today America's space program is alive
and vital and it's filled with people
like many of you who sit in this
audience or people that you've been
seeing on television and and you're
going to see right now because we have a
special treat that not sure senator
Glenn he probably is beginning to get a
hint that something funny is going on
here is amiss but it's that it this is
an honor for me to be able to introduce
commander dan burbank and flight
engineer Don Pettit live from the
International Space Station to have just
a chat with the senator so crew how do

you read me Charlie we've got you loud

and clear welcome aboard the

International Space Station this is

absolutely incredible I just like to say

that we know you have an awful lot on

your plate for the next couple of days

and and we're delighted just to get a

chance to be here at the the opening and

to maybe just take a few moments to

commemorate senator Glenn's flight 50

years ago today friendship seven was

orbiting planet earth and that helped in

a very big way pave the way for America
to become a space power and two to go

to the moon and to do the things that

we're doing right now on the

International Space Station and that we

hope it's also going to help set us this

set the stage for us down the road to do

even greater things well Dan and Don I

thank you both very much but we're going

to turn the tables on senator Glenn

right now if it's ok with you he's been

getting pummeled with questions and he

is probably the biggest champion of the

International Space Station so I'd like

to give him an opportunity to kind of
pummel you with some questions about

44
00:01:43,409 --> 00:01:47,460
life up there since he's he's

45
00:01:45,688 --> 00:01:49,828
campaigning all ready for a trip to

46
00:01:47,459 --> 00:01:52,169
station so I want I want you to I want

47
00:01:49,828 --> 00:01:54,359
you to wise him up if you will so

48
00:01:52,170 --> 00:01:56,009
senator if you'd like to pose a couple

49
00:01:54,359 --> 00:01:57,569
of questions for them or some comments

50
00:01:56,009 --> 00:02:03,299
to them you guys are not floating you

51
00:01:57,569 --> 00:02:05,459
got your foot in the strap you're not

52
00:02:03,299 --> 00:02:07,409
your are you secured their you gotta

53
00:02:05,459 --> 00:02:09,949
bail water it's great to talk with you

54
00:02:07,409 --> 00:02:12,540
welcome aboard thank you

55
00:02:09,949 --> 00:02:14,039
and he's going to have in my head to me

56
00:02:12,539 --> 00:02:16,818
on a platter if I'm not careful with

57
00:02:14,039 --> 00:02:19,679
this talk about going to the station but
no I know you're floating around that's one of the things you can do up there and one of the zero-g environment of course is why you're up there to begin with to do the research it can be done there what are you doing hanging on are you a tethered actually I've got one foot underneath the bungee another foot underneath a handrail I think Don right now is free floating and behind us is andre kuipers European Space Agency Dutch astronaut with us and andre's basically free-floating as well it took us a little while to kind of get our
space legs so to speak but everybody's pretty comfortable managing their orientation in any number of ways do you have any estimate I don't know whether you know the exact number of research experiments you have on board right now do you have a any idea of how many are on board we have well over a hundred and they all come with an acronym that you either have no vowels in so it makes it really hard to pronounce or you can't remember what all the all the words all the letters stood for in the first place however I would like to say that that
the experiments we have we've got a whole ensemble of life science experiments that basically probe the gravity knob for life since it evolved on earth under constant gravity and now all of a sudden we can change the magnitude of gravity by a factor of a million and we can look at what the effects are on living organisms including human beings under that and then we have physical science experiments growing crystals looking at surface tension and other related phenomenon that gravity masks and then
combustion experiments I did a whole

