good morning welcome to Mission Control

Houston were here inside the space

station flight control room

I'm brandy Dean I work in public affairs

here at NASA and I've got here with me

Stan loved one of our astronauts he's

been to the International Space Station

on board a space shuttle and now is

working on a lot of kind of future

planning activities for what's next for

NASA so Stan won't you tell us a little

bit about yourself

sure my name is Dan luff I joined NASA

in 1998 as an astronaut before that my
background was in physics astronomy

planetary science and spacecraft design

since then I've been done a bunch of jobs here at NASA and including working as a Capcom here in Mission Control and in our other control centers here at Johnson Space Center it's been about eight years doing that so I'm used to sitting at another console in this room and Capcom's are the people here on the ground who get to talk to the astronauts when they're in space yeah so when you hear a voice saying you know ISS Houston such-and-such
that's the Capcom speaking so I also flew in space on space shuttle mission STS 122 that was in 2008 I did a couple spacewalks worked the robotic arm on the shuttle and on the station and my crewmates in and I installed the Columbus laboratory module onto the space station which is still there today right on the front where it's easy to see and with you here today I'll be happy to answer your questions about space travel so if you're ready we can go ahead and start taking your questions to negate the effects of microgravity
okay um what astronauts do to try to
mitigate the effects of microgravity

quite a lot actually they spend at least
two and a half hours every single day in
space doing mostly physical exercise to
help counteract the effects of gravity

of course your body is like anything
else that's precious use it or lose it

so when you get up into space and you
get out of the effects of gravity you
don't have to carry your body weight up

and down stairs and things like that

your muscles get real weak your bones
can get real weak a whole bunch other

things happen in order to keep your
muscles and bones strong then you have to do a lot of exercise to try to make your body work as hard in space as it has to every day on earth you don't even realize how much work you're doing just standing up and moving around so the astronauts will be doing the equivalent of lifting weights of course you can lift a lot of weight on the space station it's not much of a workout cuz there's no gravity so instead they've got a weightlifting machine that instead of pushing a big weight you're pushing against a cylinder
of compressed air they also have a treadmill for running of course you don't stay on the treadmill and weightlessness so you have to have a bunch of bungees to hold you down make you feel like you're running on a on a surface on earth and again they're hard scheduled for that two and a half hours every day to try to keep them in good shape in the early history of the space program especially the Russians who were doing long-duration spaceflights before the United States was crew members who didn't exercise came back and were in
pretty poor physical shape it took him a long time a lot of rehab on the ground to get back their their strength and their bone density but we're finding that our crews are coming back from the station in pretty good shape because they're doing their exercises and actually if you're really interested in that you can find out more about some of the workouts that astronauts here on the ground and also in space do and with our train like an astronaut program Mike Hopkins who just launched to the space station yesterday has been real involved
with that and he's been sitting down

101
00:03:32,189 --> 00:03:35,759
some tips and we have some suggested

102
00:03:34,560 --> 00:03:37,560
workouts for you and you can find out

103
00:03:35,759 --> 00:03:40,709
more about that on Facebook at

104
00:03:37,560 --> 00:03:42,569
facebook.com slash trained astronaut you

105
00:03:40,709 --> 00:03:50,640
can see that address on the bottom of

106
00:03:42,569 --> 00:03:54,569
your screen there next question are you

107
00:03:50,639 --> 00:03:55,949
like to keep it say yes and are there

108
00:03:54,569 --> 00:03:58,289
better materials that you could have

109
00:03:55,949 --> 00:04:00,119
been you can use that you simply can't

110
00:03:58,289 --> 00:04:03,379
get up there right now or you or it

111
00:04:00,120 --> 00:04:07,079
can't be or you can't afford right now

112
00:04:03,379 --> 00:04:10,019
okay the outside of the space station to

113
00:04:07,079 --> 00:04:11,459
keep it safe you said the main threat to

114
00:04:10,019 --> 00:04:15,000
the space station and the crews living
on board is orbital debris you'll hear

