questioner which was seriously they had
to go to sleep took out the seats in the
Apollo 11 landed they were just like
sleeping on the floor really they're you
know they put a hammock in but still in
order to save weight they got really
shakes it's interesting to fly the lunar
module so I've actually got some some
stick time in our simulator for the land
on the moon it was both rusty
Schweickart and Charlie Duke who were
both hello lunar module pilots and
you're standing up you're flying the
thing you know there is no seats if
you're staying up and you know bringing
the thing in and flying it and of course
both those guys are crackerjack at it
because they flew the real thing they're
both they were both still very good at
it
you know much better than us but just
that experience of what's what's it
really like to try and go fly and land
on the moon it's it's not like flying an
airplane it's not like flying a
helicopter it's a completely unique and
different experience it has to be right
well and we're on the verge of having to
relearn that all again for a new program

and we're smarter too they said we

learned so much by you know some of the

videos of buzz and Neil jumping around

the surface Apollo 11 you'll see them

they're trying out different steps

because they're trying to figure out how

to walk in 1/6 gravity huh with the

bulky spaceship right so you see them

hostage yeah so this I was also part of

experiments well you know I wouldn't

know how could we work and live in this

environment in the moment and learn

exactly those questions that we did not
know cuz you can only simulate so much

44
00:01:53,670 --> 00:01:56,939
you have to go there yeah and that's

45
00:01:55,709 --> 00:01:59,069
where you're gonna make the big leaps

46
00:01:56,938 --> 00:02:01,289
and knowledge understanding it's like

47
00:01:59,069 --> 00:02:06,118
smooth Master says moving in those suits

48
00:02:01,290 --> 00:02:07,920
is insane look at off your shoulder all

49
00:02:06,118 --> 00:02:10,530
that yeah the lunar module is your

50
00:02:07,920 --> 00:02:11,459
favorite spacecraft my favorite

51
00:02:10,530 --> 00:02:12,400
spacecraft

52
00:02:11,459 --> 00:02:13,959
yeah well

53
00:02:12,400 --> 00:02:16,239
I want you to know that aperture

54
00:02:13,959 --> 00:02:22,780
combines says my grandfather helped with

55
00:02:16,239 --> 00:02:24,759
the design of thing I like the reason

56
00:02:22,780 --> 00:02:28,810
the lunar module is my favorite is

57
00:02:24,759 --> 00:02:31,030
because you know it's it's one of the
few vehicles that we've ever built that

is really designed only for the space

environment yeah never has to go through

an atmosphere oh right right and so it

doesn't it doesn't look like an

International Space Station is another

example but there's not very many that

are like that almost everything else

either at you know it's got to go up

through an atmosphere it's got to come

back through an atmosphere and so it's

just a very distinctly different kind of

vehicle I really like them I can see
that yeah for those of you who build spacecraft instruments for them yeah that matters very cool

so one cool thing about celebrating the anniversary is that we've been gathering people's memories and so I thought about what's my memory of Apollo I was important then but it made me think oh my gosh my dad had this video tape that he sat me and my sister down in front of he popped it on the VCR it was this weird greeny black-and-white footage I even know it was but it was the Apollo 11 moon landing and at the time I was in
elementary school or something and I didn't get it but I knew that this mattered to my dad you made us watch it.

trying to think about just being back there and just you know it was a defining moment in history in that century the world just for the whole world tuning in and watching this I think that's amazing right just like everyone across the entire group looking up at the moon just all at once that's just amazing right do you have some of those memories to share with us from I do so we have more stories and they're
actually from you all we invited people

101 00:04:20,560 --> 00:04:24,848
all over the world to serve it sure

102 00:04:22,389 --> 00:04:25,650
they're Apollo 11 minute moon landing

103 00:04:24,848 --> 00:04:28,219
stories

104 00:04:25,649 --> 00:04:31,589
and so we collected their responses and

105 00:04:28,220 --> 00:04:34,680
they are part of our NASA Explorers your

106 00:04:31,589 --> 00:04:36,629
Apollo stories podcast and here's one we

107 00:04:34,680 --> 00:04:39,870
have here from Ellen in Calistoga

108 00:04:36,629 --> 00:04:42,839
California we are all glued to our

109 00:04:39,870 --> 00:04:45,209
television that day mind you this is a

110 00:04:42,839 --> 00:04:47,429
television that only got three channels

111 00:04:45,209 --> 00:04:50,728
so I'm grateful that we were able to

112 00:04:47,430 --> 00:04:53,910
watch it was quite fuzzy but it was so

113 00:04:50,728 --> 00:04:55,769
exciting and me being young I

114 00:04:53,910 --> 00:04:57,510
immediately went outside with a pair of
binoculars to stare at the moon to see

if I could see Neil Armstrong walking on

the moon you know when you're young

anything is possible

so nice that's amazing so if you all

want to hear more stories like Ellen's

you can go to www.hsn

do you want to lead us off into

rapid-fire questions Mir really really

quickly okay so we have here from an

Easter Egg my question why the moon

before Mars I think there's a number of

reasons the the biggest challenge with

sending humans to Mars is that you know
it's so much further away it takes a lot longer to get there than going to the moon and that duration introduces lots and lots of big problems right there's longer exposure to radiation longer exposure to really no gravity you know living in a basically a tin can for potentially months plus all of the technical devices and systems that have to be reliable enough to last that long and rather than just make a go of it and give it a give it your best shot it's easier to prove all that out a little bit closer to home you know we've got a
long period of having humans in Earth

orbit on the space station the next big step is

go for that much further away from us

and to spend that much more time that

takes us to the moon and the Mars is a very different mindset as well right you know communication could be at much 20 minutes 30 minutes something very

independent when you're out there on your own space exploration

here's one from stinkbutt 34 how much fuel did it take to lift the lunar module the LEM off the moon you guys

