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Aliens of the Deep

By Unknown

At the centre of our existence
is a powerful dynamo.
The sun.
It gives us heat and light,
and drives the great engine of life.
It's the food chain,
and we're all a part of it.
No matter who you are,
even if you're a hardcore meat-eater,
your dinner started with plants
somewhere turning sunlight into food.
So we are, all of us,
solar powered.
Maybe the ancient Egyptians
were right to worship the sun.
For four billion years,
the sun has given life to everything,
on land, and in the sea.
Rover One, this is Rover Two,
We are at the edge of the wall
and are beginning our descent, Over,
My name's Dijanna Figueroa, and I'm
a PhD student at UC Santa Barbara.
- This is cool,
- Copy that. Starting descent. Over.
I think I have
one of the coolest jobs in the world.
Check out those
corkscrew coral down there,
I'm a marine biologist.
I get to go to the bottom of the ocean
and study the amazing organisms
that live there.
There's nothing I'd rather be doing.
Rover One, Rover One,
do you copy?
This wall's pretty amazing,
We're barely on the edge
of photosynthesis right here,
Ambient light's really going now,
You're totally reliant on
the technology that's in your little bubble
to dive to that depth
where it's just a mystery down there.

You never know what you're gonna see.
- Look at all that krill,
- Oh, my gosh!
Looks like we're in
krill heaven over here, Rover One,
Yeah, roger that. Pretty incredible.
Not seeing much of anything alive here,
Dijanna, What about you?
Not much life at all, I think
we're pretty much out of the photic zone,
It's like being on the moon, huh?
Copy that,
Hey, look, we got a crinoid right down here,
Hey, Dijanna, we got a crinoid here.
We finally found a citizen.
Copy that,
Yeah, it looks like we're getting deeper,
and most of the animals down here
look like they're suspension feeders,
or particle feeders,
With no light from the surface,
not much can survive down here.
But there are places in the ocean
where sunlight has never reached,
not since the world began,
and yet amazing life forms thrive there.
So when I was invited to join the new
expedition to explore these places,
I had to say yes.
"Keldysh," "Keldysh,"
"Ares" bridge.
Yeah, Dave, we're about to begin dive reef right now,
We got MIR One
going into the water at...
Like this, so that we've got a central area
to work, Rover One is gonna stay...
I'm Jim Cameron,
and here's the deal.
I love this stuff.
Exploration. Real honest-to-God
deep ocean exploration.
This is way more exciting than
any made-up Hollywood special effects.
These deep ocean expeditions

always seem like space missions to me.
So, why not combine
outer space and inner space?
Sure, we'll take marine biologists.
But why not take astrobiologists
and space researchers?
So that's how a bunch
of space scientists wound up out here,
a thousand miles from the nearest land,
where, right under our feet,
down in the darkness,
are the most insane alien life forms
that have ever been discovered.
Two ships,
four manned submersibles,
forty dives at ten sites
in both the Atlantic and Pacific.
I like big operations,
but this one was off the hook.
So we'll come down together, like this, and
we'll try to stay a couple of meters apart,
because we don't want to drift off,
If the communications are compromised
with the multiple subs in the water,
all working on the same frequency,
some in Russian, some in English,
I want to make sure
we stay on visual...
The plan was to coordinate a four-sub dive,
using both ships, so two MIRs and two
Rovers could rendezvous at the bottom.
This would be a world first.
- Hi,
- Dr, Sagalevitch,
Anatoly Sagalevitch heads
the Manned Submersibles Laboratory
for the Russian
Academy of Sciences.
We've been working together
for almost a decade.
There we are,
The adventurers,
It's all his fault that we're doing this,
because we did Titanic twice,

in '95 and '01,
and we did Bismarck.
Sometime around the middle
of Bismarck, Anatoly says:
"You know, these wrecks are good,
they're interesting,
but you have to do something real,"
"We have to do some science,
Something real,"
Genya Chernaiev
is one of the Russian MIR pilots.
He's been flying submersibles
for over 20 years now.
The most important thing about this boat,
of course, is the view,
This view makes the Rovers unique,
but because of the acrylic sphere,
they can't go as deep as the MIRs.
So they'd only be joining us
for the Atlantic leg of the journey.
We also had Jake,
the little remotely operated 'bot
we'd used to explore
the Titanic and Bismarck wrecks.
Jake had been modified
to test a variety of sampling tools.
My brother Mike is Jake's inventor
and our pilot on this expedition.
His challenge was to steer Jake safely
around the volcanically active vent sites,
and not fry our little 'bot.
This would hopefully allow us
to get up close and personal
with the creatures we'd come to see.
We've checked the decks twice,
all the rigging looks squared away,
My other brother was with us too.
JD was the safety and communications
officer on board the "Ares."
Or, as he called it,
"crap job number 27."
Our launch procedure is as per the book,
Everything's straightforward,
She's first, she's second, Recovery

is determined by Jim from the bottom,
Now, recovery can go either way,
We chose the "Ares"
for the giant A-frame at her stern.
Its massive hydraulic cylinders
can lift the sub off the deck
and out over the water with ease.
It's one of the safest ways
to launch a large payload off of any ship,
and we constantly tested our procedures
until we had everything dialed in
for the upcoming four-sub dive.
All right, let's do this,
All stations, let's do this,
I'm gonna need everybody
to keep their ears open, be observant,
Keep your eyes open
for the lights of the other submersibles,
And, you know, it's gonna be challenging,
But I think we can pull it off,
All right, here we go,
Jacks up!
Finally, everything was in motion.
And in the middle of the North Atlantic,
a thousand miles from the nearest land,
our little expedition
was about to make history.
We're in motion,
We're in motion,
Nice and slow, blue winch,
Nice and slow,
- Now we're gunnin' runnin', huh?
- Yeah,
At least, that was the plan.
All stop, all stop, All stop,
I copy you, Lima Charlie.
The only problem we have right now
is the A-frame. Over.
I'll let you know
as soon as the crew gets it sorted.
About an hour and 15 minutes
ago, we had a safety stop,
Uh, what we know
is the A-frame went south,

It's a complete breakdown of the cylinder,
It ultimately amounts to a cold stop,
These bolts all shot,
And all this paint that's been here forever
busts loose because of that situation,
And it happened on that one as well,
Yeah, right, I mean, we're in the
middle of the ocean with a broken A-frame,
That's what it sounds like to me,
How you gonna get that fixed up?
Call A-frames"R"Us? You know,
have their little service ship come by?
Thousand miles from shore?
We don't have to move on it immediately,
but it's at least something
we need to start processing,
Well, I mean,
if they can't fix this,
and we don't have an alternate way
of launching the sub, it's over,
the expedition's over,
If you are going to explore,
you have to accept the fact
that on the one hand there's risk.
You have to stay up all night long
thinking about every single factor
that's involved in what you're doing,
and making sure that
you've thought of everything.
'Cause if you can eliminate
all the things you can think of,
you've eliminated nine-tenths
of what can go wrong,
That way, when that last one-tenth
pops up, and you're in the middle of it,
you don't have to worry about all the
other stuff 'cause you've dealt with that,
Look, to be completely serious, your idea
about cutting that bulwark away at the side
is the best idea I've heard
for an alternate plan yet,
Just cut the side right out of the ship,
I say we go clear that
with the captain right now,

