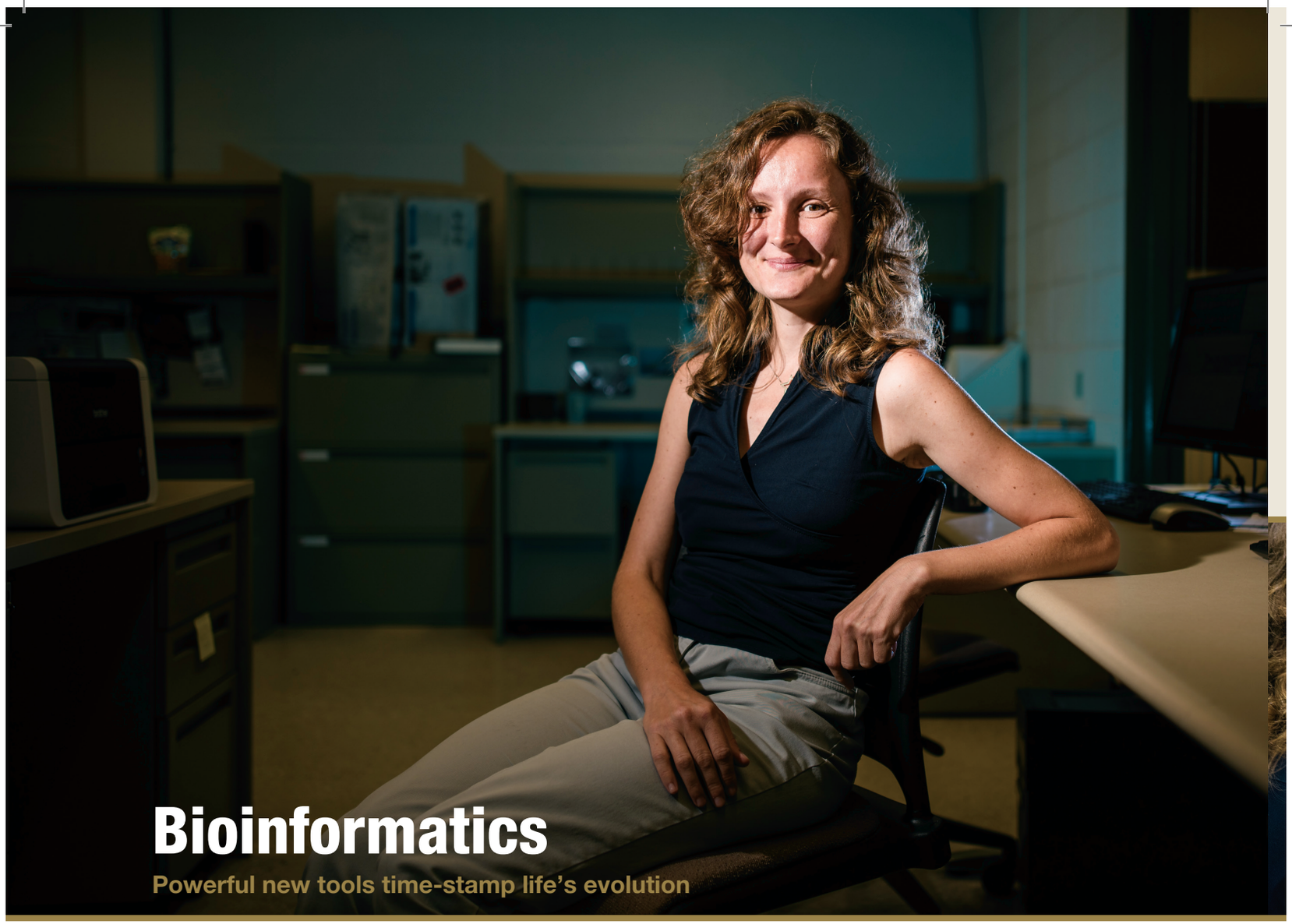


Bioinformatics

Powerful new tools time-stamp life's evolution

How did life on Earth evolve? Can life be created from non-life?

Fabia Battistuzzi, Ph.D., assistant professor of Biological Sciences at Oakland University, may be en route to the answers. Dr. Battistuzzi recently received a $600,000 three-year grant from NASA to help her research team on the journey.

"We are developing the tools to create a deeper understanding of life's evolutionary history," she said. "It may take us three years to answer the question, but the general idea behind the grant is to develop methods to give a more accurate time stamp to all of the different species that have evolved on Earth."

Back to one cell

Dr. Battistuzzi, a database-oriented evolutionary biologist, joined OU's faculty in August 2012. Her research aims to understand when and how species evolved, and she investigates the connections between their genetic variations in different environmental conditions. Since graduate school in 2002, Dr. Battistuzzi has studied the evolution of prokaryotes, a microscopic single-celled organism.

"Among all species, microbes span the largest duration of Earth's history and are extremely metabolically and ecologically diverse," she said. "These characteristics make them a powerful resource to investigate evolutionary mechanisms over long (billions of years) and short (millions of years) timescales, while tracing the origin of important ecological innovations such as pathogenicity of infectious diseases."

Traditionally, scientists have used fossils to time the origin of a species. Prokaryotes don't leave a fossil record. "Using genomes, scientists can go further and further back in time to get to the very early origin — one cell," Dr. Battistuzzi explained.

