

BOOK AND EDUCATIONAL REVIEWS

THE KINGDOM PROTISTA: THE DAZZLING WORLD OF LIVING CELLS

Pickett-Heaps, Jeremy D. and Pickett-Heaps, Julianne. 2003. **The Kingdom Protista: The Dazzling World of Living Cells**. Cytophysics, 130 minutes, U.S. \$115.91. ISBN: 0-958601-9-9.

The Kingdom Protista: The Dazzling World of Living Cells is a spectacular compilation of microscopic imagery that demonstrates the diversity, vibrancy, and complexity of eukaryotic life in a powerful and straightforward format. The DVD is over 2 h in length and contains 33 chapters. The first of which is an introduction to the microbial world, which ties microbes into our everyday experiences in nature and highlights the importance of symbiosis as a reoccurring theme in eukaryotic evolution. Each subsequent chapter is dedicated to different lineages of eukaryotes, and manages to achieve the desirable, yet conflicting, qualities of being both comprehensive and succinct. Narration by the lead author is to the point and is coordinated almost perfectly with the video sequences. The DVD uses TEM and SEM stills sparingly to illustrate concepts that are not visible in light microscopy, but the primary strength of the DVD is time-lapse and real-time video microscopy of the highest possible quality which shows fundamental processes in a diverse array of eukaryotic cells. The enormous amount of time, dedication, and skill that was necessary for capturing all of the biological phenomena depicted in this DVD is truly inspiring.

Although an explicit phylogenetic context was not adopted (especially apparent in the chapter on “rhizopods,” which included a variety of distantly related amoebae), the chapters are mostly organized in an intuitive way that flows effortlessly. The algae as a whole are very well represented, accounting for 21 chapters, of which the photogenic diatoms and green algae are particularly impressive. Non-photosynthetic protists are not as thoroughly covered but there are 11 chapters that include excellent footage, in particular, of ciliates and slime molds.

Protists are obviously the subject of the video, but much of the subject matter is actually cell biology. Because the diversity of protists in nature and captured here on video is so vast, many of the basic concepts in cell biology are best represented not in model animals, plants or fungi, but in a protist where this feature is put on spectacular display. Core processes such as sex and reproduction, phagotrophy, cytoplasmic streaming, symbiosis, secretion and Golgi function, as well as mor-

phological development, colony formation, and multicellularity are captured in stunning video clips in a variety of species where these processes are notable. Other themes in eukaryote evolution are presented to show the diverse ways these processes have been tackled in different protists groups. Hunting, suspension feeding, extrusome discharge, attachment to a substrate, and osmoregulatory behavior are all played out in different ways in different chapters. The viewers are exposed to a variety of grisly predators chasing food, with memorable displays of feeding by various amoebae, *Oxyrrhis* (dinoflagellate), *Noctiluca* (dinoflagellate), *Peranema* (euglenid), and *Coleps* (ciliate). The sophistication of suspension feeding is wonderfully captured using video sequences showing the controlled generation of water currents and discretionary phagotrophy in choanoflagellates, chrysophytes, and stalked ciliates. The DVD also includes spectacular time-lapse footage of diverse modes of cell division in choanoflagellates, synurophytes, diatoms, euglenids, and desmid charophytes.

Another reoccurring theme depicted in the DVD is the rapid discharge of “zoospores” in organisms like diatoms, brown algae, oomycetes, red algae, and *Plasmodium* emerging from human red blood cells. One of the most dramatic scenes, however, involves the “live birth” of new colonies in the chlorophyte *Scenedesmus*. The real-time, explosive discharge of specialized organelles used in defense and prey capture, namely extrusomes, was also beautifully shown in raphidophytes, ciliates, *Oxyrrhis*, and cryptomonads. The biological significance of osmoregulation is demonstrated with spectacular scenes of pulsating contractile vacuoles in raphidophytes, synurophytes, ciliates, and euglenids. Each of these scenes does a wonderful job of illustrating the dynamic cellular processes that are fundamental to the livelihood and survival of single-celled eukaryotes.

The DVD also highlights several of the most novel and peculiar characteristics found in eukaryotes. For instance, viewers are introduced to the bizarre social systems of cellular slime molds, remarkable sensitivities to environmental stimuli (e.g. electrotaxis in ciliates), inversion during *Volvox* development, the collapse and re-extension of actinopods, euglenoid movement via the sliding of pellicular strips, and the rapid contraction of the haptonema of haptophytes and the stalks of pedinellids. Moreover, several high-resolution video sequences capture distinctive behaviors that help identify major groups of eukaryotes, such as flagellar motility in dinoflagellates, euglenids (including the

flagellar hairs!), prasinophytes, synurophytes, and diplomonads. Along these lines, time-lapse video coupled with electron micrographs are used to demonstrate the organization and morphogenesis of gorgeous cell surface structures that are diagnostic of major groups of eukaryotes, such as synurophytes, diatoms, choanoflagellates, euglyphids, and silicoflagellates. Among the most striking scenes involves the deposition of coccoliths in haptophytes via a rotating cytoplasm within an emerging “scaly” wall.

Overall, *The Kingdom Protista: The Dazzling World of Living Cells* illustrates a huge array of cellular behaviors and mechanisms that are largely underappreciated and, in many cases, unexplained. The diversity observed in microeukaryotes is documented brilliantly, and the DVD is able to convey important concepts and processes in cell biology using organisms that display these features most clearly. The DVD would be an excellent teaching resource not only for courses in Protistology or Phycology but also courses in Cell Biology. We enthusiastically recommend *The Kingdom Protista:*

The Dazzling World of Living Cells and believe this DVD would greatly enrich cell biology and cell diversity teaching at many levels.

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