THE SCIENCE BEHIND THE STORY

Octopuses, Black Holes, and the Edge of What We Know

A FREE SCIENCE NOTES COMPANION

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A Note on the Science

Every novel I write plays with ideas at the edge of what we know and what we're still figuring out. Some of it is real. Some of it is speculative. All of it is meant to make you see the universe a little differently.

What follows is an attempt to ground the stranger parts of my stories in the science that inspired them. Not to explain everything away — just to give you a foothold in the impossible.

DNA: The Recipe Inside Everything

Every living thing on Earth — every person, every cat, every octopus, every blade of grass — carries inside each of its cells a set of instructions called DNA.

Think of DNA as a recipe book. Not for food. For you. It contains everything needed to build a human being from scratch: what color your eyes will be, how tall you might grow, which proteins your body will make to keep you running. The recipe is written in a chemical language with only four letters, and it is extraordinarily long — if you unraveled the DNA from a single human cell and laid it end to end, it would stretch to about two meters. You have approximately thirty-seven trillion cells in your body. The math is, as scientists say, significant.

What makes DNA remarkable is not just what it contains but what it does. It copies itself. Every time a cell divides, it makes a new copy of the entire recipe. Sometimes the copy has a small error. Most errors are harmless. Occasionally an error changes something important. Over millions of years, these small accumulated changes are what turns one species into another. This is evolution: the recipe, slowly rewriting itself.

In my novels, one of the scientists studies ancient DNA — genetic material recovered from organisms that died long ago. Ancient DNA is fragile. It degrades. Finding it intact in an eighty-million-year-old fossil would be, in conventional science, impossible. The story is interested in what lies on the other side of impossible.

Fossils: Letters from the Deep Past

When an organism dies, it usually disappears. Bacteria break it down. Time takes the rest. But occasionally, under very specific conditions, something is preserved. The soft parts decay, but the hard parts — bones, shells, teeth — are slowly replaced by minerals from the surrounding rock. Over millions of years, stone takes the shape of what was once alive. This is a fossil.

Fossils are not the original organism. They are a mineral record of its shape, the universe's way of leaving a note. They are also extraordinarily rare. The conditions required for fossilization are precise, and most creatures that have ever lived left no trace at all.

The oldest fossils on Earth are approximately 3.7 billion years old — single-celled organisms that left faint chemical signatures in ancient rock. The octopus appears in the fossil record about three hundred million years ago, and anatomically, it has changed very little since. Most species change significantly over such timescales. The octopus, apparently, found a design it was happy with and stayed.

Octopuses: The Aliens Among Us

The octopus is one of the strangest creatures on Earth, and Earth is not short of strange creatures.

It has three hearts. Blue blood. Eight arms covered in suckers that can taste and smell what they touch. It has no bones — its entire body, except for a small hard beak, can fit through any opening large enough for that beak to pass. It can change color, texture, and shape in milliseconds, matching its surroundings with a precision no human technology has replicated. It does this despite being colorblind. Scientists are still arguing about how.

What makes the octopus truly remarkable is its intelligence. It solves puzzles. It uses tools. It remembers faces. It plays. Each of its eight arms has its own nervous system and can act semi-independently — two-thirds of an octopus's neurons live in its arms, not its brain. It thinks, in some sense, with its entire body.

The octopus and the human share a common ancestor, but that ancestor lived over five hundred million years ago — long before vertebrates, long before fish, long before almost anything we'd recognize as complex life. Since that distant split, the two lineages have evolved completely independently. Whatever intelligence the octopus developed, it developed alone, arriving at something that looks like thinking by an entirely different route.

> *This makes the octopus the closest thing on Earth to a genuinely alien mind.*

Scientists have noted that octopus DNA contains an unusual number of "RNA editing sites" — places where genetic instructions are modified after the fact, in real time, in response to the environment. Most organisms, including humans, run their DNA instructions more or less as written. The octopus rewrites them on the fly. Some researchers have described this as the octopus editing its own code, and have suggested, somewhat speculatively, that this ability may be connected to its extraordinary adaptability.

My novels take that speculation seriously.

The Error in the Code

One idea I explore in the series — that humanity might be an "unintended replication" of a cosmic genetic signature — is pure fiction, but it's inspired by real debates in biology and cosmology. Some scientists speculate that life on Earth might have originated from panspermia (the idea that life spreads between planets via comets or asteroids), which would mean our DNA could have extraterrestrial roots. Others point to the unlikely conditions that allowed complex life to evolve here, suggesting we might be a fluke — a rare, perhaps unique, outcome of cosmic chance.

In the story, the "error" is a metaphor for the limits of our understanding. We assume we're the intended outcome of evolution. But what if we're just a glitch in a system we don't yet comprehend?

The Size of the Universe: A Brief Attempt at the Impossible

The universe is large.

This sentence does not convey the situation adequately, but language was not designed for the universe. Let's try anyway.

The Earth is roughly twelve thousand kilometers across. The Sun is about one hundred and nine Earths wide. The distance from the Earth to the Sun is approximately one hundred and fifty million kilometers — a distance light covers in about eight minutes.

Light travels at three hundred thousand kilometers per second. In a year, it travels about nine and a half trillion kilometers. This distance is called a light-year. The nearest star to our Sun, Proxima Centauri, is approximately four point two light-years away — meaning the light you see from it left four years ago. You are looking into the past. This is always true of stars. The night sky is a museum.

