Thanks good afternoon my name is Linda Billings I'm a consultant to the astrobiology program in NASA headquarters in Washington DC we're here at the 2015 astrobiology science conference we call our meetings apps icons for the whole week here in Chicago Illinois and thanks for joining us today we have 750 scientists from all over the world registered to participate in this conference here at the Hilton Chicago and I'm here with a panel of four outstanding scientists we're waiting for the fourth to arrive and he will be our
first speaker so will hold on for a

minute and hope he's delivered and in

the meantime I'll introduce our panel of

speakers we're here to discuss

astrobiology research and technology

developments that are advancing the

search for evidence of habitability and

our solar system and beyond and were on

the web and we're also on NASA TV our

briefing participants our first speaker

is just arriving on stage now but I'll

start his introduction John Grunsfeld

Dr. John Grunsfeld is an astronaut an

astrophysicist and associate
administrator for the science Mission

Directorate at NASA headquarters here in Washington and he's been running around from room to room he's been attending sessions we're having 12-hour days here at the conference and so he's just come from a social media gathering to join us here at the press conference dr. Grunsfeld previously served as deputy director of the Space Telescope Science Institute in Baltimore managing the science program for the Hubble Space Telescope and the forthcoming James Webb Space Telescope
Dr. Grunsfeld graduated from the Massachusetts Institute of Technology with a bachelor's degree in physics. He's the native of Chicago so he's here in his hometown and I bet he's going to the Cubs game tonight. Oh no you have to go back to Washington that's so sad and he earned his master's in PhD in physics from the University of Chicago. He's a veteran of five space shuttle flights visiting Hubble three times and performing eight spacewalks. He was inducted into the astronaut Hall of Fame this past May and I want to mention to you that he is.
passionate about astrobiology which is
why he's here he's not here in any
particularly official capacity he's here
because he's passionate about the
science of astrobiology and yesterday in
his opening remarks for our conference
he called astrobiology a unifying theme
in Space Sciences and certainly all of
us here at ab saikhan were happy to hear
that our next speaker after dr.
Grunsfeld and each of our speakers will
be talking very briefly for five minutes
because we're on a very tight schedule
here and we want to make sure we have
time for questions our next speaker is

Alexis Templeton dr. Templeton is an associate professor with the department of geological sciences at the University of Colorado Boulder and she's the principal investigator for the NASA Astrobiology Institute rock powered life team our next speaker will be Brittany Schmidt dr. Schmidt is assistant professor with the Department of Earth and Atmospheric Sciences at the Georgia Institute of Technology she's principal investigator for the sub ice marine and Planetary analog
ecosystems project known as simple and I can guarantee you it's not simple and co-investigator from one of the instruments that NASA just selected for development for the next mission to Europa our last speaker will be Vicki meadows dr. meadows is a professor of astronomy at the University of Washington and principal investigator of the NASA Astrobiology Institute virtual planetary laboratory team our speakers today are working at the cutting edge of science and technology development in their areas of expertise dr. Templeton
is exploring subsurface geological

101
00:04:16,410 --> 00:04:21,180
processes that can play a role in life

102
00:04:18,649 --> 00:04:23,759
dr. Schmidt is exploring subsurface

103
00:04:21,180 --> 00:04:26,250
oceans on planetary bodies for evidence

104
00:04:23,759 --> 00:04:27,610
of habitability and dr. meadows is

105
00:04:26,250 --> 00:04:29,468
modeling EXO plan

106
00:04:27,610 --> 00:04:32,080
environments and working on how to

107
00:04:29,468 --> 00:04:34,870
recognize signatures of habitability and

108
00:04:32,079 --> 00:04:36,609
life on exoplanets and when we get to

109
00:04:34,870 --> 00:04:38,889
questions and answers we'll be taking

110
00:04:36,610 --> 00:04:40,960
questions here from the audience and

111
00:04:38,889 --> 00:04:43,829
also by email and my colleague Leslie

112
00:04:40,959 --> 00:04:45,848
Moen we'll be fielding email questions

113
00:04:43,829 --> 00:04:48,668
and we're going to start with dr.

114
00:04:45,848 --> 00:04:51,848
Grunsfeld who's in charge not just of
astrobiology at NASA but all of space

science and as dr. Grunsfeld has told us

all that the sciences are being unified

by this theme of the search for evidence

of life in the universe

dr. Grunsfeld I don't want to take too much time before we go to these excellent speakers but I want to tell you a little bit about just the perspective overall for for NASA science and NASA in general our mission is to innovate explore discover and inspire and in particular we're all here because astrobiology fits that to a tee how we
innovate because life outside of Earth is probably going to be really hard to find we can't even agree on what a definition of life detection is and there many sessions on trying to figure that out and when we innovate we develop new technology and we apply that new technology to exploration and that's what NASA does best is to explore the cosmos and when we explore we discover things I'm convinced that scientists and engineers and explorers have a particular expression of the gene that drives them to explore because when we...
explore we discover things and that

