

Dear Charlotte,

One of my favourite questions to think about is: are there any aliens?

This might seem like a silly question, and for a lot of history it has been. But right now, above our heads there are telescopes flying that can see in more colours than our eyes. They are looking into the dark places in the sky, onto other distant stars and galaxies hiding in the deep past. And right now, on Earth, people are building bigger and bigger light-buckets to see better and better into the grandest laboratory of all—space. Anyway, silly questions are what Physics is all about!

You probably know about the seven planets that orbit our sun along with us, but did you also know Charlotte, that over a thousand planets have been discovered travelling around other stars? These are called exoplanets, and they were found by telescopes so sensitive that they can either notice the twinkle as the stars dim when their planets pass in-between us and them and block their light, or spot the tiny change in speed at the planets pull the star along or slow it down.

Some of them have three suns. Some rain molten glass. One of them is even thought to be almost a third made of diamond, the left-over heart of a massive star, whose outer layers were pulled away.

While some of these planets are far too hot or too cold or too dangerous for us, others look like places we would enjoy taking a holiday. Planets have been discovered that speed around their stars just like Earth, balancing at the right temperature to have watery seas like ours. We are even starting to be able to find out what the atmospheres of some of the planets are made up of, which means it will soon be possible to pick up chemicals that could signify life, and maybe even pollutants from alien factories!

This is where you come in Charlotte. The rate of discovery of exoplanets has been increasing rapidly, but most of the data so far comes from Kepler, a satellite that only looked at one small area of the sky and is now breaking down. This January, a new mission called Gaia was launched that will scan the whole sky for exoplanets. It will look at all the brightest and closest stars in our neighbourhood. All that information could be yours to look at and discover.

Other missions are being planned too, that aim to see exoplanets directly, not just from the dips in star's light. Some of these called 'star-shades'— shaped like flowers that will open up their petals precisely to block almost all of the light from the observed star so that we could gaze directly on an alien world. These missions are going to generate so many pictures and so much data that thousands of people, scientists and the public are going to have to get involved in sifting through them.

Maybe we'll never get to visit these planets. Maybe the ones harbouring life are simply so different that we wouldn't even know it if we saw it. But—imagine being one of a team of scientists who managed to show us that we are just looking at things the wrong way, and the universe is actually full of life.

Of course, searching for exoplanets isn't simple. These telescopes take a very long time to build and cost a lot of money, meaning that failure can be disastrous. Once the data has been collected it takes lots and lots of looking at it and double-checking before an exoplanet can be announced as discovered. There are also problems in the type of planets that can be detected—it is much easier to

see bigger ones, orbiting close to their star. This means that there will be a lot of those big planets detected, while a lot of smaller ones are left out.

Astrophysicists work hard to get round these problems, and though they might not be perfect, each discovery tells us more about our own place around our own star. Are we living on a typical or unusual planet? Are aliens likely to be out there after all? People who are brave enough to think about the biggest, silliest questions sometimes get the greatest joy of having them answered.

Ultimately, Charlotte, study whatever you enjoy. Astrophysics, like all science, can be difficult and sometimes taking measurements and having to be so careful and thorough can seem boring. But if you want to learn about something that is real world magic—that is better than magic in fact, because the more you understand it, the more incredible the trick, then I would recommend joining the hunt for exoplanets.

Thank you for reading my letter.

Best wishes,

A future exoplanet hunter