OK, Well, plan B,
All right,
we can talk it through tonight,
but I don't think
we should try for an all-up drill tonight,
I mean, people have been up

since 4:
It became apparent that
the only way to get the subs off the "Ares"
was to use the main crane and by sliding
the submersibles off the side of the vessel.
With a crane that is 30, 40, 50 feet above
the actual pick point of the submersible,
once an object starts to swing,
you can't stop it.
It's called the wrecking-ball effect.
Once it gets away from you,
you can't get it back.
I'm guessing we've got six to eight feet of
travel here, I'm thinking we should use...
It ultimately resulted
in Jim writing a 40-page manual
on what he thought the best way
to launch the vessel was.
This eye feeds into that...
So we spent a long time
devising four separate pick points,
as well as eight different points
of connection to the submersible
to stop it from swaying.
We would practice all night long.
At dawn the following day, we were ready
to attempt it for the first time.
We spent the past 24 hours rebuilding
the entire launch and recovery system,
which required us to cut this wall out, rerig
every capstan, rerig every block and tackle,
We've got about
Every single point
has to be checked by me, by hand,
Any single point fails, anything,
from the blue winch
to the cable itself, snaps, breaks,

not only do we lose the sub, but we risk the
chance of losing somebody on the deck,
I'm looking at every pulley
under tension, and it's looking at me,
Keldysh, be advised,
we are go for launch ops,
Deck crew, be advised we have 15
minutes before we start launch operation,
- Paul?
- Yeah, roger that, DP control,
MIR One's going into
the water right now,
Let's see the crane, guys,
- Oh, yes,
- Stow that, get on the line,
Bye-bye,
Tim, Straps off,
Keep going, keep going, keep
going, keep going, keep going, keep going,
DP control to "Keldysh."
MIRs are beginning their descent. Over.
Say goodbye to the surface world,
I love this part,
Everything is a go,
We're ready to vent,
SO, SO, Rover One,
Go ahead, Rover One.
We are about to start
our tandem descent,
OK, here we go,
And three, two, one...
- Venting. Go, go, go.
- OK, we're venting now,
Venting now,
All right, Rock and roll, Here we go,
The descent to Lost City
takes about 30 minutes,
which is plenty of time
to think about what you're about to do.
My name is Loretta Hidalgo,
and I'm an explorer.
Copy that, Rover One, This is Rover Two,
hearing you loud and clear,
My goal is to one day

explore the reaches of space.
- That is the bomb, Yeah!
- We're at 840 meters,
Surface, this is Rover Two, We are
at 840 meters, We are on the bottom,
God, these structures are gorgeous,
OK, there's the rendezvous point,
and they are right there,
MIR Two, MIR Two,
this is Rover Two. Do you copy? Over.
MIR Two, MIR Two,
this is Rover Two, Do you copy?
That's affirmative, Rover Two.
We have a very good visual on you.
We were doing something
that no humans had ever done.
This was the first time that four deep
submersibles had ever dived together.
The water pressure that you get
down at 3,000 feet is mind-boggling.
If you've ever carried a bucket of water,
you know that's about a foot of water.
Now imagine being under
And all that weight
of all those buckets lined up on your head
are all pressing down on you
and on the submarine.
Definitely not something
that humans were evolved to do.
OK, Loretta, can you relay to Mike
that we are in position for 'bot ops? Over,
Copy,
MIR Two, MIR Two,
are you go for 'bot deploy?
Uh, roger that,
We'll get set for 'bot ops, Over,
- OK, There it is,
- Yeah, there he is,
There's Jake,
Can you see his tether spinning out?
It's like a spider spinning its web,
I'm just gonna pull a little tether
out here, to the left, into the current,
and then I'll yaw back to the right,

We were really
pushing the boundary
of being out in
an extreme environment.
I had this incredible experience of feeling
like I'd been transported into the future.
Hi, 'bot!
That I was on a space mission, and
we were watching another spacecraft
coming up to work with us.
Hi, Mike,
Get me out of here,
- Affirmative,
- Affirmative,
Push in a tiny bit in here,
and I get just right in as close as I can go,
Oh, wow,
Are you seeing the structure?
Yeah, Beautiful,
OK, Mike, If you come right
about 30 degrees, and come forward,
you'll come to a big fan right on
the corner of that rock, Over,
Copy that.
Oh, this is gorgeous,
I feel like I'm out there,
- Are you liking this?
- I'm loving this,
OK, I'm gonna have to come up a little bit,
Well, we're doing pretty good here,
I've encountered a little
more current than I expected right here,
Oh, my gosh!
Hello, Mr, Big,
He's like, "Don't even mess with me,"
Oh! Oh, my God,
Wow,
Wow,
Kevin Hand is one of our astrobiologists.
And he's a brilliant guy.
Really.
That's one of the interesting things
I think about the Europan ocean,
is that you can ask

two questions about life on Europa,
Could life have originated on Europa?
Astrobiology is
the study of life on other worlds.
But since Kevin doesn't have any real
extraterrestrial specimens to analyze yet,
he's out here doing
the next best thing:
Looking at life in the extreme conditions
of the deep ocean.
He's a theory guy
and he's never been to sea before,
let alone inside a submersible
headed to the bottom of the ocean.
Here we go,
Into the unknown,
Rover Two, MIR Two copies you
loud and clear now. Loud and clear now.
Yeah, it looks like
it goes down for a long ways,
MIR Two is right above us,
Very few people get to see
MIR Two from this angle,
That is fantastic,
The scale of these things
is so much larger than I had imagined,
It's just amazing,
We've got this huge,
huge carbonate structure,
Unbelievable,
Copy that.
Right rotator going up, rotator going up.
It's just the hot water just flowing up
and slowly forming stalactites,
Upside-down stalactites are slowly
deposited, millennium after millennium,
So what's interesting
about these
is that you don't necessarily
need plate tectonics,
You need some means for the water
to react with the deep mantle rock,
And then you get
the serpentinization reaction

which produces the heat that drives
the formation of such systems,
It's absolutely phenomenal,
Do you want to go ahead
and proceed to the summit? Over.
Roger that,
- There's warm water up here,
- Yeah,
The vent fluid is just
coming right up out of here,
Wow, This is just amazing,
Our technology is just
at the level now
where we can safely explore
the depths of our own ocean,
- Kinda friable,
- Yeah,
OK,
Yeah! Look at that,
- We got a rock,
- Hey, we got a sample,
Rover One, Rover One,
this is Rover Two, Do you...
- Oh, my goodness, look at that!
- Oh, Christ!
Holy cow,
- OK, stop it, stop it, stop it,
- Kevin. You seeing this?
Look at that thing,
That is absolutely unreal,
See if you can
get your lights right on it.
Roger that,
Oh, my goodness,
Look at that, it's just amazing,
Oh, man, look at this thing,
Look at this thing,
This is incredible,
How can something
like that be alive?
How does a creature like this work?
That is absolutely phenomenal,
Beautiful,
Absolutely beautiful,

