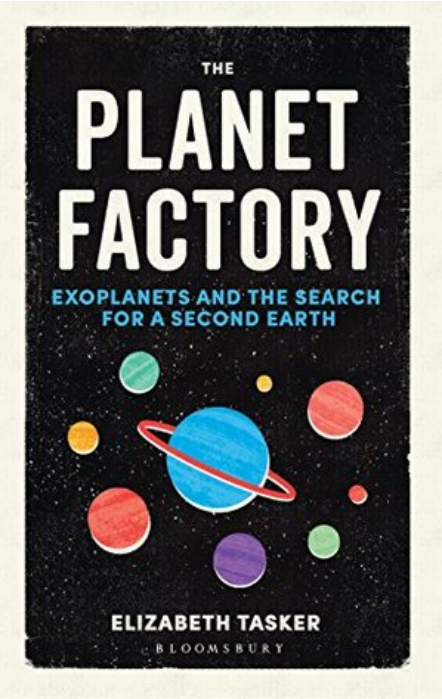

The Planet Factory: Exoplanets and the Search for a Second Earth

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Twenty years ago, the search for planets outside the Solar System was a job restricted to science-fiction writers. Now it's one of the fastest-growing fields in astronomy with thousands of exoplanets discovered to date, and the number is rising fast.

These new-found worlds are more alien than anything in fiction. Planets larger than Jupiter with years lasting a week; others with two suns lighting their skies, or with no sun at all. Planets with diamond mantles supporting oceans of tar; possible Earth-sized worlds with split hemispheres of perpetual day and night; waterworlds drowning under global oceans and volcanic lava planets awash with seas of magma. The discovery of this diversity is just the beginning. There is a whole galaxy of possibilities.

The Planet Factory tells the story of these exoplanets. Each planetary system is different, but in the beginning most if not all young stars are circled by clouds of dust, specks that come together in a violent building project that can form colossal worlds hundreds of times the size of the Earth. The changing orbits of young planets risk dooming any life evolving on neighbouring worlds or, alternatively, can deliver the key ingredients needed to seed its beginnings. Planet formation is one of the greatest construction schemes in the Universe, and it occurred around nearly every star you see. Each results in an alien landscape, but is it possible that one of these could be like our own home world?

The Planet Factory: Exoplanets and the Search for a Second Earth Details

Date	:	Published September 7th 2017 by Bloomsbury Sigma
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From Reader Review The Planet Factory: Exoplanets and the Search for a Second Earth for online ebook

Ria Voros says

The Planet Factory is filled with fascinating information about exoplanets and what properties they might have, but it's also funny and charming and readable. Elizabeth Tasker takes care to engage her reader and to show that science writing can be--should be--about curiosity and descriptive explanation, especially if that explanation is at a level that non-scientists can understand.

I loved this book and I can't wait for the new chapter that's going to be in the paperback edition in April 2019.

Rachel (Kalanadi) says

This is THE book on planet formation and the search for exoplanets.

I loved the focus on process and formation. Tasker demonstrates over and over again how our assumptions and theories about planets, solar systems, and what's possible out there get overturned all the time by new discoveries and new data. A hypothetical formation process is suggested to cover the size and orbit of one exoplanet, then needs to be revised again and again as new "formerly impossible" exoplanets are discovered.

And this calls into question our own solar system - are WE the weird ones? Are we rare? Do we need to disregard all our assumptions about planets and life when we search farther and farther out?

Tasker lets her audience have ALL the information about planets. This is some pretty technical stuff and Tasker doesn't skimp. I assume she's left out the very, VERY technical stuff, for accessibility reasons, but this is not a dumbed down version with all the corners rounded off. Some parts read a little like a textbook, but it was always interesting and the occasional side remark in the footnotes added personality.