us sometimes at NASA use the phrase mmod

which stands for micro meteorites and

orbital debris but up where the station

orbits there is actually not very much

micro meteorite

it's almost all orbital debris that is

stuff that we have put up there either

accidentally or on purpose that's

orbiting around the earth at enormous

speeds much much faster than a rifle

bullet so to keep the station safe it

has what's called a debris shield so

instead of just having your hull of your
space station which is a single wall of aluminum out there facing the orbital debris where if something hits it it could punch a hole in it we put a second wall around the whole space station and stood out from the inner wall by a few inches to maybe a foot and what that does is when a piece of oratory comes in it's coming in so fast that if hits anything even something as thin as a sheet of tissue paper that projectile is just going to break up into a spray of molten droplets and little tiny fragments and then that stuff spreads
out over the intervening gap between the

debris shield and the main hall of space

station so that when it hits the main

hall it's all spread out and doesn't

punch a hole in it so that's how you

protect against really high speed stuff

so it doesn't really matter what the

material is you know you can make strong

armor or something like that

and at the speeds of collision that

we're talking about it really makes very

little difference the important thing is

to have that shield can be very thin

doesn't matter what it's made out of


stood off from your main pressure call

the actual material that we used for all

of that is aluminum that's what

aerospace engineers the folks who go to

work here at NASA were trained to use

when they were in college studying to be

aerospace engineers aluminum's what were

used to and it works pretty well it's

also really light which is important

because everything has to be lanced

launched on a rocket and we can just

barely shave down the masses of all the

stuff we throw into space enough so that

it will actually the rocket can actually

lift it up into orbit so aluminum is a
good choice I don't think we have with anything waiting in the wings it's like a super armor that would be better slowly composite materials you may have heard of which are made out of fibers of carbon and the epoxy glue are working their way into aerospace that stuff is stronger than aluminum and a little lighter I don't know how it behaves an micro meteorite impact the physics of micrometeorite high speed impact so they're a little bit weird and things that you might expect to be super-strong like Kevlar Kevlar is great for a
bulletproof vest

it's lousy for orbital debris just depending on the physics of the material

so I don't think we have anything waiting in the wings to replace aluminum

it's a good choice next question how do

you sleep at night pretty much the same

you do on earth maybe your first couple

nights in space you're a little excited

about where you are so you may not sleep

real well but at night you can just go

to sleep wherever you are and it's

really really comfortable because

there's no gravity pulling you onto the
bed but if you just go to go to sleep

floating around the cabin you will wake

up on the ventilation inlet grill

because the air currents in the cabinet

will very slowly pull you over to the

ventilation duct so if you don't want to

wake up with all your crewmates on the

ventilation duct you could have to do

something to kind of restrain yourself

so there are sleeping bags which you can

strapped to the wall and you just climb

in your sleeping bag you can it has a

little a stick straps to hold you in and

hang out and go to sleep
so it takes a little getting used to the

00:07:41,279 --> 00:07:44,909
first couple nights some people miss

00:07:42,899 --> 00:07:48,000
having a force pulling them into the bed

00:07:44,910 --> 00:07:50,460
I know a person who when they're in

00:07:48,000 --> 00:07:52,228
space sleeps sort of sandwiched in

00:07:50,459 --> 00:07:54,029
between two big huge heavy cargo bags

00:07:52,228 --> 00:07:55,709
because it gives them that extra feeling

00:07:54,029 --> 00:07:56,848
of security but once you get used to it

00:07:55,709 --> 00:07:59,689
it's the most comfortable night's sleep

00:07:56,848 --> 00:07:59,689
you can ever get

00:08:00,019 --> 00:08:03,378
next question

00:08:10,470 --> 00:08:16,800
what are the requirements in terms of

00:08:13,829 --> 00:08:19,409
education and merit to become an

00:08:16,800 --> 00:08:21,000
astronaut that might be featured on a

00:08:19,410 --> 00:08:23,790
mission to the International Space
Station okay to be an astronaut you have to have at least a bachelor's degree in a technical field like physics or engineering or something like that you can also enter the astronaut corps as a teacher or as a military test pilot but everybody has to have at least that bachelor's degree plus some work experience or else advanced degrees beyond that it's you have to be very healthy you have to be pretty fit the rigors of working in a spacesuit on a spacewalk are pretty intense and if you're not in good shape you're not
going to be able to do well at that so

