

CANDLEWICK PRESS TEACHERS' GUIDE

JOY HAKIM

Best-Selling Author of A History of US

DISCOVERING
LIFE'S STORY



VOLUME ONE

BIOLOGY'S
BEGINNINGS



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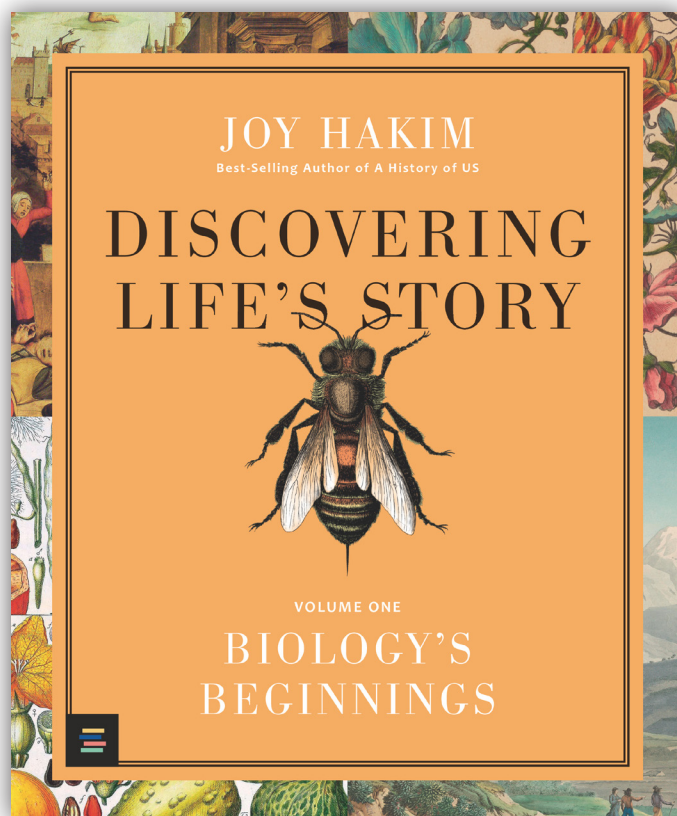
DISCOVERING LIFE'S STORY

BIOLOGY'S BEGINNINGS

JOY HAKIM

When did we start learning the scientific secrets of life? Step back to the Islamic Golden Age, when scholars ask questions about life science and medicine that will establish those fields. Chart a path through the Renaissance, as Leonardo da Vinci dissects cadavers by candlelight to learn human anatomy firsthand. In this first of four volumes spanning hundreds of years of scientific innovation and discovery, follow the evolution of life science up to the late 1800s, when a baffled Dutch biologist finds a tiny infectious particle destroying tobacco crops and gives this particle a new name: *virus*. With *Discovering Life's Story: Biology's Beginnings*, author Joy Hakim begins a series mapping the path of human discovery as we unlock the biological secrets of our own existence. Richly illustrated with archival source materials and fine art, this STEM treasure trove features a wealth of back matter certain to kindle the appetite of science lovers.

This guide supports secondary teachers across subject areas—English language arts, social studies, and science—to cultivate student inquiry, interest in the craft of nonfiction writing, and scientific and historical understanding in the discipline-specific and interdisciplinary contexts in which they may be teaching.



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Common Core Connections

This guide, which can be used with large or small groups, will help students in grades 6–12 meet several of the Common Core State Standards (CCSS) for English Language Arts: reading informational text standards for key ideas and details, craft and structure, and integration of knowledge and ideas (CCSS.ELA-Literacy.R), speaking and listening standards for comprehension and collaboration and for presentation of knowledge and ideas (CCSS.ELA-Literacy.SL), and writing standards for text types and purposes, production and distribution of writing, and research to build and present knowledge (CCSS.ELA-Literacy.W).

This guide will also help students in grades 6–12 meet several of the CCSS Standards for Literacy in History/Social Studies, Science, and Technical Subjects: the reading of texts for key ideas and details, craft and structure, and the integration of knowledge and ideas in both History/Social Studies (CCSS.RH) and Science and Technical Subjects (CCSS.RST), as well as Writing (CCSS.WHST). Discussion questions can be used as prompts for small or large group discussions as well as writing prompts for independent work.

DISCUSSION QUESTIONS

1. What is scientific literacy? What kinds of questions do scientists ask? What processes do scientists follow? How are theories generated, and how is knowledge constructed?