discovery is that wonderful act of discovering new things or discovering things that we hypothesize and confirm

is one of those driving forces that has allowed humans to evolve to have the complexity that we have and certainly the discoveries and in particular the search for life in the universe the search for intelligent life on Earth that's a joke

is something that it that inspires you know not just students but everyone we're trying with science to answer some
fundamental questions where did we come from what's the origin of the chemical elements that were made of the fact that our oxygen that we breathe the iron in our blood the calcium in our bones is all star stuff it does come from inside of stars what's the evolution what's the path by which the earth was formed with a particular chemical abundance with the particular organics that seeded the early Earth that allowed life to form where are we going what's the future history of the earth now we're a relatively young solar system four and a
half billion years old there are much older solar systems out there now where are we going what's the future of the earth what's the future of the Earth's climate what's our role in that future of course it's significant life has always changed the earth from when it started it's changed the geology it's changed the climate it's changed what we look like from a great distance and that's something Vicky will talk about so if there are is life out there intelligent life looking at earth they'll know we're here
we put atmospheric signatures in that
guarantee that somebody with a large
telescope 20 light-years away could
detect us and are we alone
is there another civilization out there
is there any other life out there now
the fact that we're here in life is so
complex on earth and that we see
extremophiles life you know deep inside
of rocks that can survive on just a tiny
bit of chemical energy or in other
extreme environments to me is convincing
that very high probability there's life
elsewhere and NASA science is looking
for that we're looking for it on Mars

we've just started a mission to Europa

that will look for evidence of life in a

subsurface ocean and that's part of our

astrobiology portfolio and all of these

things are earth science our

heliophysics the impact of the Sun on

the earth and the rest of the planets

other Suns on their planets planetary

science of course in astrophysics which

has our exoplanet investigation program

all of those are really oriented

answering those big questions and for me

it's that one of are we alone that's the
biggest driving question

00:08:44,500 --> 00:08:53,980
so with that I'll hand it over to our

00:08:46,059 --> 00:08:55,599
next speaker Thank You dr. grenfell it's

00:08:53,980 --> 00:08:58,029
a great introduction to our panel

00:08:55,600 --> 00:09:01,629
discussion we'll turn over the mic to a

00:08:58,029 --> 00:09:04,089
dr. Templeton at this point thank you

00:09:01,629 --> 00:09:05,529
and I'm thrilled to be here at apps icon

00:09:04,090 --> 00:09:08,470
and thrilled to be here in this session

00:09:05,529 --> 00:09:10,509
this today as well because this is a

00:09:08,470 --> 00:09:12,519
wonderful opportunity for discussing

00:09:10,509 --> 00:09:14,319
changes in understanding of habitable

00:09:12,519 --> 00:09:16,750
environments that exists on our planet

00:09:14,320 --> 00:09:18,550
on earth and how that informs our search

00:09:16,750 --> 00:09:20,559
for habitable environments elsewhere in

00:09:18,549 --> 00:09:23,259
our solar system and beyond and that's
some of the theme of discussion for today and I am part of a new team a NASA Astrobiology Institute team that is called Rock powered life so we're the inception of a five-year project but we are part of a very large international community there's quite interested in the capability of rocks to store energy within them that can be used to power biological systems and essentially there's a fundamental understanding that rocks have within them depending upon their chemistry the ability to release electrons or or components that can fuel
and power different systems essentially much like fuel cells do and one of the big questions at the moment is how we can couple the energy that's stored within rocks to into biological systems and one of the things that we know is that often to release that energy that is stored within rocks it requires a reaction or contact with water another ingredient that we consider to be absolutely essential for life and so there's a broad interest in understanding within our solar system the locations when water and rocks come
into reaction or in contact with each other and the factors that control the transfer of that energy into different carriers or molecules that could power biological systems.

A great example that's quite tangible to many modern technologies is the molecule hydrogen, it's something that again can be produced through the reaction of rocks and water in contact with each other. We often use these now and building batteries or fuel cells to power other systems and in particular we know many types of biological
metabolisms that can use them all

