BISP 194 / BGGN 285 **Spring 2022**

**Advanced Topics in Modern Biology: Biology of Regeneration**

Professor Andrew Chisholm adchisholm@ucsd.edu

DRAFT syllabus v1 (3/27/22). Subject to changes – any changes will be announced in class.

Class meetings will be in-person, Tuesdays 0800-0920 in Bonner Hall Room 2130. As this is a discussion-based course, in-person participation is essential.

Office Hours: in-person, Wednesdays 0900-1000 in Bonner Hall 2402, or by appointment

**Meeting Schedule**

**students will be assigned to discussion groups in week 3

| Date/Week | Format | Topic |
|---|---|---|
| March 29/Week 1 | Lecture | Regeneration basics and examples |
| April 5/Week 2 | Lecture | Analyzing regeneration<br>Neural regeneration |
| April 12/Week 3 | | Presenting and critiquing a research article: cardiac regeneration |
| April 19/Week 4 | Group Discussion 1 | Appendage regeneration I |
| April 26/ Week 5 | Group Discussion 2 | Appendage regeneration II |
| May 3/Week 6 | Group Discussion 3 | Whole body regeneration I |
| May 10/ Week 7 | Group Discussion 4 | Whole body regeneration II |
| May 17/Week 8 | Group Discussion 5 | Skin regeneration |
| May 24/Week 9 | Group Discussion 6 | Neural regeneration |
| May 31/Week 10 | No meeting | *final papers due 5 PM Friday June 3 by email* |

Prerequisites: This course assumes knowledge of molecular biology, genetics, and cell biology. BICD100 (Genetics) is a prerequisite; BICD110 (Cell Biology) is strongly recommended.

Course Description
Student-led group discussions of primary research on regenerative biology.

Evaluation: Your grade will be based on:
30% group presentation
30% participation
40% final papers (critiques). We will discuss 6 research articles total and you need to submit at least two critiques. Grade will be based on your 2 best critiques. You may not submit a critique for the paper that your group presented in class. You may also submit a critique of any primary research article in the area of regenerative biology -- subject to my approval.

Discussions will be on **primary research** papers, review articles are for background

PDFs of all discussion and background papers will be on course Canvas web site under **Files**. Presenters may also want to find the HTML versions, which sometimes have better images/movies. All papers can be found on PubMed, Google Scholar, or (for preprints) Biorxiv.

**Expect to spend 1-2 hours a week reading, more if presenting**

RESOURCES

No textbook is required, but for those who want to go deeper into the topic:
*Developmental Biology* (Barresi and Gilbert 12th edition, OUP, 2019), is a leading textbook. The library has copies of earlier editions.
*Essential Developmental Biology* (Slack and Dale, 4th edition, Wiley-Blackwell, 2021) is very good, as well as shorter and cheaper. An earlier edition is on Ebook via UCSD library.

Much of regenerative biology involves stem cells. For some basic online info try **Stem Cell Core Concepts** from the International Society for Stem Cell Research.
https://www.isscr.org/scientific-clinical-resources/education-resources

**iBiology talks** https://www.ibiology.org/ are educational talks aimed at non-experts. There are over 600 covering many areas of basic biology; most relevant to this course are talks by Alejandro Sanchez Alvarado (history of regeneration, planaria), Peter Reddien (planaria), and Elly Tanaka (axolotl limb regeneration). I recommend Reddien's talk here:
https://www.ibiology.org/development-and-stem-cells/drive-regeneration/
You may also want to check out the talk by Susan McConnell on scientific presentations.

GROUP PRESENTATIONS

- The goal of the group presentation is not to give a lecture but to stimulate class discussion. For this to work it is essential that everyone at least try to read the research article before the presentation.
- The presenting group should prepare **~10-12** slides on the discussion paper (~2 slides per member of the group) for ~ 30 minute presentation. The slides should be in a single PPT (or Google slides, etc) that will be uploaded to the course canvas site after the grup discussion.
- The presenting group should discuss with me at least 1 day before the class meeting and send me the final presentation prior to the class meeting. I will be available Mondays for in-person meetings with that week's group (apart from May 16th—an alternative time will be arranged.)
- Each member of the group should be prepared to answer questions and facilitate class discussion.
- Week 3 will be a trial run of how to present a paper.

PRESENTATION CONTENT (paper critiques can also use this structure)

- *Rationale*: What is the *biological problem*? What is the question or hypothesis that motivates the study? (can be asked of the overall study and of individual sections)
- *Methods*. What are the tools and methodologies used? It is important to spend time on this so the results can be fully understood. Especially: what are the positive and negative controls in the experimental design?
- *Results*: Each discussion group member should present one or two Figures/Tables. The discussion leaders are responsible for raising stimulating questions
- As a rule we will not have time to discuss any supplemental information (SI) or extended

data in class, but these should at least be skimmed and often contain important clarifying information.

- **Generally there is no need (or time) to go through every Figure or panel. Focus on the key points, or points that you think are worth discussing.** I will discuss with the presentation groups which aspects to focus on.
- *Rigor and reproducibility:* presenters should stimulate a discussion on how 'solid' the experimental design and results are. Sample sizes, controls, statistical tests, data transparency.
- *Conclusions:* How well do the results support the model or test the hypothesis? What are the remaining questions and next steps?