Note: Students can share their thinking on a digital whiteboard or platform of your choice and contribute new ideas as they make their way through the book.

2. What kinds of images can you identify (maps, portraits, drawings, etc.)? What is the balance of primary sources and secondary sources? Where and when did the images originate? How do these visuals connect to the chapter title? What questions do you have about these images? How do they help you predict or anticipate what your chapter *might* be about?

Note: For this discussion, assign small groups of students to each chapter and have them preview the images. It's not important that students "get this right." Rather, it is an opportunity to preview content and build some understanding of how the book is organized and the role that the images play throughout.

3. The introduction covers a lot of history! It begins in the eighth century, in the midst of the Islamic Golden Age, and concludes with the Renaissance. It covers the development of libraries, the origins of the university, new technologies such as the printing press, some of the consequences of the European invasion of the Americas, and more. *Why* do you think Joy Hakim starts the book this way? What is her intention or objective? What information, themes, and tensions are established that prepare you to begin reading?
4. What role does background color play within the design of the book and within each specific chapter? What kind of information is shared within the brightly colored boxes and pages that punctuate the text? What are some consistent ways that color is used throughout the book to signal additional information that's separate from the primary expository text?
5. Because this is a history of the origins of life science in the Western Hemisphere, white Western European men, people who had the financial means and/or the opportunity to conduct scientific exploration, feature prominently. However, they were not the only people contributing to scientific discovery. Throughout the book, Hakim includes the contributions and advancements of women and people from minoritized populations. Consider how Hakim incorporates multiple voices and perspectives across the chapters. Who appears in the primary text and who appears in inserted pages? How does Hakim model a more inclusive and more accurate history? How does this help you to think differently about your own approaches to reading and writing historical information?
6. After you have read several chapters of the book, go back to the table of contents. How do the chapter titles preview one or more big ideas within each chapter? What are other ways that the structure of the book supports you as a reader? For example, how do the quotes at the start of each chapter introduce you to important content or a theme? How do the concluding paragraphs of each chapter summarize information and preview the next chapter?

7. Building Scientific Understanding: As you complete each chapter, use the following protocol as a way to take notes and prepare for class discussions. (A reproducible version is included on the last page of this guide.)

- Who are the important drivers of discovery in this chapter?
- To what extent are their discoveries built on the discoveries of others, including those of women, Indigenous peoples, and members of other underrepresented identities?
- What new technology, if any, has been invented or improved upon?
- What biological hypothesis or understanding has been established or considered?
- What new questions do scientists have?

8. *Biology's Beginnings* is all about knowledge and understanding that grows and shifts over time. Such changes continue today in all fields of science. Think about the people in your community who work in science-based fields, like medical doctors, EMTs, pharmacists, park rangers, engineers, construction managers, and more. With a partner, develop a list of questions to ask a selection of these community members about their work and how their jobs have evolved over the years in response to scientific research.

Note: Using videoconferencing technology, connect your students with different science-based professionals so that they have an opportunity to share their questions.

9. Throughout the book, Hakim identifies the ways in which accepted knowledge, religious beliefs, and political power and tensions within specific times and places shaped intellectual identities, new scientific understandings, and the communication of those new scientific understandings. Select a chapter that you found really interesting. As you reread the history and the science within the chapter, ask yourself the following questions to prepare for class discussion:

- How did accepted knowledge, religious beliefs, and political power and tensions shape the life of a particular scientist or intellectual?
- How did religion influence scientific understanding? How did religious beliefs expand or limit the communication of that understanding?
- How did power and politics influence scientific understanding? How did power and politics expand or limit the communication of that understanding?

10. In “Looking Ahead” (page 165), Hakim writes, “There is still much to be learned for scientists in the years after the Renaissance. Pandemics run unchecked, and doctors often practice archaic and dangerous treatments, including ‘bleeding’ patients.” What unanswered and/or new questions do you have about life science? What information do you predict the second volume in the *Discovering Life's Story* series might cover? If there are four volumes in total, what time span do you think the second volume might cover and why?