those are the basics and then the hard

part is there's five thousand other

people just like you want to go do this

and you have to be lucky enough to come

out on top in the selection process but

the basics are very simple they're also

on the web if you look on NASA's website

you can download the job application and

tells you exactly what you need

you can find that at nasa.gov slash

astronaut if you want to go do some

research

what is being researched on the space
I heard something about biomechanics and microbiology and such. And surface tension or liquids what all is being researched there. I certainly cannot answer that question. There are dozens of investigations going on on the space station all the time and you listed the main ones. The main classes combustion the way flames work in one gravity is very different from how they work in zero gravity. We're trying to understand how flames work we're doing work on biology. We're also doing a lot of work on human
health so that we can send people say

all the way to Mars and back and keep

them healthy in space but I I'm sorry I
don't have a full list for you but it is

a long one next question

what is the average cost for a mission
to save the International Space Station

I don't know and neither does anybody

ever paying about sixty

right now we're paying about sixty

million dollars per seat for a seat on

the Soyuz but the accounting for how

Rockets are funded and how much they

cost in which money comes out of which

pot is so obscure that even I with a PhD
you can't follow it cost for an unmanned rocket launch fifty to seventy-five million dollars Soyuz if you multiply that seed cost times the three crew that ends up at about two hundred million dollars of course rockets that carry people are more expensive than rockets that carry satellites because the ones that carry people have to have extra safety systems which cost money and more making sure that they're really really ready to fly because you really don't want an accident with people on board
but sort of hundreds of millions of dollars per launch there are tens to hundreds of billions of dollars it's kind of the ballpark for you next question you mentioned ensuring that astronauts were exceptionally healthy how do you ensure that no particularly nasty viruses or bacteria end up on the on the space shuttle infecting anyone same way we've done for hundreds of years you quarantine everybody before they go so before a crew launches to the space station they will enter quarantine and
they will spend a week to ten days
without contacting basically anyone else
the few people that they are in contact

with either have to wear pollen masks or

have to get examined by a doctor and

make sure that they're healthy and we've

been doing that in the space program

both the u.s. space program the Russian

space programs for decades and it works

most of the time we did get the flu on

Space Station one time a few years ago

and the crew got sick and felt lousy for

a couple days just like happens when you

get the flu and then they got better
just like happens when you get the flu

but we work hard to try to keep the crews in quarantine and isolated from germs so that we don't get any bugs on the space station because we want our folks up there to be able to work and we don't want them stuck in bed feeling lousy next question and once again just a reminder definitely speak up so they can hear you clearly in Mission Control and go ahead with your next question not Copa their speeds used to project him in outer space I'm sorry say that again please how do you astronauts cope with the
speed used to project them in outer space.

I don't know how do you cope with the speed you need to write in an airplane. It seems pretty okay you know that's fine but you're going 500 miles an hour but you don't feel that inside the aircraft.

same thing in a rocket your environment travels along with you and there is little sense of the speed you're going at except during launch during launch when all those rockets are firing and you can hear the howling of the wind.
outside the capsule when you're still at

low altitude and you're not up in vacuum

yet you can hear that there is a sense

of speed and the way you cope with that

is and especially the acceleration that

the rocket produces which isn't that
great if you watch a lot of movies you

see people getting you know world--in

centrifuges and things like that the

acceleration you feel riding the soyuz

the space station tops out about four

and a half G's which is enough to make

you notice you got to pay attention to

your breathing but you're lying on your

your
back you're in a comfortable seat and you just ride there with the rocket and it's okay but there's really very little sense of speed most of the time it's the acceleration you have to think about next question when returning back to the surface of Earth how do the astronauts acclimate to the conditions on earth and how they differ from the conditions in microgravity in outer space and do they run senescence okay getting used to gravity again is about as hard as getting used to weightlessness at the
beginning of a mission when you first get into space you have to sort of relearn how to use your body because you don't have your legs of support anymore. You have to if you're working with one hand you have to support yourself with your other hand if you're doing a two-hand job you run out of hands coming back to the ground then you have to get used to gravity again your sense of balance has to rewire itself so you may feel a little dizzy or even nauseated. The first couple of days back in fact your first three days back from a short duration space flight they don't let you
drive your car because they're afraid
you're gonna get dizzy when you go
around the corner and crash so they keep
the car keys from you for three days
when you get back you may have lost some
muscle strength on my short flight I actually lost quite a bit of strength so I had to go back to the gym and work out
real hard to get my strength back we even had a couple people the first day
or two back because your heart has gotten used to pumping blood around your
body without having to work against
gravity we've had a couple people faint
which always looks alarming but they've been perfectly alright