00:06:31,800 --> 00:06:38,069
00:06:35,009 --> 00:06:39,060
00:06:38,069 --> 00:06:42,060
00:06:39,060 --> 00:06:44,519
00:06:42,060 --> 00:06:46,439
00:06:44,519 --> 00:06:48,240
00:06:46,439 --> 00:06:50,519
00:06:48,240 --> 00:06:52,769
00:06:50,519 --> 00:06:54,479
00:06:52,769 --> 00:06:58,199
00:06:54,480 --> 00:07:00,930
00:06:58,199 --> 00:07:03,149
00:07:00,930 --> 00:07:06,030
00:07:03,149 --> 00:07:07,079
00:07:06,029 --> 00:07:09,869
happen to know that's a good question

00:07:07,079 --> 00:07:15,120
you know I remember seeing the the

00:07:09,870 --> 00:07:18,418
number for the the LEM crew module and I

00:07:15,120 --> 00:07:23,340
want to say don't quote me on this but I

00:07:18,418 --> 00:07:25,529
think we didn't tear out you know a few

00:07:23,339 --> 00:07:29,339
let's say a few hundred gallons it was

00:07:25,529 --> 00:07:32,309
not a huge not a huge amount but it only

00:07:29,339 --> 00:07:35,369
had that one job to do ahead of work

00:07:32,310 --> 00:07:37,319
that one time yeah I know the numbers

00:07:35,370 --> 00:07:41,099
published I just don't have it at the

00:07:37,319 --> 00:07:41,099
tip of my tongue but that's there it's

00:07:39,449 --> 00:07:43,079
addressed all the Apollo technical

00:07:41,100 --> 00:07:45,000
documents they are out there you can go

00:07:43,079 --> 00:07:47,639
online and download all the Apollo

00:07:45,000 --> 00:07:50,490
reports all the experience reports and
like all those technical details they're all in there you can just go look them up it's really cool to just browse through it and there are some excited comments like can't wait to experience the same thing in five years as some did 50 years ago that's right where the Artemis generation we are the argument generation holla we're is Apollo but we learned from Apollo building on the shoulders of Apollo yeah we actually have a question I think it's because we talk so much about the astronauts from it's crazy K what did it take to become...
an astronaut ooh good question would it
the astronauts have to do in order to
land on the moon an education skill
determination a little luck right the I
think the last astronaut class had
something like 18,000 applicants
shows about yeah I want to be nicer when
I grow up yeah yeah and our future
astronauts for he sustains humans in
space you know we're gonna need all
different types you know engineers and
scientists but we're gonna need people
who can keep the machines working you
know any plumbers or any surveyors we're
gonna need folks who are you can climb
down you know canyon walls spelunkers
need all types of all kinds of specialties here's a really good question maybe this should be our last for now but we'll get back to more your questions later but Latino 67 su Kimberly how long did you go to college to get the to get the knowledge for your current job what'd you get here as I say I stayed in school for a very long time I did four years as an undergraduate got a physics degree physics is a great degree to learn how to help solving
problems then I did four years in grad

00:09:51,080 --> 00:09:56,690
school I got PhD in astrophysics and so

00:09:55,070 --> 00:09:58,490
yeah stayed in school and I remember um

00:09:56,690 --> 00:09:59,960
when I got my first job which was called

00:09:58,490 --> 00:10:01,700
a postdoc it's what you get after your

00:09:59,960 --> 00:10:02,900
doctorate I went to another University

00:10:01,700 --> 00:10:11,540
and my dad would call me up are you

00:10:02,899 --> 00:10:19,029
still school still in school schooling

00:10:11,539 --> 00:10:22,219
outside of high school we never stopped

00:10:19,029 --> 00:10:23,870
I mean a job here working in the space

00:10:22,220 --> 00:10:26,600
business you never never stop learning

00:10:23,870 --> 00:10:27,740
yes in a good way obviously I think by

00:10:26,600 --> 00:10:29,090
the time you're doing your PhD you're

00:10:27,740 --> 00:10:32,060
doing something you're passionate about

00:10:29,090 --> 00:10:34,730
and so you're in loving it right I do
think that school for at least for me