CLASSROOM ACTIVITIES

THE ART OF SCIENCE

Throughout *Biology's Beginnings*, we see visual art as a vital component of building and communicating scientific understanding. Scientists were artists, as evidenced by the sketch illustrations in Vesalius's *Fabrica* in 1543 (pages 17, 23, 26), William Harvey's *De Motu Cordis* in 1628 (page 67), and Robert Hooke's *Micrographia* in 1665 (pages 103–105, 108, and elsewhere) and the colorful paintings in Maria Sibylla Merian's *The Caterpillars' Marvelous Transformation and Strange Floral Food* in 1679 and *Metamorphosis Insectorum Surinamensium* in 1705 (pages 114–117). The scientific process is built upon direct observation. Today, young people document their observations of the world through cell phone cameras. What is it like to forgo modern technology and capture information by hand to share with others? Provide students with microscopes and slides, and have them draw what they see using colored pencils and markers. Or provide them with leaves, sticks, stones, and other items from the natural world. Allow students to share their drawings and to reflect upon the process. How does looking closely and repeatedly at the same thing, in order to replicate it, deepen their understanding of what they are looking at? What new questions arise?

TECHNOLOGY AND SCIENCE: ARTIFICIAL INTELLIGENCE

Throughout *Biology's Beginnings*, Hakim discusses the ways in which innovations in technology lead to new scientific discoveries and understandings, such as the development of the pinhole camera, first discussed by Mozi in China, then Aristotle in Greece in the fourth century BCE, the Arab physicist Alhazen in the eleventh century, and Robert Hooke in seventeenth-century England and Christiaan Huygens in seventeenth-century Holland (pages 95–101). We are now at the dawn of a new era in scientific technology, with the rise of artificial intelligence and the ways in which it can support life science research and medical care. Have students read and watch the following resources, or, since science is changing all the time, work with your school librarian to identify articles and videos created after the publication of this teachers' guide. Provide students with opportunities to debate the benefits and drawbacks of using artificial intelligence in scientific research and in medicine. Invite a medical doctor or scientific researcher to join the class via a virtual method for conversation.

- The Royal Society, "The AI Revolution in Scientific Research," 2019
- Caltech, "Artificial Intelligence"
- PBS NewsHour, "AI in Medicine," 2023

CCSS.ELA-LITERACY.CCRA.SL.1; CCSS.ELA-LITERACY.CCRA.SL.2; CCSS.ELA-LITERACY.CCRA.SL.3;
CCSS.ELA-LITERACY.CCRA.SL.4

THE ISLAMIC GOLDEN AGE

Hakim introduces the book by discussing the Islamic Golden Age. Provide students with the opportunity to explore this vibrant time period in greater detail, from the medieval city of Baghdad to the multicultural, multilingual, religiously diverse Al-Andalusian Spain. Allow students to work in pairs, in groups, or as individuals to cover more information and allow for conversations across groups as they share their findings through visual art, infographics, poetry, fiction, and nonfiction. As students work, ask

them to make connections between the Islamic Golden Age and today. What tensions still exist? What aspects of our everyday lives are rooted in discoveries made and intercultural connections furthered during the Islamic Golden Age? The following resources may be a useful starting point; work with your school librarian to find others.

- 1001 Inventions: Discover a Golden Age, Inspire a Better Future
- “The Medieval Islamic World: Crash Course History of Science #7”
- Medieval Muslim Societies, Khan Academy
- Islamic Art, Metropolitan Museum of Art
- Science and the Art of the Islamic World, Curriculum Guide, Metropolitan Museum of Art

CCSS.ELA-LITERACY.CCRA.R.1; CCSS.ELA-LITERACY.CCRA.R.7; CCSS.ELA-LITERACY.CCRA.W.2; CCSS.ELA-LITERACY.CCRA.W.7; CCSS.ELA-LITERACY.CCRA.W.8

TOWARD MORE INCLUSIVE HISTORY

Joy Hakim is intentional in her efforts as an author to include the contributions of women and people from minoritized populations throughout the book. Use *Biology's Beginnings* as a starting point for your students' research. Using the resources of your school and public library, have students select and read a work of middle-grade or young adult nonfiction on a topic of their choice. As they read, have them track perspectives. Who is included? Who is excluded? Why? What other voices and perspectives could be included? After students do some additional research on the topic, have them identify someone from a minoritized population who could be added to the book they just completed. Using “Three Thinkers of the Renaissance” (pages 24–26) and “Women Speak Up” (pages 59–60) as examples, have student write two-page inserts for their book, complete with a primary source document or artifact that helps to further contextualize the time, place, and/or subject.

