
30 MINUTES TO MARS
JOURNEYTOMARS
NASA
30 MINUTES

1
00:00:08,670 --> 00:00:12,370
>> For the next 30 minutes we're going to
take you on a trip to Mars and back.

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00:00:12,370 --> 00:00:16,740
Good day, I'm Amiko Kauderer with NASA Public
Affairs and I'm joined in by an expert in

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00:00:16,740 --> 00:00:21,240
the field of planetary science Jim Green,
Director of NASA's Planetary Division.

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00:00:21,240 --> 00:00:25,350
Also joining us is NASA astronaut, Stan Love.

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00:00:25,350 --> 00:00:30,109
NASA has robots and Rovers on the surface
of Mars and is planning on sending humans

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00:00:30,109 --> 00:00:34,590
there as soon as technically possible but
there are stepping stones to getting there

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00:00:34,590 --> 00:00:39,540
conducting valuable scientific research and
returning home safely. What we've learned

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00:00:39,540 --> 00:00:44,680
up to this point has been invaluable in providing
the initial exploration steps to one day sending

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00:00:44,680 --> 00:00:50,019
astronauts to Mars and Jim is here to discuss
the next steps and help answer the questions

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00:00:50,019 --> 00:00:55,420
of what a crew might experience on the Martian
surface. What kind of samples could be returned

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00:00:55,420 --> 00:01:00,540
that would provide scientific value and also
determine how crews could use natural resources

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00:01:00,540 --> 00:01:06,670
to live off of land for short and eventual
long-term stays on the red planet and no stranger

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00:01:06,670 --> 00:01:12,119
to space flight astronaut Stan Love also joins
us in the discussion of what it takes to live

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00:01:12,119 --> 00:01:17,130
in space for what we consider long durations
right but what will be considered short one

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00:01:17,130 --> 00:01:23,329
day as human missions become longer and distance
from earth become greater. So I understand

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00:01:23,329 --> 00:01:30,329
we have had few Mars Rovers out there roving
the land since gosh back in the 1990s, correct?

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00:01:32,090 --> 00:01:32,560
>> Correct.

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00:01:32,560 --> 00:01:35,790
>> So what can you tell us? What have we learned
so far?

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00:01:35,790 --> 00:01:40,679
>> Well the Rovers really provide invaluable
information about various regions that they

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00:01:40,679 --> 00:01:46,460
roam because as you get up close and personal
you can really look at the rock structures.

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00:01:46,460 --> 00:01:52,090

You can really see much more about the mineralogy
and their elemental composition and that's

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00:01:52,090 --> 00:01:56,939
incredibly important. Not only does it tells
us about the history of Mars but it allows

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00:01:56,939 --> 00:02:03,939
us to think about how we can use the resources
that are trapped in the rocks for supporting

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00:02:04,539 --> 00:02:08,970
humans as we might need to when we go there.

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00:02:08,970 --> 00:02:13,800
>> Okay and so for you Stan being an astronaut
what does this whole journey the Mars mean

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00:02:13,800 --> 00:02:14,519
to you?

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00:02:14,519 --> 00:02:19,430
>> Well, it's the ultimate goal for human
exploration the furthest thing out that we

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00:02:19,430 --> 00:02:24,659
can think of for the next 30 or 40 years.
There are other destinations in the solar

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00:02:24,659 --> 00:02:28,909
system that we could send people to but most
of them are even harsher and more difficult

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00:02:28,909 --> 00:02:35,909
to reach than Mars. Mars is a whole world.
It's as big as a major continent on earth

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00:02:36,590 --> 00:02:41,909
and it basically unexplored. We have photographs
from orbit. We have a few kilometers worth

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00:02:41,909 --> 00:02:46,090
of Rover driving but it would be wonderful
to send humans there and see what we can see

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00:02:46,090 --> 00:02:47,459
with our own eyes.

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00:02:47,459 --> 00:02:51,769
>> So what are some of your questions for
Jim Green here being an astronaut and thinking

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00:02:51,769 --> 00:02:56,300
about that harsh environment. What are the
things that you would have to ask him?