00:04:04,199 --> 00:04:08,399
suite of combustion experiments this

00:04:05,849 --> 00:04:12,090
morning it was really fascinating yeah

00:04:08,400 --> 00:04:14,250
are you are you able to keep combustion

00:04:12,090 --> 00:04:16,108
going with less fuel required I know

00:04:14,250 --> 00:04:18,689
that that was one things that they have

00:04:16,108 --> 00:04:23,310
came up on Columbia before it was

00:04:18,689 --> 00:04:23,670
destroyed I you know that I don't know I

00:04:23,310 --> 00:04:25,649
do

00:04:23,670 --> 00:04:27,540
know that you have to you have to fan

00:04:25,649 --> 00:04:30,060
the flames if you want to keep him goin

00:04:27,540 --> 00:04:33,840
up here we're looking at forced

00:04:30,060 --> 00:04:36,110
convection and the fuel that I was

00:04:33,839 --> 00:04:41,819
looking at this morning with help from

00:04:36,110 --> 00:04:43,500
folks from NASA Glenn was ethylene we're
looking at twenty percent ethylene and
and burning that in air under forced
convection and looking at at when you
get separation of the flame from the
fixture that holds it that's very
interesting I thought the those energy
experiments that were started on
Columbia I thought were fascinating and
they had a lot of important future maybe
right here on earth the I don't know
whether people here in the audience
right here today realize but you know a
candle has flame goes up because the air
is heated the convection goes up and
pulls the flame up but in space when

something burns it just collects in a

big cloud around it so you get a whole

different set of burning and combustion

principles than anything we are you

can't duplicate that here on earth and

there are some of the indications were

that that we might be able to have

combustion with far less use of fuel on

some of the Columbia experiments and

that's what you're you're continuing

that right now I guess is that correct

yes senator Glenn and and i find it

philosophically interesting that that
civilization started with fire and learning how to use fire and it's served as well for millennia and and we are slowly refining our understanding of what fire is because fire will work whether or not you really understand all the details of the chemistry and what we're doing now is again using a reduced gravity environment which changes the dynamics of combustion so that we can dissect even more detail out from how fireworks which is obviously a needed element even as we leave planet earth and go off into the go away from the
hidan we've got a number of very young students here with us and I know I was watching you earlier it may have been a replay but the first handshake between a humanoid robot and in a human in space can you talk a little bit about our two and whether our tues behaving or or is developing a mind of its own already yeah we were talking about that there's we wanted to make sure that all three laws of robotics had been incorporated but but in all seriousness with a couple of days ago we had Robonaut are two out here in the lab and we were basically
doing some checkouts on it and at this stage really it's a technology development program and the idea is that all the interfaces all the things that we have on space station that we interact with are all designed for humans for hues of human hands for human arm length for for the parallax that human eyes provide and essentially Robonaut has the same functionality the same you know capability as far as interacting with hardware so it affords down the road a very good opportunity to take the tasks that are routine and
perhaps some of the tests that might be
more dangerous four crew members to do
and basically help offload us and and
share those tasks with with a
anthropoids robot and ultimately I think
it also has a lot of promise for doing
space walks and those can be of course
one of the most dangerous things we do
in space now put the three of you guys
on the spot because I don't think the
senator has ever been asked a question
from space so how about if three of you
put your heads together play like you're
newsmen and give us a question it's
really rough for you thanks a lot

in any sweating beads and so senator

Glenn did you ever really find out what

the fireflies were on your first orbit

yeah we did I think the scott Carpenter

on the second flight was able to hit the

capsule and send the whole shower amount

in the the scientists working on this

could relate them to the water

dripping out through the heat exchanger

which was a controlled thing and then
they just collected in a large cloud

around the spacecraft the one
thing I don't know that scientists have

ever figured out yet is why the glowing

luminous color water particles that go

out and freezin and that the light comes

from the Sun and through the Earth's

atmosphere and back out to the

spacecraft again and what what changes

the light in that what is refracted

there so that when it hit these frozen

particles they glow sort of a glowing

luminous color and I don't know that we

ever figured that one out not if we do I

don't know what the answer was on it but

they were not they weren't anything it

was going to do me any harm so I wasn't
too concerned about him if you guys had

an opportunity to bring this since

he's bugging me all the time if he had

an opportunity to bring him up for say a
couple of months stint on station okay

Annie I'm just kidding which experiment

that you're doing now would you most

like to hand off to him and why

we know one thing that we didn't talk

about already which i think is a key

thing that we're doing on board space

station right now we do a lot of the

life sciences and physical sciences but

one thing that we're doing on station
really i think falls in the category of engineering development technology and i think this is some of the key things that will help us leave low-earth orbit go on to the moon asteroids and on to Mars and I think one of the things that we learn an awful lot about every day that we get a chance to interact with it is the regenerative environmental control system that we have here so I think based on his experience the center's experience it would be really neat very interesting to get a chance to work with him on the
systems that we have to provide that capability if we spend so much time
sometimes focused on the details of those tasks it would be really good to have a big picture look on about that and also from somebody who has thought about leaving low-earth orbit from the perspective of lawmakers in our government and really what Dan meant to say was what he's talking about the regenerative life-support system that's a fancy word for our toilet and so he wants to put a senator Glenn busy of fixing the plumbing up here that's
exactly what I thought I was going to