See the reticulation inside this thing?
Look at that,
That is amazing,
I have no idea what that is,
- No,
- That's what I love about this stuff,
Every single dive, you're gonna see
something you've never seen before,
And you might even see something
that nobody's ever seen before,
Are you seeing this thing?
Look at this,
This is, like,
the ugliest fish in the world,
Oh, he's got feet! Look, he's got feet,
He's got, like, little toe-socks,
The thing about deep diving is you
always need to expect the unexpected.
Oh, my God,
look at that squid,
Oh, it's massive,
Look, look, look,
Quick, look,
See it?
Absolutely fantastic,
Look at that fish,
You see that guy?
All right, we got us a Dumbo,
Been hoping for this for a while,
What a beautiful animal,
What a beautiful animal, Look at that,
Like a dancer,
What an amazing creature,
God, you could watch this guy all day,
Almost looks like
he's glowing from within,
MIR One, MIR One,
This is Rover Two, Do you copy?
MIR One, MIR One,
do you copy? This is Rover Two.
MIR One, MIR One,
This is Rover Two, Do you copy?
It's intermittent, Jim,
Sometimes yes and sometimes no,

Uh, roger, Mike,
We're seriously low on power
and will have to leave the bottom,
I cannot get ahold of Vince,
We must go up,
Genya, We must go up,
Oh, he's trying to say something,
about...
He's trying to say...
Look out the porthole,
I can't see him,
Can you call surface?
He's saying, "Up and over"?
Might be,
We need you to contact the surface
that we are ascending,
Can't read it, Zoom in,
Let's see if you can read the sign,
"Contact surface, must surface,"
Understood, We'll contact them right now,
Ares surface comm,
Rover Two leaving the bottom
at X minus 244, Y minus 25,
depth 741 meters,
- So, how was it, Jim?
- We got the goods, We definitely got it,
Ah, that thing is phenomenal,
How you doing?
- What did you see down there?
- Oh, it was just incredible, Just incredible,
There was a huge, um...
Was it a jellyfish?
Some type of gelatinous...
Massive, Like, a meter,
We think that it was feeding
off of the, uh,
off the amphipods and the plankton
and the copepods that were next to...
- Hanging out at the lights?
- Hanging out at the light, yeah,
- How's it work?
- Man, we don't know,
- But it's there, So it's working somehow,
- Exactly,

- Life's pretty cool,
- Yeah, absolutely fantastic,
- Welcome back, Kevin,
- Thanks,
- Team Rover,
- Go team Rover!
My name is Maya Tolstoy,
and I'm a marine seismologist
at Lamont-Doherty Earth Observatory.
I study underwater volcanoes,
and particularly I study the earthquakes
that these volcanoes make.
And I'm trying to understand
how the Earth is made,
how the surface of
the planet is formed.
I'm going to be deploying
ocean-bottom seismometers.
Those are instruments
that listen to earthquakes
and other noises on the ocean floor.
In the ocean,
the light only goes so far.
And so sound allows you
to basically see the bottom of the ocean,
and to see into the ocean crust, the way
that light lets you see on the surface.
We put the instruments over the side of
the ship. They drop, they gather the data.
Normally, I don't have to dive
in order to do my job.
So it was very exciting
to finally see the environment
that I've been working on
for over a decade.
MIR two, copy,
We have a visual on you.
We are inbound.
Roger that,
- Can you see them?
- Yeah, It's out my window,
It looks like a spaceship,
Wow,
That's incredible,

That's like another planet,
It's such
an incredible world down there,
and it's so important
to the formation of our planet.
It's where two thirds
of the surface of our world was created,
and we still know so little about it.
Do you see how
they're all shiny and glassy?
- Oh, yeah, Look at that,
- That shows that it cooled superquickly,
That's just, like, it really turns
to glass, basically, To obsidian, it's called,
Look at that,
And you see how there's
hardly any sediment on it?
That's when it's really fresh,
This is brand-new crust we're looking at,
Wow,
Now, can you just imagine
being down here when this stuff erupts?
Molten rock oozing out
and hitting the freezing cold water,
I just can't imagine it,
It must have been insane,
Must look pretty cool,
For the few seconds before you die,
I miss my son.
He's five months old.
It was such a hard decision
to make to come out here.
But I think it's important to study
one of the most remarkable phenomenon
we've ever discovered
in the oceans.
MIR Two, just keep going
upslope on this heading,
The chimneys should be
at the top of this sulfide mound, Over,
Roger that,
Wow,
There it is,
All around our world,

running down the middle of the oceans
like seams on a baseball,
are these cracks,
these spreading centers,
where the crust of the planet
is literally ripping apart.
Up above,
the sea looks normal.
But two miles down,
it's a violent landscape
where fresh lava flows
out of the crack and freezes into rock.
When the sea water seeps down to the
molten rock just beneath the new crust,
it gets superheated,
far hotter than boiling.
But it can't boil, because of the intense
pressure at the bottom of the ocean.
So it comes roaring up
out of the sea floor.
When the superheated water hits the
freezing ocean, minerals condense out,
forming the chimneys,
and creating the black smoke.
When you see black smoke,
what you're really seeing
is a blowtorch of
superheated water.
Uh, we're getting in position
to get a water sample
from the top
of one of these structures, Over,
Yeah, roger that.
That's good.
OK, let's get in as close as we can
on this chimney, Genya,
These chimneys
reach 750 degrees Fahrenheit,
and that's hot enough to melt
the windows of your submersible.
That's a bad thing.

Mental note:
the windows of the submersible.

Guys, we're getting really close
to this black smoker here,
- Close enough?
- I think this is maybe a little too close,
Uh, well, we're starting
to get into the plume,
Right underneath the sub,
Genya, move back.
You better move back.
OK, I start to move back,
That's normal.
We usually drive right in 'em like that.
We were right on top of it,
That was a little freaky,
That's pretty cool, Kevin,
The geology's fascinating.
But it's not why I came out here.
Keldysh, Keldysh, MIR Two,
We are on the bottom,
Depth 3526 meters,
And we are at the top
of the Moose structure, Over,
These sites were
first visited 25 years ago by geologists.
And they weren't looking for life.
But it wasn't until
they got into a submersible
and went down to the bottom
to see with their own eyes...
It was like, "Oh, my God.
There's life down here, and it's beautiful. "
It's an entire ecosystem.
Wow, That's awesome,
Copy that. That's what
we're imaging right now. Over.
- Look at all that hot water,
- They're right in the flow,
Oh, man, Check this out,
It's like liquid fire,
and these guys are dancing right next to it,
They are really tickling
the dragon's tail,
The science community
was stunned.