issues not really especially now that people are doing their exercises they're coming back in pretty good shape in the past people lost a lot of bone you can rebuild bone with a lot of heavy loaded weight lifting things like that there have been a couple cases where people didn't get all their bone back but as far as you know looking at somebody and seeing that they have a health issue now people look great I have a chance now working in the astronaut working out in
the astronaut gym and see guys when they're two days back from space station and they look really good next question

you mentioned some physical effects on the muscles and the skeleton are there any effects on the immune system spending so much time usually absent from pathogens ah yes although we're getting a little outside my field of expertise here if you got fizzies questions I'm good with that biology and that's not where my PhD is but I'll tell you what I know so actually there are changes in your
immune system and has nothing to do with

being isolated for pathogens it has

everything to do with being in a

stressful environment people on earth

under stress like you know students

during College finals weeks and things

like that they get stressed out and it

actually depresses your immune function

that is things that would not ordinarily

make you sick will make you sick because

you're working hard you're worrying a

lot you may not be sleeping too well and

astronauts get that in spades and that's

been the subject of many studies now

fortuitously in space you are isolated
from pathogens so even though your immune system may be weaker maybe because of the stress maybe because of something else from being in space we don't really know right now we have yet to run tests on astronauts in space who aren't working hard so we don't know whether it's the stress or the space that does it but because there's no pathogens on Space Station or very few because of the quarantine you have fewer opportunities to get sick what other things do astronauts do to
prepare for space like physical training

or like things they have to do I don't

I saw a bunch of interesting like

simulations that astronauts have to go through before they understand yeah

takes minimum of two years of preparing to fly in space and for most people it ends up being more like eight so you're working hard for those eight years you're not just sitting at your deskthumbing through the internet you will be doing a lot of physical training as you mentioned you'll be doing a lot of flying in our t-38 trainer jets which
teaches you how to handle complicated systems while moving very very fast in a situation where if you mess up you can die there's training in the giant swimming pool in the spacesuits learn how to do spacewalks there's training on the robotic arms both using real robotic arms and also sort of very sophisticated simulated environments which you know has the same joysticks as a video game but someone's going to give you a stern talking-to if you not give your robotic arm into something during one of those Sims there are what we call integrated
simulations where we have crews in
mock-ups of the space station on earth
connected to the real Mission Control
with real flight controllers and
elsewhere there’s a team of instructors
who are throwing malfunctions at the
space station every few minutes and the
flight controllers and the crew have to
respond to those malfunctions prevent
further problems from happening and
recover from them so it’s a very very
intense and very long training scheme to
take somebody who just comes in the door
and get them ready to fly in space
next question space do you have a set
area for waste storage both human waste and food waste or do you release it into space from the ship we do not release waste into space and our first question I think was about orbital debris and anything you put into space as waste can come back to haunt you at 8000 meters per second and we really don't want that we don't want to dispose of everything in space that are all waste that we generate in space we want to dispose of so that it does not stay in orbit and then knock out ourselves or knock out somebody else's
really expensive satellite so all of the waste that's generated on the space station gets loaded into one of our several cargo ships that go to the space station they bring fresh supplies and when it's empty they load it up with trash separate the spacecraft from the space station and then deorbit it so that it burns up in the atmosphere over the South Pacific so that even if a few little pieces do reach the ground there's no people there it's just open ocean there are no islands or anything and even very very few ships because the
shipping routes don't run under the place where we dispose our stuff so of our cargo ships right now we have a handful of them only the SpaceX Dragon capsule actually lands intact under parachute and we use that for returning cargo but the trash haul gets burned up in the atmosphere I was wondering how you preserve food in space and keep it from spoiling with things like milk things like that no we don't get a lot of milk in space all the food in space has to have a shelf life of a year or more
it all comes up on cargo ships those are