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00:02:56,300 --> 00:03:01,170
>> Well the things that we'll have to solve
before we can send people to Mars include

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00:03:01,170 --> 00:03:05,360
what's the radiation environment like down
on the surface? We already know what sort

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00:03:05,360 --> 00:03:11,250
of temperatures we'd have to protect our people
and systems against. How prevalent are the

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00:03:11,250 --> 00:03:17,810
dust storms and especially how bad is that
dust to deal with on a personal level? We

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00:03:17,810 --> 00:03:21,629
understand that it can have effects on solar
panels. So if we're using solar power how

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00:03:21,629 --> 00:03:26,099
on the surface of Mars you don't want your
power station to get covered with dust and

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00:03:26,099 --> 00:03:31,430
not produce power anymore. We're interested
to know if the chemistry of the rocks and

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00:03:31,430 --> 00:03:36,159
dust are somehow dangerous to people. We're
used to living with rocks and dust here on

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00:03:36,159 --> 00:03:41,260
earth and it's usually not a big problem but
if the chemistry on Mars is different enough

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00:03:41,260 --> 00:03:45,170
we come back into our habitat with dust all
over our suits is that going to give people

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00:03:45,170 --> 00:03:51,659
allergies or poison them, all good stuff to
know and then of course, most of our activities

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00:03:51,659 --> 00:03:55,799
on the surface of Mars are probably going
to be related to geological science. When

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00:03:55,799 --> 00:04:02,060
we send crews there we will send some pilots
and engineers. We're also going to send some

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00:04:02,060 --> 00:04:06,659
geologists and planetary scientists and it
will be interesting to know what tasks they'll

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00:04:06,659 --> 00:04:08,670
be doing down there on the surface.

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00:04:08,670 --> 00:04:14,590
>> We actually understand the radiation environment
reasonably well and what we find since we've

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00:04:14,590 --> 00:04:21,109
been measuring in space that down on the surface it's about half as much as it is in space.

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00:04:21,109 --> 00:04:26,650
So the atmosphere doesn't really provide an extensive amount of protection. The reason

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00:04:26,650 --> 00:04:33,650
why it's half as much is because the planet is protecting you from half of the sky. In

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00:04:34,290 --> 00:04:40,640
terms of other resources, the dust is a problem although it may not be as big a problem as

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00:04:40,640 --> 00:04:47,640
we thought. Mars is very dusty through the whole planet and in fact at some times and

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00:04:48,430 --> 00:04:54,930
there are certain seasons in particular where global dust storms may exist but the dust

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00:04:54,930 --> 00:05:01,930
actually is fairly not thick but thin in the sense that dust storms can actually reach

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00:05:04,580 --> 00:05:11,580
very high altitude and really provide an opaque view of your horizon and the sun. So they

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00:05:16,600 --> 00:05:22,120
block out a lot of the light, still get into everything and we'll have to watch how to

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00:05:22,120 --> 00:05:28,340
manage and manipulate that, but it's probably not as big a problem, something that we'd

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00:05:28,340 --> 00:05:35,340
be able to manage. There are regions on Mars
where there might be some pretty harsh chemicals

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00:05:35,460 --> 00:05:42,460
that are embedded in the soils and so you're
going to want to constantly take soil samples

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00:05:43,750 --> 00:05:48,740
perhaps before we land in a particular area
we're going to want to return those samples,

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00:05:48,740 --> 00:05:54,070
analyze them and know exactly what we're getting
into before we go there. So that would be

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00:05:54,070 --> 00:06:00,350
something important. I agree with you completely.
A lot of geology can be done. The geology

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00:06:00,350 --> 00:06:07,350
will tell us the history of Mars. We now know
that Mars in its past had extensive amount

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00:06:07,760 --> 00:06:14,760
of water perhaps oceans, certainly rivers,
lakes, fast moving water for tens of millions

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00:06:16,170 --> 00:06:22,360
of years maybe even hundreds of millions of
years and so consequently, there's a fair

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00:06:22,360 --> 00:06:28,450
amount of water still left on Mars. We know
that the atmosphere has changed significantly.

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00:06:28,450 --> 00:06:33,290
The water is mostly evaporated but it now
looks like a lot of water is actually seeped

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00:06:33,290 --> 00:06:40,170
into the ground and so you'll have some resources
available to you. You'll have water resources.

