Question 1:

Dear Cheap Astronomy – Interstellar trade

As regular listeners are aware, here at Cheap Astronomy, we think faster than light travel just ain't going to happen. That limits your trade options a good deal if our potential alien trading partners are anywhere up to a hundred light years or more away. There are over 500 G-type stars, that is Sun-like stars, within a 100 light year radius from us, including some old science fiction favourites, like Tau Ceti and 82 Eridani, which are just 10 to 20 light years away from Earth. But that's still ten to twenty years travel time assuming you can get near the speed of light, which is kind of unlikely also – since collisions with dust grains, let alone anything bigger will at least slow you down if not destroy your starship.

So, if there is to be trade it would be managed by long haul robot transportation since no human or alien is going to fritter their life away to hand (or tentacle) deliver what someone purchased on ET-bay. But even then, what would you purchase from an alien – and equally what would they purchase. We need to forget about Star Trek aliens who look like humans with lumpy bits on their forehead. It's unlikely our physiologies would be close enough to allow you to drink Romulan ale, let alone enjoy or get intoxicated by it. So forget food and drink. We might trade artefacts, like trinkets and shiny beads, just because they are alien and have a certain novelty value, but more functional items like furniture or clothing aren't likely to be mutually compatible. You could just exchange the raw materials, exotic alien timbers or fabrics, but even then the transport cost overheads would be astronomical – small astronomy joke there.

So, another option is cut the whole transport part out altogether and just exchange information. After all, that can be moved at the speed of light. General information about each other's local environment would be interesting, as would each other's perspectives on the wider Universe. So for example, we might exchange James Webb Space telescope pics for whatever they've got. We could also swap engineering tips on rocket engines or particles accelerators or even refrigerators. However, the closer you get to mundane items the more likely differences in physiology, gravity and atmosphere will make some things worthless. Flatscreen TVs are unlikely to be of interest to aliens unless they have forward facing eyes that perceive light within our visual range – and even if they did they probably couldn't make any sense of our movies, but perhaps we could sell them natural history documentaries with some kind of subtitling they could understand.

What might also work is 3d printing. If there is an existing interstellar trade network, you'd think this is what it would be based on. There'd some kind of standard universal printing machine, the schematics of which can be downloaded and once you've built yourself a printer you can then select from a catalogue of items – recipes really – which would list the elemental ingredients you would need to load up at your end and then the printer would follow the recipe to assemble those ingredients into the physical object you'd chosen from the catalogue. There'd also be an expectation that we would contribute things to the catalogue – indeed that might be the basis of trade transactions, you have to think a recipe for something that aliens want, and thereby earn credits so you access recipes for things that you want.

To kick all this off, we almost certainly have to start broadcasting our presence either at specific candidate stars or just broadly across a 360 sweep of the sky and establish communications. To do that we first have to get over our illogical thinking about not drawing attention to ourselves. Our natural resources are ubiquitous across the Universe, our planet is unlikely to be readily-habitable to an alien species, we're extremely unlikely to be edible to an alien species and anyone who can readily cross interstellar distances won't be interested in stealing our comparatively-primitive technology. It's time to start a conversation – and given it's going to take decades or centuries to get an answer, we might as well start now.

Question 2:

Dear Cheap Astronomy – Why aren't we doing more with artificial gravity

Good question. As we've discussed on this podcast and as others have discussed on pretty much every space-related podcast there is, zero gravity – OK, microgravity – is really bad for you. Your bones dissolve, your muscles wither, your cardiovascular system is deconditioned, your eye geometry changes and if that's not bad enough your face gets all puffy too. We've pushed microgravity exposure time out to a year or more – and people do recover, but if it going to take a year or more to get to Mars, our first Martian astronauts are going to take that one small step and then collapse in a heap.

Regular listeners will be aware that here at CA we think the idea of humans landing on Mars in the 2030s is laughable – and the lack of an effective artificial gravity solution is one of the reasons we're laughing. That along with the lack of an effective landing and relaunch solution, or a radiation protection solution or a mental health solution, just for starters.

But hey let's drop all this negativity and flip the narrative – living and working in microgravity is actually a good thing! If you look at any visuals of the inside of the International Space Station, there's s#!+ everywhere – more specifically there's s#!+ on all four walls of a room. Look at an equivalent workspace on Earth and nearly everything is on the floor, the ceiling is just dead space and the HR team live in constant terror that anything attached to a wall could also detach and fall on someone.

So microgravity allows a crew to make maximal use of the cramped quarters of their spacecraft, the risk of falling or dropping something on someone's foot is non-existent and with a few well-placed handholds you can move around quite fast and in all directions. Once you spin the ship to create artificial gravity you'll be back to working on one surface again.

Also, you can't just spin any old spaceship to create gravity. The radius of the spin has to be quite large – otherwise you get gravity at your feet but not at your head. So you might need a spinning wheel of around a hundred metres in diameter or otherwise you spin a cabin around on a 50 metre tether. There's some substantial engineering challenges either way and if you just spin parts of your spacecraft, there will be a lot of frictional wear and tear at the axes of rotation, which is not ideal for a spacecraft on a long and lonely voyage. The less moving parts you have to worry about, the better.

So, there are some compelling arguments against spinning spacecraft to create microgravity. Star Trek notions of graviton emitters and duranium plating may just be geometrically unworkable even when we do have such magical technologies at our disposal. A more practical and indeed more likely solution for a small spacecraft is to have human sized centrifuges, that crew members can hop into for a few hours a day while they watch a movie, read a book or even sleep. They'd probably still need plenty of weight bearing aerobic exercise sessions to stay in optimal condition, but the spinning sessions should particularly help in reversing some of the fluid redistribution issues. At least that's the theory, we're yet to test whether this will really work in space apart from one very brief and somewhat inconclusive test on STS-90, a space shuttle mission.

A 20 metre diameter machine spinning at 50 rpm gives you 1g at your head and 5g at the your feet with your feet facing the outer edge – the difference doesn't matter since you're not actually standing. Maybe 50 rpm is more than you need, but equally maybe any spin won't deliver the effect you want – we just don't know because we've never really tested it. Admittedly, it would be difficult – you'd need two counter spinning centrifuges to prevent the surrounding spacecraft from being spun around, so that's a lot of mass, a lot of engineering, a lot of power, a lot of precious cabin space and a lot of injury potential – but if the outcome is healthy astronauts, maybe it's worth looking into?

A few hours in a five metre diameter machine spinning at around 15 rpm with your feet towards the outer edge might be enough to shift your fluids temporarily back towards Earth-normal, without inducing nausea, though it won't do much for your bone density since it will have about the same effect as lying on a tilted bed on Earth – where the tilt is towards your feet. Whether this is would really be enough to make a difference isn't really clear because we've never really tested it.