How could these animals
be living in these toxic chemicals,
at these pressures,
around extremes of temperature
from freezing to beyond boiling
in just a few inches?
How could there be a whole ecosystem
living without sunlight?
And not just living,
but thriving!
Unbelievable,
This is the most insane
amount of biomass I ever saw in my life,
Wow,
Holy pancakes, Batman,
And they're right there in the flow,
just enjoying the hydrothermal fluid,
Oh, look at 'em swarming,
They love it in the smoke,
Oh, yeah,
The vents
were providing the energy for life.
It was coming from chemicals
dissolved in the water,
coming from inside the Earth itself.
Not photosynthesis,
but chemosynthesis.
It was a whole new basis for life,
one that didn't need the sun,
only water and heat.
That party's been going on down
there in the dark for the last billion years,
and it's gonna be going on
for the next billion years,
They're just doing their thing,
it's got nothing to do with us,
the sun could go out tomorrow and they
wouldn't know and they wouldn't care,
Exploring and discovering
ecosystems like this,
which may not depend
on energy from the sun,
opens up all sorts
of interesting possibilities

when we think about
the search for life elsewhere.
Wherever we've found liquid water
on planet Earth, we've found life.
That's pretty profound.
If we find liquid water elsewhere in
the solar system, are we gonna find life?
We won't know
unless we start searching.
In fact, NASA is planning a mission
called the Jupiter Icy Moons Orbiter.
AKA JIMO.
At 120 feet long
it's gonna be several times longer
than any planetary probe
ever launched,
and its nuclear reactor will power
ion engines and a big science radar.
The main goal of JIMO
will be to use that radar
to look down through the ice
of Jupiter's three largest moons.
First, it will study Callisto,
and then it'll move to Ganymede.
And these are bizarre moons,
the largest of Jupiter's 61 known moons.
Callisto and Ganymede
both have crusts of ancient ice and rock
that may hide oceans
miles below the surface.
Further in is Io,
which is a moon of fire, not ice.
Io's eccentric orbit causes it
to deform as it circles Jupiter.
This intense tidal pumping
pulls at the moon like taffy,
generating friction at the core
which then becomes heat,
and this heat drives the solar system's
largest active volcanoes.
There are constant eruptions,
rivers of lava,
and volcanic plumes shooting
hundreds of miles into space.

But the gem of the Jovian system, at least
as far as the search for life is concerned,
is Europa.
It's here where fire and ice
come together in perfect harmony.
The scientific community
is relatively certain
that beneath the icy, chaotic shell of
Europa, there exists a liquid water ocean,
with twice the volume
of all the Earth's oceans combined.
So tidal heating is working here too,
keeping that water from freezing.
And possibly providing
energy for life.
The same kind of life that we're finding
at the deep vents here on Earth.
You see all that out there,
all that yellow and white and orange?
That's just a huge
colony of microbes,
This is just acres and acres
of this bacterial mass,
Look at that, This could be like
a little glimpse back in time,
Yeah, couple of billion years ago,
Hydrothermal vents
have been on planet Earth
since the oceans were formed.
It may have been sites like these
around which life itself began.
If we can just sort of
scoop up the top area of that,
maybe a little bit of
the sediment below,
Excellent,
Nice sample,
You can see all the stringy
little filaments that make up the mat,
Extremophiles are simply
life forms that thrive in the extremes
of temperature and pressure
and radiation,
environments that to us are deadly.

These microbes go far beyond anything
which our imagination could conceive of
back when we first started studying
where we might find life.
Now, if we find anything on Europa,
it's probably gonna look just like this,
Absolutely,
So I think if we're gonna try to get
evidence for life on another planet,
we've certainly gotta look
for evidence for life on our own first,
It's the only sample
we've got, right?
Pan Conrad. She was
one of our senior astrobiologists.
She comes from
the Jet Propulsion Laboratory,
and she's one of those valuable people
who knows how to make science fun.
So you know when you were little, and you
used to play like you were in a submarine?
That was this,
How cool is this?
This is way better than the cardboard box,
Tolya, just see
if you can ease in on this structure,
Absolutely,
It's just like the Mushroom Planet,
It looks exactly like a mushroom,
Ah, that's gorgeous,
It's like a mirror,
That's the hot water
forming a surface,
That is very cool,
See the bacteria growing right along
the edge, right in the hot flow?
I see it,
It's all bacterial mats on top,
Certain molecules
found in living organisms
will glow when they're hit
with an ultraviolet laser.
Is that a good place
for a fluorometer reading?

I think this is a great place
for a fluorometer reading,
We designed
our life detection tool in such a way
that we could point it
at a rock and say:
"Aha! There's evidence
of life over there. "
Lights out,
OK, I'm going to start
the measurement now, Ready...
Go,
OK, Lasers firing,
We got a lot of signal here,
Whoo, this is good, We've got,
like, 14,000 counts in ultraviolet,
Very interesting, Doctor, But is it life?
There's definitely organic stuff there,
It's so important
to study what you can
about extreme environments
on the Earth
before you go out
into the solar system and look for life.
MIR Two, do you copy?
Go for it, Ares.
My name is Kelly Snook.
I work at NASA. I'm a planetary scientist.
Copy that,
I study the process of exploration.
Rover Two and MIR Two...
What I do in my day-to-day work
is learn how to use the Earth as a training
ground for going to another planet.
So here
I was looking for the analogs.
Baboom! You did it,
- It's in the basket,
- Slam dunk,
Slam dunk from the center line,
These, I thought these were bacterial,
so I told Anatoly to pick some up,
Most people were on a ship,
in the middle of the ocean,

studying the hydrothermal vents
or making a film.
I was on Mars.
And the people that were
down at the bottom of the ocean,
they were out on
the surface of Mars.
Everything that we do in the ocean is ten
times harder than you think it's going to be,
and you go in thinking
it's gonna be really hard, you know?
- So I don't see Mars surface ops...
- Same with space,
...being any different,
Yeah, hopefully we'll have time in that day
to sort of debug our comm protocols
and the way we're interacting...
My team included
astronaut Megan McArthur
from NASA Johnson Space Center,
and astrobiologist Tori Hoehler
from NASA Ames Research Center.
We worked together to explore ways
in which humans and technologies
can improve the science and discoveries
we'll make on the Moon and Mars.
This combination
of science and technology,
especially in an environment
like under the ocean,
it's very similar to space exploration.
The submersible is like
a pressurized rover on Mars,
and so we were using this as an
opportunity to learn lessons about space.
Go ahead, Roberto,
If you can find any
microbial mats right near the chimney...
Uh, I guess that depends on how we're
able to configure the MIRs, and how...
I would talk to
the remote scientists at NASA,
and I would get their requests
for particular rocks,