Unlike other pieces I've read on exoplanets, *The Planet Factory* always seemed firmly rooted in what we know (and what little we sometimes can find out), rather than speculating too much and creating an "artist's impression" instead of a scientific one. I'm going to be rather put out next time I read a sensationalistic news article touting "the most Earth-like exoplanet yet", because the real scientific data *probably* doesn't support that (it will be real news when it does!).

Highly recommended for readers and amateur scientists searching for detailed and cutting edge information on planetary science and exoplanets.

(My understanding is that *The Planet Factory* is out in the UK now, and will be out in the US in November 2017. I received an e-ARC from NetGalley for review, so thank you to NetGalley and the publisher.)

Peter Tillman says

A good, up-to-date summary of the search for and discovery of exoplanets, planets around other stars. This is

pretty much essential reading for people who are interested in this search, which certainly includes me.

Things that struck me while reading the book:
* The discovery of exoplanets is really, really hard, finicky work.
* Astronomers were always pretty sure that other stars had planets. And they assumed other solar systems would be pretty much like ours. This wasn't the case!
* The easiest exoplanets to find are large, and orbit near there parent stars. But it was still a big shock to find so many "hot Jupiters"!
* Per Sara Seagar, a noted planet-hunter:
"Any planet you can imagine is probably out there, somewhere, as long as it fits within the laws of physics and chemistry."
* There are a lot of planets out there. Billions and billions of them! And the techniques and technology for finding them are still getting better. Early days in this branch of astronomy.

So, why only three stars? The author is not a graceful writer, and that's being kind. Be prepared for all sorts of jarring phrases and similes. And the proofreading is pretty bad. I still recommend the book, but I wish it had been better-written, and more carefully edited. You should still read it. I've followed the search pretty closely, over the years, and I still learned a lot.

Cristina says

In a fantastic primer for budding planetary scientists or armchair explorers, astrophysicist Elizabeth Tasker shares her passion and expertise for the astronomical sciences. Planet Factory chips away at the mountains of exoplanet research and presents it in approachable chunks of historical context, current research and exciting conjecture. Tasker describes how celestial bodies emerge from swirling space dust, details prevailing theories for the varying compositions of known planets and explores the incomprehensibly strange worlds that exist in distant systems (hot Jupiters, super Earths and rogue planets, oh my!).

There were some stretches of text in the middle that felt a bit tedious and recursive, going through the litany of possible explanations for any findings that didn't fit neatly into the currently accepted theories. But hey, that's science! The repetitive circular critique of hypotheses is both a strength and weakness in the text: it was honestly very refreshing to have each theory delineated with a little dollop of doubt, teaching the reader to question and critically assess previous explanations when presented with new evidence. It's even addressed point-blank in the introduction: any scientist trying to report this amount of interstellar research as fact with the pretense that 'we've got it all figured out' is doing a disservice to the reader and to the field. Overall, this book is a very friendly introduction to the awe-inspiring mysteries of our universal neighbors.

Sidenote: I was a little surprised to see no mention of the TRAPPIST-1 system until I realized that announcement was just made February of this year so of course the author didn't have time to cram in a whole new chapter of reactions to these 7 little buddies and their ultra-cool dwarf. That said, this book leaves me feeling well-equipped to tackle the news of exoplanet discoveries on my own.

// disclosure: NetGalley ARC

Russell Atkinson says

The author has attempted to make a captivating but very technical subject accessible to the general reading

public, with mixed success. I found it fascinating, but I have a math degree and was an A student in physics and astronomy; I suspect that others might find it too dense. The author makes a valiant attempt to make basic concepts understandable, including use of a great many metaphors and similes from everyday life, especially in the early chapters. Some of these could be helpful, I suppose, but I found them at times condescending (do we need to spin in an office chair with arms outstretched to understand you spin faster if you bring them in?), at times amusing, and occasionally confusing. The author often uses British colloquialisms for these, leaving a poor American like me to discern from context that a roundabout is not a traffic control device but some sort of merry-go-round. As for throwing a jelly at someone, I have no idea what that means; wouldn't the jar crack his noggin?

