

**Course Name (code if available): Developmental Biology****Point of Contact person:** Dr. Kasturi Mitra with Dr. Vijay Raghavan and Dr. Hiroshi Hamada

**Overview:** The field of developmental biology aims to understand how an organism develops from a single cell to fully matured. Interplay of various gene products (proteins) guide key cellular processes to allow the appropriate developmental task to happen at the right time and place. Errors in developmental processes lead to serious disorders and diseases. The course will take a multidisciplinary approach and will aim to cater to students beyond biology department with the goal of training minds to contribute in tackling major outstanding tasks in the broad field of fundamental developmental biology.

**Learning Outcomes:** This course will have both basic and advanced contents. The main learning outcome will be to understand all the genetic and cellular process in key

**Prerequisites:** None. For students who have not taken the core Biology courses, extra reading materials will be provided.

**Course Contents:**

| <b>Week</b>   | <b>Broad topics to be covered</b>          | <b>Details (subtopics)</b>                                                                                                        |
|---------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>Week 1</b> | Refresher of the basic Biological concepts | Summary of topics covered in Bio-2 and Bio-3 courses                                                                              |
| <b>Week 2</b> | Overview of development                    | Molecular and cellular processes involved in development                                                                          |
| <b>Week 3</b> | Use of model systems and basic techniques  | Advantages and disadvantages of various developmental model systems                                                               |
| <b>Week 4</b> | Embryology and germ layer development      | Events happening post fertilization upto formation of the three germ layers. Both basic and advanced concepts will be covered.    |
| <b>Week 5</b> | Pattern formation                          | Involvement of morphogen gradients, lateral inhibition etc. Developmental timing will be covered. Basic and advanced concepts     |
| <b>Week 6</b> | Development of symmetry and asymmetry      | Basic and advanced concepts will be covered.                                                                                      |
| <b>Week 7</b> | Stem cells and regeneration                | Properties of embryonic, adult and neoplastic stem cells. Principles of regeneration and application in applied fields. Basic and |

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|----------------|-----------------------------------------------|----------------------------------------------|
|                |                                               | advanced concepts will be covered.           |
| <b>Week 8a</b> | Cellular reprogramming                        | Animal cloning and iPSC technology           |
| <b>Week 8b</b> | Plant development                             |                                              |
| <b>Week 9</b>  | Integrating disciplines                       | Importance of physics, math and engineering  |
| <b>Week 10</b> | Neural development                            | Basic and advanced concepts will be covered. |
| <b>Week 11</b> | Developmental disorders of brain and behavior | Basic and advanced concepts will be covered  |
| <b>Week 12</b> | Paper presentations                           | Students will present                        |

**Requirements (Reading List and other materials):**

1. Molecular Cell Biology. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A and Scott MP. 7th edition. New York: W. H. Freeman and Company.
2. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. 6th edition. New York: Garland Science.
3. Principle of Development, Lewis Wolpert, Cheryll Tickle and Alfonso Martinez Arias, 6th edition, Oxford University Press. This textbook explains principles of development (not too much detail), so may be suitable to undergraduate students.
4. Additional reading, including research papers and review articles, will be provided.