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MICROBIOLOGY FOR CHILDREN: WHAT ARE THEY LEARNING?

Cells. Darlene R. Stille and Carol Ryback. Gareth Stevens, Strongsville, OH, 2008. 48 pp., illus. $27.00 (ISBN 9780836884371 cloth).

Germ Stories. Arthur Kornberg. University Science Books, Herndon, VA, 2008. 84 pp., illus. $22.50 (ISBN 9781891389511 cloth).

Microquests: Mighty Animal Cells, Powerful Plant Cells, Daring Cell Defenders, Amazing DNA, and Ultra-Organized Cell Systems. Rebecca L. Johnson. Millbrook Press, Minneapolis, MN, 2008. 48 pp. per book, illus. $29.27 each (ISBN 9780822571360 cloth).

Sneeze. Alexandra Siy. Charlesbridge, Watertown, MA, 2007. 45 pp., illus. $16.95 (ISBN 9781570916533 cloth).

A World of Microorganisms. Robert Snedden. Heinemann-Raintree, Chicago, 2007. 48 pp., illus. $22.00 (ISBN 9781403495624 cloth).

Children are captivated by animals—both the creepy, crawly ones and the furry, cuddly ones. They often have knowledge of plants from collecting autumn leaves or from growing garden tomatoes. But how much experience do children have with the microbial world? And how well are children's science authors addressing this knowledge gap by stimulating a child's curiosity about the invisible living world? The following four books and one book series relate to microbiology. All but one present their material in an engaging and highly readable fashion. Most do an excellent job of educating—delivering information in a clear, accurate, and stimulating way.

I was most impressed with *A World of Microorganisms* (ages 11 to 13), by Robert Snedden. It is an excellent introduction to and comprehensive survey of the microbial world. The book contains information on cell structure, viruses, prions, bacteria, archaea, protists, and fungi. Even though no one category of microbe is treated in great depth, the detail provided for each type of microbe is impressive. For example, in the virus section Snedden covers virus anatomy, the requirement of a host cell for replication, dormancy, coevolution of virus and host, and retroviruses. More pages of the book are devoted to bacteria than to any other type of microbe. Besides basic information on bacteria, Snedden also covers the endosymbiotic theory, quorum sensing, transformation, transduction, conjugation, plasmids, and different types of bacterial metabolism. These are among the advanced topics in bacteriology, but Snedden explains them simply and succinctly and gives the reader a concise and contemporary introduction to bacteria. Additionally he includes information on the Archaea, extremophiles, nanobes, and the possibility of microbial life on Mars. I was quite pleased to see these often-neglected microbes included in his book.

A World of Microorganisms, from the Microlife series (second edition), is dense with information but still very readable. The pages include numerous color photographs and stunning electron micrographs of microbes. Although overall the book is very timely, I was surprised to see the terms "archaebacteria" and "eubacteria" still being used. Both are outdated, and microbiologists use "Archaea" and "Bacteria" instead. Snedden also uses units of microinches rather than metric units. Other than these minor drawbacks, the book is an excellent children's microbiology resource. If a young person has a keen interest in microbiology and would like a solid introduction to it, this book is the place to start. It is a minitextbook of microbiology for kids.

Another title that presents itself as a minitextbook is *Cells* (ages 9 to 12), by Darlene R. Stille and Carol Ryback. This book is a dense and disappointing introduction to cells. It includes five chapters: "What Is a Cell," "Animal Cells," "Plant Cells," "How Cells Reproduce," and "Cells as Factories." Unfortunately, I found it to be short on depth and long on breadth, which led to an unfocused and choppy writing style. The book is detailed and text heavy—yet 19 of its 40 pages of information have no illustrations or photographs. Most children would find this book to be very dry and unengaging.

Unlike *A World of Microorganisms,* which covers the full range of basic microbiology beautifully, *Cells* gives little attention to single-cell organisms such as bacteria, protists, and yeast. The only mention of bacteria is in two paragraphs of the first chapter. My belief is that a book about cells should devote an entire chapter to single-cell organisms. In most of the chapter on animal cells, Stille and Ryback describe different cell types such as skin and muscle, yet little attention is given to the overall basic, common anatomy of animal cells. This highlights a consistent problem throughout the book: more attention is given to advanced details than to basic biological principles.

Additionally, new terms are periodically introduced without a description of the concepts related to those terms. For example: "Biologists once thought the amoeba was an animal. We now classify amoebas as organisms called protozoans. Some amoebas can cause serious diseases in humans." The term "protozoan" is never mentioned anywhere else in the book, not even in the glossary. And: "Bacteria can also exchange genetic information during a process called conjugation. It does not involve sex cells." There is no other mention of "conjugation" or an explanation of what it is, nor is it defined in the glossary.