Quickly, though, the author moves into the details of planet formation, fortunately without the equations. Rather, we must take her word, and that of countless other scientists, as to what is possible or impossible. For the 99.999% of us who can't do the calculations ourselves, Clarke's Third Law applies: the rules of planet formation are indistinguishable from magic. The problem with this is that what we/they thought was impossible is now being observed in distant star systems. Huge gas giants are orbiting very close to their stars. So are rocky superearth planets where they should not be able to form. There are planets whose density is between those of the rocky planets we know (Earth, Mars) and the gas giants we know (Jupiter, Saturn). So what are they made of? Water? Silicate rock? A rocky core surrounded by gas? What we "knew" about planets isn't true anymore. The author explains all the theories that the experts have come up with, but she states right up front that we really don't have good explanations for much of what the observational science is producing. The exciting part is that we are finding more and more exoplanets. New discoveries bring new knowledge.

If you are primarily interested in whether there is life out there or a planet capable of hosting us after we destroy the one we're on, you'd be advised to skim liberally up to the last few chapters where these questions are addressed more directly. The short answer is that alien life is certainly possible, maybe probable, but it is unlikely to be in a form we could ever communicate with or even observe. A place where we could relocate would have to be closer to home and the only candidates seem to be moons within our own solar system, although none of them look all that promising. Still, it is amazing to consider all the factors that life as we know it require and how lucky we are to be in that Goldilocks zone. Once you do that, then consider those organisms like tube worms and anaerobic bacteria that do not require sunlight or oxygen. Life has a way of adapting to some very inhospitable environments.

The author and publisher have bravely aimed for what seems to me to be a very small slice of the reading public. The book is too simplified for researchers in the field and too technical for most other readers. She writes very well but there are a few errors. On p. 232 she states that the temperate zone in our solar system is conservatively estimated at 0.84au to 0.14au. That second number should be 1.14au. Otherwise we wouldn't be alive. All in all I really enjoyed the book but I find it hard to recommend to most people. What I can say is that when you see the next headline that reads "Second Earth Found!" don't believe it.

Caitlin says

The description of this book led me to believe it would describe exoplanets and their systems. And while it technically accomplishes this, it reads more as a guide to how scientists think planets are formed even though they continue to be wrong. I did not need an explanation of every wrong idea they have had (reading the first half of this book was such a waste of time). Also, she continues to say incredibly weird things such as: "This book is the... travel log of how [planets] came to form from dust particles to worlds so diverse that even Hollywood has failed to be weirder" (23). If the author had cut similar statements to the one I quoted above, this book could easily be 100 pages shorter. Why on Earth was the book published like this? Tasker is clearly

trying (and failing) to be funny throughout the novel. If I wanted a funny book, I would not have chosen to read a non-fiction novel about the planets.

Pop Bop says

How To Build A Planet, or To Find One That's Already Been Built

You know how with many college science courses they number them from intro courses up to pre-major? So you get Bio 101, Bio 103, Bio 105, and Bio 107, and then you select more advanced courses in the major. Well, I'd put this text somewhere between Astrophysics 105 and Astrophysics 107. An interested amateur can get most of it, (or all of it if he really, really tries), but there is no shame in browsing/skipping a bit here or there.

The book is fairly described by the blurbs that promise it will "demystify the crucial technical details of the research with impressive clarity and a light, engaging touch". The important point is that the material is indeed presented clearly, the author does have a light but not overly jokey or dummified touch, and there are a lot of technical details. And once you realize that there will be no final exam you can relax and enjoy the ride.

