Fundamentals of Cell Biology – A New Open Textbook

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Introduction

In recent years, colleges and universities, like the University of British Columbia (UBC) and Oregon State University (OSU), have expressed a commitment to increasing the use of Open Educational Resources (OER) in their courses. Cell Biology is a core course in every biology program in North America, and yet no widely available open textbook exists… until now.

As two instructional faculty of large enrollment cell biology courses, we saw a need to create an open and freely available textbook. We learned much in the process and are excited to now be sharing the result and impact of this work.

Designing for Impact

Goal 1: Make a textbook that is freely available and open access

- A primary impact for students is a significant savings in textbook costs.
- UBCO and OSU serve 1000+ students collectively. Thus, in this course, we anticipate will save students $100,000 CDN per year.

Goal 2: Create new open cell biology images

- Our illustrator Heather Ng-Cornish created 120+, CC-licensed images specifically for this book. This has greatly increased access to high quality cell biology figures for all.

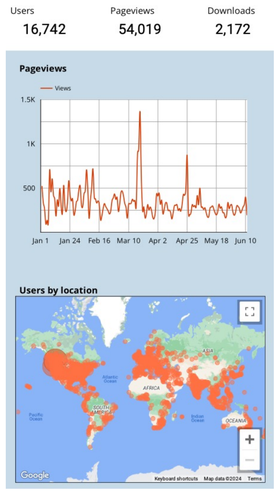
Goal 3: Leverage a multimedia format for multimodal learning

- Because we wrote this text as an E-book, we had the opportunity to create animations and find relevant videos that complement the conceptual material in the book.

Included Chapters

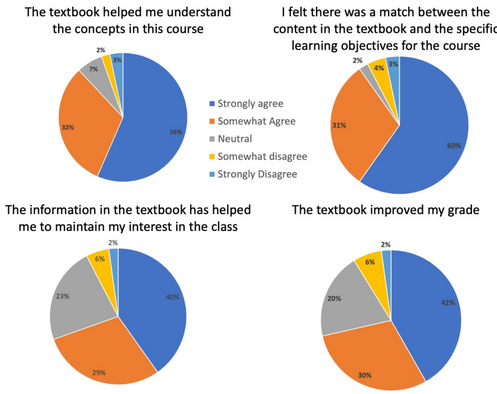
Ch 0: 1st Year Review & Background Info
Ch 1: Visualizing Cells Through Microscopy
Ch 2: Biological Membranes
Ch 3: DNA, Chromosomes and the Interphase Nucleus
Ch 4: The Endomembrane System
Ch 5: Mitochondria & Chloroplasts: Structure-Function Relationships
Ch 6: The Cytoskeleton
Ch 7: Cell Signaling
Ch 8: The Cell Cycle and Mitosis.

Measuring Success/Impact



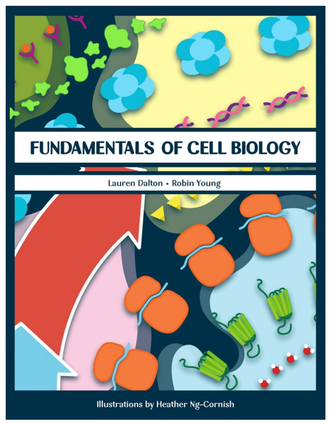
Data Collected June 11,2024

Qualtrics survey data: UBCO/OSU students who used the book (Jan-May2024)



Visualizations of student feedback from an anonymized Qualtrics survey at or near the end of term.
115 responses – 52% from UBCO and 48% from OSU.

Access *Fundamentals of Cell Biology*



Let us know what you think of the book and any additions that would make it better.

If you decide to adopt it in your course (or know someone that did), please let us know as we also are tracking that data

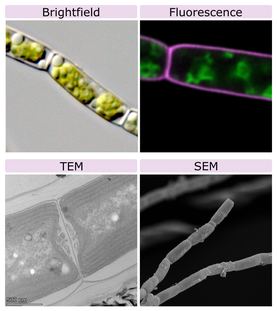
Future Plans

1. Create downloadable figures for instructor use in the classroom
2. Additional chapter topics (depending on demand, time and resources):
   - Extracellular matrix
   - Cell-Cell Adhesion
   - Programmed Cell death
3. Monitor adoption and student impact

Example figures

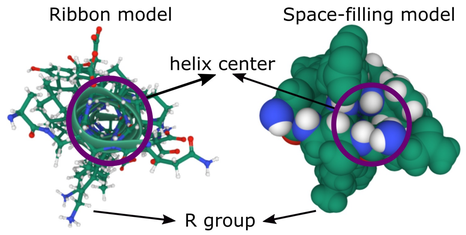
Our approach focused on using "real" data when possible, and designing high-quality diagrams for the rest.