school got even more fun and exciting

more years of it I had yeah you know I

think back to like my freshman year of

college and it was a lot of work and it

was really challenging and I didn't know

what I was doing and as I spent more

years in my academic career it actually

got easier and more fun

that didn't stop being challenging yeah

but it be can take on a different note

so if you're if you're just starting in

college or if you're in high school or

even in elementary school you know
it does get easier and I would argue it

gets more fun as you as you go along so

don't be afraid of spending watching

free-school

that's great excellent alright so we're

gonna get back to more questions later

and before we move on I just want to let

people know I want to invite you to join

us in celebrating the 50th anniversary

of the Apollo 11 moon landing and hear

about our future plans to go to the moon

and then on to Mars by tuning in to a

special two-hour live NASA television

broadcast that's tomorrow at 10:00 a.m.
Pacific so to learn about the show and how to watch you can go to WWF and click on events are you gonna watch definitely I will be watching I'm excited this stuff is really really cool it's nice to you know go back in time and revisit history and see that you know what Amy yes and so let's dig a little bit deeper into the Apollo history and talk about all of those those cool cool facts thing you don't know about you know in order to do that we have our history year James tell us about yourself so my name is James Anderson and I'm the nasa ames
historian i've been here for a couple
months right in all the excitement
leading up to jump Dryden and the last
few months have been really wonderful
we've had an opportunity to meet a lot
of Apollo era veterans who worked at
Ames and just getting to hear even more
stories from that time many of which you
know we're not the ones that yeah but
you hear you know sort of all the time
again so what what do you know about
that time at Ames it was an exciting
time the during the whole Apollo program
the scope of the number of people
involved at its peak there were around
400,000 Americans men and women from diverse backgrounds working on the Apollo project.

and here at Ames there is also it was a time of building to a number of new facilities came online and got funding at that time and a lot of that research directly influenced the design of Apollo.

Wow that it's amazing four hundred thousand people all coming together you know this to solve this ambitious and really get this this this plan going and this project going to get to the moon to incredibly huge you know
that's a lot of effort yeah what are

some of the facilities that they were building to support the new missions

well funny you should ask I've brought some historical artifacts with me from our facilities here at Ames Kimberly was showing a little bit earlier the model of the Apollo command module I've got another kind of model of the Apollo command module oh so you've got this one here it's just like it yeah it's got the exact same shape of Apollo and you notice one side is pointing and the other side not why is that Chad well
It's interesting this is one of the unique contributions that Ames Research Center made to not just the Apollo program but all of the manned spaceflight programs of the time. Harvey Allen was one of the aerodynamicists here at the center's later one of the center's directors and he was studying how to protect these vehicles from heat as they came back into the Earth's atmosphere and previously all the high speed vehicles they were very pointy right sort of like the front end you know I had a sharp
point because that was the least amount

00:15:01,039 --> 00:15:05,839
of drag coming back into the atmosphere

00:15:03,289 --> 00:15:08,419
but they got too hot and Harvey Allen

00:15:05,840 --> 00:15:12,110
realized that if you went with this very

00:15:08,419 --> 00:15:14,179
blunt shape it created a lot more drag

00:15:12,110 --> 00:15:17,269
and it would slow them down but it

00:15:14,179 --> 00:15:19,039
allowed the heat to go out and around

00:15:17,269 --> 00:15:21,199
and the heat would not be transferred

00:15:19,039 --> 00:15:23,870
into the surface of the vehicle so

00:15:21,200 --> 00:15:26,240
basically that you know that the crew

00:15:23,870 --> 00:15:28,429
members in the vehicle would be

00:15:26,240 --> 00:15:30,259
protected from all that heat as the as

00:15:28,429 --> 00:15:32,179
it came back into the atmosphere and of

00:15:30,259 --> 00:15:34,490
course we're doing basically the same

00:15:32,179 --> 00:15:36,439
the same concept today so it's really a
lasting contribution that you made you can see that with all the vehicles returning from the international space station you know even the Commercial Crew you know the the Boeing and the and the SpaceX capsules followed the same engineering judgment to shave me something right the design and engineering of something but how would you come up with that chain if you had to he was an eccentric character and it really is sort of ideas come from the eccentric it's an odd idea that turned out to work really well and that concept
the blunt body concept was developed.

It's older than NASA itself. NASA was founded in 1958, but Allen came up with that idea here at Ames in the 50s when it was still part of the NACA so Ames was NASA Ames yeah exactly. He was before was NASA Ames and solving a problem that was gonna be not you know who's gonna be used decades later oh yeah you know that's incredible - well forward thinking that a lot of working.

Forward thinking that a lot of working.

In the future James what do you do with that model what is it solid metal it is and you launched them all right and one.
of the facilities that was built

construction began in 1964 on what's known as the hypervelocity free flight facility and it formally opened in 1965

and this model and I've got another one here this facility imagine a tube okay

75 feet long three and a half feet in diameter and from one end you've got a really high speed stream of air at one end and in the other you've got a cannon

would we do with this cannon while you shoot it and these these projectiles

they're made here in Ames's machine shops and this is another Apollo
model quite a bit smaller than the first

