

Biology 41: Cells into Organs: Assembly, Function and Disease Fall 2020

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Office Hours: Tue 12:30 PM – 1:30 PM, Thurs 11 AM – 12 PM Eastern Time
Meeting times: Time block D, 11:45 AM – 12:50 PM Eastern Time

Course Description:

How do cells organize into the myriad forms of tissues, and how do they work together to perform specific physiological functions? In this course, we will use epithelial tissues as an example to explore these fundamental questions. Epithelia are among the most common types of tissue organization in animals. They line the cavities, ducts and surfaces of all the major organ systems and provide a variety of functions such as secretion, protection and sensing. During development, epithelial tissues also function in morphogenetic processes that guide the formation of body patterns. Defects in epithelial growth control and function play a major role in human diseases such as cystic fibrosis and cancer. The goal of this course is to understand the form, dynamics and function of epithelial tissues, and how dysregulation of epithelia can lead to various human diseases.

Pre-Requisites: Biol 012 or permission of instructor

Learning Objectives:

1. Gain a working knowledge of the general principles of tissue organization and function.
2. Understand the mechanisms underlying epithelial reorganization in morphogenesis.
3. Learn about how dysregulation of epithelia leads to human diseases.
4. Become familiar with the experimental methods used to study tissue organization, function and morphogenesis.
5. Become comfortable reading research papers from the primary literature that investigate fundamental aspects of epithelial organization and function.

Teaching Approach:

The teaching approach combines lectures, discussions of the assigned reading, and question-based exercises performed in small groups. For this term, the course will be delivered remotely with both synchronous and asynchronous components. The lectures will be delivered asynchronously as recordings accessible on the Canvas page. Using Zoom, we will meet synchronously once or twice each week (see below for the detailed schedule) in the normal meeting times for the D timeslot. The synchronous meeting will be used for group activities, paper presentations and discussions. The exercises are designed to help reinforce the lecture material and master skills for data interpretation and problem solving. All synchronous Zoom sessions will be recorded and posted on Canvas. Be sure to read the "Consent to Record" document (Page 7 on the syllabus, also available on Canvas), since you are agreeing to this by enrolling in the class.

Reading Materials:

There is no required textbook for this course. Instead, I will post selected review articles to supplement the lecture material. These readings are intended to reinforce and contextualize material covered in class. Optional textbook readings for further independent study (will not be covered on the exams):

- *Epithelial Organization and Development*. Edited by Tom P. Fleming
- *Epithelial Morphogenesis in Development and Disease*. Edited by Walter Birchmeier and Carmen Birchmeier

TOPICS AND SCHEDULE:

Part 1 (week 1-3): Epithelial organization, cell polarity and tumorigenesis

Week 1:

Lecture 1. From cell in solitary to cell aggregates – Self-organization of tissue architecture

Lecture 2. How do cells glue together? – The nuts and bolts of cell-cell adhesions

Lecture 3. Epithelial polarity and tumorigenesis – Lessons from model organisms

(9/16 W) Introduction & Course logistics

(9/18 F) Zoom group activity

Week 2:

Lecture 4. Epithelial-mesenchymal transition in development and metastasis

(9/23 W) Paper discussion 1: *Cooperative regulation of cell polarity and growth by Drosophila tumor suppressors. Bilder et al. Science. 2000*

(9/25 F) Zoom group activity

Week 3:

Lecture 5. How do cells talk to each other? – Chemical communication between cells

(9/30 W) Paper discussion 2: *The transcription factor Snail controls epithelial-mesenchymal transitions by repressing E-cadherin expression. Cano et al. Nat Cell Biol. 2000*

(10/2 F) Zoom group activity

Midterm Exam 1

Part 2 (week 4-6): Regulation of tissue size and shape

Week 4:

Lecture 6. Coordination of cell proliferation and cell death in organ size control

Lecture 7. Control of cell growth by ECM and integrin signaling

(10/7 W) No meeting

(10/9 F) Zoom group activity

Week 5:

Lecture 8. Planar cell polarity: from hair orientation to body axis elongation

Lecture 9. From 2D to 3D: epithelial folding and the role of actin–myosin contractility

(10/14 W) Paper discussion 3: *Role of YAP/TAZ in mechanotransduction. Dupont et al Nature 2011.*

(10/16 F) Zoom group activity

Week 6:

Lecture 10. Human neural tube defects

(10/21 W) Paper discussion 4: *Pulsed contractions of an actin–myosin network drive apical constriction. Martin et al., Nature. 2009*

(10/23 F) Zoom group activity

Midterm exam 2

Part 3 (week 7-9): Tissue malfunction, repair and regeneration

Week 7:

Lecture 11. Molecule transport across the epithelium – What causes Cystic Fibrosis?