and I would process the rocks
and prepare to take them back to Earth.
I think it's probably
loaded with bacteria,
I think the white stuff is most likely,
like I say, sulfur oxidizers,
Analogs like this
are key to understanding
how we'll do scientific exploration
on the Moon and Mars.
Will we need manipulators,
like we have on the MIR? Probably.
And how will we handle
the problems and technical glitches
that no doubt we will have
on an extended planetary mission?
Whatever you just switched off
you better switch back on,
Right,
Rover One and MIR One,
be advised we have lost
our starboard horizontal thruster,
Uh, we've lost AC
and we have lost pan and tilt,
so we're probably
gonna have to abort,
Every event here,
both planned and unplanned,
generates data
we can apply to the future.
Much of what I study is
how humans interact with the technology
that allows them
to accomplish their tasks.
Some of the technology
is very simple,
but in space and at the bottom
of the ocean, nothing is simple.
Yes!
Oh...
Is it gonna go? No!
Ay...
- You can't rotate the scoop more?
- It's on the edge of this carousel,

You can put it in,
- Can you rotate the scoop?
- I did, I did,
- It's in?
- One piece has gone inside,
Yeah? OK, good, All right, you got it,
You got it, One is out, one is in,
The better we can integrate
technology like this, and robotics,
into our human exploration systems,
the more effectively we'll be able
to explore the solar system.
- I feel like I'm in a spacecraft,
- I'm sorry?
- I said, I feel like I'm in a spacecraft,
- You are,
- That's right,
- You are in...
- Inner space,
- ...the world's best spacecraft,
to explore this planet,
You're in it,
The experience of human beings
inside the submersible
is what we're most interested in.
It's Marge,
It's Marge Simpson's hairdo,
It's not only
the hardware in the process,
but the communications
between the people and the robots,
because the scientist is
the interface between the technology
and what we're trying to study.
OK, guys, what I'd like you
to do is come to your right
when you've had a look at that, 'cause
we're not getting much of an image here.
And the current
is of course not favorable,
That's OK,
It wouldn't be fun if it was easy, right?
- What's that fish?
- It's a big fish. Don't be scared.

If you want to take a sample
of any of these small sulfide rocks
down here at the bottom,
that would be fine.
It's a very
technologically difficult thing to do,
to pick up a rock
at the bottom of the ocean
and put it into
a sample collection device.
That's really at the core
of what we're interested in.
How are humans going to do these small,
easy tasks in a difficult environment?
Whoa, we got currents,
Come on, gripper, Grip,
It's got it.
Oh! Hang onto it, baby,
All right, you got it,
Barely got it, but you got it,
OK, try to get it over to the carousel,
Well, a task
that would take a person in the field
a couple of minutes on Earth
can take hours on Mars.
Every step is a new challenge.
Now translate right just a little bit.
About another two inches.
We can't send 150 people to Mars
right away. We would send probably six.
These few people will be responsible
for all the science
and exploration on the surface.
Kind of like proxies for
the thousands of people back on Earth
interested in the mission.
Mars is the obvious first place
to look for life in the solar system,
because there's evidence
that the Earth and Mars
share a similar history
of abundant water.
And one of the most important key
elements of life as we know it is water.

Now, the Mars you see today
is dry, dusty, cold, apparently dead.
But if you set the way-back machine,
it didn't look like that.
If you could imagine
if life was evolving on Mars,
and there was an impact great enough...
based on what we know now
about extremophiles,
we think that life could survive
a trip from Mars to Earth in a rock.
It's possible that life
could be viable after that long of a trip.
We might all be Martians. We might all
be from another solar system entirely.
All right, Put up your hand if you would
sacrifice ten years of your life to go to Mars,
- I'm going,
- Sure,
How would you talk your husband
into letting you go to Mars?
Say, "All right, honey, Now,
it's only gonna be for five years, OK?"
"And I'm gonna write every day,
we'll have email,"
Whoa,
That's a loaded question there,
It's funny, 'cause when you asked me
the question, "Would I go to Mars?"
I raised my hand without even thinking
about the consequences or life at home,
My husband, my cat,
my mom and dad...
My cat,
That'd be hard,
I think he'd say, "Go for it," I really do,
'Cause I think all of us, we're all human
and we all have that exploration bug,
and if somebody that we love
has the opportunity to go out there
and represent humanity and explore,
I think he'd push me and go for it,
When you've been on the "Keldysh" for almost a month,
it's very easy to pretend

that you're on your way to Mars.
You're far away
from everything you know,
in a small environment
with the same crew,
who are there for the same
professional interests that you are.
They're there to explore,
they're there to do science.
The Russians are very resourceful.
They were showing us
some of their sampling tools,
and they have a tool that can sample
just about anything you'd want to sample.
Some of the things are really clever.
Or as simple as the Nikolai pot,
which is basically a pot
we stole from the cook, Nikolai.
It's something that
I just love getting to be a part of.
You know, we get to be in their culture,
and look at how they do engineering
and how they do operations.
It's an incredible environment
to be working in.
I love it because of
the way it brings people together.
Victor,
Obed?
Your... Your lunch?
- Yeah,
- Yes, that's right,
Yeah? Yay!
This expedition
captured a lot of that spirit.
OK, all right,
The idea of doing something
that was really difficult,
and how people can come together
to make something like that happen.
Poyehaly.
The way they communicate
with each other.
No, forward,

