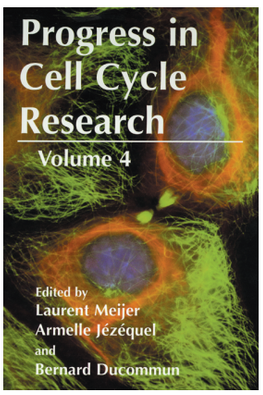
Different faces of the cell cycle



Progress in Cell Cycle Research: Volume 4
edited by L. Meijer, A. Jézéquel and B. Ducommun
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focus on *cell division*

Sergio Moreno

All living organisms are made up of cells that have been generated by division of pre-existing cells. Our bodies, like those of all existing organisms, are merely the carriers and descendants of germ cells. Knowing the molecular mechanisms that ensure orderly cell division should help us not only to understand how all living creatures are generated, but will also increase our understanding of the uncontrolled cell divisions of cancers, thereby aiding our search for effective strategies to combat this terrible disease.

Over a decade ago, we witnessed the 'cyclin revolution'. A symbiosis between yeast and fly genetics and clam, starfish, frog and mammalian tissue-culture biochemistry rapidly gave rise to the currently upheld idea that DNA replication — and mitosis — are induced by the activation of S- and M-phase-specific cyclin-dependent kinases (CDKs). Hence, CDKs emerged as the universal master regulators of the cell cycle. Although this revolution occurred in several different laboratories, in 1988 a cell-cycle meeting was held in a small marine biology station in Roscoff, France, and this was the place where the most important changes in this field were announced.

Progress in Cell Cycle Research is also a product made in Roscoff. This is the fourth volume in a series of books that review different aspects of the cell cycle. The editors have made a special effort to select topics that fall outside the main stream of cell-cycle research, avoiding areas that have been extensively reviewed in other specialized review journals. Therefore, if you wish to read about the regulation of DNA replication and segregation checkpoints (the molecular mechanisms that ensure the correct succession of cell-cycle events), or the role of proteolysis in the control of the cell cycle, this is not the book you are looking for. You can, however, find interesting reviews on less studied aspects. For instance, the book deals with how extracellular signals stimulate cells to grow and how growing cells are forced to divide, the regulation of cell anchorage during cell division, the mechanisms of oocyte maturation, and the role of phosphorylation-dependent prolyl isomerases on CDK substrates as a new cell-cycle regulatory mechanism. One particularly useful chapter is dedicated to the continuum model of the cell cycle. This model proposes that initiation of DNA replication is the product of a cumulative process that occurs throughout the cell cycle, and that it is not due to a process that is specifically associated with G1 phase. Many classic experiments are re-interpreted on the basis of this different view. I suspect that this review will be especially illuminating for those working on tissue-culture cells, in which there has been some confusion between signals that regulate cell growth (like the ones generated by Ras or Myc) and those that regulate the cell cycle.

The book ends on a different note — the final chapters are more exotic and address issues that are still in their infancy, such as the cell cycle in protozoan parasites — eukaryotic microorganisms that cause devastating diseases in developing countries. Differences between the cell cycles of parasites and hosts should lead to the identification of cell-cycle events that are unique to a given parasite, and which may present new targets for antiparasitic chemotherapy. For example, trypanosomes that cause Chagas' disease in South America or sleeping sickness in Africa lack the checkpoint that prevents cytokinesis before the completion of mitosis. *Plasmodium*, the agent that causes malaria, lacks the checkpoint pathways that prevent mitosis in response to DNA damage or spindle assembly. In the future, systematic sequencing of the genomes of several species, combined with reverse genetics, will allow researchers to speed up the functional analysis of candidate cell-cycle genes. In summary, there is no doubt that fascinating discoveries in this area of research are just over the horizon.

Two chapters address circadian control of cell proliferation. We are all influenced by 24-hour light–dark cycles, and this 'circadian rhythm' seems to influence when cells divide during the day. These studies may be important for determining the best time of the day for anti-cancer treatment to have minimum impact on normal cells. Finally, a chapter on the development of new anticancer drugs and another on the rather speculative hypothesis that neurodegeneration in Alzheimer's disease can be viewed as neurones re-entering the cell cycle are also worth reading.

This book is in general clearly written. Unfortunately for an area of research that is moving so fast, the references are a bit out of date, as there are no references for 1999 and 2000 and the figures and photographs (all in black and white) are of varying quality. For this latter reason, I do not expect this book to be of great use to teachers preparing undergraduate courses. It is probably more appropriate for researchers working on the cell cycle or related problems who wish to learn more about aspects of cell division that hitherto have not been studied in so much depth.