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00:06:40,170 --> 00:06:46,380
You'll have a variety of minerals and maybe
building materials that you can get access

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00:06:46,380 --> 00:06:51,600
to. That'll be important in terms of supporting
humans. The science that you'll do will be

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00:06:51,600 --> 00:06:58,130
absolutely spectacular. You know Rovers have
been on Mars for many years like Spirit and

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00:06:58,130 --> 00:07:03,260
Opportunity. Spirit no longer is operating
but Opportunity still is and Curiosity just

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00:07:03,260 --> 00:07:08,270
passed its second year anniversary and although
they've made a lot of measurements and done

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00:07:08,270 --> 00:07:13,330
a lot of things and traveled many kilometers
on Mars, actually humans could have done most

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00:07:13,330 --> 00:07:20,330
of what they did in a much more rapid timeframe
perhaps a matter of days if not weeks could

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00:07:20,520 --> 00:07:25,380
have collected the kind of information they
are doing but with that information it's providing

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00:07:25,380 --> 00:07:32,380
us what we call ground truth. It enables us
to then use our orbital assets and say here's

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00:07:33,130 --> 00:07:38,270
what hematite looks like. Here's what the
clays and sulphur look like down on the ground

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00:07:38,270 --> 00:07:42,700
and here's what it looks like when we map
that from space and then we can look at the

84
00:07:42,700 --> 00:07:49,200
rest of the global resources that exist on
Mars. Mars is truly a fantastic place. The

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00:07:49,200 --> 00:07:56,200
vistas are absolutely unbelievable. There's
huge canyons you know, like Valles Marineris

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00:07:56,350 --> 00:08:01,920
if it was on the United States Valles Marineris
would stretch across the United States from

87
00:08:01,920 --> 00:08:08,920
one end to the other. Huge shield volcanos
you know. Mount Olympus is as big as the State

88
00:08:10,390 --> 00:08:17,390
of Missouri. I mean, there's just a tremendous
variation in the land and the geology and

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00:08:18,140 --> 00:08:21,520
that provides a lot of exciting opportunities
for the scientists.

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00:08:21,520 --> 00:08:24,630
>> It's a lot of really interesting things
we're talking about here. First I'd like to

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00:08:24,630 --> 00:08:29,690
go back to you. You talked about some of the
things about getting to samples. I know we

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00:08:29,690 --> 00:08:34,649
gathered a lot back in the days of the Apollo
days when we had the moon rocks. What is it

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00:08:34,649 --> 00:08:39,210
that you hope that we'll be bringing back
and returning Mars rocks?

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00:08:39,210 --> 00:08:43,969
>> Well you know we're still actually still
looking at the lunar rocks. We have a variety

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00:08:43,969 --> 00:08:49,620
of fabulous laboratory equipment that's been
developed that allow us to really take those

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00:08:49,620 --> 00:08:56,620
rocks apart and understand the early evolution
and composition of the moon and the earth.

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00:08:58,939 --> 00:09:03,819
We want to do the same thing at Mars. We want
to be able to obtain samples, analyze them

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00:09:03,819 --> 00:09:09,189
in our laboratories. You know, we just can't
build a Rover big enough to be able to take

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00:09:09,189 --> 00:09:14,360
the equipment that we currently have in our
labs now and that's essential if we really

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00:09:14,360 --> 00:09:19,420
want to study the detailed geology and the
geological history of Mars.

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00:09:19,420 --> 00:09:24,620
>> So, can you tell me now what from those
samples just from the images alone not the

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00:09:24,620 --> 00:09:29,720
actual rocks what do we know so far just from
the images that we've received from Curiosity

103
00:09:29,720 --> 00:09:31,220
and the other rovers?

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00:09:31,220 --> 00:09:36,949
>> Well what we're finding out now is Mars
has some fundamental material that is incredibly

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00:09:36,949 --> 00:09:43,949
important. It has in the rocks we find hydrogen,
nitrogen, oxygen, phosphorous and sulphur.

106
00:09:46,329 --> 00:09:52,069
Those are some of the basic building blocks
of life. It also sees that this material was

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00:09:52,069 --> 00:09:59,069
deposited over time in rapidly flowing water
and so we can tell that the water in millions

108
00:09:59,860 --> 00:10:04,920
and billions of years ago when it existed
on Mars was actually drinkable. It wasn't

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00:10:04,920 --> 00:10:11,920
salty at all. So it really looks like back
in Mars' early history based on the chemistry

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00:10:12,149 --> 00:10:18,569
and based on what we're finding in the rocks
that Mars could have had a number of habitable

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00:10:18,569 --> 00:10:24,499
environments in it and perhaps life started
on Mars just like it did here on earth.

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00:10:24,499 --> 00:10:29,259

>> So is it safe to say that Mars is we feel resourceful enough for us to actually live

113
00:10:29,259 --> 00:10:34,560
off the land which I'm going to turn now to Stan and ask you? Now that's a long trip.

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00:10:34,560 --> 00:10:38,690
How do you think that we're going to go about it? What are the plans?