Victor's been practicing,
Vitka, khorosho, khorosho.
One of the things
I enjoy about Russian culture
is the way that
you integrate play and work.
Vosem-pyaty.
I mean,
I've studied Russian in college,
because I always wanted to work
with the Russian space program.
And the "Keldysh" is a great analog for,
you know, a space launch complex.
And I understood what
all the astronauts are always saying,
when they say that the technicians
and the engineers on the pad
are the real heroes,
making sure that you're gonna be safe.
This expedition
captured a lot of that spirit.
Engines start.
While we were out at sea,
two incredible explorers
were already on their way to Mars.
"Spirit" got there first, blazing into the thin
Martian atmosphere at over 12,000mph.
"Opportunity" arrived
a few weeks later.
Landing for both
was a nerve-racking affair.
Current altitude approximately 25,000 feet.
Awaiting confirmation.
We're moving at a speed of 173 miles per
hour. We are near our terminal velocity.
Cleaner separation of end
has been detected.
No signal at the moment.
Deep-space network tracking stations at
Canberra searching for primary signal.
We're on Mars, everybody.
Equipped with
high-resolution stereoscopic cameras,
and a Swiss army knife's

worth of geological
and chemical science instruments,
the mission of
the Mars Exploration Rovers was clear:
Find evidence of water in Mars' past,
when conditions
may have been more favorable to life.
You can learn a lot from a rock,
if you know how to ask.
And you know where to look.
Of the two rovers,
"Opportunity" really hit the jackpot.
The ancient bedrock
was absolutely loaded with hematite,
an iron-bearing mineral that usually
forms from interaction with liquid water.
Then scientists detected jarosite,
a mineral that suggests the rocks may
have been soaked in acid ground water,
or in a hot springs environment,
like Yellowstone National Park.
Other clues included
empty cavities inside rocks,
where salt crystals
may have dissolved away,
and rippled sediment patterns,
hinting at the presence of free-flowing
water over thousands of years.
And then there were the "blueberries."
Tiny spheres of hematite,
eroded out of the rocks
and spilled out all over the surface.
On Earth, spheres like this form
in the presence of water over time.
Both "Spirit" and "Opportunity" helped
confirm where the water was on Mars,
but they were not equipped
to tell us where the water is now.
That job fell to
the Mars Odyssey Orbiter,
which detected what is believed
to be massive quantities of water ice,
just a few feet below the surface, with
the highest concentrations at the poles.

In 2008, "Phoenix" will rise
from the ashes of the Mars Polar Lander,
and, using many of that
failed mission's spare parts,
will land near the Martian north pole.
And, for the first time ever,
a Martian probe will do more
than scratch the surface.
"Phoenix" will dig deep
into the permafrost
and sample Martian water
for the very first time.
Everything we learn about Mars
makes the story more exciting.
There's evidence of past water,
there's evidence of past volcanism,
the chemistry checks out.
All the ingredients for life are there.
That's why we keep searching.
Of course, that's not the only way
we're searching for life in the universe.
- Look at this, he's computer coordinated,
- I know,
It says, "SETI Institute"
on your shirt and on your laptop,
- It's a little over the top,
- That's impressive,
- You're putting the message out there,
- Well, you know, they gave it to me,
One of the groups
I'm affiliated with
is the Search for Extraterrestrial
Intelligence Institute.
And what the SETI Institute does
is try to detect intelligent signals
from distant civilizations
around another star.
To do this, Frank Drake,
one of the founders of the SETI Institute,
wrote down just a set of factors
known as the Drake Equation.
And it includes factors such as the fraction
of stars around which planets form,
the fraction of habitable planets

on which life emerges,
and the fraction of life
that then evolves to intelligence,
and eventually to becoming
tool-using civilizations
that can communicate with
other civilizations in the galaxy.
The last factor is the lifetime of the
intelligent communicating civilization.
At the same time
that we develop the technology
to communicate
with beings on a distant planet,
we also develop the technology
to annihilate ourselves.
And if that's standard
for intelligent civilizations in the galaxy,
we're not going to have much luck
searching for life elsewhere.
Let's say that my
kind of modified Drake's Equation
says that life was possible on any planet,
any distance from a sun,
or not even anywhere near a sun,
or any planetarylike body,
like a moon of Jupiter or whatever,
that had ice around it, OK?
And had some kind of tidal pumping
from some other gravity source near it,
so that it had a liquid core
and it was generating heat,
and it was making heat like these
hydrothermal vents that we're seeing,
If we said there were maybe ten or twenty
or fifty times as many worlds like that,
isn't it logical to assume that when we get
a call from one of your buddies out there,
when SETI Institute
finally picks up a signal,
it's gonna be coming from somebody
who had to bore up through ice
and set their transmitter
out on the ice?
Statistically, isn't that indicated

by what we're talking about here?
There's a flaw in that statement,

and that is:
We have no idea
about that right now,
We got one liquid water planet
in our solar system,
and we've already identified
three potential hydrospheres
- that are ice-covered and far from the sun,
- Right, But...
Based on our own immediate experience,
it's a three-to-one ratio,
Sure, sure,
Do we know if any of them are habitable?
- We don't, but we gotta go look,
- Right,
We may find that
icy little worlds like Europa
are where the bulk
of liquid water exists in our galaxy.
And, in fact,
that's where the bulk of life may exist.
Who knows?
But it is really interesting
to think about the evolution of intelligence
in an icy world system.
Would you evolve to intelligence?
Would you wonder about
the bottom of that ice shell?
Our primary focus at this site
will be for the mussels and the crabs,
OK, And you need mussels and crabs, and
we're gonna do the crabs in a crab trap?
We're gonna do crab traps,
So we're hoping that whatever we fix
in the crab trap will trap these guys,
Now, do you care
where we put the crab trap?
Preferably where there's crabs,
Yes, we're currently at
X coordinates minus 106,
Y coordinates minus 76. Over.

The story of the vents
is really the story of the microbes.
This is it, right here,
Bottom of the food chain,
Waving fields of bacteria,
The vent fluid is a kind of liquid sunshine,
powering the whole
food chain down here.
Some of the animals
are eating the bacteria,
some of them are preying
on the ones that eat the bacteria.
It's kind of ethereal, huh?
Who would have thought
that bacteria could be beautiful?
The animals
are eating the bacteria,
but there's something else
going on here too.
It's symbiosis, a dance of life
between partners of different species.
Vent animals,
like the shrimp and the mussels,
have formed
symbiotic relationships with microbes
that can live off of
the chemicals in the vent fluid.
Oh, we're near
something big, guys,
Large mussel beds,
This is the jackpot,
I study the metabolic
and molecular physiology
of mussels and crabs
that live at these deep sea vents.
I'm focusing on their ability
to withstand variations,
large variations, in temperature.
The genus Bathymodiolus
is the scientific name
for the mussels that we study.
We've got a mussel mound
over to the right, Genya,
I think this will be a perfect spot

to do our mussel collections,
- Yes,
- You see what I'm talking about?
I think these are mixed sizes,
Or can you get some small ones?
- We will take small and big also,
- But I need small,
- Only small?
- Only small,
- OK,
- Malinky. Yeah? Is that small?
- Yes,
- OK,
All right,
Keldysh, Keldysh, MIR One,
We have collected a full batch
of mussels in the clam bucket,
X minus 487, Y minus 64,
Oh, yeah! Bingo, baby,
Looks like you got your crabs,
Yes. We got crabs.
Big time. It's, like, full.
You did it, you did it!
Bio box is closed,
We have crabbage,
We have crabbage.
- Wanna open that?
- Yeah,
My PhD advisor is Jim Childress.
He's been studying
hydrothermal vent communities
since their discovery
in the late 1970s.
And he has years of experience
going to sea and doing science
in these extreme environments.
So the Childress lab
is one of the only labs in the world
that's able to keep
these animals and maintain them
in an environment similar
to what they come from.
As fast as we can,
we take the animals that were collected