I did start this book with the mistaken expectation that it would mostly be a tour of the different possible types of exoplanets, along the lines of those books of speculative art that imagine what the landscapes of other worlds might look like. There's some of that, but just some. This is a more technical and rigorous work that focuses heavily on how tiny bits of dust in the planetary disc around a new star can ever grow to be a planet. We start with how exoplanets are found, (radial velocity technique, transit technique, and so on), but this book is primarily about how planets are made - how they make themselves and how they make each other, why they are composed of certain elements, and why they are where they are instead of somewhere else.

To get into the material we start with out own solar system and a discussion of how each of the planets we are familiar with might have come to be. We consider the other types of planets that we don't have, but that could exist. We then review how exoplanets are found. We talk about what we know is out there, and then we talk about what might be further out and how we might go about looking for them. In the course of doing all of that we have to consider all of the different types of stars and star systems, and how each might have its own sorts of planets.

There's a sort of chicken and egg problem here. Do you find something and then try to figure out what it is? Do you posit what might exist, and then try to find it? Do you find something and then work backwards to recreate how it came to be? Do you theorize a planet making process, and then look for a planet that may have been made that way? Our author does all of that, sometimes at the same time. If this book has a challenge it would be how to organize, make sense of, and present the field. This isn't settled material, and it hasn't developed in a nice straight line. All of this science is happening right now; ideas and discoveries are popping up all over, and every direction you look something is happening. Tasker does a wonderful job of trying to keep the story, (the problems, the solutions, and the problems with the solutions), on track, but sometimes she's herding Schrodinger's cats.

There are also fascinating digressions. I very much enjoyed the discussion of how you look for markers that suggest life on various exoplanets. There is a good deal of discussion of Pluto, (not just griping about its demotion), that explains why Pluto is different, and this segues into a discussion of a possible Planet 9 and of

other planetary objects that orbit our sun, (who knew about Sedna?, or that Neptune was so important).

The bottom line is that if you are at all interested in planetary science or astrophysics, this book is a rich and rewarding feast. A very nice find. (Please note that I received a free advance ecopy of this book without a review requirement, or any influence regarding review content should I choose to post a review. Apart from that I have no connection at all to either the author or the publisher of this book.)

Otherwyrld says

This was a great book which not only covered the current search for exoplanets, but also looked in detail at how planets are formed. Not only that, it used reasoned explanations as to how some of the weirder exoplanets (such as hot Jupiters) may come to exist. It turns out that there seems to be almost an infinite variety of types of worlds out there, depending on the enormous number of variables in star and planet formation.This may be bad news for people looking for another Earth because this book pretty much suggests that we won't find one, there are just too many variables to come up with something even close to our own world. This isn't to say that there aren't inhabitable (and inhabited) worlds out there, but we might have to work a lot harder to actually live on them than we would like to think about.

There's a fair amount of technical detail but it is generally handled in a breezy and informative manner, and most people should be able to follow the authors arguments with little difficulty. The author draws no conclusions, but presents us with the facts as they stand at the moment. The only real issue with a book like this is that it lies in such a fast changing science that a lot of the information may be either outdated, superseded or proven wrong within a short space of time.

Still, if you are interested in the subject, this book is well worth the read.

Brian Clegg says

The way this book opens has the feel of an author trying too hard to get her personality across, as popular science books sometimes do. Elizabeth Tasker opens by asking an astrophysicist 'What would make you throw my book out of the window?' and as a reader, I hardly take in the next page and a half wondering why anyone would ask such a question. Then, just as I regain the ability to process what I'm reading, I get 'In 1968, Michael Mayor fell down an ice crevice and almost missed discovering the first planet orbiting another sun'. And I'm thinking 'But no one made such a discovery in 1968', not realising that this statement had nothing to do with his much later work on exoplanets (planets that orbit other stars) but was just a way to try to make the character more interesting.