1. Use real data when possible



Above: Real data from BC scientists

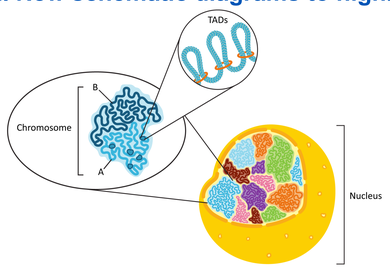
Figure 01-01: *Examples of the four different types of microscopy, imaging green algae cells: brightfield light microscopy, fluorescence light microscopy, transmission electron microscopy (**TEM**), and scanning electron microscopy (**SEM**). An average algal cell is between 2 and 7 µm. All images were collected by Dr. Davis Iritani, Multi-functional Microscopy Technician from the Summerland Research and Development Centre in Kelowna, British Columbia, Canada, and used with permission*



Left: Using the protein databank (PDB), we constructed these models to illustrate misconceptions about the structure of membrane alpha helices.

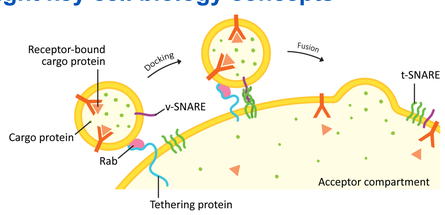
Figure 02-13: *Ribbon models of helices (shown on the left, can give an illusion that there is space inside the helix large enough for molecules to pass through. The space-filling model confirms that the internal area of the helix is filled by the space taken up by the atoms of the peptide backbone. This image is a derivative of **5EH6** created with **NGL viewer** by **Dr. Lauren Dalton** and is shared under a **CC BY-SA 4.0** license.*

2. New schematic diagrams to highlight key cell biology concepts



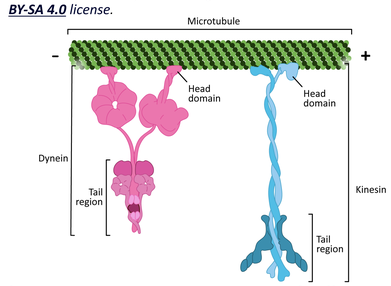
Above: New figures based on the most recent scientific literature

Figure 03-06: *Chromosomal organization within the nucleus. Chromosomes inhabit specific spaces within the nucleus, which are indicated by the different colors inside the nucleus in the image. Further, each chromosome is organized into A and B compartments depending on their transcriptional activity. A is more transcriptionally active than B, and TADs can be observed. This image was created by Heather Ng-Cornish and is shared under a **CC BY-SA 4.0** license.*



Above: Schematics of cellular processes

Figure 04-21*: Docking and fusion. Tethers bind to Rabs to help bring the vesicle close to the target membrane (docking). When close enough, SNARE proteins interact to fuse the membranes together. This image was created by Heather Ng-Cornish and is shared under a **CC BY-SA 4.0** license.*



Above: Accurate representations of cell structures/ proteins based on molecular data

Figure 06-17: *Structural representations of kinesin and dynein on a microtubule. The head domain binds to the microtubule reversibly (in an ATP-dependent manner). Through cycles of ATP hydrolysis, these motors are able to walk along the microtubule in a specific direction. This image was created by Heather Ng-Cornish and is shared under a **CC BY-SA 4.0** license.*

Acknowledgements

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- *Those who graciously agreed to let us use their content in our book, including **Megan Barker, Lacey Samuels, Davis Iritani, Kyle Nguyen, Lucia Queseda-Ramirez,** and more.*
- *The thousands of students that have taken BIOL200 at UBC (and its equivalent at OSU) over the years, and the many faculty and TAs that have formed our teaching team, especially: **James Berger, Ellen Rosenberg, Sunita Chowrira, Lacey Samuels, Nelly Panté, Ljerka Kunst, Liane Chen, Marcia Graves, Megan Barker, Karen Smith, Ninan Abraham, Vivienne Lam**, and so many more!*

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