00:17:54,460 --> 00:18:02,529
one that we saw but actually this one it

00:17:57,400 --> 00:18:06,340
would be loaded into the mccannon at one

00:18:02,529 --> 00:18:08,980
end and launched upstream into that air

00:18:06,339 --> 00:18:09,548
so that it's traveling really really

00:18:08,980 --> 00:18:11,558
fast

00:18:09,548 --> 00:18:14,048
Wow no way through the years we look

00:18:11,558 --> 00:18:17,829
this oven the facility has a top speed

00:18:14,048 --> 00:18:22,089
for that model of about 27,000 miles per

00:18:17,829 --> 00:18:24,609
hour well so it's not moving yeah and

00:18:22,089 --> 00:18:28,449
it's really to reproduce the conditions

00:18:24,609 --> 00:18:30,399
of capsule coming back into the Earth's

00:18:28,450 --> 00:18:32,830
atmosphere or or the atmosphere of

00:18:30,400 --> 00:18:34,780
another world and traveling from say a

00:18:32,829 --> 00:18:36,308
distance as the moon I mean this was a
unique problem for when you're sending

something really far away and it's

coming back right right right

we have an image don't we of what they

would see here taking high-speed photos

of that I think tell us what that's all

about so you're looking at an image of

the shock wave that's coming off of that

little tiny model as it goes down down

the tube and in this image the the

capsules traveling from right to left

right so as it comes into the atmosphere

this shock wave is created and we talked

earlier about how this blunt shape on
the end of the capsule protects it from the heat here you can see it actually is making this layer the shockwave is making a layer around the capsule that's protecting it from the heat generated by friction as it comes into the atmosphere it's a it's an amazing photo to see you can you know this is this was you know back in the you know pre digital age and so they had a cameras set up down the tunnel to snap pictures as as the thing was flying down it amazing that is amazing we actually have a
comment here from quark saying amazing

how far we have come in such a short amount of time it's not that long and

just yeah old Morgan says awesome stream

NASA thank you yeah thanks for watching

um I had another comment to share I'm over the moon so are we mm-hmm excellent

all right James did you bring anything

else for us yeah we've got another exciting artifact here it's encased in glass

what is that James tell us what that is

that is a genuine moon rock Wow this one

was returned by Apollo 15 and weighs
under a pound

0.3 pounds

and it's still but I don't know I get

shivers every time I see it it's it's

it's so weird just to to wrap your mind

around 3.4 billion years old that's kind

of the age of the first life rolling of

the ocean here on earth

understanding yeah the the moon is this

treasure trove of science the moon

preserves the ancient history of the of

the solar system and even today

researchers applied to NASA all over the

world to look at samples of the apollo

moonrocks
oh yeah and it still we're still learning new new things Wow
I love it that in a way it kinda just looks like a rock because that just reminds me that these objects and places in space are part of our solar system you know just like earthen well this is I'm noticing that I don't know comes across on the video is it kind of sparkle it does flexure and and I'm looking at the monitor in the studio and I'm not sure that that really comes across it is it is not just this gray lump that it
appears like there's some really neat stuff going on that just kind of brings it brings it well let's get to 

time back in the 1960s we didn't know whether life was on other worlds and 

it's still a quest n't NASA and the 

humanity is looking for are we alone and 

when the apollo samples were returned 

ames was one of two nasa centers that 

actually analyzed the samples and looked 

for whether or not they actually had 

like there were signs of life that's so 

cool i think we actually have some
footage of this we do yeah here in our

guns yes from our archives here at Ames

there's some recently rediscovered

footage we're seeing it here now what's

goin on here Kimberly what are we oh so

this is Apollo 11 soil samples that

brought to the Ames lunar Biological

Laboratory and they're being held in a

sterile condition of these glove boxes

in a clean room and you see petri dishes

and what they're trying to do is see if

life arose on the lunar samples and

you're mimicking conditions for which

life has been known to grow on earth
bacteria microbes and like and and

00:23:25,930 --> 00:23:33,000
looking at it through a microscope and

00:23:29,160 --> 00:23:35,350
you know it's it's a very dedicated

00:23:33,000 --> 00:23:37,480
systematic study and it laid the

00:23:35,349 --> 00:23:39,429
groundwork for the beginning of what we

00:23:37,480 --> 00:23:42,309
call astrobiology at the time it's

00:23:39,430 --> 00:23:45,039
called exobiology the study of the

00:23:42,309 --> 00:23:46,480
search for life elsewhere in the

00:23:45,039 --> 00:23:49,420
universe and the study of the origin of

00:23:46,480 --> 00:23:51,549
life here Wow and the techniques here

00:23:49,420 --> 00:23:53,590
you know they learn that the the the

00:23:51,549 --> 00:23:55,210
lunar cycle samples did not have life

00:23:53,589 --> 00:23:57,399
but they didn't know at the time until

00:23:55,210 --> 00:23:59,620
in filming experience right you had to

00:23:57,400 --> 00:24:00,850
check it even so still laying the
foundation for more science

research yeah yeah the techniques that
techies and other techniques looking for

amino acids and carbon compounds and the

stuff of life and stuff of life led to

the development of the instruments that

flew on Viking that went to Mars in 1976

to look for life on Mars and then you

know several packages that were also

exploring life you know on other places

in our solar system because our

knowledge of the solar system today is

way different it's a much beautiful more

diverse solar system then the scientists
back in the 60s could have ever imagined

because we've been sending all these robotic explorers over the last couple of decades out to Pluto out through the giant planets the moons of the giant planets it is an amazing place to explore we're still looking today and we have yet to find you know our life on this pale blue dot our blue Oasis world here is still one of a kind yeah the land oh yeah more to come you know I have a few moon rock questions maybe we could take these as like rapid-fire okay first of all what is the difference
between moon rocks and earth rocks and