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The Microquests series (ages 8 to 11), by Rebecca L. Johnson, includes five books that examine animal cells, plant cells, the immune system, DNA, and human-body systems. Although the series is termed "*micro*quests," most subjects studied by microbiologists (e.g., bacteria, viruses) are not included, except for a cursory introduction to germs in the immune system book. The series is nonetheless informative and extremely readable. Johnson does an excellent job of explaining the biology covered in her books. Her writing style is succinct, clear, and enthusiastic, and each book is filled with colorful diagrams, drawings, and photographs to reinforce the material. The series should be readily accessible and appealing for most children who are interested in cells.

The structure and organization of *Mighty Animal Cells* and *Powerful Plant Cells* are very similar. Both cover cell organelles, cell division, different cell types, and meiosis. Stem cells and their unique properties are included in the former title; photosynthesis and the differences between plant and animal cells are covered in the latter. Both volumes serve to stimulate a young mind as they explain the basics.

Daring Cell Defenders is a terrific introduction to the immune system and how it works. Besides describing innate immunity and the different cell types involved in the immune system, Johnson is superb in conveying the timing of a response and the order in which different immune cells respond to microbial invaders. She explains the body's immune response to an infected puncture wound of the skin, introducing neutrophils, macrophages, helper T-cells, killer T-cells, B-cells, and memory cells. After reading this volume, I was ready to assign it to my college immunology class because it captures the essence of the immune response so succinctly. Anyone looking for a clear, readable introduction to the immune system would be wise to consult this book.

Continuing in her entertaining and educational fashion, Johnson completes the series with *Amazing DNA* and *Ultra-Organized Cell Systems.* Both are excellent, albeit not extremely relevant to microbiology. *Amazing DNA* includes information on DNA structure, replication, transcription, translation, gene expression, mutation, and alleles; *Ultra-Organized Cell Systems* describes different types of human cells, tissues, and body systems.

The books and series above all aim to give readers a comprehensive picture of cells in microbiology. These next two titles are just as readable and educational, but they are more specialized and even more entertaining. *Sneeze* (ages 7 to 10), written by Alexandra Siy and illustrated by her former collaborator, Dennis Kunkel, is a delightful book that first examines items that trigger sneezes and then explains the neurological and physiological mechanisms of the body that produce a sneeze. This book is a fascinating read with lots of visual appeal. Kunkel cleverly captures the why's and how's of sneezing, as Siy beautifully conveys the biology behind the behavior.

The first half of *Sneeze* focuses on nine different irritants that cause sneezing, such as dust and pollen. Two facing pages are devoted to each—the verso page contains a black-and-white picture of a child in a situation that may trigger a sneeze (pillow fighting, looking under a couch, dusting, etc.), and a detailed caption describes the irritant or allergen causing the response; a beautifully colored electron micrograph of each irritant, including its magnification size, is on the opposite page. Taken together, the effect is both educational and visually stunning.

The second half of the book details the neurological response that leads to a sneeze. The biology of neurons and the way in which they transmit signals are explained well, and the respiratory system is briefly covered. Again, explanations are enhanced by beautiful electron micrographs of neurons and alveoli. The book includes additional information on sneezing and electron microscopy, and also offers relevant Web sites and a glossary. This visually stimulating volume with its interesting subject matter would appeal to most children.

Finally, the poetic gem titled *Germ Stories* (ages 4 to 12) is Nobel prize-winner Arthur Kornberg's last book, and it is a fanciful delight. Written "to all, young and old, who adore 'the little beasties,'" it suits microbiologists of any age. Kornberg used to entertain his three sons at bedtime with educational rhyming stories about germs. When the boys grew up, they encouraged him to continue the tradition with his eight grandchildren. That is what spurred Kornberg to pen these germ stories.

The book contains twelve stories—one an introductory "germ parade," seven about bacteria, two about viruses, and two about fungi. All are educational rhyming tales, and most describe a microbe and the disease it causes. The rhymes are supplemented with both colorful artistic drawings of the microbes as well as photographs of macroscopic microbial growth, or colored micrographs of individual microbes. The strength of the stories is that they are simultaneously fun to read and educational. Any child (or adult) fascinated by germs will enjoy reading this wonderful book.

In this assortment of children's books on microbiology, clearly the vantage point lies at the cellular level. It is unfortunate, however, that these authors describe plant and animal cells almost exclusively. These books introduce children to nuclei, mitochondria, and chloroplasts, but what about the bacteria, fungi, protists, and viruses of the world? Are they not just as deserving of attention? And when microbes are the focus, as in the specialized books *Sneeze* and *Germ Stories,* they are portrayed only as causes of disease. Any future microbiologist should learn that the vast majority of microbes do *not* cause disease. A book describing the amazing properties of microbes would be a spectacular discovery for a child—I am still waiting to read one.

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