00:21:49,849 --> 00:21:52,638
separated by months we need to keep a

00:21:51,319 --> 00:21:54,408
reserve supply of food on Space Station

00:21:52,638 --> 00:21:56,178
in case one of the cargo ships doesn't

00:21:54,409 --> 00:21:57,559
make it that happened a couple years ago

00:21:56,179 --> 00:22:00,169
we had a cargo ship full of food and

00:21:57,558 --> 00:22:02,269
supplies that crashed well it was

00:22:00,169 --> 00:22:04,490
heading for orbit and the crew did not

00:22:02,269 --> 00:22:06,528
got that batch of supplies so they had

00:22:04,490 --> 00:22:08,179
to eat stuff that was in storage so what

00:22:06,528 --> 00:22:09,829
we have for food is a whole bunch of

00:22:08,179 --> 00:22:12,679
freeze-dried stuff like backpacking food

00:22:09,829 --> 00:22:15,138
which he had water - we have a lot of

00:22:12,679 --> 00:22:16,730
thermal stabilized stuff which is sealed

00:22:15,138 --> 00:22:19,519
in a package and then the whole package
gets boiled so that it kills all the bacteria and then the sealed package can remain on the shelf for years you see

those in MREs the rations that are issued to our soldiers overseas and then we have some dried foods and then the best treats anyone can get is when a cargo ship is just getting ready to launch they'll throw a few things in like fresh fruit and vegetables because you don't get too many of those on Space Station and the crews remark about how wonderful some of those capsules smell when you first open up the hatch and
it's got some fresh apples and oranges

what future plans does NASA have for manned missions and what's like where

some eventual goals of NASA right now

our stated long-term goal for people is to get people on Mars by the 2030s

closer to that we are hoping to get our new human-rated space capsule that we can carry people back into space from the United States which we have not been able to do since the shuttle retires and

I really hope that we can do that again

soon I'd like to see US astronauts
launching on a u.s. flag carrier so

we're hoping to be flying that capsule with people here in the next five or

five years or so there's some test flights of that coming up without people sooner than that we've also got a plan to go out with a robotic spacecraft and grab a little asteroid from near-earth space and we're busy looking for asteroids to the right size right now bring that back with the robot ship and put it into orbit around the moon and then fly up there with people and do some work on that small asteroid there's
going to be some steps in between

00:24:00,470 --> 00:24:04,130 visiting a little asteroid and going to

00:24:02,210 --> 00:24:06,880 Mars and we're still working out what

00:24:04,130 --> 00:24:06,880 those might be like

00:24:12,170 --> 00:24:17,970 huh you talked about capturing an

00:24:14,759 --> 00:24:19,950 asteroid um how do you identify an

00:24:17,970 --> 00:24:23,700 asteroid they don't give off any light

00:24:19,950 --> 00:24:25,170 is there any way you can see them well

00:24:23,700 --> 00:24:27,809 the moon doesn't give off any light you

00:24:25,170 --> 00:24:30,039 can see that right

00:24:27,809 --> 00:24:32,589 so asteroids don't give off light of

00:24:30,039 --> 00:24:34,119 their own but they do reflect sunlight

00:24:32,589 --> 00:24:35,349 just like everything else in the solar

00:24:34,119 --> 00:24:40,839 system including the moon in the earth

00:24:35,349 --> 00:24:42,909 and spacecraft in orbit so the problem
is asteroids are really tiny so the moon

is a couple thousand miles across and

it's close so it's easy to see now when

you're talking about something that's

one mile across or for the sizes of

asteroids that we're talking about now

maybe 20 feet across and out many times

more distant than the moon it's like a

little mosquito that's pretty far from

the streetlight and it's very hard to

see to find those things we use big

telescopes that can big mirrors that

gather a lot of light and wide field of

view so that they're not just looking
down a soda straw but looking at a big area of the sky and those telescopes some of which are automated they do everything robotically look for things identify moving targets and those guys are busy every night looking at the skies finding new asteroids in order to find really tiny ones that are appropriate for fetching back to the moon we may have to have to actually build a new telescope there's one on the books called the large synoptic survey telescope there's gonna be an 8 meter mirror that is the light-gathering
mirrors 25 feet across that'll be a good one and we're hoping that that can identify asteroids like that incidentally that facility and others like it will help identify asteroids that might hit the earth which is also a topic of interest we'd rather that didn't happen and when we develop the technology to move asteroids around to put them near the moon so that people can visit them we'll also be developing the technology we need to protect the earth against asteroids that might strike it
all right it looks like those all the

time we have for questions so I'd like
to thank you guys for attending today
and thank you dr. love for coming in and
answering all the students questions for
the students do you guys have any final
word you want to say you're welcome my
pleasure great questions