

Philosophy of Science for Biologists

Biologists rely on theories, apply models, and construct explanations, but rarely reflect on their nature and structure. This book introduces key topics in philosophy of science to provide the required philosophical background for this kind of reflection, which is an important part of all aspects of research and communication in biology. It concisely and accessibly addresses fundamental questions such as the following: Why should biologists care about philosophy of science? How do concepts contribute to scientific advancement? What is the nature of scientific controversies in the biological sciences? Chapters draw on contemporary examples and case studies from across biology, making the discussion relevant and insightful. Written for researchers and advanced undergraduate and graduate students across the life sciences, its aim is to encourage readers to become more philosophically minded and informed to enable better scientific practice. It is also an interesting and pertinent read for philosophers of science.

KOSTAS KAMPOURAKIS is the author and editor of books about evolution, genetics, philosophy, and history of science, and the editor of the Cambridge University Press book series *Understanding Life*. He is a former editor-in-chief of the journal *Science & Education*, and the book series *Science: Philosophy, History, and Education*. He is currently a researcher at the University of Geneva, where he also teaches at the Section of Biology and the University Institute for Teacher Education (<http://kampourakis.com>).

Cambridge University Press & Assessment
978-1-108-49183-9 — Philosophy of Science for Biologists
Edited by Kostas Kampourakis , Tobias Uller
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TOBIAS ULLER is Professor of Evolutionary Biology at Lund University, Sweden. He works on the relationships between development, heredity, and evolution, using an integrative approach guided by mathematical modeling and conceptual analysis. He has held fellowships in the United Kingdom, United States, and Sweden, and was the 2018 recipient of the Tage Erlander Prize, awarded by the Royal Swedish Academy of Sciences for research in Natural Sciences and Technology.

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KOSTAS KAMPOURAKIS

University of Geneva

TOBIAS ULLER

Lund University



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CAMBRIDGE
UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom
One Liberty Plaza, 20th Floor, New York, NY 10006, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India
103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

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www.cambridge.org
Information on this title: www.cambridge.org/9781108491839

DOI: 10.1017/9781108648981

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First published 2020

A catalogue record for this publication is available from the British Library

ISBN 978-1-108-49183-9 Hardback
ISBN 978-1-108-74070-8 Paperback

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Contributors

Ingo Brigandt

University of Alberta

Carol E. Cleland

*University of Colorado
Boulder*

David J. Depew

University of Iowa

Michael R. Dietrich

University of Pittsburgh

Carrie Friese

*London School of Economics and
Political Science*

Kostas Kampourakis

University of Geneva

Tim Lewens

University of Cambridge

Kevin McCain

*University of Alabama at
Birmingham*

Emily C. Parke

University of Auckland

Erik L. Peterson

*University of Alabama at
Tuscaloosa*

Anya Plutynski

*Washington University in
St. Louis*

Angela Potochnik

University of Cincinnati

Barbara Prainsack

*University of Vienna, and King's
College London*

Thomas A. C. Reydon

Leibniz University Hannover

Michael Ruse

Florida State University

Tobias Uller

Lund University

Preface

Is philosophy of science of any use to biologists? A well-known response is that philosophy of science is as helpful to science as ornithology is to birds. Whether or not it was Richard Feynman who actually said this does not affect the fact that many biologists that we have met, especially those older than us, would readily agree. Among these biologists one can find top researchers, with prestigious grants and publications, who think that any philosophical discussion is a waste of time. The experienced researcher, they would say, knows what has to be done; the inexperienced has to learn from the experienced ones in the lab or in the field. Whatever Kuhn or Popper said (they have not heard about Lakatos, or any philosopher after him) is irrelevant to the actual practice of science. Philosophy of science is, at best, a nice endeavor for retired scientists, if they decide to reflect upon their own career and work. Or so the story goes.

This response is a caricature, of course, and many biologists do not think like this. But even those who are not in principle opposed to philosophical reflection and discussion usually do little to promote it. They have data to analyze, papers to write, and grant proposals to submit. Science is a full-time job, and there is little time left for philosophizing, which thus becomes a luxury. However, our aim with the present book is to show that it is not a luxury but a necessity. Philosophical reflection is inherent in any scientific activity, and what is necessary is to guide the experienced researchers to make it explicit, and the inexperienced ones to understand it. We hope that the chapters in the present book show how important philosophy of science is for biology, and how much biologists will benefit from thinking and reflecting in a philosophical manner.

We must note that the chapters in this book cover some philosophical aspects only, focusing on those that we considered the most important for biologists, especially the younger ones, to understand. We begin with a chapter we wrote that sets the context by explaining in some detail why biologists should care about the philosophy of science. The next three chapters discuss some very fundamental issues: what constitutes

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an explanation in biology (by Angela Potochnik); what biological knowledge is (by Kevin McCain); and what the nature of theories and models in biology is (by Emily Parke and Anya Plutynski). Then we focus on concepts, devoting four chapters on the nature and role of concepts, discussing how biology concepts are used and transformed (by Ingo Brigandt); why it matters that many biology concepts are metaphors (by Kostas Kampourakis); how concepts contribute to scientific advancement (by David Depew); and how conceptual analysis can contribute to scientific practice (by Tim Lewens).

The subsequent chapters discuss the methods used in the life sciences (by Erik L. Peterson); how biologists study the past and why this kind of work can be as solid as experimental science (by Carol Cleland); what the basis of biological classification is (by Thomas Reydon); what the nature of scientific controversies in the biological sciences is (by Michael R. Dietrich); and what the relation is between facts and values in biological science (by Carrie Friese and Barbara Prainsack). Last, but not least, Michael Ruse, one of the founders of the field we call philosophy of biology, shares his fifty-year-long experience of doing philosophy of biology. We conclude with some practical suggestions of our own about how to teach philosophy of science to biologists.

We are of course indebted to the contributors to this volume for their high-quality chapters and their excellent collaboration. We are also indebted to Katrina Halliday, publisher for life sciences at Cambridge University Press, who supported this – rather unusual for the life sciences series – book project right from the start and toward publication. We are also very grateful to Olivia Boulton and Sam Fearnley for their work and collaboration during production, as well as to Chris Bond for his meticulous copyediting of the book. Finally, we are indebted to each other for an excellent collaboration, the outcome of which you are now holding in your hands. We hope that you will enjoy reading it as much as we did.

Kostas Kampourakis and Tobias Uller