Lecture 12. Polarized protein targeting in epithelial cells

(10/28 W) No meeting

(10/30 F) Zoom group activity

Week 8:

Lecture 13 & 14. Autosomal Dominant Polycystic Kidney Disease (ADPKD) – Defects in signal sensing and transduction

(11/4 W) Paper discussion 5: *Misfolding diverts CFTR from recycling to degradation: quality control at early endosomes. Sharma et al., JCB. 2004*

(11/6 F) Zoom group activity

Week 9:

Lecture 15. How do injured tissues heal themselves? – Mechanisms of wound repair

Lecture 16. Tissue engineering and regenerative medicine

(11/11 W) Paper discussion 6: *Polycystins 1 and 2 mediate mechanosensation in the primary cilium of kidney cells. Nauli et. al., Nat Genet. 2003*

(11/13 F) Zoom group activity

Week 10:

(11/16 M) Review session

Final Exam (Exam 3)

ASSESSMENT:

- Midterm exams (15% each)
- Final exam (20%)
- Paper evaluations (6 papers; 30% in total)
- Class participation (20%)

(1) Exams:

- Exams will focus on material covered in lecture, emphasizing data interpretation and problem-solving. Material on the PowerPoint slides or from the readings that are not discussed in lecture will not be tested. Students taking the exams are expected to abide by the Dartmouth Honor principle. The midterm and final exams are open book, but they must be completed independently. The answers that you provide must be entirely your own work.
- Graded exams will be returned to the students approximately one week after they are taken. Exams are graded not only for content but also for clarity and conciseness.
- The exam key will be posted on the course Canvas site. If, after reading the key, you feel there was an error in the scoring of your exam, you may submit an error correction request. Include a typewritten explanation stapled to your exam detailing the mistake made in the grading. Do not write or alter the exam prior to handing it in for error correction. The error correction request must be submitted within one week of the distribution of the graded exam.

(2) Paper Evaluations:

- We will read and discuss 6 research papers from the primary literature throughout the term.
- For each paper, you will either complete an assignment addressing a short list of questions related to the paper, **OR** write a brief summary for the paper (one page or less, typed, see below for a detailed instruction of page format), focusing on (i) hypotheses being tested, (ii) experimental design, (iii) results, and (iv) interpretation of the results (a guideline will be provided for each paper).
- The assignments and summaries should be submitted electronically (Canvas) **before** the beginning of class on the day we discuss the paper.
- One-page paper summary format:
 - Recommended fonts: Arial (NOT Arial Narrow), Georgia, Helvetica, Palatino Linotype
 - Font size: must be 11 points or larger
 - Line spacing: single
 - Margins must measure at least 0.5 inch (top, bottom, and sides)
 - File format: Word

(3) Class Participation:

- Your active participation in this course is essential and will be evaluated through your attendance at the zoom activity sessions (10%) and active engagement during the in-class exercises and paper discussions (10%) throughout the term.
- I recognize that we are facing challenging circumstances due to the pandemic. If you are aware of circumstances that will affect your ability to participate in the course regularly or occasionally, please arrange a meeting with me so we can plan ahead. I will be more than happy to work with you to find an avenue for participation that works for your situation if you reach out.

REMOTE LEARNING: CANVAS AND ZOOM

I have created a Remote Learning Plan for this course, available on Canvas. The plan outlines the expected changes to our course structure this term and describes the methods and technologies we will use to support online learning (and how to get them installed and running on your devices). Please review this document as soon as you can and follow the steps for technological onboarding before our first class meeting, if possible.

Course materials will be made available and assignments will be submitted via [Canvas](#), as usual. Class meetings and office hours will be held via [Zoom](#). You may need to use Dartmouth's [VPN client](#) to access campus resources. If you have any difficulties accessing these technologies or are unsure of how to use their necessary features, please reach out.

Useful Resources for Remote Learning

Dartmouth IT support (This is the place where you can seek assistance from ITC for technology related issues):

<https://services.dartmouth.edu/TDClient/1806/Portal/Requests/ServiceDet?ID=42638>

Remote Learning Resources from Dartmouth's Academic Skills Center

<https://students.dartmouth.edu/academic-skills/about/remote-services-learning-resources/remote-learning-resources>

REMOTE ACCESS TO CAMPUS RESOURCES

Due to the unusual circumstance, many of you may be facing greater challenges than usual given the changes to your living and learning environment, public health concerns, and a host of other factors. There are a number of campus resources available to support your needs. Many offices are prepared to meet with you via phone or Zoom. For concerns about health and wellness, you may reach out to the [Dartmouth Health Service](#) (603-646-9400 or Secure Message in DartHub)

<https://students.dartmouth.edu/health-service/>, [Counseling Services](#) (603-646-9442)

<https://students.dartmouth.edu/health-service/counseling/about>, and the [Student Wellness Center](#)

<https://students.dartmouth.edu/wellness-center/>.