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00:10:38,690 --> 00:10:42,639
>> Well, that's two different questions. How are we going to get there for the long trip

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00:10:42,639 --> 00:10:47,699
and what could we use to live off the land? How we're going to get there is a tough, tough

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00:10:47,699 --> 00:10:54,389
problem. We would need a ship about the size of the International Space Station and then

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00:10:54,389 --> 00:10:57,540
we would have to accelerate that clear out of the earth's gravity. It would have to fly

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00:10:57,540 --> 00:11:02,699
through space for nine months to arrive at Mars and then when you get to Mars you can't

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00:11:02,699 --> 00:11:06,410
just plant the flag and come home the way we did on the moon. The moon is always circling

121
00:11:06,410 --> 00:11:10,279
the earth you can come home anytime you want. If you land on Mars and then take right back

122
00:11:10,279 --> 00:11:16,040

off again try to come back to the earth, you
are likely to arrive at the Earth's distance

123
00:11:16,040 --> 00:11:22,209
from the sun while the earth is on the other
side of the sun and then that's not so good.

124
00:11:22,209 --> 00:11:28,779
We never come home that way. So you're sort
of committed to a stay of about one Earth

125
00:11:28,779 --> 00:11:35,769
year or about half a Mars year on the surface
of Mars before you can come home. All total

126
00:11:35,769 --> 00:11:41,279
trip duration 30 months, so two and a half
years. Then the systems that we'll need, we're

127
00:11:41,279 --> 00:11:46,120
not sure how to land a 40 ton habitat on Mars.
Remember you're going to live in this thing

128
00:11:46,120 --> 00:11:50,459
for a year. So if you try to live in something
the size of a minivan with your three buddy's

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00:11:50,459 --> 00:11:54,629
for a year it's probably not going to work
so well. Plus you have to bring all your food,

130
00:11:54,629 --> 00:12:00,220
all your water, all your breathing air in
case you're not able to use the resources

131
00:12:00,220 --> 00:12:06,199
that are there on Mars and that adds up to
a lot of weight. Right now you can land something

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00:12:06,199 --> 00:12:10,499

up to a few hundred pounds on Mars under a parachute with airbags but if it's bigger

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00:12:10,499 --> 00:12:15,509
than that the atmosphere is too thin to provide enough deceleration of parachutes so you have

134
00:12:15,509 --> 00:12:19,879
to go to a rocket stage that actually slows you down and then lands you gently on the

135
00:12:19,879 --> 00:12:26,600
surface. We're not sure how to do that. One of the things that the Space Station is teaching

136
00:12:26,600 --> 00:12:31,509
us is that once we've built a machine and near and dear to the crew's heart is the life

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00:12:31,509 --> 00:12:36,749
support systems, a machine that takes carbon dioxide out of the atmosphere for instance.

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00:12:36,749 --> 00:12:40,459
You're always breathing in oxygen. You're breathing out carbon dioxide. Once carbon

139
00:12:40,459 --> 00:12:47,019
dioxide gets up to a percent or so of the air you're breathing or even less it starts

140
00:12:47,019 --> 00:12:52,329
causing headaches. You get changes in your blood chemistry. It's not a good scene. We

141
00:12:52,329 --> 00:12:56,589
have those machines on the space station and there not as reliable as they we hoped they

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00:12:56,589 --> 00:13:00,749

would have been so the crews always having
to tear them a part and put them back together

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00:13:00,749 --> 00:13:06,019
again using spare parts brought from earth.
Now if you're on your way to Mars for two

144
00:13:06,019 --> 00:13:11,290
and a half years you have to bring all the
spare parts with you or do without. So that

145
00:13:11,290 --> 00:13:17,660
kind of reliability is something we still
need to perfect. We're not there yet. As far

146
00:13:17,660 --> 00:13:24,660
as living off the land. So Mars has the chemicals
of life. The atmosphere is carbon and oxygen

147
00:13:25,199 --> 00:13:30,050
and nitrogen. That's great. Oxygen and nitrogen
are what we breathe here but Mars' atmosphere

148
00:13:30,050 --> 00:13:37,050
is very, very thin. It's like being at a hundred
thousand feet altitude on the Earth and you

149
00:13:37,420 --> 00:13:42,600
can't live at that altitude. They call above
26,000 feet on Earth the death zone. Once

150
00:13:42,600 --> 00:13:47,309
you're up there climbers of high mountains
like K2 in Mount Everest their bodies are

151
00:13:47,309 --> 00:13:54,119
breaking down every minute they're above 26,000
feet plus the chemistry of Mars' atmosphere

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00:13:54,119 --> 00:13:58,439

we're breathing oxygen. It's a very reactive chemical. If we didn't have plants regenerating

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00:13:58,439 --> 00:14:03,110
our oxygen here on Earth in a few hundred years it would be gone completely and the

154
00:14:03,110 --> 00:14:09,529
atmosphere would not support human life. Mars does not have that kind of biosphere creating

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00:14:09,529 --> 00:14:15,019
oxygen that we can breathe so its atmosphere is chemically at equilibrium with the surface.