- like hydrogen or any kind of carriers

of electrons - then drive many of their

life activities one of the interesting

things is that in the geological studies

that have occurred to date most of them

have looked for life-forms that can

exist in this way in areas that are

geologically active hydrothermal centres

on our planet but we're very interested

in trying to look at environments that

are essentially quieter and colder

throughout the solar system and

understand whether or not these

processes are occurring at measurable
rates there and whether or not again

ey may sustain or support biological

activity so I just want to give a few

tangible examples today of research

that's being highlighted a taps icon and

in many papers that are coming out in

the literature at the moment and I will

put up a first slide and that is not a

first line maybe this picture has been

with me and I was unaware okay so the

picture that I have behind me at the

moment this is one actually I took

myself in January this year I and other

members of the team that I'm working
with have been traveling to Oman so

these are from the deserts of Oman and

what you're looking at here are rocks

that are come from the mantle of the

earth so rocks that are typically stored

underneath the surface of our planet but

there are places where they're exposed

at the surface through geological

processes in many areas on the modern

earth that have small exposures of these

rocks and I wanted to highlight this one

in particular because if you look in the

upper picture at these mountains this is

a dry barren landscape in Oman we're in
the desert

there's very little water and there's very little sense that there's anything alive here in the surface environment at all however there are small amounts of water that do come into the contact with these rocks infiltrate them and are stored in the subsurface over very long periods of time and it is the continued reaction of that water with those rocks that changes the water chemistry progressively and we would have no indication of that if it didn't essentially get released up to the
surface in various locations so in the
00:12:54,220 --> 00:12:58,629
lower picture that's present here is an
00:12:56,169 --> 00:13:00,338
image of a small spring where water is
00:12:58,629 --> 00:13:02,289
released back to the surface after
00:13:00,339 --> 00:13:04,570
prolonged periods of being stored and
00:13:02,289 --> 00:13:06,338
it's changed significantly in chemical
00:13:04,570 --> 00:13:08,050
character and in particular what's
00:13:06,339 --> 00:13:10,270
noticeable here is that you can come and
00:13:08,049 --> 00:13:11,019
find as dissolved gases bubbling out
00:13:10,269 --> 00:13:12,610
hydrogen
00:13:11,019 --> 00:13:14,049
and methane and some of these energy
00:13:12,610 --> 00:13:16,389
carriers or electron carries that were
00:13:14,049 --> 00:13:18,279
interested in one of the things that's
00:13:16,389 --> 00:13:20,019
been particularly noted and the system
00:13:18,279 --> 00:13:22,839
studied like this across the world in
the Philippines California Canada here

in Oman and all those good examples are

on our seafloor is that they're also

waters that are very alkaline meaning on

our pH scale from 0 to 14 these waters

often are up somewhere on the far end

towards 12

it's a rare type of water to find on

earth but it's it's noted by it has a

history of the chemical reactions that

have occurred within it and there's been

many questions then about whether or not

life could persist in waters in these

extreme conditions it's very challenging
for life to exist in these types of waters but work that's being highlighted for example in several sessions that are here that have started already this week refer to the ability to detect life activity in these hyper alkalyn waters and being sustained by these geological sources of energy of hydrogen and methane and the DNA has been extracted and sequenced and we're starting to understand something more about who these organisms are but in particular we're also able to I'd say for example work that's recently been published from
kidney Olsen's lab has shown that there are organisms that can grow and study their biology that are adapted and optimized to these high pH fluids so there's not only that they can tolerate them and eke out a living but they're actually optimized and can function well at pHs of 11 or 12 and this has been very exciting to start to imagine that there's biological life-forms that may be well adapted in the subsurface environment to being sustained by the reactions between these rocks and waters so I'll just jump again then to another
image here which is a schematic from the

Jet Propulsion Laboratory what you have

in this picture here is a cart

essentially a cartoon of Enceladus

one of Saturn's moons and looking at the

cartoon of Enceladus

concept of a rocky core surrounded by an

ice shell and there are many questions

again about the potential ability to

detect any activity on this type of a

satellite and in one of the noticeable

things from the Cassini mission has been

the detection of plumes of particles

that are ejected from the South Pole

and there's been a lot of excitement

about the concept that those those
plumes represent the potential for liquid water that stored underneath the ice shell and then to relate it to what I've been talking about earlier as you can see in this cartoon would be the contact of that water with the rocky core and the existing papers that have been published have suggested it's a salty water that it's that it would have picked up many of those salts from reaction with those rocks a recent paper that's come out of Chris Klein at all in the Carnegie Institution is geochemical modeling that then has
gone and shown that they infer that the ph of these waters is again in these hyper alkaline types of conditions and would indicate there had been extensive communication in interaction of those waters with the rocks in the interior of Enceladus and now we are giving rise to a condition that again we're studying in the subsurface of the earth that we confer to be potentially habitable and this then gives us room for a conversation about discussing what are the signs of life you would try to detect and when you could find fluids
front they are being stored beneath the surface of some of these moons so with that I'd like to transition to Brittany and she'll talk a little bit further about some of the missions that are planned thank you dr. Templeton now we turn to dr. Schmidt that is an excellent segue since dr. Schmidt has been studying possible possibility of habitability in the subsurface oceans of Europa and Enceladus thanks very much it's a pleasure to be here so I'm going to talk to you a little bit about research into icy world
so alexis was talking about the earth

