Essay

Thinking About Values in Astrobiology

Imagine you're on a team that just discovered signs of microbial life beneath the ice of Europa, one of Jupiter's moons. What do you do next? Do you send a probe to collect samples? Do you tell the world immediately? Do you do anything at all?

These aren't just scientific questions. They're ethical ones. And they're exactly the kinds of questions that the field of astrobiology invites us to wrestle with.

Astrobiology is the study of life in the universe: where it came from, how it survives, and whether it exists anywhere beyond Earth. But here's what makes astrobiology unusual among the sciences, it doesn't just ask "what is true?" It also asks, "what should we do?" and "what do we owe to life we haven't even met yet?"

Those harder questions don't have easy answers. But thinking carefully about them requires something beyond data and experiments. It requires values. What follows is one way of naming and exploring the values that seem to matter most when humans go looking for life in the cosmos.

Life Has Value, Even Life We Don't Recognize

One of the most important ideas in astrobiological thinking is that life may have intrinsic value, meaning it matters not because it's useful to us, but simply because it exists. This sounds straightforward until you realize how radical it actually is. Humans tend to judge other living things by how similar they are to us. We protect pandas more readily than bacteria. We relate to mammals more than to microbes.

Astrobiology questions that instinct. If life exists on another world, it may look nothing like anything on Earth. It might not have DNA. It might not use carbon. It might not even move. Does that make it less worth protecting? Many astrobiologists would say no, and that's a genuinely provocative position worth debating.

Humility Is a Scientific Value

Another value that runs through astrobiological thinking is humility. The history of science is full of moments when humanity assumed it was at the center of things and turned out to be wrong. The Earth isn't the center of the solar system. The solar system isn't the center of the galaxy. And "life as we know it" might just be one narrow version of something much stranger and more diverse.

This kind of thinking has a name: non-anthropocentrism. It means resisting the habit of making humans the measure of everything. When scientists look for biosignatures on

other worlds, they have to be careful not to only look for the signs that Earth life would leave behind. Life on a distant moon might leave a completely different signature, one we'd miss if we only knew how to look for ourselves.

Planetary Protection as a Moral Question

Here's a question that sounds like science fiction but is completely real: what happens if we accidentally contaminate Mars with Earth bacteria before we've had a chance to find out whether Mars already has life? We'd never know if what we found was truly Martian, or just a hitchhiker from our own planet.

That's why NASA and other space agencies take planetary protection seriously as a practical matter. But there's also a deeper ethical question underneath the practical one. If there is life on another world, do we have a responsibility not to harm or obscure it, even before we've confirmed it exists? That kind of precautionary thinking, protecting something we haven't yet proven is there, is a genuinely new frontier in ethics, and astrobiology is one of the fields forcing us to confront it.

Science Belongs to Everyone

Astrobiology also raises urgent questions about inclusion. The big questions this field asks: Are we alone? Where did life come from? What is our place in the cosmos? — are not new. People have been asking them for thousands of years, across every culture, every tradition, every language on Earth. Indigenous knowledge systems, philosophical traditions, and religious frameworks all have deep things to say about life, origin, and our responsibilities to the living world.

One important argument is that science is less robust when it ignores those perspectives. Broader thinking, drawing on more voices and more ways of knowing, tends to produce better questions.

Why Does This Matter to You?

You don't have to be a scientist to care about these ideas. Questions about who deserves protection, how we make decisions under uncertainty, what we owe to living things different from ourselves, and whose voices get included in big decisions, those questions show up everywhere. In climate science. In medicine. In how we design AI. In how we treat each other.

Astrobiology just happens to ask them at the biggest possible scale: across the entire universe, across billions of years, across forms of life we haven't imagined yet.

Key Vocabulary

Astrobiology	The scientific study of the origin, evolution, and distribution of life in the universe. Astrobiology draws on biology, chemistry, geology, physics, and philosophy to ask whether life exists and how life could exist elsewhere.
Biosignature	Any chemical, physical, or biological marker that could indicate the presence of life. On Earth, oxygen in our atmosphere is a biosignature. Scientists search for similar clues on other planets and moons.
Intrinsic Value	The idea that something has worth in and of itself, not because of what it does for others. Saying life has intrinsic value means life matters even if it is never useful to humans.
Non-Anthropocentrism	A way of thinking that resists placing humans at the center of all moral and scientific judgment. Non-anthropocentric thinking asks: what if our human perspective is too narrow to recognize life, intelligence, or value in other forms?
Planetary Protection	The practice of preventing Earth organisms from contaminating other worlds (forward contamination) and preventing potential extraterrestrial organisms from being introduced to Earth (backward contamination). NASA maintains planetary protection policies for all space missions.
Extremophile	An organism that thrives in conditions once thought too harsh for life — extreme heat, cold, acidity, pressure, or radiation. Extremophiles on Earth help scientists imagine what life might look like beyond Earth.
Precautionary Principle	An ethical guideline suggesting that when an action risks harm, even if that harm isn't fully proven yet, caution is warranted. In astrobiology, this applies to decisions about exploration, contamination, and contact.
Epistemology	The branch of philosophy concerned with how we know what we know. In astrobiology, epistemological questions include: how would we recognize life we've never seen before? What counts as evidence?