BISP 194 / BGGN 285 **Spring 2021**

Advanced Topics in Modern Biology: Biology of Regeneration

Professor Andrew Chisholm adchisholm@ucsd.edu

This syllabus is subject to change in view of the unpredictable public health situation. Any schedule changes will be posted on the Canvas site, which should be checked regularly. Class communications will be via Canvas.

DRAFT syllabus version 1 (3/27/21).

We will use real-time ('synchronous') Zoom meetings for class discussions, and these will be recorded for reference. Week 1 will be devoted to ensuring that everyone has connectivity for this purpose. Zoom meetings will be waiting room controlled and only enrolled students will be admitted. **Do not share class Zoom meeting links beyond this class.

Office Hours: TBD, by Zoom teleconference or in-person if campus guidance permits.

UCSD remote learning resources: https://digitallearning.ucsd.edu/learners/learning-remote.html

Schedule

**students will be assigned to discussion groups in week 2

March 31/Week 1: Test Zoom / Canvas connectivity; course goals, logistics, introductions.

April 7/Week 2: Introductory Lecture.

April 14/ Week 3: Group Discussion 1. Whole body regeneration I

April 21/Week 4: Group Discussion 2. Limb regeneration I

April 28/ Week 5: Group Discussion 3. Limb regeneration II

May 5/ Week 6: Special Guest Lecture on Nervous System Regeneration.

May 12/ Week 7: Group Discussion 4. Genomic control of regeneration

May 19/Week 8: Group Discussion 5. Skin regeneration

May 26/Week 9: Group Discussion 6. Bone regeneration

June 2/Week 10: No meeting

June 5: *final papers due 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 literature on regenerative biology.

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

You can change your grading option for this course through week 10. Students with questions about choosing between P/NP (S/U) versus letter grades should seek advising from Biology USIS staff.

Discussions will be on **primary research** papers, with secondary (review) articles for background
PDFs of all discussion and background papers are on the course Canvas web site under **Files**. Presenters may also want to find the HTML versions, which have better images downloadable as ppt files, or other interactive features. We will go over how to find papers using Pubmed (https://www.ncbi.nlm.nih.gov/pubmed/) or Google Scholar (scholar.google.com).

Each presenting group should put together a presentation that they can either upload to the Canvas site or send directly to me to share during Zoom meetings.

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

RESOURCES
There is no textbook. Most developmental biology textbooks have a section on regeneration. The leading text is *Developmental Biology* (Barresi and Gilbert 12th edition, OUP), which is excellent but unnecessary for this course. An older edition is free online (https://www.ncbi.nlm.nih.gov/books/NBK9983/) and is a good place to review basic developmental biology (some will be covered in lecture 2).

Much of regenerative biology involves stem cells. **Stem Cell Core Concepts** from the International Society for Stem Cell Research may be useful.
https://www.isscr.org/scientific-clinical-resources/education-resources

iBiology talks https://www.ibiology.org/ are useful online resources. These are given by distinguished scientists and are trustworthy sources of information. There are over 600 covering many areas of basic biology; most relevant to this course:
1. Alejandro Sanchez Alvarado (3 lectures: history of regeneration, 2 lectures on planaria)
2. Elly Tanaka on limb regeneration (2 lectures)
3. Peter Reddien (molecular mechanisms of regeneration, planaria).
How to find them: go to the iBiology site and search for 'regeneration'.

GROUP PRESENTATIONS

- The goal of the group presentation is 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 (roughly, up to 2 slides per member of the group) for about a 20 minute presentation.

- The presenting group should discuss with me their presentation at least 1 day before the class meeting and send me the final presentation prior to the class meeting.
- Presentations will be saved on the course Canvas site.
- Each member of the group should be prepared to answer questions and facilitate class discussion. Please practice your presentations so that they keep to time.
- After the group presentations we may break into smaller groups using the 'breakroom' feature in Zoom. Each group discusses among itself for 15 minutes (I will attempt to join each one at a time). At the end we will rejoin as a single class.