Our galaxy, the Milky Way, is approximately one hundred thousand light-years across and contains somewhere between one hundred and four hundred billion stars. Most of those stars have planets, and many sit in what scientists call the "habitable zone" — not too hot, not too cold, with the right conditions for liquid water. The number of potentially habitable planets in our galaxy alone is estimated in the billions. The observable universe contains approximately two trillion galaxies.

This number is so large it has stopped meaning anything, which is itself a meaningful thing. The human brain evolved to navigate a savanna. It was not built for two trillion galaxies. That we can calculate the number at all is one of our more improbable achievements.

In my novels, objects move through the universe at speeds that exceed the speed of light. This is not currently possible according to known physics — Einstein's special theory of relativity establishes the speed of light as an absolute limit; as an object approaches it, the energy required to accelerate it further approaches infinity. Nothing with mass can reach it. Nothing can exceed it.

The universe, however, has not always done what the equations predicted. The equations themselves were once impossible. Science is a record of the things we were certain about until we weren't. The story is interested in what happens when the certainty runs out.

A Cosmic Network and the Holographic Principle

The idea of a cosmic network that preserves all information — memories, experiences, even entire worlds — might sound like pure fiction. But it's not as far-fetched as it seems.

In physics, the holographic principle suggests that all the information in a volume of space can be encoded on its boundary, much like a hologram. First proposed by Gerard 't Hooft and later expanded by Leonard Susskind and Stephen Hawking, it implies that our 3D universe might be a projection of information stored on a 2D surface — whether that's the edge of the observable universe or the event

horizon of a black hole.

This idea also aligns with John Archibald Wheeler's "it from bit" hypothesis, which suggests reality is fundamentally made of information, and with quantum entanglement, where particles remain connected across vast distances in ways that defy classical physics.

In the Veins of Blood series, this becomes a biological and narrative version of those theories — a way of exploring what it might mean if the universe were not just a place but a living, breathing network of information. And if that's true, then perhaps we are not just observers of the cosmos, but participants in it.

Black Holes: Where the Rules Stop

A black hole is a region of space where gravity is so strong that nothing — not matter, not light, not information — can escape once it has crossed a certain boundary, called the event horizon.

Black holes form when very massive stars reach the end of their lives. The star's fuel runs out, the outward pressure that balanced gravity disappears, and the core collapses. If the star is massive enough, this collapse continues until it produces a singularity — a point of infinite density where the known laws of physics cease to apply.

"Cease to apply" is a technical phrase that means "we do not know what happens there." The equations break down. The map ends. This is not a failure of mathematics. It is mathematics telling us it has reached the edge of what it was built to describe.

What lies beyond the event horizon is, in the strictest scientific sense, unknown. We have never been there. We have never received any information from there. The event horizon is the universe's locked door. My novels imagine what might be on the other side.

The Cosmic Web: How Everything Is Connected

The universe is not randomly distributed. On the very largest scales, galaxies cluster together along vast filaments of dark matter, like dewdrops on a spider's web stretched across the sky. Between the filaments are enormous empty voids, hundreds of millions of light-years across, containing almost nothing.

This structure — the cosmic web — emerged from the earliest moments of the universe, when tiny quantum fluctuations in density were amplified by gravity over billions of years into the pattern we observe today. It is the largest structure in existence. It has no center and no edge. Everything we have ever seen is part of it.

The idea that living systems might develop their own version of this web — a biological network mirroring the cosmic one, carrying information rather than gravity — is a central metaphor of the series. It is not, strictly speaking, established science. But the underlying principle is real: complex systems self-organize into networks. Neurons do it. The internet does it. Fungi do it, threading through entire forests and sharing nutrients and chemical signals along mycorrhizal networks that function, in some ways, like a nervous system for the soil.

Life is very good at finding ways to connect.

Why Any of This Matters

Science is not a collection of facts. It is a method for being wrong in increasingly useful ways. Every model we have of the universe is an approximation — a simplified version of something too large and complex to hold in a human mind. The approximations get better. They never become perfect.

This is not a weakness. It is the most honest thing about science: it knows it does not know everything, and it keeps looking anyway.

The questions in my novels — about the origin of life, the nature of intelligence, and the possibility of connection across unimaginable distances — are real questions. They are being asked by real scientists in real laboratories, often with insufficient funding and excessive paperwork. The answers are not yet in.

My books imagine some of them. The imagination is not separate from the science. It is where the science begins.

For Readers Who Want to Explore Further

The octopus: start with *Other Minds* by Peter Godfrey-Smith. It will change how you look at the tank at the doctor's office.

Ancient DNA: the work of Svante Pääbo, who received the Nobel Prize in 2022 for sequencing the Neanderthal genome, is a good place to begin.

DNA history: *The Violinist's Thumb* by Sam Kean, and *The Double Helix* by James Watson.

The size of the universe: look up the Hubble Deep Field, taken in 1995 — about three thousand galaxies in a patch of sky the size of a grain of sand held at arm's length. Sit with it for a while.

Black holes: anything by Kip Thorne, who helped design the physics of *Interstellar* and has spent his career making the impossible legible.

The cosmic web: search for the Millennium Simulation, a computer model of the large-scale structure of the universe. It looks, unmistakably, like a human brain. That is probably not a coincidence. Or it is. Either way, it's worth thinking about.

Liked thinking about the impossible?

This essay is a companion to the **Veins of Blood** series — five novels about octopuses, ancient Egypt, the collapse of civilization, and a universe that may be more connected than anyone thought. Kristin Hannah–style heart, with a lot more bickering and a lot more tentacles.

“The ocean has been watching. Now it's done waiting.”

Read the series & get new release updates at
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— Tony King