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00:14:15,019 --> 00:14:19,869
It's just carbon dioxide. We can split carbon dioxide up into carbon and oxygen and make

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00:14:19,869 --> 00:14:26,600
oxygen but that takes a lot of energy and the machinery to do it we're not sure we can

158
00:14:26,600 --> 00:14:31,569
make to be perfectly reliable. We know there's lots of water on Mars. It has polar caps made

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00:14:31,569 --> 00:14:36,430
out of frozen carbon dioxide, dry ice and water ice and we know there's a lot of water

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00:14:36,430 --> 00:14:42,490
frozen in the ground. You can dig that up and use it but again you need digging equipment

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00:14:42,490 --> 00:14:45,939
that's going to work on Mars essentially in a vacuum at temperatures that can go down

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00:14:45,939 --> 00:14:50,680

to a hundred degrees below zero at night and
you know your car doesn't like to start at

163
00:14:50,680 --> 00:14:57,119
100 degrees below zero. So, there's a great
deal of technology that we sort of take for

164
00:14:57,119 --> 00:15:02,199
granted here on Earth mining machinery, chemical
processing machinery. You go up the road here

165
00:15:02,199 --> 00:15:07,269
you know. We live in Houston see all these
amazing huge chemical plants. That kind of

166
00:15:07,269 --> 00:15:12,240
chemistry you can do with the infrastructure
that we have here on Earth. On Mars we'd have

167
00:15:12,240 --> 00:15:18,829
to bring it all with us. So the near term
missions from Mars that I've seen described

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00:15:18,829 --> 00:15:24,470
are a little hesitant to use what's on Mars
not because it's not there but because we're

169
00:15:24,470 --> 00:15:29,040
not sure we'll have the technology we need
to use it when we get there. So we'd rather

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00:15:29,040 --> 00:15:34,170
bring something with us and be absolutely
sure we can get it and use it than be depending

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00:15:34,170 --> 00:15:36,819
on something get there and find out we can't
get it.

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00:15:36,819 --> 00:15:37,309

>> Definitely.

173
00:15:37,309 --> 00:15:38,430
>> That's not so good.

174
00:15:38,430 --> 00:15:43,699
>> Well that's very interesting. So, let's
talk again now. I'm going to just throw it

175
00:15:43,699 --> 00:15:48,290
out there because everyone wants to know.
Is there life on Mars? I mean, we say it's

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00:15:48,290 --> 00:15:53,980
a living planet. Do we know? Are we hoping
that maybe we'll find something? What would

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00:15:53,980 --> 00:15:58,079
Stan be looking for if he's out there, if
he's out to search for life on Mars?

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00:15:58,079 --> 00:16:02,670
>> We don't know if there's life on Mars or
not you know, so we're actually seeking the

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00:16:02,670 --> 00:16:09,670
signs of life. Life may have been in an environment
in its past where it could have started and

180
00:16:12,160 --> 00:16:18,269
evolved over a period of time. There's certainly
not complex life. There might be microbial

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00:16:18,269 --> 00:16:24,300
life and if microbial life is there it's going
to be probably under the surface you know,

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00:16:24,300 --> 00:16:31,129
when an environment gets tough life seems
to move into the rocks. You know, here on

183
00:16:31,129 --> 00:16:36,959
Earth planetary science has an activity of
looking for life in the extremes. We go out

184
00:16:36,959 --> 00:16:43,529
in the driest deserts. We go down in the deepest
mines and every place we go we do indeed find

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00:16:43,529 --> 00:16:50,339
life on this planet. It's really remarkable
and so Mars may also have been an environment

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00:16:50,339 --> 00:16:57,290
for which as the climate changed which it
did at some time in its past in a significant

187
00:16:57,290 --> 00:17:04,089
way, losing most of its water and a lot of
its atmosphere then life could have gone underground.