PRESENTATION CONTENT (paper critiques can also use this structure)

- *Background/Introduction*: What is the *biological problem*? What is the question or hypothesis that motivates the study? What tools or methodologies are used and why?
- A lot of the methods and tools are cutting edge modern biological methods. It is perfectly fine if we spend time on how these methods work and what they mean.
- *Results*: Each discussion group member should present one or two Figures/Tables. For each Figure or experiment, state (a) what is being shown, and (b) why and how was this experiment done. Discuss any questions you have about the data. Focus on the main paper; we may discuss supplemental information, but this is usually not essential. Supplemental information is sometimes formatted separately from the article PDF.
- In the more complex papers **there is no need (or time) to go through every Figure or panel.** 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?

NON-PRESENTERS: 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 7 papers; you need to write at least 2 critiques by June 5. Final paper grading will be based on your best 3 critiques.
- By 'critique' I mean a brief *summary* and also an *evaluation* of the work. Evaluations should address strengths and weaknesses, but there is no need to focus solely on weaknesses. You can raise any questions you have about the paper. You can use the same rubric as for the presentations.

ACADEMIC INTEGRITY

The 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; I will be using plagiarism detection tools. 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 (voice).

ATTENDANCE/PARTICIPATION

'Participation' counts for 30% of your grade. This can be as simple as asking 1 question per session. Sessions will allow ample time for everyone to participate.

ZOOM MEETING ETIQUETTE

- You must be signed in via your UCSD Zoom account
- Video is optional unless you are presenting/speaking. However, it often helps instructors and presenters to be able to see people's faces!
- As meeting host I will automatically mute everyone to avoid feedback due to too many microphones.
- If you want to speak, use the 'raise hand' function (look at the Participants list).
- Use the chat to ask questions.
- I will control screen sharing and will make presenter groups co-hosts for their sessions.
- At times I may divide the class into break rooms for small group discussions; students will be randomly assigned to break rooms.

There are guides to Zoom and Canvas in the course web site.

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 31: Introductions, class organization, discussion of learning goals

Week 2/April 7: Introductory Lecture

--What is regeneration? Examples and towards a definition
--Key questions in understanding regenerative phenomena
--Review of the 'conceptual tool kit' of developmental biology and stem cells

Before the lecture I recommend watching Alejandro Sanchez Alvarado's first iBio lecture (brief history of regeneration, from 2007).

Some general review articles (posted on Canvas site in 'week 2' module):

Sanchez Alvarado 2000. Regeneration in the metazoans: why does it happen?

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

Mokalled and Poss. 2018. A regeneration toolkit.

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

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

Week 3/April 14: Presentation group 1. Whole body regeneration in planaria

Presenters:

Discussion paper: Wagner et al 2011. Clonogenic Neoblasts Are Pluripotent Adult Stem Cells That Underlie Planarian Regeneration. Science.

Background reading: Reddien and Sanchez Alvarado 2004. Fundamentals of planarian regeneration. Ann Rev. Cell Dev. Biol.

**Marc Freeman Seminar 12 noon

Week 4/April 21: Presentation group 2. Limb regeneration I.

Presenters:

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

Background: Nacu and Tanaka 2011. Limb regeneration: a new development? Ann Rev. Cell Dev. Biol.

Week 5/April 28: Presentation group 3. Limb regeneration II

Presenters:

Discussion paper: Mitogawa et al 2018. Hyperinnervation improves Xenopus limb regeneration. Dev. Biol. 433: 276-286.

Background reading: Sinigaglia et al 2019. The multifaceted roles of nerves in animal regeneration. Curr Opin Genet Dev 57: 98-105.

Week 6/May 5: Special Guest Lecture on Nervous System Regeneration

Background reading:

Week 7/May 12: Presentation group 4. Genomic control of regeneration

Presenters:

Discussion paper: Wang et al 2020. Changes in regeneration-responsive enhancers shape regenerative capacities in vertebrates. Science 369: 1207. 4 Sept 2020.

Background.

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 (review)

Week 9/May 26: Presentation group 6. Bone regeneration in deer

Presenters:

Discussion paper: Wang et al. 2019. Genetic basis of ruminant headgear and rapid antler regeneration. Science 364, 21 June.

Background reading: Kiersdorf et al. 2007. Deer Antler Regeneration: Cells, Concepts and Controversies. J. Morphology. 268: 726

Week 10/June 2: No meeting; Final papers due June 5