



**EPIGENETICS – PCB 4133-B51/U02**  
**Spring 2018**  
**3 Credits**



**FLORIDA  
INTERNATIONAL  
UNIVERSITY**

**AHC2-160 (MMC Campus)**

**MSB-150 (BBC Campus)**

**Fridays, 12:00 pm – 2.30 pm**

**Pre-requisites: BSC 1011 (General Biology II), PCB 3063 (Genetics)**

**Professor: Dr. Jose M. Eirin-Lopez**

[environmentalepigenetics.com](http://environmentalepigenetics.com)

## **OVERVIEW**

The organization of our DNA is modified by reversible signals responsive to environmental factors. Those signals constitute epigenetic information (inheritable changes not involving modifications in the DNA sequence) and are responsible, for example, for the phenotypic differences between one of your neurons and one of your skin cells (even though they are genetic clones), for the differences between two monozygotic twins or even the differences between babies born in a post-war period (usually less weight and height) and those born at peace time. The present course wants to introduce you to the fundamentals of Epigenetics and its relevance for virtually all biological processes. The course is intended for senior undergraduates interested in an updated view of this exciting and still young discipline.

The course is divided into two major parts:

- **Part I** will introduce students to the structural organization of DNA in the chromatin fiber and the chromosomal proteins regulating DNA metabolism.
- **Part II** will explore the interaction between chromatin structural components, RNA and DNA in determining epigenetically inheritable traits.

## **LEARNING OBJECTIVES**

Upon successful completion of this course, you will be able to:

- Explain what is Epigenetics and apply this concept to the study of inheritance in natural populations.
- Describe different epigenetic mechanisms and identify how do they interact with genetic mechanisms affecting phenotypes.
- Distinguish the epigenetic information in DNA methylation from the genetic information in the DNA.
- Understand how DNA is dynamically organized into nucleosomes constituting the chromatin fiber.
- Identify the different types of histones and their chemical modifications.
- Understand how modifications in histone structure change the chromatin and modify the expression of the information on the DNA.
- Identify the differences between somatic chromatin and germinal chromatin.
- Integrate different evolutionary mechanisms leading to the differentiation of the chromatin structure in eukaryotes.
- Understand the epigenetic role of RNA modulating the expression of the information on the DNA.
- Identify how different epigenetic mechanisms participate in dosage compensation in mammals.
- Define imprinting and give an example of it.

- Understand the role of epigenetic mechanisms during development.
- Describe how epigenetic mechanisms can lead to disease.
- Explain the epigenetic links between sources of environmental stress and acclimatization responses.

### **HOW THIS COURSE WILL HELP YOU SUCCEED**

The study and understanding of epigenetics is fundamental to take your life sciences education to the next level. Think about it, you know pretty much everything about how the nucleic acids carry the genetic information, the parts of a cell, the different tissues, biodiversity, evolution... however, by studying epigenetics you will be able to understand the actual mechanisms making all that possible, in other words, how the expression of the genetic information is regulated in different environmental, developmental and temporal scenarios. In addition, this course will help you acquire a conceptual and practical framework that you can apply to solve complex problems in in your future research, professional practice, or clinical practice.

Beyond its formal learning objectives, I hope that this course will inspire you to:

- Realize your potential to learn and master complex concepts
- Be open minded about science and epigenetics
- Appreciate the role of epigenetics shaping life on earth
- Care about nature and the environment and their benefits for society
- Be understanding about others' interests, limitations and background
- Become curious and creative in using evolutionary thinking to solve biological, medical and legal problems

### **IMPORTANT INFORMATION**

#### **Policies**

Please review the [FIU's Policies](#) webpage. The policies webpage contains essential information regarding guidelines relevant to all courses at FIU, as well as additional information about acceptable netiquette for online/hybrid courses.

#### **Professional and Academic Integrity**

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and to honestly demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the [Academic Misconduct procedures and sanctions](#).

Academic Misconduct policies and procedures will be strictly enforced regarding cheating. Anyone caught cheating will be asked to leave the class, will be given an “F” for the whole course and a petition will be sent to Academic Affairs. **NO EXCEPTIONS.**

#### **Accessibility And Accommodation**

The Disability Resource Center collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The DRC provides FIU students with disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact the

Center at 305-348-3532 or visit them at the Graham Center GC 190.

Please visit our [ADA Compliance](#) webpage for information about accessibility involving the tools used in this course.

Please visit [Blackboard's Commitment Accessibility](#) webpage for more information.

For additional assistance please contact FIU's [Disability Resource Center](#).