and bring them into our lab,
where we place them
in a maintenance respirometry system.
We call this thing "the condo."
We put the animals in
these little condos,
we repressurize them up to
the pressure that they were collected in,
and we make sure that
we have them back at the temperature
that is optimal for their survival.
Then we pick some of the animals
to use for our experiments,
and we transfer them
into another system
that's called
the high-pressure respirometry system.
Now, this system
is extremely unique and special,
because here we can manipulate
the environmental conditions,
and we look at
the metabolic rates of the animals
as we vary their environmental condition,
and that's what I love to study.
By looking at mussels,
you can gain a better understanding
about temperature adaptation,
and that might help us in the future
when it comes to
the warming of our planet.
Global warming is real.
It's putting our planet at risk,
life as we know it, not just species.
I mean the whole food chain,
the whole ecosystem.
And at some point
we're gonna have to deal with it.
I think I got into the ocean
because it's mysterious to me,
it's unknown.
It's not explored,
it hasn't been conquered,
and I appreciate it,

and I have respect for it.
Did you ever think
you'd end up here?
Oh, God, no.
But I guess this is the path
of questions that I tried to answer,
which has led me on a path
that ended up here,
And so now the question
that I'm trying to answer
has me taking submarines
down to the bottom of the ocean,
OK, let's, uh...
Let the meeting come to order,
The dive will be Snake Pit,
The pilots will be Dr, Anatoly Sagalevitch,
MIR One, Genya Chernaiev, MIR Two,
We find a structure
that we can work the 'bot,
So we'll land at the base and we'll just
try to work up through the structure,
ideally up all the way to a chimney,
There is not supposed to be
too much hot venting on the wall,
some shimmering water,
but I don't think the hot vents happen
until way at the top, is that correct?
The best way to visualize this stuff
is wherever you see something black,
that's like a blowtorch,
That's, you know,
a blowtorch made out of water,
OK, there's MIR One,
They're coming up
with us, aren't they?
You're about halfway
up the structure right now,
so if you just work your way
forward along the wall.
Copy that.
There's an antler-shaped stone
bowl that's filled with juvenile "Rimicaris."
Roger that,
All right, This is, I think,

the structure he was describing,
and I think I can get in
a little closer to it,
That's it,
You should see 'em now, Over,
- Got it,
- Oh, wow,
Copy that, We see it,
These little shrimp are different,
Are these related?
Yes, Juvenile and adults,
The vent shrimp, "Rimicaris exoculata,"
are grazing on the bacteria
growing all around them.
- Are you seeing this crab?
- I sure am,
Look at 'em, They're eating the bacteria
that's growing all over that crab,
Oh, he almost got that guy,
Look at that,
He's all covered with this bacteria,
He doesn't know it, he just thinks
the shrimp are picking on him,
It's like crab-fu here
at the bottom of the ocean,
- The shrimp colony, There you go,
- There it is,
- Let's check that guy out,
- OK,
- This is black smoke,
- Look at these guys,
I can't believe they're swimming in and out of it,
Oops, Aah! It's hot,
OK, if it's not cooking them,
it's not gonna cook me,
So I'm gonna move in a little closer,
Being bold,
- Now let's get out, Back out,
- I've got full back command,
- What the heck?
- All right,
- They're attached to us,
- Let's stay away from that,
- They're on us,

- They're attacking us!
Lookit, the shrimp love him,
They're all over him,
The shrimp are loving Jake,
Check that out,
Look at that,
Oh, wow, Oh, my goodness,
I can't even see the fly,
I just see shrimp,
Yeah, looks like
we've got some piggybackers,
some shrimp that are
along for the ride, Over,
Wow, That's amazing,
I can get shrimp at Sizzler, This...
You can't get this shrimp at Sizzler,
"Riftia," the giant tubeworms,
are hands down
the stars of the deep vent community,
and also the best example
of symbiosis in action.
I've got a little bit of
shimmering water here,
We should be OK,
Wow, Oh, this is gorgeous,
These animals don't even have a stomach.
They literally can't eat.
They depend completely on
a large sac of microbes inside their body,
which produces their food.
When you get in really close,
you can see some pretty neat stuff,
Oh, wow,
You see that guy?
Can we grab him?
If you want to,
You get ready, I think we're set,
On your mark...
- Oh, he might come to us,
- Go,
Oh!
Crab got away, Tell 'em nice try,
Nice try, nice try,
They're gorgeous underwater,

The long red plume is like a gill.
It takes in oxygen,
and also nutrients from the vent fluid.
The worm's job
is to keep this plume in the flow,
sucking in nutrients
which feed the bacteria inside.
And it's the bacteria's job to convert the
sulfide chemicals into food for the worm.
So the question is,
do the bacteria work for the worm,
or does the worm
work for the bacteria?
If these animals didn't exist,
we could not have imagined them.
It makes me wonder what else
is out there, waiting to be discovered.
You've got a cool job, Genya,
Thank you,
So the real question is, could you
imagine a colony of these on Europa?
Where would the oxygen
be coming from, you know?
If the whole idea is they don't
need sunlight to drive this ecosystem,
it's just chemosynthesis,
but they need some ambient oxygen,
- The oxygen in the water came from...
- Photosynthesis,
Photosynthesis
a million years ago, maybe,
It doesn't matter, however long
it takes for the water to turn it over,
So the question becomes,
is oxygen necessary for life?
- Ah, yeah, Yeah,
- OK?
It may be for large animals, OK?
But if we get down to the microbial level...
- But we want to see large animals,
- You want to see large animals,
We want to see large animals,
We don't want to spend all this money
to go out into space and find a microbe,

Oh, come on, microbes are great,
You know, they're highly underrated,
But they're not good conversationalists,
I mean, look, I would want to give...
Here, look, let me just go forward
to one of these cool Riftia patches...
What do you think
makes life here possible?
These guys have this
incredible symbiosis with microbes,
Yeah, they're living on the bacteria,
But I'm not gonna give
a bouquet of bacteria to my mom,
but I would give her
a bouquet of these Riftia.
Look at these things,
They're beautiful,
So what Jim says is right.
O xygen is the afterburner that fuelled the
explosion of multicellular life on our world.
And even though chemosynthesis
happens beyond the light of our sun,
many of the biological processes
still require some free oxygen,
and this oxygen is typically supplied from
photosynthesis at the surface of the Earth.
So where might oxygen
come from on Europa?
Europa's orbit sits within Jupiter's
enormous magnetic field.
The intense radiation
continually slams energetic particles
into the Europan surface,
and has the potential
to transform vast amounts of water ice
into things like hydrogen peroxide
and molecular oxygen.
Assuming those oxidants make their way
into the ocean on a regular basis,
through cracks
and upwellings or comet impacts,
they would represent an energy jackpot
for any life forms trying to survive there.
And so this is where