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00:17:04,089 --> 00:17:11,089
So that's a possible approach for us to take
in the next series of missions where we actually

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00:17:11,150 --> 00:17:18,150
are then more sure that we can go to an area
where there's possible conditions, habitable

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00:17:19,050 --> 00:17:23,010
areas where we would look for life but we
don't know that they're there. We don't know

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00:17:23,010 --> 00:17:30,010
if extant life meaning current life is there
now. There's also potentially some past life

192
00:17:31,570 --> 00:17:37,990
that may be found within the rock remnants
that we would want to bring back and analyze.

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00:17:37,990 --> 00:17:43,330
We don't know if that's possible or not. So
those are approaches but I tell you what's

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00:17:43,330 --> 00:17:49,840
really exciting is we're really now starting
on the path of looking for life at Mars whether

195
00:17:49,840 --> 00:17:56,840
it's extinct or currently their extant life
and I think we're going to find some exciting

196
00:17:57,510 --> 00:17:59,570
things as we move in that direction.

197
00:17:59,570 --> 00:18:03,670
>> I actually to be honest I never thought
that I would be sitting here talking about

198
00:18:03,670 --> 00:18:08,520
going to Mars and here we are. So it is all
so very exciting. So just tell me though exactly

199
00:18:08,520 --> 00:18:12,610
where are we as far as going? There's a lot
that we know but there's still a lot we don't

200
00:18:12,610 --> 00:18:17,070
know. Where are we on the slide rule of getting
to Mars?

201
00:18:17,070 --> 00:18:22,980
>> Well indeed with our orbiters and our rovers
we know an extensive amount about Mars. This

202
00:18:22,980 --> 00:18:29,980
actually helps Stan and the engineers here
at JSC to really do a number of practical

203
00:18:32,580 --> 00:18:39,250
things in terms of the life support system,
in terms of where they might go, what they

204
00:18:39,250 --> 00:18:45,580
might do and the resources that they would
need but we're really just starting that process.

205
00:18:45,580 --> 00:18:50,560
I think as we get towards the end of this
decade and certainly into the next decade

206
00:18:50,560 --> 00:18:57,560
we're going to start using a variety of instruments
and experiments that we put on the surface

207
00:18:57,980 --> 00:19:04,740
of Mars that would extract those resources.
Now a perfect example is a rover that we're

208
00:19:04,740 --> 00:19:11,140
putting together right now. It's designed
to be launched in 2020. We'll sit on Mars

209
00:19:11,140 --> 00:19:17,480
in 2021 and it has one instrument that will
bring in the carbon dioxide and separate the

210
00:19:17,480 --> 00:19:24,010
carbon from oxygen, separate and create the
02. So it's our first major step in being

211
00:19:24,010 --> 00:19:31,010
able to demonstrate that we can actually do
this in a reliable way and understanding when

212
00:19:32,040 --> 00:19:38,670
it might work the best. The huge swings in
temperature on Mars, does it work better during

213
00:19:38,670 --> 00:19:44,600
the day than the night? What about seasonal differences. All those things we can begin

214
00:19:44,600 --> 00:19:50,890
to collect data and that will really aid the mission planners and be able to develop those

215
00:19:50,890 --> 00:19:53,280
systems that they can begin to rely on.

216
00:19:53,280 --> 00:19:57,640
>> And do we have a landing site determined yet for the 2020 rover?

217
00:19:57,640 --> 00:20:02,360
>> Actually, we're right now in the process of finding out where are the best places for

218
00:20:02,360 --> 00:20:09,360
the 2020 rover to go to. We started out with 100 sites. We took a good look at about 30

219
00:20:10,790 --> 00:20:16,060
of them. Now we have about the top nine or 10 of them for which we're requiring much

220
00:20:16,060 --> 00:20:22,060
more data from our orbiting assets and this data will be used to whittle it down to the

221
00:20:22,060 --> 00:20:24,390
top site over the next couple of years.

222
00:20:24,390 --> 00:20:28,660
>> Can you describe what these areas of interest are or somewhat like?

223
00:20:28,660 --> 00:20:35,660

>> Well one of the things that we want the
2020 rover to do is to core into the rock

224
00:20:35,810 --> 00:20:42,120
and then interrogate the hole, look at what's
happened over time in that rock record and

225
00:20:42,120 --> 00:20:47,840
then if we find something really exciting
we want to be able to cache the rock. Put

226
00:20:47,840 --> 00:20:53,020
it in a little sleeve and stick it in a container
for potential return to Earth where we can

227
00:20:53,020 --> 00:21:00,020
analyze it much more extensively as I mentioned
earlier. So we want to go a geologically diverse

228
00:21:00,860 --> 00:21:07,860
site, an ancient site, a place that held a
lot of water for long periods of time on Mars,

229
00:21:08,940 --> 00:21:15,940
a place where life could have existed if it
started there at that time and so there are

230
00:21:16,490 --> 00:21:23,490
many sites on Mars that give us that exciting
opportunity and the orbital assets will bring

231
00:21:24,320 --> 00:21:27,380
us back the data to help us make that decision.