and we think a lot about Mars in the search for life in the solar system but

there's a whole host of ice rich worlds that potentially Harbor subsurface oceans and these are important places to think about in the search for life even within our own solar system I'm showing two examples of exciting science that NASA is doing right now and science that NASA plans to do in the future that's Astro biologically relevant so if we look at the two images behind me we're looking at an image that's
actually just been taken by the dawn spacecraft it's currently orbiting the largest asteroid or the innermost dwarf planet a place called series that you may not have heard about series is about a thousand kilometers across roughly the size of the state of Texas but completely spherical unlike asteroids that you may think about and what's interesting about Ceres is that for a long time its shape and its low density has indicated that potentially there was ice and water below the surface these first images are very new
images from dawn suggest that perhaps volatiles may be ice maybe ice rich may be salts are being erupted near the surface or at least making it up and showing their presence on the surface this is the kind of synergy from older missions like Hubble Space Telescope like Herschel Space Telescope that told us these places were interesting and we could use our scientific understanding of these places to prepare missions like don to go out there and do that exploration so that picture that I'm showing is really a culmination of an
entire industries worth of work to try

to explore a new place that we've never really thought about before

so Ceres is very exciting and that's what we're doing right now to highlight icy bodies and that one's really close

Ceres is actually just between Mars and Jupiter so much closer to us if we move just farther out the moons of Jupiter are some of the most incredible places

in terms of our search for life within our solar system because three of its major moons Harbor subsurface oceans the image that I'm showing to the lower
right of your screen is an image an

00:18:55,740 --> 00:19:00,180
artist's concept of mission to Europa

00:18:58,230 --> 00:19:02,279
which has recently been studied and

00:19:00,180 --> 00:19:05,549
hopefully will be selected by NASA for

00:19:02,279 --> 00:19:07,649
flight to launch in 2022 currently

00:19:05,549 --> 00:19:11,250
called the Europa multiple flyby mission

00:19:07,650 --> 00:19:12,690
this mission will go back to Europa like

00:19:11,250 --> 00:19:15,420
I said one of the moons of Jupiter and

00:19:12,690 --> 00:19:17,640
certain search for activity in the ice

00:19:15,420 --> 00:19:19,830
shell search for the indications of a

00:19:17,640 --> 00:19:21,720
subsurface ocean that we know or we

00:19:19,829 --> 00:19:22,980
think we know is there but actually to

00:19:21,720 --> 00:19:25,440
confirm that and then to try to

00:19:22,980 --> 00:19:27,750
understand how this geologically active

00:19:25,440 --> 00:19:30,870
young surface is formed through
interactions of the ice shell the ocean

and perhaps a volcanic Li active

interior just below as alexis was hat

was highlighting sub subsurface aqueous

processes in hydrothermal reactions with

interiors like rocks and places like

Enceladus and like Europa may be enough

energy to power biology in

he's very distant and seemingly so alien

worlds and so I'm showing another

graphic of some places that we might

explore the ice shell of Europa where we

think there's subsurface water the ocean

which may be circulating energy between
the reducing interior and the oxidizing surface it's a really exciting place so we're really very excited to be going back to Europa personally I'm thrilled to be a part of the mission team I've helped on studies for a while and it's just been a large group of people that have been working for the past 20 years to get this mission going I'm personally on the radar team the instruments called reason which is an ice penetrating radar led by Don Blankenship of the University of Texas and the great thing about this is that
we may actually be able to using ice-penetrating radar that we've used to explore the earth actually be able to image these processes for the first time in the subsurface within the ice shell of Europa finally answering that question where is the water and where do we land so moving forward I'd like to move to the next slide and show you what we're doing in the meantime as we wait for this mission to get off the ground it turns out that Europa may seem alien to you and I but if we go to the Earth's poles it doesn't seem so far-fetched so
what I'm showing you here is a NASA

Astrobiology funded program through the

Astrobiology Science and Technology for exploring planets program it's called

simple it's an ironic name because it's far from simple the sub-base marine and

planetary analog ecosystems project

which I'm very very pleased to be the lead working with a great team of

individuals from the institutions that are highlighted here on this slide and

one of the cool things about this project is that as dr. Grunsfeld

mentioned one of the amazing opportunities in NASA is to look at the
synergy between technology and science

and this program does exactly that so

what we've done here is to actually work

with a number of different vehicles a

number of different remote sensing and

institutes and sensing platforms in

order to study our ocean the same way we

want to study the ocean of Europa or the

ocean of Enceladus in the upper images

I'm showing images from this field

season this past field season in

Antarctica we work at the McMurdo ice

shelf NSF is gladly hosting us

in that in their main station in
Antarctica and in the McMurdo ice shelf
these are images of a vehicle that we've
built at Georgia Tech called ice Finn
being deployed on the right side of the
screen that's the vehicle about to be deployed through the McMurdo ice
shelf so tens of meters of ice to explore the ocean below on the left hand
side you're seeing an image of the vehicle below the sea ice just for some perspective of it doing its work just below that there's a small diagram of deep skinny which was a an instrument that was also funded under the simple
project just this year went out with the NASA or with an NSF wizard program and was the first to see small small fish swimming out at 200 or 300 kilometers from the front of the ocean underneath this permanent ice cover some of those work some of that work is very synergistic with the types of science we'd like to be able to do it you're open one day at the very bottom of the slide I'm showing an image of Artemis which is a large AUV that we are going to be deploying this field season so beginning in August also at McMurdo
Station where we're gonna do long-range