some of the hydrothermal samples
come into play again.
We're trying to replicate the Europan
surface environment in the lab.
Now, these,
these are rocks from the deep ocean,
So let's prep this for the chamber,
- Maybe take a little piece off of here,
- OK, sure,
So this is Europa in a can,
This part down here
is a vacuum chamber,
We've got liquid nitrogen coming in,
and we can grow ices
and basically replicate
the surface environment of Europa,
Then, up here,
we've got a high-energy electron gun,
and what this does is replicate the radiation
environment of the Jovian magnetic field,
this tremendously large
and powerful magnetic field of Jupiter,
What would happen to life
exposed to that environment?
We're taking microbes that we found
down at the hydrothermal vents,
putting them into this environment,
and bombarding them, blasting them,
with this high-energy radiation,
making sort of a chemical junkyard,
a biological chemical compound junkyard,
And this is sort of comparable to,
say, going to a junkyard here on Earth,
and you wander around the junkyard
and you see a steering wheel and a tire,
and you know that at one point
there was a complete car,
When we send a spacecraft to Europa,
we're going to have to understand
what are the chemical and molecular
biosignatures that are left behind?
Are we seeing that same
kind of signature on the surface of Europa?
If we do, what does that imply

for the habitability of the ocean below?
Menez Gwen's
an underwater volcano.
It's this really unique place because
you have your hydrothermal vents there,
and shimmering water everywhere.
- Are we digging this place?
- We're digging this place big time,
Big time,
Really see the clear fluids,
So these are a little bit cooler, 'cause
you're not getting the black smoke here,
This site has an amazing dreamlike quality.
The cooler, clear vent fluid
isn't as toxic as the black smokers.
So you wind up
getting a lot of visitors.
Including some opportunistic predators.
Oh, look at all that shimmering water
coming out of that structure,
If we can collect a sample down there,
that would be fantastic,
MIR One, MIR One, MIR Two,
This is MIR One.
Go ahead.
OK, Jim, we're ready now to launch Jake,
Ready to go now,
Here we go,
Coming out,
- Everything working OK?
- Yeah, it seems OK,
So getting to work with Mike
and Jake is just absolutely fantastic,
because you can think about this thing
as the distant ancestor of a vehicle
that may someday
explore oceans on other worlds.
OK, Mike, looking good, You should
be able to take your core sample
right at the base of
that chimney, Over,
- Looks pretty hot though, Kevin,
- It's just like a burning tree stump,
That is just incredible,

OK, it looks like most of the fluid
is coming out here and here,
Can we go in right there?
I will do the best I can,
but I'm working really hard,
We're in some kind of
convective flow here,
We're in there now,
You wanted close, we're close,
Be careful,
Looks like he's hit a blowtorch, doesn't it?
Think he's getting hit,
Mike, back up, back up, You got the top of
the 'bot is right in the vent fluid, Over,
Can you see if I'm in the hot water?
You really want to know?
Nice, Mike,
Just be the 'bot, Mike, Be the 'bot,
Stay calm, you got it,
Yeah, I'm gonna
just do this as quick as I can,
- Oh, yes!
- I think we got it, I think we got it,
Hey, we gotta just go cap this sample,
We just poked it right into the chimney,
Yeah, copy that, Congratulations,
Go back and cap it,
Roger that,
Coming home,
- Yeah,
- Look at...
Jake took some hits,
Other than the damage here
and here, it looks in pretty good shape,
Yeah, that was pretty fun,
Pretty intense,
Diving with Mike was great fun.
He is a mastermind with the robot.
I didn't realize how much
went into making that 'bot work right.
All right, it needs to come up,
A little more, Pete,
The 'bot had to be small
so that it could fit on the MIR.

It had to have
its own onboard power supply.
...back to neutral and we're ready to go,
Inside the sub,
I have a laptop and a joystick,
and that's all I have inside the sub.
The fiber is unique.
It allows us to send
a light pulse back and forth to the vehicle.
That's how we talk to the vehicle.
And we can control
the little camera as well.
The 'bot creates
a telepresence for us.
It actually allows us to feel
like we're outside of the submarine.
- All right, I'm gonna get a little bit closer,
- Oh, he's beautiful,
I never saw anything
like this, Look at that,
Uh-oh, he sees us now,
Hey, hey, hey!
He's going after you!
Look, look, look,
he's grabbed the gripper,
He's putting his tentacles on the gripper,
This is cool,
Who's grabbing who?
That was incredible,
It deliberately reached straight out
and probed the gripper,
I've never had
an encounter like that with the ROV,
with an animal that came right up
to us and touched the ROV like that,
It was an extraordinary encounter.
It was as though
I got to shake hands with an alien.
As an underwater explorer,
that was probably one of the highlights
of my whole experience underwater.
It's not hard to imagine
that someday it would be possible
to explore oceans on another world.

So getting an idea
of what it's like to explore
these extreme environments
on our own planet
could very well
pave the way to exploring Europa.
A mission to explore
under the ice of Europa
would be the ultimate
robotic challenge.
During the landing,
the team in mission control
would pretty much
be along for the ride.
Europa is so far away,
that even at the speed of light
it would take more than an hour
for a command just to reach the vehicle.
It's really on its own.
It has to be smart enough
to avoid terrain hazards,
and to find
a good landing site on the ice.
Now we have to get through the ice.
You need a melt probe.
It's basically a nuclear-heated torpedo.
The ice could be anywhere
from three to sixteen miles deep.
Week after week, the melt probe will sink
of its own weight through the ancient ice.
Until finally...
Now, what are you gonna do when
you reach the surface of that ocean?
You need an AUV,
an Autonomous Underwater Vehicle.
It needs to be one smart puppy,
able to navigate and make decisions
on its own in an alien ocean.
Europa has internal heat.
It may well have hydrothermal venting.
If it does,
and if the chemistry is right...
It will have an enormous impact on humanity
if we find life

in an ocean on another world.
But in order to find it,
we have to go there.
And to go there,
we have to continue the journey here.
Exploration is like a muscle. You have
to exercise it to make it stronger.
And if water is
the common ingredient for life,
we need to take what we know
about deep ocean exploration
and apply it to space, giving scientists
and explorers the experience they'll need
to follow the water,
wherever it might be.
Discovering life at the vents
shows us that nature has more to teach us
than we can possibly imagine.
But I wonder,
what would it be like
if we were exploring
the ocean on another world?
- All stop,
- Stopping,
Hold it steady here,
It might completely
change our definition of life.
Let's see what they do,
Right on,
Houston, "Endurance." We have arrived
on station at the coordinates,
and we have some new friends.
Who knows what's out there?
So we have to go.