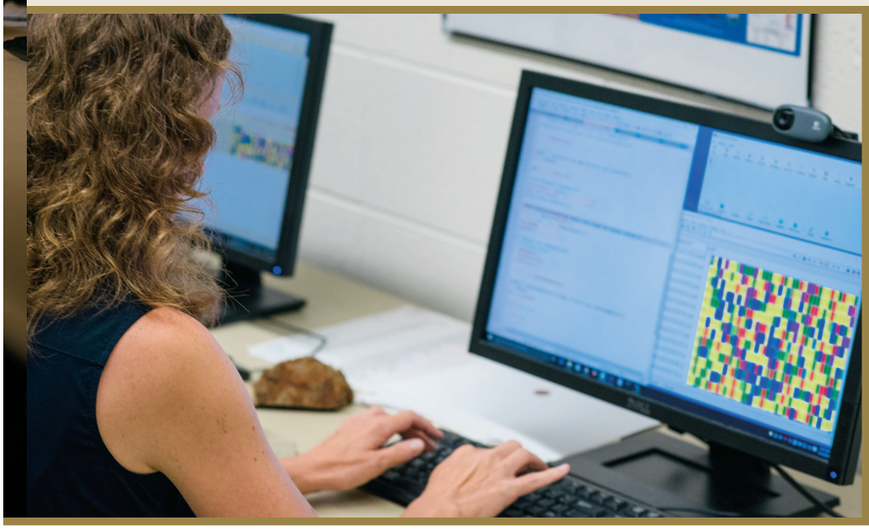
Genomes are repositories of information that over time show changes an organism underwent to survive and to adapt, she said. "When we understand what kind of changes that pathogen has figured out to adapt to the human host, then we can have a better understanding of how it can actually infect us and how it can hurt us."

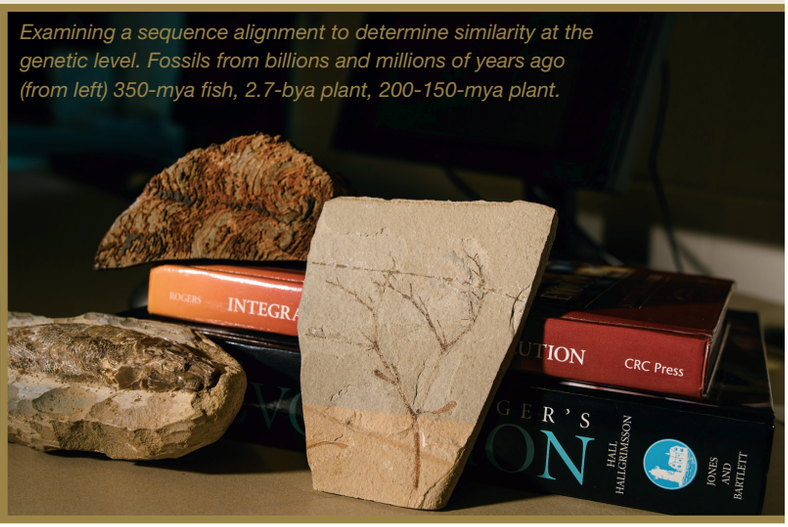
What's next?

"Real-world applications include determining how infectious diseases evolve. Different pathogens can infect other animals,

Fabia Battistuzzi, Ph.D., assistant professor, Biological Sciences

The research interests of Dr. Battistuzzi include the evolution of early life, phylogenomics, molecular clocks and the evolution of infectious diseases. Dr. Battistuzzi obtained her doctoral degree in Evolutionary Biology and Astrobiology from Pennsylvania State University in 2007, focusing on reconstructing the evolution of the earliest life forms on Earth. During postdoctoral training at Arizona State University, Dr. Battistuzzi built on this work to integrate geological and molecular data to obtain a timeline of life on Earth. She also applied similar methodologies to understand the evolution of pathogens and their interactions with other species. Since joining Oakland University, her research has focused on the development of new bioinformatics tools to improve the precision of the timeline of life and on using genome complexity as a signature of evolution and adaptation in species.





Examining a sequence alignment to determine similarity at the genetic level. Fossils from billions and millions of years ago (from left) 350-mya fish, 2.7-bya plant, 200-150-mya plant.

they can infect plants, they can infect other microbial organisms and eventually they can infect us," Dr. Battistuzzi said.

With this grant, "we're going to focus our research on early life specifically; however the method will be applicable to pretty much every group," she said. "This particular question arose because of the debate that is still going in the field: How do we determine how old a species is? Is it six million years? Is it one billion years?"

One goal is to determine how life originates from non-life. "Once we get that connection, we're going to have the whole history," she said. "And with the history of life at hand, its applications will span multiple fields, from ecology to medicine."

Key role for 'big data'

Large dataset analysis is key to Dr. Battistuzzi's work. The new interdisciplinary Center for Data Science and Big Data Analytics, a collaboration of the College of Arts and Sciences, the School of Engineering and Computer Science and the School of Business Administration, will be central to her research.

"Without the computers, I can't do anything of what I do right now," she said. "With a strong and constant institutional support, the Big Data Center will be a great support for my research and the research of many of my colleagues. It will allow us to remain competitive in research grants and faculty/student recruitment."

The implications of her research are far-reaching.

"The importance of my research lies in its role as a predictor," she said. "Past trends and patterns are regularly used to predict future reactions, whether it be the reaction of the stock market to a type of event or the reaction of a biological community to environmental change. Understanding how life and Earth interacted and reacted to each other in the past 4 billion years is the basis to predict how future changes in our planet might affect our current life forms."

By Susan Thwing, a freelance writer from Rochester Hills, Michigan.