to go with that our moon rocks more porous compared to the rocks on earth or

are they just about the same how do you know it's a range so short answer the

rocks on the moon are very similar to that on earth so we have igneous that were made in a volcano

we have metamorphic that were made with high temperatures and high pressures we have not quite sedimentary which were

made on the earth with wind and water on the moon they're called Breck is there

there shocked
so we've slightly different types the

moon on average is lighter in terms of its rocks than the earth it's less dense oh and this can lead to another discussion of how the earth I mean form so they were similar but they're slightly also different but they're made of the same things we're all made out of start us essentially yeah nice perfect history questions for James before you have to go do the original Mission Control Computers still work do you know the computers themselves images of them have been used to recreate the Mission Control
in Houston and I would actually have to check but I know that the recreation was done some of the material in there is original and other stuff was actually just sourced on eBay so the coffee pots the cigarette ash trays all of that stuff to really give the feel of what Mission Control was like during that time and the flight director Gene Kranz when he went in just a few weeks ago and saw this installation I think he made the comment was something like he could hear the voices of all the controllers at their
computer stations at their monitors that

recreation was so spot-on that just

brought back it’s a really intense

moment of a memory that you know how

could you not forget so they really got

it right one last comment before the

moon rock has to go away

emergy a member Jim not sure sar coming

even though we're still have a lot

you've still studying there spend

samples that have been kept in have not

been touched in 47 50 years that are

being looked at researchers say because

our laboratory equipment today is much
more sophisticated in advance so I'm

thanking the scientists of the previous

today so that we can continue our search

of knowledge and when we get even

different moon rocks from different

places of the moon yes we will be able

to answer some pretty tough questions

that we haven't been able to answer the

moon rocks gave is a huge leap in

understanding and we're still being

studied

that's awesome amazing time capsule or

time capsule yeah there are teams of
ames that are gonna study those samples

so we'll be able to provide an update as

sometime in the future

sometimes yeah well thank you James for

joining with the history yeah we'll see

you another time

and you all don't forget to join us and

celebrating the fiftieth anniversary of

the Apollo 11 moon

landing and her about our future plans

to go forward to the moon and on to Mars

by tuning in into it to a special

two-hour live NASA television broadcast

tomorrow at 10 a.m. Pacific time learn

more about the show and how to watch by
going to WWN ase gov fort / apollo 40th
and don't forget to click on event
Apollo 50th in fact about our next giant
leap Artemis
yes Artemis so what what is Artemis well
why do we call it Mars Artemis the art
of Artemis was Apollo's twin sister
right so if you know your mythology it's
Diana
but it's Greek maja Kimberly with the
fun factor evocative I mean she's the
goddess of the moon I mean it's very
appropriate and and also with the
Artemis charge we're going to place the
first woman on the moon yes so with the
next crew to go to the moon yes and an
amazing leap for womankind yeah
humankind absolutely it's about time
women out there students young girls who
are like watch out moon yeah coming for
you that since we're having our Artemis
is a sustainable lunar exploration
program it's just different than Apollo
Apollo was like a road trip I mean it
did amazing things
it was a huge engineering challenge just
to even conceive going from suborbital
flight to going to the moon and back in
less than 10 years and to build that whole infrastructure with a very elegant but complicated and logistical solution was immense I mean Artemis is different we're doing not doing it alone it's no longer the realm of governments and superpowers it's a different era yeah we have commercial and international partners sustainable present and you know in the pursuit of knowledge in the pursuit of innovation with opportunities for economic and you know more spin-offs you know the Pala
programming of us a lot of spin-offs

what we call things that we use today as a result of the research and the engineering technology

development that that it's not just to go right the objective of Apollo was to go to the moon and safely return right but that was that was the objective right with Artemis it's to have a longer-term sustained presence and of course it's the path to Mars which is the next giant leap so that it's fun as Kimberly said it's fundamentally a different approach to then Apollo wise you know okay it's the same basic
destination but we're not going to land directly on the moon we're going to the Gateway first that'll be orbiting an orbiting space station around the moon and then going down to the surface from Gateway we're going to the South Pole which is a very different place in many respects more challenging than where Apollo was landing so there's many fascinating different things that are going into Artemis that were really never something that was even approachable back in the Apollo era yes it's a big big stretch from where we
were at with Apollo and of course we have this longer objective than of taking what we learned from the Moon portion and taking that with us to Mars nice summary there are a bunch of questions that we'll get to about the goals and what's different and I think you just gave a great overview of course a huge part and really kind of the first and biggest step for Artemis right is how do you launch how do you get there yeah we're talking about carrying a lot of material we talked earlier about the
Saturn 5 yes well the big rocket for