CRITIQUES OF PAPERS

- Read the discussion paper **before** class and be prepared to discuss it. During the class presentation you are expected to actively participate in discussion.
- We will discuss 6 papers (in weeks 4-9); write at least 2 critiques by June 3.
- You can select other papers for your critiques, subject to my approval. The papers must be primary research articles and relevant to this course.
- Critiques should be 1 page, single or double spaced and in a standard 12 point font.
- You don't need to include references but if you do, they must also fit on 1 page.
- By 'critique' I mean *evaluation* of the work. Address strengths and weaknesses: what is good about the paper, what could be improved, what was unclear, and any questions raised by the work. Critiques should NOT simply summarize the paper, although some summary is unavoidable. Examples will be posted on Canvas.

ACADEMIC INTEGRITY

Group presentations are collaborative efforts and each member of the group will receive the same points for the presentation.

Paper critiques are expected to be your own individual work as outlined in the UCSD Policy on Integrity of Scholarship. Do not plagiarize either from online resources or from each other. If you quote from the paper or from another source, make the source of the quotation clear.

Academic misconduct is broadly defined as any prohibited and dishonest means to receive course credit, a higher grade, or avoid a lower grade. Academic misconduct misrepresents your knowledge and abilities, which undermines the instructor's ability to determine how well you're doing in the course. Please do not risk your future by cheating.

ACCOMMODATIONS

Students requesting accommodations and services due to a disability for this course need to provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD), prior to eligibility for requests. Receipt of AFAs in advance is necessary for appropriate planning for the provision of reasonable accommodations. Please note that instructors are unable to provide accommodations without authorization by OSD. For more information, contact the OSD at (858) 534-4382.

ATTENDANCE/PARTICIPATION

'Participation' counts for 30% of your grade. Sessions will allow ample time for everyone to participate.

UCSD Principles of Community

Class meetings should be a safe environment for all students and instructors. Class discussions should be conducted in a respectful and collegial manner, in accord with UCSD's Principles of Community. Disruptive behavior may be referred to the UCSD Office of Student Conduct.

READING LIST (Subject to change)

Week 1/March 29: Lecture 1: Examples of biological regeneration and towards a definition

Week 2/April 7: Key questions and how to study regeneration

--Key questions in understanding regenerative phenomena
--Review the 'conceptual tool kit' of developmental and stem cell biology

**Background reviews for lectures 1 and 2 (PDFs are on Canvas site in 'week 1' module):**

Reddien and Tanaka 2011. The cellular basis for animal regeneration.

Slack 2017. Animal regeneration: ancestral character or evolutionary novelty?

Maden 2018. The evolution of regeneration – where does that leave mammals

Mokalled and Poss. 2018. A regeneration toolkit.

Week 3/April 14: Presenting a research article

**Reading: Lepilina et al 2006. A dynamic epicardial injury response supports progenitor cell activity during zebrafish heart regeneration. Cell 127: 607-619.**

Week 4/April 21: Presentation group 1. Appendage regeneration I.

**Presenters: to be assigned at the meeting in week 3**

**Discussion paper: Sugiura et al. 2016. MARCKS-like protein is an initiating molecule in axolotl appendage regeneration. Nature 531: 237-240**

**Background:** Simon and Tanaka 2013. Limb regeneration. WIREs Developmental Biology Reviews 2: 291-300.

Week 5/April 28: Presentation group 2. Appendage regeneration II

**Presenters:**

**Discussion paper: Abrams et al 2021. A conserved strategy for inducing appendage regeneration in moon jellyfish, Drosophila and mice. eLife.** *10: e65092*

**Background reading:** Cox, Yun and Poss. 2019. Can laboratory systems instruct human limb regeneration? Development 146: dev181016.

Week 6/May 5: Presentation group 3. Whole body regeneration I

**Presenters:**

**Discussion paper: Wagner, Wang and Reddien 2011. Clonogenic Neoblasts Are Pluripotent Adult Stem Cells That Underlie Planarian Regeneration. Science 332: 811-816.**

**Background reading:** Reddien 2018. The cellular and molecular basis for planarian regeneration. Cell 175: 327-345

Week 7/May 12: Presentation group 4. Whole body regeneration II

**Presenters:**

**Discussion paper: Atabay et al 2018. Self-organization and progenitor targeting generate stable patterns in planarian regeneration. Science 360: 404-409.**

**Background reading:** Reddien 2021. Principles of regeneration revealed by the planarian eye. Curr. Opin. Cell Biol 73: 19-25.

Week 8/May 19: Presentation group 5. Skin regeneration in mice

**Presenters:**

**Discussion paper: Seifert et al 2012. Skin shedding and tissue regeneration in African spiny mice (*Acomys*). Nature 481: 561**

**Background reading:** Erickson and Echeverri 2018. Learning from regeneration research organisms: the circuitous road to scar free wound healing. Dev. Biol. 433: 144-154.

Week 9/May 26: Presentation group 6. Neural regeneration

**Presenters:**

**Discussion paper: Park et al 2008. Promoting axon regeneration in the adult CNS by modulation of the PTEN/mTOR pathway. Science 322: 963-966.**

**Background reading:** Sofroniew 2018. Dissecting spinal cord regeneration. Nature 557: 343-350.

Week 10: No meeting; Final papers due by 5 PM Friday June 3