Thankfully, once we get past the introductory section, Elizabeth Tasker's style settles down in a big way - if anything it goes to the other extreme and becomes distinctly dry, delivering more of a collection of facts than a narrative. However, in terms of content, The Planet Factory can't be faulted. It is excellent, for example, on planetary system formation. We're used to hand waving explanations of planetary formation from a disc of dust and gas, but Tasker shows how there's not long (in planetary timescales) for this to happen, and why it's really distinctly difficult for a cloud of dust grains to do anything more than bounce off each other, rather than clump together to form a planet.

Even in the heavy fact sections there is a tendency to use odd analogies, for example: 'this uncertainty leaves us as much in the dark about the planet's type as would the sex of a foetus with its legs crossed in the womb,'

but these become less frequent after a while. Tasker gives us oodles of detail, emphasising how complex the planet formation process is, as new discoveries often make old theories wrong, or at least throw oddities into the mix. As readers, we soon realise that an awful lot is being deduced from a relatively tiny amount of data, so there is a strong whiff of speculation in the air much of the time. This is emphasised when Tasker describes the way that three planets found orbiting Gliese 581 were later thought not to exist - in the case of two of them, it was enough that the star had the equivalent of a strong sunspot to produce the misleading data.

This is the first popular book I've read about the formation of both our solar system and exoplanets that gives a real, gritty, coal-face feel for the complexity of the process involved, how much we know... and how much we don't. To be honest, it's not the most engaging book - I don't think that's Tasker's fault - it's just that as a topic it's rather like geology - probably the hardest of all scientific topics to make interesting to the general reader. It's notable that in the final section, where Tasker takes on whether or not planets (and moons) are correctly placed to be able to provide the essentials for life as we know it, things get more interesting. But if you have an interest in the solar system or planetary formation on a wider scale, and are hazy on the details, it's a must-read.

Chris watson says

Nice read

Don’t hesitate to take this journey of exoplanets. Just technical enough to please the nerd but with enough story to make the prose smooth and enjoyable

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Nikki says

Reviewed for The Bibliophibian.

If you’re interested in planets outside our solar system, this is obviously going to be for you. It explains how planets form and the different ecosystems (of a sort) that different types of planets form in. Like the other Bloomsbury Sigma books, it’s readable and fairly light in tone. I think it could actually have used some more diagrams: sometimes, Tasker explained something and my brain just couldn’t grab hold because I couldn’t do the imagining she was suggesting. (If you start with “imagine an ellipse”, I’m afraid I fall at that first hurdle, so I’m a bit of an outlier here — but I still think some more diagrams could have clarified the more technical stuff.)

I do also have some issues with terminology, although this isn’t Tasker’s fault so much as an issue with astronomy in general: hot Jupiters and super Earths and so on all start to blur together for me. Once you say “it’s like Jupiter only x and y and z and a and b” then I don’t know why you’re still calling it a Jupiter-like object. Some of the hot Jupiters are pretty close to Jupiter, of course, but… I don’t know, it felt like a meaningless phrase that got in the way of me actually following what sort of planets were being discussed. “A gas giant on a close solar orbit” seems more informative…

Anyway, that’s probably mostly down to personal taste. It’s an informative book with which I have no scientific quibbles.

Jennie says

Dr. Elizabeth Tasker is very talented at making the science of planet formation understandable for people without a science background! This was a fascinating read, different from anything I've read before. It took me longer than most of my pleasure reading material, because I wanted to absorb what she was saying. Tasker does not simply talk about how exoplanets are being discovered and best-supported theories of planet formation and composition; she shares theories that seem plausible, debunks them, then walks you through currently regarded theories that hold up better according to science. There is so much really exciting discovery going on, I can't wait to hear more about the work being done on exoplanets, as well as the search for potential life without and within our own solar system on some of our gas giants' moons! I look forward to returning to this book down the road, to soak up information I missed the first time.

Adam Whitehead says

Up to the early 1990s, the discussion of how life is formed and how many habitable planets there may be in our galaxy was massively restricted by us having only one star system - our own - and only eight planets and two dwarf planets to study. In the last quarter of a century, that has radically changed. 3,710 confirmed planets circling other stars have been discovered, with an additional 15,000 suspected to exist and awaiting verification. We have gone from having a handful of planets to look at to veritably drowning in them, with more discovered almost every month.