Artemis is the Space Launch System SLS

and SLS is if you thought Saturn 5 was

impressive SLS is even more impressive

you can see some video of it here an

animation that's the Rockets

the engines are anything under a lot of

tests right now right and a lot of this

is materials that we learned from doing

the Space Shuttle missions so it's a

little bit shorter than the Saturn 5 its

322 feet tall stature and v was 363 feet

so it's before t1 feet shorter but it's

that's also a lot bigger than the space

00:32:30,509 --> 00:32:36,720
Saturn 5 yes well the big rocket for

714
00:32:34,289 --> 00:32:40,740
Artemis is the Space Launch System SLS

715
00:32:36,720 --> 00:32:43,289
and SLS is if you thought Saturn 5 was

716
00:32:40,740 --> 00:32:48,120
impressive SLS is even more impressive

717
00:32:43,289 --> 00:32:51,149
you can see some video of it here an

718
00:32:48,119 --> 00:32:52,979
animation that's the Rockets

719
00:32:51,150 --> 00:32:54,750
the engines are anything under a lot of

720
00:32:52,980 --> 00:32:57,900
tests right now right and a lot of this

721
00:32:54,750 --> 00:33:00,269
is materials that we learned from doing

722
00:33:00,269 --> 00:33:05,759
little bit shorter than the Saturn 5 its

723
00:33:05,759 --> 00:33:12,000
322 feet tall stature and v was 363 feet

724
00:33:12,000 --> 00:33:15,930
so it's before t1 feet shorter but it's

725
00:33:02,339 --> 00:33:09,059
that's also a lot bigger than the space
shuttle which is one we're used to

00:33:13,829 --> 00:33:19,500
flying right this shuttle was huge and

00:33:15,930 --> 00:33:21,420
it's only 184 feet tall so this is as we

00:33:19,500 --> 00:33:24,059
said earlier Saturn 5 is taller than the

00:33:21,420 --> 00:33:28,620
Statue of Liberty and right so is SLS

00:33:24,059 --> 00:33:30,119
right that's it's almost when we have it

00:33:28,619 --> 00:33:33,179
flying it's going to be the biggest

00:33:30,119 --> 00:33:34,709
rocket ever built Wow so this capability

00:33:33,180 --> 00:33:37,500
even take payloads to Saturn and Jupiter

00:33:34,710 --> 00:33:40,049
I mean this is a very capable machine we

00:33:37,500 --> 00:33:42,059
talked about our rush how much thrust at

00:33:40,049 --> 00:33:44,309
how much payload the Saturn 5 had and

00:33:42,059 --> 00:33:47,609
SLS is over a million pounds of thrust

00:33:44,309 --> 00:33:51,450
more powerful oh wow right so the SLS

00:33:47,609 --> 00:33:53,339
can deliver more cargo to the moon than
the shuttle could take to low Earth orbit.

Wow, Wow, this is just an enormous capability and it's Kimberly no do it
take this lots of other destinations in

this is a huge capability it's a unique capability it's not something you need
to put satellites into orbit for example

it's that's really for this unique

history unique mission awesome very cool

yeah we have a comment here from King

throne when their astronauts on the moon

I will stand and wave at the moon at the

full moon I hope they wave back

I'm sure they'll be waving back I'm
doing you

Artemus if I get my wish I want to land astronauts on the far side of the Moon because we haven't been there yet

in fact Allāh only may have only gone to about 4% of the surface of the Moon

there's a lot of terrace right Luna ain't caused me to channel my Latin that

we unknown territories on the moon that you have seen we also have not yet been
to the South Pole right destination dismiss and to remind everyone what

exactly we're counting down I'm here

this is the time until 2024 when the
Artemis mission will land people on at the South Pole of the moon right there.

is a question someone was asking what's special about the lunar South Pole could you tell us quickly what we might oh yeah just in the last 10 years our understanding of the moon flip it set itself on the head and we learned that there's water on the moon I mean of the Apollo generation we thought the moon was bone-dry turns out there is actually water moon is actually all over the moon has different sources but the poles seem to
have large quantities of water now we

should we should know this is not liquid

water and water in different yeah frozen

water crystals in the soil in the soil

and so it's scientifically interesting

cuz I shouldn't have been there and why

is it there we'd like to know why it's

there and trigger it is but as for my

human exploration its water is h2o can

be used for hydrogen and oxygen for fuel

oxygen to breathe so the poles going to

the poles is a step in a human

exploration using resources off the land

and the same techniques reduced to

harvest the moon water is similar to
what we do in Mars because we know Mars

has subsurface frozen order as well okay

so training ground that's the big reason

think that's a big reason to go to the

South Pole South Pole is hard because

you know it's it's in a lot more shadow

right sunlight is a much lower angle so

you have to really think about how you

build your mission much more carefully

how do you generate electricity how do

you stay warm there's a whole new set of

challenges that were we really didn't

have to worry too much about in the

Apollo missions
because they're easy because they're hard yes and the Artemis program will have humans on the moon for weeks at a time initially and company two months at a time I mean it's all so different than Apollo Apollo is you know Apollo 11 was two and a half hours on the surface 21 hours just there on the surface 22 and a half hours walking around we most went up to three days on the surface so this is a very different approach to being offworld for long periods of time and how you do that from an engineering solution your power your fuel your water
your air your energy the temperature

extremes you'll experience they all can

be overcome and they'll all be and the

solutions are gonna be amazing

yes you answered a question from pi day

what are some new difficulties with

Artemis that were not present during the

Apollo missions yeah long duration

that's maybe one of the biggest ones is

we are sending humans out there for much

longer periods of time and they're

beyond the the shielding from radiation

that's afforded by Earth's magnetosphere

so when astronauts are on the
International Space Station for long periods of time right up to a year as the record that that's a challenging environment but it doesn't have the same degree of exposure to radiation that going out away from Earth has and so that's so NASA is gonna need a lot of doctors and biologists and people who study human physiology to work on mitigation and also to help with how humans the fragile aslong duration space to you know exploration how the Box numa body behaves and reacts and recovers yeah it's gonna happen at Mars too yeah this question from Sleepy underscore
Gary some of your answers already