exploration under the ice shelf so this

has been a really long-term project with

a number of individuals and institutions

I wanted to highlight that the reason

that we're doing this is actually funny

I should say reason is actually to help

reason out the instrument I just talked

about that's flying to Europa so you'll

notice that there's a picture of a plane

in here that's a Basler converted dc-3

aircraft flown by the University of

Texas and the National and the National

Science Foundation and this is doing

ice-penetrating radar studies of the ice
shelves of the Antarctic and those are perfect analogs for the processes that one day we'll be imaging with ice-penetrating radar on Europa so taking you to an exotic place and I think we're gonna go a little further out and I'd like to turn it over to dr. meadows thank you dr. Schmidt very very interesting now we go beyond the solar system with dr. meadows thank you okay so today following on from what brittany's talked about I'm going to talk about studying another planet in our solar system one that's very
familiar to you the earth and how we're using studies of the earth to try understand what we should look for when we look at extrasolar planets and try to determine whether they're able to support life or have life on them and so the first piece of research I'd like to highlight is from led by a member of my team ty Robinson and it essentially is the first observational test of a technique that we one day hope to be able to use to characterize extrasolar planets around other stars to search for signs of liquid water ocean
technique uses something called the glint effect and that's something that should be very familiar to you if you've ever sat on a beach at sunrise or sunset. You know that path of light that connects you and our star the Sun that is the glint on a larger scale if you look at the Earth as a globe you also see the glint on the Earth but in that case it would look a little bit more like you had pushed a Christmas tree near the window and you were seeing reflection of the window on one of the Christmas ornaments that glint from our
ocean on that ball it is our earth

is in fact much more detectable if you

can see the earth at Crescent face the

same way you would see a new moon and so

the technique essentially looks at the

brightness of the earth when it's near

full phase and the brightness of the

earth or the exo earth when it's near

Crescent phase and so by comparing the

brightness there we can determine

whether or not the glint effect is

working so we predicted this and we had

some data that showed sort of the full

earth but we didn't have an observation

of the earth a crescent phase to be able
to validate the technique so in this paper we were able to use data from the L cross mission which you may remember ended spectacularly by crashing into the moon in search of water in the lunar crust but that mission before it collided with the moon bounced around the inner between the earth and the moon and got us pictures of the earth and this is one of them up here and I think it's interesting that Britney is so excited about her high-resolution image of Ceres and I'm so excited about this blurry image of the earth because you
can imagine that this is you know a

distant Earth something we're trying to
to discover and understand and I think

you can see from this image very clearly

that that's not a smooth present there's

a ball in there that is from the glint

from our oceans so you are actually
detecting an ocean on a distant planet

by looking at that image and so by

comparing our models and that data we

were able to confirm that

our models are accurate so we have more

confidence now about predicting the type

of signals we might be able to detect
for extrasolar planets when we go for
the gold and try and actually detect an
ocean on another planet the other area
of research I'd like to highlight from
my team the virtual planetary laboratory
is in the area of looking at oxygen as a
bio signature so many of you probably
heard that we have abundant oxygen in
our atmosphere because of our
photosynthetic biosphere so lots of tiny
little microbes over billions of years
and our modern-day and more recent
vegetation have worked to build up a
very large fraction of oxygen in our
atmosphere just over 20 percent and we like this as a bio signature because it's a large change to our environment which is something that we're looking for in a very distant world we need a large change or we weren't detected and secondly we were pretty confident that we couldn't think of any other way to build up large amounts of oxygen in the atmosphere but my team in the last year or so has come up with four separate ways in which a planet interacting with its star in particular or based on its actual intrinsic composition may be able to build up oxygen in its atmosphere and
so these techniques involve the way the ultraviolet radiation from the star interacts with molecules in the atmosphere or even the catastrophic loss of an ocean and water early on in the planet’s life that helps to build up oxygen in the atmosphere and this is research being led by Robin Wordsworth by Peter Gao by Rodrigo Luger and by Shonda Miguel Goldman and so what’s interesting about this is you might think I’m really depressed about this news but actually I’m very excited because we now are getting a much more
mature of view of what we should be looking for and what might fool us and
so this knowledge I like to say forewarned is forearmed now we know in particular which targets we should choose preferentially that will help us avoid these potential false positives for life and also what other things in the planetary spectrum we should look for that might in fact help us figure out what's going on and so this diagram here is just showing that it's not enough to just detect the oxygen in a planetary atmosphere now we have
to go after other gases for example if

we see methane that increases our confidence that the oxygen comes for life but if we see carbon monoxide that decrease

confidence that the oxygen comes for life so now we're getting to the point where we can start to figure out exactly what measurements we want to make when we have these fantastic large telescopes that allow us to study the environments of extrasolar planets and so just

summing up I think what you've seen here today in the work of Alexis and Brittney
and my team as well is that we are combining knowledge and expertise from many different disciplines bringing all of that knowledge and expertise together to address very very large questions that we couldn't address otherwise and that is the core of astrobiology is to bring all the systems together and work together to address the question of the search for life beyond the earth Thank you dr. meadows for that terrific summation of what we're all doing here this week and thank you all for your remarks I'm going to start by taking a couple questions from the media in the
799 00:29:32,119 --> 00:29:37,399
audience and then we'll go to questions

