Question 1:

Dear Cheap Astronomy – What kind of robots will we send to other star systems

This questions assumes any interstellar travel from Earth will be undertaken by robots rather than us, This is a reasonable proposition given that going to the nearest star would take at least forty years assuming you can achieve speeds in the order of ten percent of the speed of light, which is a pretty big assumption.

It makes vastly more sense to send robots, have them check the place out first and send back data. If the place looks liveable, you could then send more robots to establish a base camp for a subsequent human mission. Current thinking about the first such reconnaissance missions is to send a fleet of wafer-thin robots-on-chips attached to light sails that are propelled by laser light fired from an array of lasers we either build on Earth or out in space. These robot craft will have to be wafer-thin to keep their mass right down and there will have to be a fleet of them since the plan is to accelerate them up to 20% of the speed of light so they might get to the nearest star system, Alpha Centauri within 20 years. At that speed a lot of them will be taken out or at least knocked irretrievably off course by collisions with dust grains. Indeed there's no guarantee any of them will make it and if they do they will be screaming through the system at 20% of the speed of light, so all they may manage to do is send back a few short exposure snaps of the system with no guarantee that the possibly-habitable exoplanet Proxima Centauri b will be in a proximal segment of its 11 day stellar orbit as the wafer-thin robots do scream past.

So, this quick mission option carries a high risk of either outright failure or long-term disappointment and hence wafer-thin robots are not necessarily the best approach. While you do get a relatively-quick outcome, relatively- quick is still twenty years travel time plus another four years to send the data back at 100% light speed – and there's probably a decade or more of development work to get the idea from drawing board to launch. So, whoever signs the first pay cheque is likely to be dead before the mission achieves anything.

If instead agree it was agreed the mission would be funded as a long-term investment to benefit future generations, then the timeframe ceases to matter. And if we did send a slower spacecraft with the capacity to maneuver both en route and at its destination, the chances of success would go way up although you are then looking at a spacecraft with a lot more mass. Once you are relying on propellant-based propulsion, you will have to carry all the propellant you need with you and since you are dealing with a trip that involves hundreds of years rather than decades you will need to rely on onboard power generation rather than just batteries – and since you are travelling between stars it's going to have to be a nuclear power generator. So, since it's clearly going to be a big ship anyway, you might as well take some robots that aren't wafer-thin.

So firstly consider the ship itself is essentially a robot. It might be carry some independent functional units that would do maintenance and repairs and it might have shuttlecraft that could leave the mother ship to explore distant stellar systems, but there's no need for Robbie the Robot or C3PO – the only purpose in human form robots is if they are going to operate systems or use tools that have been designed for use by humans. And since the spacecraft won't have any humans, it won't need life support or gravity, so the functional units that move around the ship and repair things might be more octopus-form – since legs are unnecessary, but lots of arms are useful and a robot needs a head for visual and audio input, central data processing and communications. Robots that descend in shuttlecraft to explore alien worlds might be rover-like, with wheels rather than legs for mobility, lots of sensors, drills and rock hammers, a bit like R2D2 who might also be accompanied by a small fleet of flying drones, assuming the planet they're exploring has enough atmosphere

Question 2:

Dear Cheap Astronomy – Do we really need to send humans into space.

Well yes, we really do. Cheap Astronomy is a big advocate for getting robots, our manufactured progeny out there, but the technology isn't yet good enough for robots to replace the role and function that people will play. They robots will be able to do all those things one day and on that day us humans can just stay home and let them get on with it, but before then there's a gap that needs to be filled – and there is some growing urgency to get on with it soon.

The urgency is driven by population growth and resource utilisation – that is, you can't have one without the other. A fundamental truth of life as we know it is that anyone who doesn't want to have children doesn't contribute to the gene pool and hence the gene pool will always be dominated by people who want to have children. Most doomsday scenarios about unrestrained population growth have turned out to be wrong, since science and technology have improved the efficiency of resource utilisation and given us access to resources we didn't have before, but one planet must eventually have its limits. So now we are looking to science and technology to access new resources we couldn't access before, out there in the Solar System and beyond.

By and large population expansion is a good thing. It is tough on the environment, but more people means more brains and more diverse ways of problem-solving. So, let's hope that problem solving is used to effect in both sustaining the environment while also getting us back to the Moon and at least getting robots to other planets. This is all a good if it allows us to access more resources and hence expand our capacity for growth. If that doesn't happen all sorts of bad things could eventuate, like wars and stuff, so yep sending humans to space really is important.

As we've detailed in previous podcasts, the space resources we might be able to exploit in the near future range from rare metals for high-tech manufacturing and not so rare metals for just general manufacturing and also phosphorus, a limited but totally vital resource for agriculture. A quick and effective way to grab large volumes of such materials is Cheap Astronomy's CSOTM proposal – that is, crash $#!+ on the Moon. But even to achieve that we will need an import supply chain that can transport and gently land resources back on Earth as well as an export supply chain to get the necessary machinery and workers off world to make it all happen. Again, the time may come when robot workers can do everything, but that's beyond what's possible with 21st century technologies and the 21st century is where you want to see all this taking off.

We will send robot scouts out to the asteroids to grab candidate rocks and steer them around to crash on an uninhabited part of the Moon, but managing the logistics and mechanics of refining, packing and sending the desired products back from use on Earth needs people and those people are going to need infrastructure and services to operate effectively in space, which also need people. So the idea that we are going to build colonies out in space for people to live once it gets too crowded here is unlikely to happen since no one's really going to want either do it or pay for it – but create a space economy, where people to want to pay to get the goods and people to want to live and work out there to get the pay, then you've got yourself a workable human race expansion strategy.

The problem of course is getting started, not to mention defining and focusing efforts on an objective that's puts us on the path. Establishing a moonbase, great. Creating a space tourism industry with orbiting snack bars, brilliant. Chasing a hugely-difficult, dangerous and largely symbolic objective like landing someone on Mars, maybe not so much. We need to start getting out there in large numbers, not just a couple of people at a time, and we need to start laying some foundations, the sooner the better.