00:11:23,179 --> 00:11:31,969
get assigned to thank you it and I think

00:11:29,750 --> 00:11:34,610
now now that downs pointed it out I may

00:11:31,970 --> 00:11:37,399
find myself replaced outright the

00:11:34,610 --> 00:11:39,139
senator you got anything else for this

00:11:37,399 --> 00:11:42,110
yeah one other question do you have any

00:11:39,139 --> 00:11:45,819
a plant growth studies on board right

00:11:42,110 --> 00:11:45,820
now because those are fascinating too

00:11:46,059 --> 00:11:52,909
well just just has a little

00:11:50,679 --> 00:11:56,359
investigation on the side I've been

00:11:52,909 --> 00:12:00,289
growing a few plants and senator Glenn I

00:12:00,289 --> 00:12:03,230
was able to get a zucchini plant to

00:12:00,289 --> 00:12:05,419
bloom and it bloomed on Valentine's Day

00:12:03,230 --> 00:12:08,930
and I had a special conference with my

00:12:05,419 --> 00:12:11,269
wife and I presented her with up with a
zucchini flower I mean it's it's not a rose it's not a lily it's not a carnation it was a zucchini blossom but and she could only see it on the downlink video but I did I pick that blossom and I stuck it in our world atlas I pressing up between pages and I'm gonna bring that home and give it to her that's good everybody went oh hey we're here for a future forum so for the next one thing going it just so right here I wonder about how far around the earth they've traveled just while we've been talking to them probably a fourth
of the distance around the earth just in
the time we've been talking either of
you watching the map and I'd say that's
about right so it's it's been basically
yeah fourth of the way around the earth
so the order of about 10,000 kilometers
they're about yeah quick question for
you as I was saying we're here for a
future forum for the next day and a half
you know what just from what you've seen
so far what would you like to be a topic
that this group considers in terms of
where should we be 20 years from now or
30 years from now based on what you've
what you've seen and experienced this
time and you know I know it's your
second time up there done well I think
there's a lot of aspects to that and and
I think one thing that one of the
biggest challenges that we have on board
space station that we've probably had in
any spacecraft before and it's something
that with the space shuttle we really
didn't have this case in the space
shuttle every time we flew it we
returned it to the factory in essence we
returned it to the people who knew how
to build it on board space station right
00:13:24,019 --> 00:13:34,220
00:13:27,440 --> 00:13:36,890
00:13:34,220 --> 00:13:39,590
00:13:36,889 --> 00:13:41,480
00:13:39,590 --> 00:13:43,610
00:13:41,480 --> 00:13:45,200
00:13:43,610 --> 00:13:47,810
00:13:45,200 --> 00:13:49,070
00:13:47,809 --> 00:13:50,359
00:13:49,070 --> 00:13:52,310
00:13:50,360 --> 00:13:54,560
00:13:52,309 --> 00:13:56,929
00:13:54,559 --> 00:13:59,839
00:13:56,929 --> 00:14:01,639
now astronauts have to be essentially