800 00:29:34,788 --> 00:29:40,220
by email from media participating

801 00:29:37,400 --> 00:29:42,169
virtually we already received a question

802 00:29:40,220 --> 00:29:44,600
by email yesterday so that one will come

803 00:29:42,169 --> 00:29:48,020
up first in the queue my colleague

804 00:29:44,599 --> 00:29:51,199
Leslie Mullen is going to use the mic in

805 00:29:48,019 --> 00:29:53,960
the back to read questions submitted by

806 00:29:51,200 --> 00:29:56,720
e-mail but we'll start here and I would

807 00:29:53,960 --> 00:29:59,269
ask my colleagues in the astrobiology

808 00:29:56,720 --> 00:30:00,890
community to save their questions for

809 00:29:59,269 --> 00:30:02,990
their colleagues up here on the panel

810 00:30:00,890 --> 00:30:05,150
for after the press conference because

811 00:30:02,990 --> 00:30:09,319
we're on a really tight schedule to

812 00:30:05,150 --> 00:30:12,288
finish up at 1:45 other questions from
the audience yes hi calico field with

space comm I think in the past couple of

months especially as the euro

Commission's getting going there have

been some very informed people

making some big predictions about when

we might find signs of life but I think

that's multi-decade decades away so can

each of you talk about maybe some more

realistic goals that you're hoping to

achieve even just in the next decade

perhaps before some of these missions

launch in the search for life things

that we can look forward to on a
slightly smaller timescale I'll take a quick start at that which is that again

staying on the earth-based systems for a moment before we go beyond would be that enormous amount of activity internationally for drilling into the deeper subsurface of our earth to look for signs of life and to demonstrate activity in the systems that we think do have great relevance within our solar system and so I think that there that this will be an excellent connection to what are some of the targets within
these missions for in the search for

00:31:15,049 --> 00:31:18,889
life so I think as we validate some of

00:31:17,089 --> 00:31:21,529
our hypotheses and theories at the

00:31:18,890 --> 00:31:23,150
moment that that will connect well I'm

00:31:21,529 --> 00:31:24,680
just going to comment that one of the

00:31:23,150 --> 00:31:26,120
themes of the conference here this week

00:31:24,680 --> 00:31:27,980
is habitability right that's the

00:31:26,119 --> 00:31:29,509
overarching theme and in fact that's

00:31:27,980 --> 00:31:31,400
what we're trying to do with this next

00:31:29,509 --> 00:31:32,629
mission to Europa the first thing you do

00:31:31,400 --> 00:31:34,220
is you go and explore and you get

00:31:32,630 --> 00:31:36,500
answers you get the basic information

00:31:34,220 --> 00:31:38,089
that you need to make hypotheses so we

00:31:36,500 --> 00:31:40,549
have those now and so what we're trying

00:31:38,089 --> 00:31:42,559
to do now is to advance our
understanding of the system the whole planet not just an individual terrain or one part of the system but everything and how it cycles how it couples how those processes are active and so there's kind of a synergy between all of the instruments that are planned for that Europa flyby mission and so there's kind of there's a graphic that you can look for and it's kind of a triangle that shows the three pillars that are really the focus of that mission one is water one is chemistry and one is energy and those are the three things that we
think about on a planetary scale that we can actually quantify how many chemicals of what kind are on the surface how does the ice shell recirculate is it bringing material up and down which we can image with the radar so we've got a spectrometer to find chemicals we've got a radar to find activity in the ice show we have plume instruments to potentially detect higher-order hydrocarbons or larger chain instruments we have a magnetic field and plasma instruments to try to detect more detailed information about the ocean so
to me the next milestone is to connect
those things and figure out now that we
know those things about the system about
the planet itself where do we go that's
the perfect place to ask those next
questions which is is it there well let
me address kind of an ensemble because
Europa certainly part of that that you
know in in the solar system we have
quite a lot of going on and also
and astrophysics looking beyond our
solar system in 2017 we're going to
launch the transiting exoplanet survey
satellite it's very much like Kepler and