For academic needs, you may contact your [undergraduate dean](#) (603-646-2243)

<https://students.dartmouth.edu/undergraduate-deans/>, [Student Accessibility Services](#) (603-646-9900)

<https://students.dartmouth.edu/student-accessibility/>, and the [Academic Skills Center](#) (603-646-2014)

<https://students.dartmouth.edu/academic-skills/>.

Students with concerns related to campus employment may connect with the [Student Employment Office](#) (603-646-3641) <https://www.dartmouth.edu/seo/>.

Those with visa-related concerns may reach out to the [Office of Visa and Immigration Services](#) (603-646-3474) <https://ovis-intl.dartmouth.edu/>.

I encourage you to take advantage of these resources, and to speak with me if you need support in the class.

NOTE TO STUDENTS WITH PHYSICAL OR LEARNING DISABILITIES:

I encourage students who may need disability-related academic adjustments to see me privately as early as possible in the term, preferably before the end of the first week. Students requiring disability-related academic adjustments or services must consult the Student Accessibility Services (SAS) office (Carson Suite 125, student.accessibility.services@dartmouth.edu). Once SAS has authorized adjustments or services, I will need to view the originally signed SAS Services and Consent form and/or a letter on SAS letterhead. If you have questions about whether you qualify to receive academic adjustments or services, please contact the SAS office directly. All discussions will remain confidential.

RELIGIOUS OBSERVANCES:

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in this course, please speak with me as soon as possible to discuss appropriate accommodations.

MENTAL HEALTH:

I recognize that the academic environment at Dartmouth is challenging, that our terms are intensive, and that classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including: your undergraduate dean (<http://www.dartmouth.edu/~upperde/>), Counseling and Human Development (<http://www.dartmouth.edu/~chd/>), and the Student Wellness Center (<http://www.dartmouth.edu/~healthed/>). I want you to be aware of these resources and encourage you to use them as needed.

TITLE IX:

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community.

The Sexual Respect Website (<https://sexual-respect.dartmouth.edu>) at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community. Please note that, as a faculty member, I am obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see <https://sexual-respect.dartmouth.edu/reporting-support/all-resources/confidential-resources>). Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator (Kristi.Clemens@Dartmouth.edu) (and deputies if appropriate).

ACADEMIC HONOR:

The Dartmouth College Student Handbook (page iii) states “Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Students who submit work which is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth.” The complete text of the Dartmouth Academic Honor Principle is given in the Dartmouth College Student Handbook.

Honesty is the foundation of the academic pursuit of knowledge. In recognition of this, the faculty of Biology 41 will not overlook any violations of the Academic Honor Principle. Indeed, the Faculty Handbook of Dartmouth College states explicitly that College Faculty members are obligated to report potential violations of the Academic Honor Principle to the Dartmouth College Committee on Standards. Should the Committee on Standards find the student to be in violation of the Academic Honor Principle, punishments usually involve suspension for multiple terms or separation of the student from the College.

CONSENT TO RECORDING:

(1) Consent to recording of course and group office hours

- a) By enrolling in this course, you affirm your understanding that this course and any associated **group** meetings involving students and the instructor, including but not limited to scheduled and ad hoc office hours and other consultations, may be recorded within any digital platform used to offer remote instruction for this course;
- b) You further affirm that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part, and distribution of any of these recordings in whole or in part without prior written consent of the instructor may be subject to discipline by Dartmouth up to and including expulsion;
- c) You authorize Dartmouth and anyone acting on behalf of Dartmouth to record your participation and appearance in any medium, and to use your name, likeness, and voice in connection with such recording; and
- d) You authorize Dartmouth and anyone acting on behalf of Dartmouth to use, reproduce, or distribute such recording without restrictions or limitation for any educational purpose deemed appropriate by Dartmouth and anyone acting on behalf of Dartmouth.

(2) Requirement of consent to one-on-one recordings

By enrolling in this course, you affirm that you will not under any circumstance make a recording in any medium of any one-on-one meeting with the instructor without obtaining the prior written consent of all those participating, and you understand that if you violate this prohibition, you will be subject to discipline by Dartmouth up to and including expulsion, as well as any other civil or criminal penalties under applicable law.