232
00:21:27,380 --> 00:21:32,580
>> And so do you have any questions for Stan?
What do you need to know from him?

233
00:21:32,580 --> 00:21:37,560
>> Well what I want to know from him are the

requirements in terms of those sites that

234
00:21:37,560 --> 00:21:44,560
we would both like to go too. It'd be great
to find those sites that humans can live off

235
00:21:45,300 --> 00:21:50,680
the land to the extent of possible and that's
only going I think to increase in time as

236
00:21:50,680 --> 00:21:56,790
we begin to do more of those experiments but
also go to really interesting sites where

237
00:21:56,790 --> 00:22:03,340
we can do a lot of science. It's going to
be geologically diverse. We're going to want

238
00:22:03,340 --> 00:22:10,340
water resources very close. Those water resources
not only supporting humans but also could

239
00:22:12,230 --> 00:22:18,390
tell us a lot about past life, tell us a lot
about the amount of water that's existed on

240
00:22:18,390 --> 00:22:23,540
the planet in the past. So I think as we work
more closely together in the future we'll

241
00:22:23,540 --> 00:22:30,420
find those sites that overlap, that are both
scientifically rich but also those that would

242
00:22:30,420 --> 00:22:37,420
be really spectacular for humans to be able
to set down, put in a base and explore.

243
00:22:37,450 --> 00:22:42,550
>> So to touch on a point that was made earlier

what do we need to know about Mars before

244
00:22:42,550 --> 00:22:47,300
we can send people there? We already know
more about Mars than we did about the Moon

245
00:22:47,300 --> 00:22:52,480
when we sent astronauts there. So depending
on how much risk you're willing to take we

246
00:22:52,480 --> 00:22:59,380
can go. We know enough. For the requirements
for human landing remember that at least at

247
00:22:59,380 --> 00:23:05,660
the first time we send people there we're
probably not going to send a mining team.

248
00:23:05,660 --> 00:23:12,040
We are therefore going to be bringing with
us most of what we need and if we use any

249
00:23:12,040 --> 00:23:16,620
local resources from Mars it'll be resources
from the atmosphere. So as long as the landing

250
00:23:16,620 --> 00:23:22,210
site touches the atmosphere which I think
doesn't rule very many of them out we're good.

251
00:23:22,210 --> 00:23:25,790
Another thing from the human standpoint of
course, we're look for a place that's relatively

252
00:23:25,790 --> 00:23:32,110
safe to land. The view from the rim of the
Valles Marineris may be the most amazing spectacle

253
00:23:32,110 --> 00:23:36,270
in solar system but we'd like to land a few

kilometers shy of it just so that we don't

254
00:23:36,270 --> 00:23:41,980
accidentally go off the edge when we land.
So safe landing site, atmosphere and beyond

255
00:23:41,980 --> 00:23:47,270
that the people, the reason we send people
into space is that they're adaptable and we

256
00:23:47,270 --> 00:23:54,260
could probably adapt our mission to any landing
site on Mars and again if we do plan to use

257
00:23:54,260 --> 00:23:59,140
resources that are local to Mars on the first
few missions it's likely to be atmosphere

258
00:23:59,140 --> 00:24:00,970
which is good anywhere.

259
00:24:00,970 --> 00:24:07,150
>> So landing on Mars and talking about the
people. You kind of touched on this. We need

260
00:24:07,150 --> 00:24:11,400
the people together. Can you explain first
of why it is that we want people? I think

261
00:24:11,400 --> 00:24:15,270
you touched a little on it when you talked
about the rover and it took what two years

262
00:24:15,270 --> 00:24:20,530
for Curiosity to move from point A to point
B where it is today the same distance that

263
00:24:20,530 --> 00:24:24,799
maybe a human being could actually do in one
day. Is that correct?

264
00:24:24,799 --> 00:24:25,260
>> Exactly.

265
00:24:25,260 --> 00:24:31,040
>> So can you elaborate more on why it's necessary
for humans to go and explore. Why don't you

266
00:24:31,040 --> 00:24:31,320
start?