that can identify these transiting

899
00:33:16,898 --> 00:33:20,798
exoplanets but the planet blocks a

900
00:33:19,089 --> 00:33:22,480
little bit of the sunlight but instead

901
00:33:20,798 --> 00:33:25,778
of looking at a very distant part of our

902
00:33:22,480 --> 00:33:26,890
galaxy which is what Kepler did it's

903
00:33:25,778 --> 00:33:28,179
going to look at all our nearest

904
00:33:26,890 --> 00:33:30,610
neighbors so we're going to find out

905
00:33:28,179 --> 00:33:32,440
where all the nearest exoplanets are

906
00:33:30,609 --> 00:33:34,740
around our own solar system and

907
00:33:32,440 --> 00:33:36,788
specifically to look for rocky

908
00:33:34,740 --> 00:33:39,788
exoplanets so we're gonna have a catalog

909
00:33:36,788 --> 00:33:41,829
of Earth's super Earths around the

910
00:33:39,788 --> 00:33:43,929
nearest stars because they're on the

911
00:33:41,829 --> 00:33:45,939
nearest stars they're close and it will

912
00:33:43,929 --> 00:33:47,798
allow us to do a better job at looking
at their exoplanet atmospheres through transit spectroscopy or with the James Webb Space Telescope if they're close enough by direct imaging which might allow us to see glint and get a spectrum of the atmosphere and of course in 2018 October we're going to launch the James Webb Space Telescope the James Webb Telescope is is a wonderful telescope in fact if we wanted to design an astrobiology Explorer in the infrared we would design the James Webb Space Telescope even though when it was conceived we only knew about nine
planets in the universe that was then
demoted to eight and now we know about
thousands so the James Webb Space Telescope is going to be able to study
the atmospheres of many many exoplanets
get high relatively high-resolution
spectra in the mid infrared and hopefully look and see for water vapor
and carbon dioxide and methane and allow
us to start decomposing what these these
rocky planets might look like
of course Mars 2020 follows that by just a couple of years which is an
astrobiology Explorer it has a wonderful
suite of instruments and it's going to take core samples in relative relevant you know astro biological context to try and find spots that like the Curiosity rover are places that we know are habitable and then the question is get those samples back to earth at some point to see whether Mars you know once was had ancient life certainly the Europa mission we want to get started we are getting started with the mission we want to launch it as soon as we can it has a wonderful suite of instruments and we're not done yet
add you know some other capabilities to

00:35:22,119 --> 00:35:26,170
the overall mission to try and perhaps

00:35:24,519 --> 00:35:28,719
even answer the question of is there

00:35:26,170 --> 00:35:31,210
life on Europa even before all of that

00:35:28,719 --> 00:35:34,019
2016 we launched the osiris-rex mission

00:35:31,210 --> 00:35:36,789
which is going to go out to a 500-meter

00:35:34,019 --> 00:35:38,769
carbonaceous asteroid called ben new

00:35:36,789 --> 00:35:41,139
it's going to characterize it down to

00:35:38,769 --> 00:35:44,289
very fine scale both spectroscopically

00:35:41,139 --> 00:35:47,529
the minerals the characteristics image

00:35:44,289 --> 00:35:49,779
it and then do a quick touch and go and

00:35:47,530 --> 00:35:53,410
grab samples up to two kilograms of

00:35:49,780 --> 00:35:54,760
samples and motor that back to earth we

00:35:53,409 --> 00:35:56,589
know that there's lots of organic

00:35:54,760 --> 00:35:58,030
compounds we want to be able to study
those in great detail and the best laboratories on earth to answer one of the fundamental questions or at least to give us some leverages did asteroids like Venu seed the earth through the organics that were then that then helped enable the start of life so that's just some of the missions that are much more near term than Europa but I consider Europa being washed in the early 2020s is pretty near term as well sorry can I follow I'm just specifically for extrasolar planets so I think you know in the search for life in the next ten
years I mean our best chance to start

that search as Dr. Grenfell pointed out

we're gonna definitely get good targets from Tess and potentially K2 as well but

JWST for habitable zone planets it's

going to be very challenging for it to

get spectra but I'm pretty sure we're

going to try anyway and one of the

things that in particular my team's been

looking at is we always think again about looking for oxygen but we've also

done some research on something called the oxygen dimer which is when two oxygen molecules sort of pass in the
night and very briefly form an O₄

molecule so that type of absorption from

that type of molecule might actually be

something we could potentially go after

with JWST but it is a really long shot

we would have to have exactly the right
target be able to observe pretty much
every single possible opportunity to