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Other cell cycle books

The Cell Cycle
by Andrew Murray and Tim Hunt
Oxford University Press, £21.95/$30

Cell Cycle Control
edited by C. Hutchison and D. Glover
Oxford University Press, £9.99/$55

Cell Cycle
by Peter Fantes
Company of Biologists, £40/$50

Cell Cycle: Materials and Methods
edited by Michele Pagano
Springer-Verlag, £70/$105

Dynamics of Cell Division
edited by Sharyn Endow and David Glover
Oxford University Press, £32/$60

Cycling through the World Wide Web

As the use of the web increases for leisure activities, so does its use as a second textbook for academics. Already the web is full of sites dedicated to cell biologists, fly geneticists and *Caenorhabditis elegans* enthusiasts (to name but a few). Today, even individual laboratories are generating their own home pages to show the world their research, their results and, more often than not, their beautiful images. The aim of this small review is to highlight a few websites that cover research on the cell cycle and cell division. This is not meant to be a comprehensive list of sites, or to highlight those that are necessarily the best, but these are just a few personal favourites that cover a wide range of topics.

General cell-cycle and cell-division websites

These sites are often run by large organizations or scientific institutions. Their aim is to promote general areas of cell-cycle research and to provide links to primary research papers and more specialized sites.

http://www.biology.arizona.edu/cell_bio/tutorials/cell_cycle
A good, comprehensive overview of the cell cycle with useful links. Includes great diagrams and problem-solving exercises.

http://www.mailbase.ac.uk/lists-a-e/cell-cycle/
Mailbase list dedicated to cell-cycle biology.

http://vl.bwh.harvard.edu/
Virtual library of cell biology with links to the cell cycle and cytokinesis.

http://www.stke.org
Website run by *Science* for general links to signal transduction and the cell cycle.

http://www.sdsc.edu/kinases/
Website focusing on protein kinases which highlights those that are important in the cell cycle and cell division.

http://www.nature.com/ncb/celldivision
This site is a special website with access to the Focus on Cell Division issues of both *Nature Cell Biology* and *Nature Reviews Molecular Cell Biology*.

Organism-specific cell-cycle and cell-division websites

Most of us who are involved in research have our own particular favourite organism. Here we highlight a few that may be useful to those working with yeast or flies.

http://cellcycle-www.stanford.edu
Yeast-specific site with many links. Not much raw information but plenty of places to go and find it.

http://sdb.bio.purdue.edu/fly/aignfam/cellcycl.htm
An interactive fly site with information on every known *Drosophila* cell-cycle gene. Good links to related references.

http://flybase.bio.indiana.edu/
The bible for fly geneticists and fly cell biologists. Information is provided on all known *Drosophila* genes, but there are no specific links for the cell-cycle researcher.

http://elegans.swmed.edu/
Nematode-specific website, which can tell you anything you ever wanted to know about *C. elegans*. However, none of its content is specific to the cell cycle.

Molecule-specific websites

http://www.blocks.fhcrc.org/~kinesin
Excellent website focusing on kinesin. There are links to great movies, all the background knowledge you would ever need, and information on kinesin-related proteins. Recent publications are also highlighted. Throughout this site there are also links to the myosin homepage.

http://www.mrc-lmb.cam.ac.uk/myosin/myosin.html
Run by Dr. J. Kendrick-Jones from the MRC-LMB (Cambridge, UK), this site is constantly updated to highlight the recent advances in the field and provides many links to myosin databases.

Lab-specific cell-cycle and cell-division websites

http://www.unc.edu/depts/salmlab/mitosis/mitosislabs.html
Website run by the laboratory of Dr E. Salmon (Univ. North Carolina). Contains links to all the individual home pages and main journals in the field you could ever ask for. There are also great movies.

http://www.wadsworth.org/BMS/SCBlinks/WEB_MIT2/HOME.HTM
Dr. C. Rieder's (Wadsworth Center, Albany) personal website, which has beautiful pictures and some handy hints on the tools used to generate them.

http://mcdb.colorado.edu/labs/winey/databases.html
Great for links on *Saccharomyces cerevisiae*, especially the *Saccharomyces* Genome Database (SGD).

New for 2001

http://biomedcentral.com/nspprimers/
http://new-science-press.com/primers.asp
See this website for the early chapters of David Morgan's new book entitled *The Cell Cycle* published by New Science Press.

http://www.blacksci.co.uk
In January 2001 Blackwell Science will publish a new book entitled *Cell Cycle Biology* by F. Monette. Please see website for details.