267
00:24:31,320 --> 00:24:36,970
>> Sure, well humans have the ability to make
decisions on the field that's far quicker

268
00:24:36,970 --> 00:24:43,830
than what we can do robotically. Right now
even though we are on Mars through our robots

269
00:24:43,830 --> 00:24:50,830
they're really a distance away and the light
travel time from receiving information right

270
00:24:52,220 --> 00:24:57,650
on a rover and getting it back to Earth before
we can even begin to make a decision can be

271
00:24:57,650 --> 00:25:02,980
anywhere from four minutes to 22 minutes and
that's the light distance from were Mars is

272
00:25:02,980 --> 00:25:09,540
and where the Earth is during those time periods.
Then so we have to make decisions about what

273
00:25:09,540 --> 00:25:14,000
we want to do and then we have to go back
and tell the rover okay. Now we want to do

274

00:25:14,000 --> 00:25:21,000
this or now we want to do that and so they
also have a limited dexterity if you will.

275
00:25:21,630 --> 00:25:26,560
A human obviously could begin to chip away
at a rock, see that he needs a different tool.

276
00:25:26,560 --> 00:25:30,940
Be able to do that. Be able to then look at
it and then make a decision I want to keep

277
00:25:30,940 --> 00:25:35,240
that or I don't want to keep that. It has
the information that I want or it doesn't

278
00:25:35,240 --> 00:25:42,230
and so all the dexterity and all the decision-making,
real time decision making are so far superior

279
00:25:42,230 --> 00:25:46,740
then anything we currently have at Mars. It's
just a huge step for us.

280
00:25:46,740 --> 00:25:47,480
>> Very well.

281
00:25:47,480 --> 00:25:52,850
>> There's a great quote that I like to tell
people and this is from the leader of the

282
00:25:52,850 --> 00:25:58,290
Mars Rover Team or one of the Mars Rover teams
who has good reason to emphasize how good

283
00:25:58,290 --> 00:26:05,030
the rovers are and he says, "That one day
of rover operations on the surface of Mars

284
00:26:05,030 --> 00:26:12,030

is one minute of work for a human geologist."
So what Jim said is absolutely right. A human

285
00:26:13,100 --> 00:26:17,750
in the field can do much more scan the scene,
see what the interesting thing is, go take

286
00:26:17,750 --> 00:26:24,090
a look at it and that takes a long time to
do with a robot. Now there is a caveat there.

287
00:26:24,090 --> 00:26:28,690
Every year the robots get better. Every year
the people are about the same. So we're sort

288
00:26:28,690 --> 00:26:33,440
of in a race and we'll see by the time we
get people there the robots are likely going

289
00:26:33,440 --> 00:26:38,700
to be far more capable. I'm not sure they'll
be capable, as capable as a human geologist

290
00:26:38,700 --> 00:26:43,540
in the 2030s when we're talking about sending
people there but they do get better each year

291
00:26:43,540 --> 00:26:45,290
and that's something to keep in mind.

292
00:26:45,290 --> 00:26:48,590
>> Perhaps if we're working together side
by side robots and humans.

293
00:26:48,590 --> 00:26:53,860
>> I think that's absolutely how it has to
go. I think to be able to support humans,

294
00:26:53,860 --> 00:26:58,070
to be able to be in a site and then take a

sample and then stick it in a rover that's

295
00:26:58,070 --> 00:27:04,090
walking along side of you and then analyze
that and say, "Okay. That soil is okay. It

296
00:27:04,090 --> 00:27:10,750
doesn't produce carcinogens or something you
take back in the Hab. There's just going to

297
00:27:10,750 --> 00:27:15,720
be a variety of equipment and capability you're
just going to want alongside you and I think

298
00:27:15,720 --> 00:27:22,720
having your pet rover as I've called it sometimes
walking along and being able to provide some

299
00:27:24,470 --> 00:27:30,890
detailed analytical measurements is just going
to make world a difference.

300
00:27:30,890 --> 00:27:34,620
>> It's totally fascinating and I think that's
about all the time that we have. I really

301
00:27:34,620 --> 00:27:38,630
appreciate you guys coming out and talking
with us. You can get more information going

302
00:27:38,630 --> 00:27:45,630
to the website at www.NASA.gov and as always
continue and join the conversation on Twitter

303
00:27:46,210 --> 00:27:50,330
using the #journeytomars. We appreciate you
guys coming out. Thanks very much.