The key question is can any of these planets harbour life, even intelligent life, and if they do how can we find them? And how do you build a planet and a solar system anyway?

Astrophysicist Elizabeth Tasker tackles a large number of questions in her book. It looks at how the Earth was formed and the role played by the rest of the Solar system in its creation. This involves a detailed look at the phenomenon which, highly unusually, resulted in our gas giants ending up in quite distant orbits from the Sun (most gas giants end up orbiting their stars at a mere fraction of the orbit of Mercury, becoming so-called "hot Jupiters"), allowing the Earth to form unmolested in the inner Solar system. The book also looks at how water is formed and gets deposited on planets, and the degree to which water is essential for life or if other substances could be used.

The book also explores several dozen of the more exotic exoplanets, including worlds which orbit pulsars and are fried in their radiation beams on a regular basis; worlds covered in thick tar and others where diamonds literally rain out of the sky. There are water worlds with oceans thousands of kilometres deep and frozen iceballs which have been catapulted out of their parent systems and now wander on their own between the stars. These descriptions are vivid and show how chemistry and physics can combine to create worlds far stranger than any science fiction has come up with.

The book is approachable, with occasional dips into more complex discussions of chemistry and orbital resonances, but for the most part the book is perfectly readable for the layman. There's a nice line of humour in the book and the use of pop culture references to explain how certain planets work (a chapter on exomoons compares them to the Forest Moon of Endor from Star Wars, for example, and the one on rogue planets briefly invokes the Transformers homeworld of Cybertron which was likewise blasted out of its orbit around its home star).

The book also explains the techniques used for detecting exoplanets and how they are being refined further to look for planets the size of the Earth, or smaller, and how we may be able to pick up the telltale signs of life through atmospheric conditions.

One of the things I liked most about the book was its upbeat tone. Given that exoplanets seem to have added a whole load of extra steps to the conditions necessary to have life, it would have been easy to have concluded that if life is out there, it's even rarer than we thought and would be very difficult to find. However, Tasker instead keeps showing how even the craziest worlds may still be able to give rise to (at least) bacteriological or microbial life. In one of the most positive chapters, she even looks at the problems Earth has had in developing life - its frequent ice ages as the result of Milankovitch cycles caused by the gravitational tugs on its orbit by other planets, its occasional collision with large asteroids - and postulates planets that wouldn't have these problems and where life and even intelligent life could develop much more quickly than on Earth.

The Planet Factory (****½) is a fast-paced and readable non-fiction book which expands on current science, explains planet formation theories in an approachable way and is highly informative. It's also a good watch of catching up on what is a very rapidly-evolving field. The book is available now in the UK and USA.

Jeremy says

A terrific overview of current thinking on planetary formation, drawing both on knowledge of planetary science gleaned from our own solar system and observations of exoplanets. I appreciate both the emphasis on the observations and measurements our thinking is based on and the recognition that there is no settled and well-understood vision of planetary formation. Highlights the amazing strides made in this area of science without glossing over the many mysteries that remain.

Eric says

Tasker’s book comes close to being a technical manual for the explanation of the different star and exoplanet types and their orbital perturbations as applied to the possibility of life elsewhere. She demonstrates a true scientist’s critical eye and is quick to point out the many ways that an exoplanet would probably not meet the requirements of life to counter more optimistic claims of its prevalence universe wide. We then gather that water worlds are more likely than not and moons offer a greater chance of habitability then might have been previously thought. Finally, she’s on the mark factually. I’ve read to many popular science books as of late with glaring basic knowledge mistakes. For example, the popular Star talk podcast made an error in reference to the Trappist planetary system, which Tasker was originally correct to say that several of the exo planet claims were later found to be anomalies.
