hello and welcome to open science I'm dr. Marshall Porterfield from NASA headquarters in Washington DC and joining me today is dr. mark wise Louisville from Portland State University I'm mark you've been a principal investigator for our complex fluids experiments for a number of years and we've all seen the videos of astronauts playing with spheres of water in space this is your research area can you explain the general phenomena and then talk to us a little bit about what you've discovered in your International
Space Station research people don't understand that the lot of the forces that we see on the ground are the same in space those actually don't change but what does change is the impact of gravity so with less gravity then we start seeing small forces that were not accustomed to dominating the fluid process so we see giant spheres of liquid we see giant bubbles we see liquid going to places where they're not used to seeing they see this absence of an up-or-down kind of thing floating or sinking those things all go away and so
that catches us by surprise and so

there's really a lot to learn to make

systems work in space so how is what you

have learned in your research program

contributed to the development of a more

reliable spacecraft and technologies

that are needed to support humans in

space okay it's kind of another thing is

kind of odd is that almost nothing no

fluid systems that we have on earth will

just work you just take it to space and

it'll work

most of the systems will be corrupted by

large bubbles plugging lines or liquid
spilling and going someplace they shouldn't be that kind of a thing so as soon as we learn how to position and make fluids do things on their own using surface tension and not say gravity then we learn how to expect where the liquid should be so that we can make refrigeration systems work make filter systems work make cooling systems work make drinking systems actually work that kind of thing and so all of our work even though it tends to be fundamental it has an immediate application we find two systems that are on spacecraft so one of the the most
popular new things that I've seen that

result of your work is the development

of the coffee cup for the astronauts to

use in space um and the shape is very

interesting can you tell me a little bit

about the geometry of the coffee cup and

you know very quickly so that we can

understand yeah well the coffee cup

actually utilizes all we've learned

about capillary stuff in space and you

can learn a lot of that stuff on the

ground too but in space you see it on a

big scale in that in it with that we can

make a cup large enough to still exploit
capillary forces so that when the astronaut brings it to his face there's a gradient in the driving force from surface tension to drive that liquid right into the mouth the astronaut in a way we've designed a cup so that the bottom of the cup is actually the lip of the cup so but from the astronaut makes that connection that serves as the bottom and it will drain the cup into his mouth at the rate that he or she takes it in yeah the video of seeing the astronauts use the coffee cups in that and the drinking process is is very
interesting I'm sure that the audience is really gonna enjoy getting a chance to see those videos also but in addition to the coffee cup your research has contributed to development or the modification of other hardware systems that are very important on the International Space Station can you give us some examples of that right so in the coffee cup actually has a lot of science in it and engineering too so if we can design a system for instance for processing urine or processing wastewater other streams or condensing.
streams of water by just having a simple

maybe it's a complex shape but a simple

non moving part shape that make all the

liquid go to one place then we can get

it out we can get the bubbles out we can

get the liquid out we can keep the

system operating and with no moving

parts with no electrical power just the

surface shape the just the shape of the

container and the wetting properties and

surface tension of the liquid so how

long have you been involved with this

type of research well I when I was a

master's student I saw some images of

low gravity fluid phenomena and got
absolutely hooked that drove me to look for a job at NASA got one and for the first decade of my career I worked at NASA so this started this was in my blood then when I finally wound up at in academia then I worked like crazy to try and continue that research that's my favorite thing to do so in addition to the work that's being done on the space station and the application to supporting astronauts right now in the space station how does your research benefit us back on earth we have a unique focus because we see
gravity less processes things that you don't see on on earth very often because gravity masks everything but for micro scale systems all this stuff applies so everything we learned in space is directly applicable to the ground systems so that when we see all of these biological process small flows wetting and spreading floats we have almost immediate tools to apply to those systems to make them work better and so from lab on chip technology stuff to medical tubing and things like that we can have direct impact and we definitely
want to go that direction and what about the journey to Mars where do you see your research having the most impact and in terms of the journey to Mars in that one we think that we can have a very significant impact now our stuff won't displace other methods that are being used but we'll give it but we might and we definitely teach how to avoid catastrophe due to capillary failure like a bubble fouling the system and we definitely make systems that are that are more reliable that free up astronaut time to do other research not just
maintain the systems that that are

00:05:48,430 --> 00:05:53,620
passive with no power requirements and

00:05:50,918 --> 00:05:55,629
things like that or even are redundant

00:05:53,620 --> 00:05:57,610
meaning they're silent in the background

00:05:55,629 --> 00:05:59,680
continuing to function even though a

00:05:57,610 --> 00:06:01,990
primary system may be at work so it

00:05:59,680 --> 00:06:04,300
makes systems much more reliable there's

00:06:01,990 --> 00:06:05,769
definitely multiple systems multiple

00:06:04,300 --> 00:06:07,569
technologies that are making the system

00:06:05,769 --> 00:06:09,399
function for life support that would be

00:06:07,569 --> 00:06:10,779
a very nice thing to have well I think

00:06:09,399 --> 00:06:12,849
another area you need to think about too

00:06:10,779 --> 00:06:16,149
is the quality of life because a crew

00:06:12,850 --> 00:06:18,790
performance is tied to quality of life

00:06:16,149 --> 00:06:21,759
and just the coffee cup itself I think
is really a major contribution because

that's something that people always do

it reminds them of home right

in fact the coffee cup you know it their

aromatic drinks you know would be much

more desirable in the cup well the

astronauts might have to do the dishes

every now and then but that could be a

really advantage too because hey there's

tons of bags that are being thrown away

every time a drink is drank so that you

could actually have a

significant savings if you use something

like a cup and this necklace
demonstration is hey you can have scalding drinks in open containers safely just like you do around your coffee with your coffee cup or on your laptop in the morning that's awesome thank you Mark drinking coffee in a work environment is an important part of life on Earth and because of your work now as possible off the earth as well to learn more go to nasa.gov