CCSS.ELA-LITERACY.CCRA.R.3; CCSS.ELA-LITERACY.CCRA.R.5; CCSS.ELA-LITERACY.CCRA.R.6; CCSS.ELA-LITERACY.CCRA.W.2; CCSS.ELA-LITERACY.CCRA.W.7; CCSS.ELA-LITERACY.CCRA.W.8

WRITING NONFICTION

Offer your students the opportunity to write their own work of nonfiction, drawing on *Biology's Beginnings* as a mentor text. After completing the book, have students identify the chapter structures and design principles at work. How is color used? How many different fonts and sizes? What is the balance of text to illustration? What kinds of visuals illustrate chapters? Next, students can select a topic of their choice or one within the context of your current unit of study. As they research and take notes, have students track primary sources that are useful to their research and highly visual. To support their search for these visuals, guide students to various library and museum collections connected to their topic. Students can digitally publish their chapters and present them to one another, discussing both the content as well as the design and publishing decisions they made.

CCSS.ELA-LITERACY.CCRA.R.5; CCSS.ELA-LITERACY.CCRA.R.6; CCSS.ELA-LITERACY.CCRA.R.7; CCSS.ELA-LITERACY.CCRA.W.2; CCSS.ELA-LITERACY.CCRA.W.7; CCSS.ELA-LITERACY.CCRA.W.8; CCSS.ELA-LITERACY.CCRA.W.9

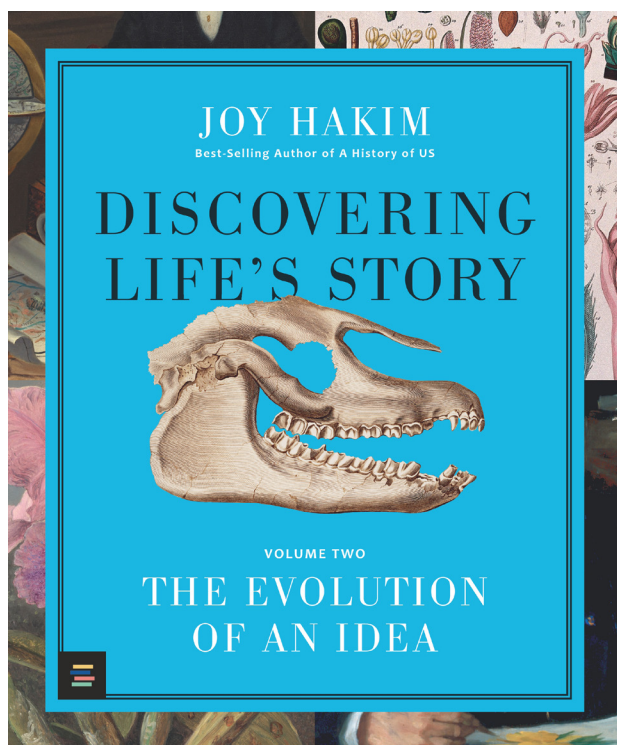
Notes for Chapter _____ of *Biology's Beginnings*

<i>Who are the important drivers of discovery in this chapter?</i>	
<i>How are discoveries built upon the work of others (including women, Indigenous peoples, and members of other underrepresented identities)?</i>	
<i>What new technology, if any, has been invented or improved upon?</i>	
<i>What biological hypothesis or understanding has been established or considered?</i>	
<i>What new questions do scientists have?</i>	

ABOUT JOY HAKIM

Joy Hakim is the best-selling author of *A History of US*, a ten-volume history of the United States, which has sold over three million copies, as well as of a much-lauded series about the physical sciences called *The Story of Science*. Joy Hakim has worked as a teacher, newspaper writer, and editor and lives in Maryland. You can learn more about Joy Hakim and her work and find additional resources, including materials specifically for science teachers, at www.joyhakim.com.

Look for the second volume in the series:



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A Junior Library Guild Selection

*In the second volume of the **Discovering Life's Story** series by best-selling author Joy Hakim, the theory of evolution takes hold—transforming ideas about survival, extinction, and life itself.*

Can species change? Or go extinct? In the eighteenth century, most people answer no to both questions. But in the century that follows, that certainty gets challenged as some people in Europe question the common belief that all creatures are the same as they've been since life's creation. *The Evolution of an Idea*, the second volume of *Discovering Life's Story*, opens with the Swedish naturalist Carl Linnaeus, who attempts to create an organizing system for the myriad forms of life on earth. It continues into the late 1800s, when two Englishmen—Charles Darwin and Alfred Russel Wallace—each develop their own version of a startling new theory of how life-forms change over time. This evolutionary idea will alter the understanding of our place in the great web of life. In this remarkable volume, author Joy Hakim continues charting the path of human discovery and shows how groundbreaking thinkers began to unlock the biological secrets of our own existence.