Question 1:

Dear Cheap Astronomy – Will we just go nuts on a two-year mission to Mars

Well, we might if the space radiation doesn't kill us first. As we may have noted in previous episodes, current timelines for when we'll land on Mars seem to take little account of the fact that there are many mission components we don't even have conceptual solutions for let alone anything flight-tested or even prototyped. So current aspirations of having footprints on Mars in the 2030s are just aspirations.

Leaving spacecraft logistics to one side, it's equally important to ensure the crew survive the journey there and back again, which requires solutions for radiation shielding, the slowing if not preventing of the skeletomuscular and other physiological degradations that result from extended periods in microgravity and yes, you also have to stop the crew from going nuts.

The idea of flying a crew of maybe five people in an Orion capsule to Mars and back again over a two-year mission really is nuts. Astronauts are generally very well-adjusted, very smart and very resourceful people – the best of the best, if you like, but they are still people. Like war, a flight to Mars will be months of boredom, punctuated by moments of sheer terror, when something goes wrong and you realise how alone you are and that there's a thin sheet of metal between you and an unpleasant death. Coping with that ever-present for two years or more when you're all living in one little room, where everyone has to live, sleep and attend to all their bodily functions will be tough going. People survive such experiences in prison, but no-one does so voluntarily and the experience doesn't leave many in a healthy state of mind. It's also the case that people in prison don't have to operate a lot of hi-tech machinery, where pressing the wrong button could kill both them and everyone else in their cell.

It is worth wondering whether mission control is going to let a Mars crew have access to a control panel where pressing the wrong button could kill everyone. Notwithstanding the mental and physical deterioration that may develop over the mission, two years is a long time for anyone to not to stuff something up by accident. It's also the case that space agencies have been sending successful robotic missions to Mars for decades, so we won't really need the crew to actually fly the ship.

But, while not having to do much on the long flight to Mars might relieve the crew of stress, it's not really conducive to good mental health. The crew will have a certain amount to do with respect to managing the life support system - filter changes, waste disposal, that sort of thing – and they'll also have to keep the place reasonably clean and hygienic, since they also have to prepare and eat food in that same little room. These will not be inspiring or engrossing activities, but you can bet the rest of the crew are going to notice if you don't leave the place spotless when it's your turn.

On the subject of food, pre-cooked, ready-to-eat meals are an easy solution and you can extend their storage life if they're also dehydrated. However, after a few days straight on such a diet people do start losing interest in their food, which can lead to under eating and malnutrition. It's certainly possible to grow salad vegetables in space. It will take up precious room and only add

a few extra nutrients, but as a mental health strategy, it's brilliant – not only giving the crew something to do and to nurture, but also producing something to add to an otherwise bland diet.

So, lets start there, Cheap Astronomy thinks it would be nuts to send astronauts on a two year mission to Mars if they can't grow salad vegetables on the way. They might still go nuts anyway, but it's a start. As for other ideas, well you'd be nuts to think we could cover everything in one go – so stay tuned for part 2.

Question 2:

Dear Cheap Astronomy – Will we just go nuts on a two-year mission to Mars, Part 2

In the last episode, we discussed the mental duress involved in sending a crew of up to five on a two year mission to Mars – which is 7 months each way with an extended stopover in the middle, with the whole experience involving relentless exposure to the risk of imminent death, and where radio delays with Earth may stretch out towards 20 minutes, enhancing the whole experience of isolation and helplessness.

However, let's get a grip here, a lot of us do spend long hours in air travel where there's just a thin sheet of metal between us and instant death and if there's no wifi we do it without any contact with loved ones on the surface. It's human nature to adjust to your surroundings however peculiar they may be. Obviously, a flight to Mars, particularly the very first flight, has many added layers of risk, fear and stress, but astronauts have years of training in managing such experiences. The real challenge for their mental wellbeing is the duration of the experience.

A key component of mental health is physical health, so here we'll just assume some solutions have been found to protect the astronauts from space radiation and to minimize the physical degradation arising from extended periods in microgravity. ISS astronauts have coped with up to one year in microgravity, although they had access to exercise equipment that would be difficult to squeeze into an Orion capsule.

So, there's one issue to deal with. It's highly unlikely we'll send five astronauts in just an Orion capsule. It is current thinking that the Orion will be the command module of the mission and the re-entry vehicle that will finally return the astronauts to the Earth's surface. But the trip to Mars and back will almost certainly involve additional components– perhaps one or more inflatable modules.

Mind you an additional module is one of those easy to say, hard to implement ideas. Assuming the Orion capsule is the core part of the Mars transit vehicle, it only has one docking port and the mission will need to manage quite a bit of docking since it won't have capacity to take everything with it – food, water, oxygen, fuel and spare parts, so will need to have one or two resupply stops. So, if the Orion is already docked with a pressurized module, it may have to

undock with that so as to then dock with the resupply module, since the Orion has the maneuvering thrusters needed for the job.

All that docking and undocking isn't an insurmountable problem, but there'll be a lot procedure-wise to think through and every docking procedure carries a degree of risk, so you do want to keep them to a minimum. So, there's a balance needed between giving the astronauts some mental health space and maximizing their physical safety. If the latter is the primary concern, then it would be best just to keep them all locked up in a little room for the whole mission, but you also need them in good physical and mental health to deal with other mission parameters including landing and walking around on another planet.

The extra inflatable module gives you space for the exercise equipment and radiation shelter in the event of a approaching solar flare outburst as well as the headspace benefit. Plus, all the undocking and redocking does give the crew something to do and will have them briefly feeling like they are actually piloting the otherwise mostly automated spacecraft.

Anyhow, to whatever extent we do embrace all these enhancements, it remains the case that there's a lot of infrastructure we need that we just don't have yet and a lot of untested procedures will be required to make it all come together. So, if it seems a bit nuts to be talking about flying astronauts to Mars in the 2030s, you'll hear no argument from us.