answered his question what are the main scientific goals of the Artemis moon mission and answering those questions are scientific and kind of awesome or things that we want to you know find out right those are our goals yes scientifically I mean some of the biggest unanswered questions even after processing the wonderful lunar samples from Apollo we still don't really know what happened during the early phases of the early times of our solar system because the rock
samples that we have might have have a bias in it they might not have been sampling some of the oldest places on the moon so looking for older rocks how the moon's interior looks like we would like to have samples of the moon from the mantle something below the crust oh yeah that that will take service but going to different parts of the Moon where we can actually get to the mantle and press we can understand how that moon formed and how it cooled and the moon also potentially could tell us what happened with our early Sun we're
interested in how the Sun behaved during

the earlier solar system and this could

help us understand extrasolar planet

systems where we're looking at planets

around other stars today you know more

planets and stars out there so our view

of the universe is changing we have our

solar system in our backyard here that

moon has has the answers to some of

these questions

awesome the early phase there's also the

basic science around you know human

physiology right which as we said yeah

how does the human body respond to

how does the human body respond to
radiation exposure to you know long-term deprivation of gravity all these things and those are really basic questions that are they're important for our eventual journey to Mars but they're also you know the the just the basic knowledge that's often really helpful in unexpected ways for improving life on Earth and as a astrophysicist I would be amiss if I didn't say I mean I would love to put a telescope on the far side of the Moon and open up a different range of the electromagnetic spectrum that we have not explored before because it shields from the radio emissions from
the earth so it becomes a new window into the universe just right in our backyard because the far side is facing away from us I know it could make it really big maybe you'll get your telescope speaking of human bodies what kind of spacesuits should be used big and bulky but safe or a small tight but flexible have been some really exciting work done exactly in this area and there's a number of different designs that are still being considered but they kind of both ends of that spectrum right some of
them look like that more traditional a

little bulkier suit because it offers a lot of protection from the environment

some of them are a little more streamlined and sleeker because they're just easier to walk around in and do things and get stuff done and they just don't weigh as much but I think the jury's still out as to which is the preferred one right now there it's an area of ongoing research and development yeah there's a cool idea of a particular design of one of the Landers on the moon to deal with the
lunar dust which is a kind of a

hazardous glass like because there's no

wind or water on the moon flowing water

to just smooth it out and one of them

has you sort of layer in your your

spacesuit and you go in and you leave

your face spacesuit on the outside you

know in kind of a cloak or something and

then yeah therefore the dust doesn't get

into your habit it never comes in oh

yeah I like the docks

yeah so your suit always stays on the

outside where all its all the dirt all

the contaminants stay yeah out there so
there's and there's a lot of work ahead

I mean you're gonna when you're on the surface doing things are gonna learn Oh

like like the Apollo astronauts learned

they're gonna skip and hop to get

maneuvering with that bulky things the

Artemis astronauts are gonna find new things with their spacesuits and what

things to change I can't drill as much I can't climb I can't you know rappel down

the crater in yeah easiest ways I'd like

you know so there's there's gonna be a lot of different suit designs for the

applications it needs and so we need those we need those solutions and we
need to while we learn those as we explore more yeah always learning and we're learning are we learning
give a question in mind they think I do well we have one here for Chad it's and it's about the SLS so why why are we designing a new system to get to the moon and not just use the same Apollo equipment that be used last time yet well it's a good question maybe you want to tell everybody the what the full system consists of we talked about SLS mm-hmm well I think that's the main one we're talking about but there's also you
know the equivalent to all the Apollo vehicle

that Kimberly was showing with the little props right there's a there's a command module which now is the Orion

there's equivalent to the service module which actually the Europeans are providing there's a you know lunar vehicle that will be you know putting the humans down on the moon what's different this time from Apollo is we also have the Gateway which is an orbiting space station around the moon and of course the big rocket so the
question is why don't we just use what

we had in the Apollo era well in

principle you could use those

designs right but for one thing we'd

like to carry additional people and the

Apollo capsule is only big enough to

carry three we'd really like to carry

four we have some video footage of the

Orion they can run that maybe I'll talk

while we go right and you could you can

see it's pretty good-sized one of the

other reasons is that all those designs

haven't been produced for fifty years

and so to go back and recover the design
recover the tooling it's basically as

big a job as making a new one there's a

story about how Ames participated in a

21st century detective story on the

re-entry the thermal the tiles on the

bottom of the production thermal

protection system of the Apollo capsules

they were made of a chemical thing

called avcoat

and I had a re-engineered the chemical

formula and a 21st century version of

that is on the Orion capsule so we think

we thank the Apollo engineers were

providing that groundwork and we're

using that the research using the
learning the ideas if not the actual specific designs are carried along in the new program and I'll you know a lot of the elements of this program have actually been in development now for more than 10 years so we're not starting from scratch today this has been in development for some time but a lot of the times if you want to take literally the old design and reuse it it can be just as much work as doing a clean sheet of paper and doing the new design also allows you to bring you all our latest and greatest technology
and ideas which can make things lighter