deserve that target so I think JW's T is

our first chance to start the search but

I wouldn't hold your breath that will be

successful there thank you do we have

any other questions from the media in

the audience if not I should also
mention that any questions submitted by

00:37:29,469 --> 00:37:35,649
e-mail that we can't address by 1:45

00:37:33,420 --> 00:37:38,170
my colleagues and I will attempt to

00:37:35,650 --> 00:37:40,180
direct them to the appropriate people so

00:37:38,170 --> 00:37:44,349
you can get your answers if not before

00:37:40,179 --> 00:37:45,940
1:45 sometime after that I will have I'm

00:37:44,349 --> 00:37:48,969
going to read the first question we

00:37:45,940 --> 00:37:53,730
received by email yesterday from Keith

00:37:48,969 --> 00:37:53,730
cowering directed the doctor Grunsfeld

00:37:53,789 --> 00:37:58,269
given the similarities between both

00:37:56,349 --> 00:37:59,980
present day and past Martian

00:37:58,269 --> 00:38:02,019
environments two environmental

00:37:59,980 --> 00:38:04,780
conditions existing on present-day

00:38:02,019 --> 00:38:07,059
earth where life can be found why has

00:38:04,780 --> 00:38:09,370
NASA nuts and instruments to the surface
of Mars to look for possible evidence of
excellent life there's a couple of reasons why we haven't well the Curiosity rover was designed to look for habitability and we know that the surface of Mars is bathed in ultraviolet light it's bathed in radiation Mars's magnetic field is essentially gone and so the theory has been that the surface of Mars is essentially sterilized now there are places we could go on Mars that are much more interesting for the possibility of extant life where there's current
surface water for instance you know in
places where there's currently frozen
water on the surface and at those margins
there's also subsurface water we believe
there's large subsurface glaciers or two
places like the lanai and the edges of
craters where we see salty water perhaps
salty water seeping out those are the most likely places we might see evidence
of extant life if it's there those are one challenging places to get to the crater walls we we don't quite have the technology to do that yep but also the
belief that if there is life it probably
has to be subsurface even the
preservation of organics on the surface
if the surface is exposed for more than
about 50 million years we believe that
the cosmic radiation in combination with
the perchlorates probably has you know
broken up the organics such that even
that's not detectable you know if
there's ancient life and the organics
were preserved so it's a very
challenging environment I think as we
get more
capable the ExoMars 2018 Lander will

have a deeper drill than we've ever sent
to Mars before us so that we can start
going below the zone which is really a couple of meters where radiation would kill any extent life I think then we're gonna start moving more forward towards what kind of extant life detection we might have now that said curiosity did see a transient methane signal as it was driving along which was many times over the background which could be a biotic or it could be biotic and so I think it's a very exciting possibility and I anticipate that on future missions we're gonna look more towards what kind of
instruments could detect life and that's one of the great themes of this conference is what would that detection look like because we can't assume that it's gonna be life just like Earth so a DNA sequencer for instance might fail miserably even if it was surrounded by extant Martian life last week do we have a question from email no questions we have another question here in the audience John Doe D I'm here with NASA social somebody on Twitter wants to know it's lr1 lr1 i think they're talking about the bright spots on Ceres the
infamous bright spots they want to know

if there's any possibility of ice or

maybe a new compound or mineral we found

on Ceres your opinions on that sure I

mean this is work that's ongoing

so we've just finally reached what's

called survey orbit so we have several

phases of mapping orbits with with Dawn

so one of the things that's interesting

is that you know on cameras that we have

and then we we hold on earth we can just

zoom in alright you have a you have a

changing focal length on your camera

well on the spacecraft we don't have a
changing focal length so our resolution

is a function of the altitude above the

surface that where they were currently flying at so we're in our first orbit called survey we'll go down then to high altitude and then low altitude mapping

orbits and so the the answer to the question is we don't know yet it's a really good indication that something's there there was Herschel Space Telescope indications that these areas had water vapor near them we don't have a direct confirmation and the science team is working
is working very hard these are new data

1127
00:42:00,730 --> 00:42:04,090
this is the other thing is it takes a

1128
00:42:02,590 --> 00:42:05,650
little while to get all of the data down

1129
00:42:04,090 --> 00:42:07,870
and to work on it but it's really

1130
00:42:05,650 --> 00:42:10,840
exciting because it's something we maybe

1131
00:42:07,869 --> 00:42:12,190
imagined could be there but not exactly

1132
00:42:10,840 --> 00:42:13,539
the way it presents itself that's always

1133
00:42:12,190 --> 00:42:15,190
the the exciting part of space

1134
00:42:13,539 --> 00:42:16,570
exploration is that you put these

1135
00:42:15,190 --> 00:42:17,889
hypotheses forward and maybe you get

1136
00:42:16,570 --> 00:42:18,850
pretty close but there's always

1137
00:42:17,889 --> 00:42:21,489
something a little bit different that

1138
00:42:18,849 --> 00:42:23,349
throws a wrench into the plans so it's

1139
00:42:21,489 --> 00:42:24,909
currently under work by the dawn team so

1140
00:42:23,349 --> 00:42:27,969
that's a whole international
collaboration NASA and ISA several different partner organizations so those teams are working on it so it's one of the leading candidates for what's there people have talked a lot about salts in the past have talked about hydrated minerals have talked about ice we've talked about those types of things so I think the answer is stay tuned because we like to have those kinds of results ready for primetime so great and that's gonna have to be our last question we need to wrap up because the working astrobiologists here need to come back
into this room to continue their work

and I'm just gonna echo Dr. Schmidt's message stay tuned because there's always something new going on thank you

all for listening and come back next time