00:14:04,779 --> 00:14:10,100
to fix anything and everything that

00:14:07,100 --> 00:14:12,980
happens we need to essentially be

00:14:10,100 --> 00:14:15,290
professional technicians on a par with

00:14:12,980 --> 00:14:17,330
the people that for decades have have

00:14:15,289 --> 00:14:19,819
put their heart and soul into into

00:14:17,330 --> 00:14:21,230
taking care of incredibly complicated

00:14:19,820 --> 00:14:22,879
exotic vehicles in the form of the space

00:14:21,230 --> 00:14:26,240
shuttle if we leave low Earth orbit one

00:14:19,820 --> 00:14:22,879
of the key things one of the most

00:14:21,230 --> 00:14:26,240
important things I think we need to have

00:14:22,879 --> 00:14:28,370
is we need to have the capability to to

00:14:26,240 --> 00:14:30,209
essentially cut the umbilical to be able

00:14:28,370 --> 00:14:32,769
to maintain
spacecraft to a degree that if something breaks you can replace a part out right you need to be able to fabricate apart you can't bring you cannot bring with all the pieces and parts that you might anticipate that might break over the course of a couple of year mission so we one of the key technologies and it's something as I think is a unique need for Space Flight is to find some way to be able to fabricate parts that we can replace and to be able to do those things obviously in conjunction with the group with the ground that's
going to help you talk you through those

things remotely but the fabrication part

in the in the and the repair capability

is one of the biggest challenges I

think we have and then I think that one

one aspect of going away from Earth that

we need to think hard about is do we

take everything with us on the mission

from planet earth do we lift everything

we need from Earth's gravity well or do

we figure out how to take materials from

elsewhere and use them to enable

missions and this all boils down to what

I refer to as the tyranny of the rocket
equation and what the engineering implications are to the rocket equation for the designing for the design of our rockets that we launched from the surface of Earth and and the implications of how much payload can any given rocket take up and what do you use for that payload and when you look at at building bases elsewhere it's going to take hundreds of tons of material to build and maintain a base and how do we get those hundreds of tons of material up into space and and I think we need to do some serious
thinking about the rocket equation maybe

alternate ways to try to get things into space that don't necessarily use the rocket equation and possibly take about getting materials a brute force and ignorance of materials that we need by the multi-ton from other than planet Earth

Don you let me ask you one one go ahead on risk yes as an international representative of the international partner I think it would be nice to at the the question to the Future Forum how the future is going to be in a sense of international cooperation we work
together with a lot of partners here now

and I'm curious what the forum thinks

about going beyond Earth orbit as an

international efforts fantastic!

appreciate that because I'm thinking

about it let me we don't have a lot of

time left but let me ask you all to just

tell the all of us if you can you know

we're getting ready to send the first

private spacecraft up to get ready to

bring you supplies what type of training

are you doing to stay ready they're on

board in case you know the dragon or

cygnus happens to get there doing your
watch that's a great question it's really important for us to be able to maintain currency and and that comes right down to the piloting skills of being able to do a robotics capture of a free flying vehicle and should-should spacex dragon make it here during my watch and I hope it does the way we're staying are keeping ourselves current is by practicing using a program called robot and that is essentially a robotic simulator that uses some of the tools we already have developed at Johnson Space Center by folks that work in the virtual
reality lab there and those tools allow
us to essentially simulate the environment right down to the dynamics of how the space station robotic arm works the dynamics of the motion control system of Dragon and in very high fidelity graphics and it allows us to essentially go through all of the crew coordination skills and the monkey skills of flying the arm right up to capture we can do it multiple times in addition to that we can also do dry run captures using the real space station robotic arm to grapple fixtures on space
station that's something we have done a

couple of weeks ago

hey I want to thank you guys I know it's

you know you're really busy up there

I appreciate you taking time to to just

help us entertain this crowd here and

I'm going to turn it over to senator

Glenn for a final farewell well this

really a great surprise this morning I

didn't know I was going to have the

honor of talking to you guys up there

and I just was sitting here thinking a

minute ago about the heck nology has

gone ahead so rapidly in the space age

because here we are watching
high-definition television here and you

guys coming through perfectly back in

the mercury days we had to go over each

station on the ground apart and couldn't

even keep communications now we have the

teachers technical data relay satellite

that you relay through so you have

constant communication around the earth

it's just amazing that we can sit here

and talk to you back and forth so thank

you very much for helping kick off our

forum it's really great congratulations

to all of you thank you and from and I
guess from the ohio state university i'm
learning your way the home of the

Buckeyes we're going to pass it back to

Houston and let you guys go about go

about your work but thanks again this

has just been incredible for us thanks

so much thank you so much it's been an

honor and a pleasure for us as well

that's amazing it is