more cost-effective and in many cases a lot safer so we're always looking at

those things as we come up with new new pieces I mean even the Orion capsule

that we were just looking at it's essentially Apollo on steroids because it has an incredible amount of computing

power then the Apollo capsule did not have that means it can carry a lot more payload and it is supports more astronauts for very long durations in space it's a very different design as similar as the Artemis
The program is to Apollo in that we're going to the moon a lot of it ends right there because the basic requirements for what it has to do for how long it has to go for how many people it's going to carry are all different from a plane which leads you to you know somewhat different solutions in the design make sense make sense so we have the SLS rocket we have the Orion spacecraft and then we have gateway you talk a little more about Gateway it's gonna be my next favorite species it's designed in mind to be essentially our first.
interplanetary space tug and IO it's a face ship that could have would have the

capability of allowing us to maneuver things in space and propelling other
vehicles to Mars but it is a orbiting ship around the moon it gets us close to
a thousand miles of the moon surface and it goes as far away as forty thousand miles it's in this rectilinear or orbit it allows you to land on anyplace on them on the moon Wow which we didn't have with Apollo although the the orbit trajectory was you know on a specific place could only had Lander on the equator this allows us to go to the
poles which we were talking about earlier it allows the far side but it has a very unique propulsion on it a solar electric propulsion and it's more powerful than anything of that type that we've seen before and that's the type of propulsion we're going to need when we're far from home like on our journey to Mars and so that's going to be used and I also love the fact that it's open architecture all the ports are gonna be made available online because we want it's gonna have commercial and international
partners docking coming and going and

having humans on it and not having

humans on it it's gonna be a

vacation-home type thing you know the

Astros will be there for a few weeks or

months at a time and then then they'll

be empty for some time and it really is

a way a different approach to thinking

about long term human exploration in

space it's kind of like a space condo

the staging place we hang out there for

a while and then we'll come back later

and we'll pick back up this proposal to

be a tugboat it also allows us to put
biological or other science experiments
on it
I'll put a telescope on it went on yeah
on the surface
I think we actually have an animation of
Gateway to show there we go this is
showing all the different component
modules from both commercial and
international partners as well as NASA
being assembled to form you know
eventually this this really functional
outpost and orbit around the moon and it
also lets have constant communication
with earth which again is you know
something you won't have when you go to

Mars but at least this time while we're

working out all the interesting

challenges of being away from planet

earth and being in this environment for

long periods of time it truly is a

proving ground and it's it's flexible in

terms of what it can be used for awesome

you guys answered a question from oh

gosh I've lost it Yoga fire is Artemis a

joint venture the way that the

International Space Station is

International you talked about very very

much so yeah and and more partners as

well International Space Station this
has about 15 partners I mean now we have 89 nations on this planet that have satellites in orbit we are a very different species than were years ago yeah so as you know the future of space is for the whole world and we have a lot of nations you know working in space in terms of their economics or the communication and they'll be partnering with you this is what this the honors program is mm-hmm yeah you have a question about mm-hmm bigger than the ISS no no it's a ISS is
really huge and Gateway because it's so much further away is going to be a much more compact vehicle you know it'll it'll have a lot of the functionality that ISS does just be a little smaller well a lot smaller is they still need to be occupied not so the ISS an amazing achievement has been continuously occupied for almost 20 years November of 2000 was the first occupants that's people on space and definitely designed for that reason it's who are tough so Gateway is gonna be designed
differently because it has to be able to support humans for periods of time in that period where it doesn't have humans and so that can be done because of our advancements in robotics and autonomy and smart software I mean you know it's a different vehicle but you know we're starting to see self-driving cars self-driving trucks are satellites are a lot more autonomous we are smarter species now and now the space could take advantage of the knowledge that we've gained in that field yeah I think we have time for a like one more question
yeah the best maybe this one from a

random clown what are some of the design challenges that have yet to be solved for this trip can you identify there's so many I mean if you just think about the Apollo earlier in this show when the charge came to go to the moon in 61 it was only 20 days after what they had done a first suborbital flight they hadn't even done an orbital flight they hadn't figured out how to do rendezvous to spacecraft that had been a lot of or they didn't done a spacewalk they didn't even have a spacesuit
no doubt about it they'll be new and

that's the beauty of it because when you

have a problem that has not been solved

that's when you get your creative new

solutions now you know you're gonna

attack a problem and come back with

something that no one's ever thought of

before and then who knows where that's

going to me lead us nicely said yeah

well I guess we can that's the perfect

way to end this huh it is that's about

all the time we have today you guys a

huge thanks to our guests and everyone

who joined us in the chat today on
Twitch we will be back on Thursday July 25th talking about how to get an internship at NASA that's how it starts.

There are a lot of people here today who serve as interns right yeah so that's our next show for this gang here but remember to join us tomorrow in celebrating the Apollo 50th and hearing about more about our future plans to go to the moon and on to Mars so tune in to our special two-hour live NASA television broadcast tomorrow at 10:00 a.m. Pacific and you can learn more about the show and how to watch it by.
going to www.nasa.gov slash Apollo 50th

and click on events so check it out and

we'll see you soon thanks for joining us

bye