Question 1:

Dear Cheap Astronomy – Is there really no way to do FTL travel?

Well, no – but there's no harm going through the options again.

Just doing it. As we've discussed many times, the maximum speed you can move through spacetime is the speed at which your duration of travel between two points approaches zero. This is an unachievable state since you would literally be in two places at once. Relativity physics suggest that as you approach this maximum speed distances in your direction of travel will begin to shrink towards zero – so whatever destination you choose you get there almost immediately without ever exceeding light speed.

From our backyards we can observe photons in a vacuum moving at the maximum speed possible in the Universe and we can imagine that if those photons had consciousness they would experience neither time nor distance – nonetheless we subliminal beings who do experience space and time can watch them flit by, crossing 300,000 km each second, knowing it will take them years to cross light years. So even if you could fly up near the speed of light, you can't go to Alpha Centauri and be back in time for tea. It might seem quick trip for you, but anyone back on earth won't see you again for more than 8 years. But putting these thought experiments aside, even with a magical star drive that capable of maintaining constant acceleration almost indefinitely, you still will never be able to achieve light speed. The Universe is not empty and collisions with dust grains will slow you down, with more and more force the faster your speed becomes. So not only can't you travel faster than light you can't even travel as fast as light.

Quantum stuff. There are various possibilities that get tossed around in quantum discussions, entanglement for example. Since two entangled particles placed at opposite sides of the galaxy still respond to each other's confirmed states, then there must be some kind of spooky action at a distance to enable a signal to cross light years in an instant. This doesn't sit well with the way we understand the Universe through relativity physics, but that's quantum mechanics for you. Quantum mechanics also offers various options for tunneling straight through spacetime, not in that way wormholes do, but throughout the inherent uncertainty of nailing down the position of a sub-atomic particle, which could be there or hey look now seem to be over there. However, these are possible mechanisms for very small and insubstantial things to move faster than light – the moment you try to scale it up to accommodate spacecraft, none of it works anymore. There's a similar problem with wormholes – which are hypothetical things from relativity physics. While you might be able to make photons cross galaxies in an instant by slipping into a wormhole here and slipping out of another there, any material object would be crushed into a singularity on its way through.

Send information. You can readily send information at the speed of light – in the form of radio waves or whatever. And maybe if there was a way to send information by the quantum spooky action at a distance effect then you could send information faster than light, although even quantum physicists don't think this is possible. Either way though, it's a lot faster than any spacecraft will manage. The idea is to apply the premise of the movie Species, where you radio instructions for building a human genome across the galaxy. An alien civilisation receives the message, feeds it into a 3d printer and voila a human has travelled across the galaxy as fast as light – or faster if you manage to achieve spooky action at a distance transmission.

However… In reality you'll need to transmit more than just nucleotide coding. An actual chromosome is a weave of DNA supported by histones and requiring ribosomes to read it and pretty much the whole cellular machinery is required to respond to those instruction, including mitochondria which have their own genetic coding. Viruses get by on Earth because they have evolved to exploit the existing cellular machinery of other Earth-based organisms. And it remains to be seen if an alien race receiving this information is going to be able to comprehend it, or have the underlying molecular materials available to construct the necessary carbon-based building blocks and even if they did, whether they could actually be bothered going through with it. If they did, the information pack you send would have to include information on nutrition, health care and a whole bunch of stuff about bringing up a child which makes the whole thing start to sound a bit nightmarish – or a bit like an episode of implausible engineering. But if it all somehow work out I guess you could say that there is a way for people to travel as fast as light.

But, faster than light? Given photons can't even manage it, it's seems highly unlikely we'll ever get spacecraft to do it. On the bright side though, new ideas for how we might do it are popping up everyday so there'll be plenty more Cheap Astronomy episodes that investigate why none of those ideas will work either.

Question 2:

Dear Cheap Astronomy – Is cosmic expansion just the tail-end of early inflation

Cosmic expansion – that is, the ongoing expansion of the Universe – is something we can readily observe. Indeed, since the further our we look the further back in time we are looking, it's apparent that varying rates of expansion has been going on since the cosmic microwave background was released. That occurred when the hot, young and dense Universe had cooled down sufficiently to enable the first atoms to form, which cleared the way for radiation to move unimpeded in straight lines for the first time. This the radiation proceeded to do in one big flash, the cooled remnant of which is still observable today as the cosmic microwave background, the CMB.

The CMB is the earliest light that is visible to us – so what happened before then is an area of some speculation, which might eventually be confirmed or otherwise by gravitational wave or neutrino data or just by higher resolution observations of the CMB. The CMB's existence represents evidence that the Universe was already undergoing expansion at that early time and hence the Universe must have been even smaller, hotter and denser before its release. Extrapolating this thinking and applying our modern understanding of subatomic particle physics has led to the widely-accepted conclusion that the Universe expanded from a tiny Planck-scale volume about 380,000 years before the CMB flash.

If it is the case that the Universe's current energy-mass density has persisted right back to those earliest moments, then that early and very dense Universe surely should have just collapsed into a black hole unless some expansive process was at work right from the start. Indeed, the remarkable evenness and minimal clumping seen in the the CMB, essentially a baby photo of the early Universe, suggests that in those earliest moments gravity was largely overwhelmed by whatever expansive processes were in play. So, current thinking is that there must have been an orders of magnitude inflation that took place within the first microseconds of the Universe, sufficient to spread everything right out from the scale of a dot to a pan galactic scale, all before any gravitational clumping began the formation of the first stars and galaxies.

But, all that said, it's important to note that early inflation is largely a hypothesis while current cosmic expansion is a readily observable phenomenon. It's hence difficult to say anything definite about whether current cosmic expansion is just the tail-end of inflation, since we are not even sure that inflation actually happened. A lot of theorists favour the idea that it's the energy-mass density of the Universe's contents that determines its rate of expansion. On this basis it makes sense that initial inflation would have been stupendously rapid and then slowed as the Universe's contents became diluted due to volume expansion. However, this line of thinking runs into a problem where the Universe's expansion started speeding up again as it approached 10 billion years of age.

So, if it is the case that the Universe's expansion rate is being driven the density of its contents, it hence becomes necessary to prose a new type of contents, dark energy, which is maintaining the accelerating expansion in our now 13.8 billion year old Universe. Mind you, other theorists propose that the Universe's expansion isn't especially driven by its contents, it just expands because that's what it does – and its rate of expansion has accelerated as the gravitation of the Universe's increasingly diluted contents has weakened. In either case, no one has the faintest idea what the underlying mechanism that makes spacetime expand actually is. It's not a phenomenon we can replicate in a laboratory, although it clearly happens out there on pan-galactic scales.

Back to the original question though… At this point in time, it's just not clear if inflation and expansion are related processes. Current expansion is proposed to be driven by dark energy, while inflation is not. Current expansion is accelerating, while inflation is thought to have started in a huge burst which then decelerated. Whether either inflation or expansion are driven by the same mechanism is also unknown, given we haven't the faintest idea what that mechanism or mechanisms could be. And so, back to the telescopes.