars helicopter so when we said Mars 2020 to Mars in 2020 of course it's not only going to have the rover it's also going to have attached to the rover a helicopter that Mimi has been involved in developing now for many years as a matter of fact over four years so tell me how did this come to
your mind as an idea was it was it out

there before was it your brainchild had

it how did this come into being no a

feasibility of helicopters flying at

Mars have been proven in the early in

the 90s okay in fact Bob elrom who's the

chief engineer on our project he had

done research in those days showing that

you know feasible it's possible there's

enough atmosphere to lift fly a

helicopter the challenge of course is it

has to be very light yeah

similarly over in Ames you Larry Young

has some research that have been proven


but the thing that had not made it
possible until recently is the availability of technologies with these lightweight capable flying vehicles okay
so around 2012 or so our previous director Charles elachi was on a lab tour and he will see these drones being used to demonstrate autonomous navigation algorithms and after the Tory said hey why don't we do this at Mars Wow and so we connected him back in fact I happened to be on the bus in his tour because he was visiting our division autonomous systems division and I was deputy divisions manager of autonomous
systems division at the time anyway so

so why don't we do this so we connected

him back to Bob Bell Ram who had done

research in the 90s and then he started

from there okay so maybe tell me why is

it important to have a helicopter on

Mars today we explore planets from

spacecraft in orbit and Rovers on the

surface but we're not using the aerial

dimension to explore surfaces so the

helicopter would open doors to exploring

you know exploration through aerial

dimension yeah

and that will help with forward
reconnaissance far ahead of Rovers or in the future astronauts right astronauts are there to explore and so for reconnaissance is very important and it's a new dimension secondly we'll be able to get to places we simply can't get to today right right and and even in the future with Rovers or even astronauts for example you know sites of these cliffs right recently there are these exposed ice carps that have you know we would have to fly there to get a sample and analyze them on Leonard assets or bottom of crevasses and steep
volcanoes yeah a new dimension adding it

so so when the Mars 2020 rover lands the helicopter will be underneath it is that correct that's right and then it will be released it will unfold and then it will take off how long will it be able to fly we plan to do incremental series of flights so the first thing we would want to do is repeat the flights that we have demonstrated in Mars like atmospheric density in our 25-foot chamber here all right so that would be the first flight we'll want to do you exactly what we have modeled and demonstrated on earth
and so we will go up and hover and come
down go up to 3 meters so I want to take
a moment when you lift off of Mars and
then set down on Mars what do you think
that moment will be like I would if you
yeah if I dare say so it would be just
like a rights brother moment yeah really
because flying in this thin atmosphere
is it just hasn't been done before
yeah so it's Ordinary tell me about the
atmosphere we compared it to earth what
is what is it has
it's very thin so compared to earth less
than 1% of Earth's atmospheric density
so we have algorithms that show that we
can fly we can control but too real and

we have done experiments on earth in our

chamber but to definitively demonstrate

doing this on Mars it's the huge master

will be and ok so as you mentioned you

have your Wright brothers moment where

you actually take off the surface of

another world and then land again with a

helicopter okay then after that what's

the next test that you want to do then

we'll start doing incrementally further

lateral flight so we'll ascend and then

go laterally start with modestly with a

few tens of meters and they come back
and land and then after that you know

falling incrementally further up to 150

meters or so out and back okay and that

would fully confirm all the models all

the assumptions that we've done in and

can definitively include what it's it's

weird to think about because when you're

in atmosphere that's that thin as you

mentioned less than 1% of Earth's

atmosphere it seems like once you start

going it becomes very difficult to stop

so everything it has to be so much more

precise the way the way you start moving

requires a certain you know a certain
amount of you know \( \frac{L}{D} \) in order to

tilt the helicopter and move it but then

you have to be able to stop it but the

atmosphere is sufficiently thin is does

it does it scale is it comparable to

Earth's atmosphere I mean it seems like

it's far more complicated than it is

what normal people might think that it

is yes it's very counterintuitive the

thin atmosphere reacts the the blase

reactive friendly with the thin

atmosphere for example their residence

resonances in all rotorcraft you know

and on earth very with very thick
atmosphere a lot of the resonances get
dampened out sure within atmosphere they
continue ring so for example our
development our test demonstration and
the design and the selection of
frequencies have to be very carefully
aligned and be aware of those reaction
of the vehicle while it's a thin
atmosphere response is actually slower
in
since and faster than others so for
example you know you turn the blade and
here on atmosphere you are pushing so
much air you suddenly turn right there
it takes a little longer so definitely
our team had had to model from the very fundamentals of a blade
taking a blade that's you know where 1.2 meter diameter blades so rotor system so
1/2 a point 6 meter or so per blade we actually had to cut into 33 virtual pieces and analyze them for the lift and the drag of each of the piece well you know with the high fidelity CFD analysis take the lift and drag integrated them and then model how the dynamics of the vehicle would be in this thin atmosphere these little Reynolds numbers and this is you know low density area you're
starting from scratch and it's been a surprise nice

but definitely starting from the fundamental right so that's why when you asked us now about how would you feel what does it mean that very first like to unconditionally confirm our models in the real environment fantastic first of its kind it'll be monumental we're so looking forward to seeing it happen and of course it's gonna be part of the Mars 2020 Rover so it's really not that far away we're almost there
and we look forward to coming back here in 26 months in order to watch a very safe and effective Mars 2020 lander and thereafter a Mars helicopter take off and land on the surface of another world for the first time in human history. Thank You Mimi um for all of your great work thank you and waiting to see all of your accomplishments in the future. well thank you for watching watch this space I'm NASA Administrator Jim bridestine you can follow me on twitter bridestine you can follow me on twitter at jim bridestine and of course if you want to watch this again you can do so.
at nasa.gov slash watch this space