### **Expectations of this Course**

As a student in this course, you are expected to:

- **Review the Syllabus**
- Review and follow the course **calendar**
- Submit assignments by their respective **due dates**
- Log in to the course **blackboard at least 2 times per week**
- Respond to emails within 2 days

I, the professor, will:

- Log in to the course at least 2 times per week
- Respond to emails within 2 days
- Respond to General Discussion posts within 2 days (see Course Communication section)
- Provide feedback on assignments within 7 days of submission

**Reference Textbooks (Recommended but NOT required, the information and materials I will provide in class will be enough to successfully complete the course)**

1) *Epigenetics*. Allis, Caparros, Jenuwein, and Reinberg (Eds.). Cold Spring Harbor Press, 2015.

2) *The Epigenetics Revolution: How Modern Biology Is Rewriting Our Understanding of Genetics, Disease, and Inheritance*. Nessa Carey. Columbia University Press, 2011.

### **COURSE DETAIL**

#### **Course Format**

This course will be **taught every FRIDAY of the semester, 12 pm – 2:30 pm, simultaneously at BBC (MSB-150) and MMC (AHC2-160) through polycom**. I will teach in person one week at each campus (with polycom to the other, from now on the “remote” campus). The course will combine **lectures, presentations of current scientific literature and in-class discussions**, focusing on the current questions in Chromatin and Epigenetics and how they are being addressed experimentally.

#### **Class attendance**

Since the course will be taught simultaneously at both campuses, a **monitor** (i.e., faculty, LA or TA) will be monitoring the class in the “remote” campus to which the lecture is transmitted through polycom. Students are required to bring **CLICKER** to class to complete **RANDOM** attendance checks (see assessments below) and in-class quizzes.

#### **Course Communication**

Outside of our in-person meetings, we'll stay in touch through **Blackboard**.

**Email**. Use email for personal, or time-sensitive questions. The Email feature is an external communication tool that allows users to send emails to users enrolled within the course (including the professor). The Email tool is located on the Course Menu, on the left side of the course.

**General Discussion Forum**. Post your question or comment here if it is related to class

material and your classmates could also benefit from my response. Keep in mind that your discussion forum postings will likely be seen by other members of the course. Please review our [netiquette policies](#).

**Office Hours.** Anytime by appointment, email me (jeirinlo@fiu.edu) to set one up.

### **ASSESSMENTS**

**a. Weekly quizzes (36% final grade, 12 in total, 3% each):** A quiz consisting of 10 multiple choice questions will be available each week (except the first week of class) at Blackboard, from Monday afternoon until Sunday 11:59 pm. These quizzes will consist of questions referred to the class from the previous week. Once started, the **quiz will must be completed in 15 minutes** (if internet connection breaks down in the middle of the quiz it will be possible to log in again and finish, however, remember that the clock will keep running. **MAKE SURE YOU STUDIED the contents and MAKE SURE YOU HAVE A GOOD INTERNET CONNECTION before taking the quizzes**). Students are responsible for completing the quizzes on time, if they do not, it will be graded as 0 points without option to make up. Correct answers will be released after each quiz's due date.

**b. Exams 01 and 02 (40% final grade, 2 in total, 20% each):** Each exam will consist of 60 multiple choice questions covering the lectures 2-7 (Exam 01) and lectures 8-13 (Exam 02). **Exams will be completed IN CLASS by students**, where they will be proctored by the instructor and monitors at both campuses. The day of the exam, students will be responsible for bringing their own laptops to class. In order to complete the exam, they will connect to Blackboard and log in the corresponding exam. Once started, each **exam must be completed in 60 minutes** (if internet connection breaks down in the middle of the exam it will be possible to log in again and finish, however, remember that the clock will keep running. **MAKE SURE YOU STUDIED the contents and MAKE SURE YOUR COMPUTER has ENOUGH BATTERY to complete the exam**). Correct answers will be released after each exam's due date. MAKE UP EXAMS WILL NOT BE AVAILABLE IN THIS COURSE.

**c. Online Paper discussion (24% final grade, 6 in total, 4% each):** After the add/drop date, the class will be randomly divided into groups in Blackboard. After this date, access your group space by clicking on "*My Groups*" on the course menu. During the semester, you will engage in six (6) online group discussions within your group's Discussion Board. The group discussions will be based on scientific papers provided in the course at the beginning of the semester. The goal is to promote critical thinking, engagement, and application of the material. Please refer to the course calendar. Further details will be given in class.

General Requirements:

- Addressed **discussion prompt in 3-5 complete sentences**
- **Commented on at least 2 peers' posts**

Keep in mind that your discussion forum postings will likely be seen by other members of the course. Care should be taken when determining what to post.

**e. Extra Credit:** There is the possibility of getting extra credit by doing a **Research Paper Presentation**. Presentations should be approx. 10-15 minutes long, supported by slides, and include background information as well as future directions. Following each presentation there will be time for questions and discussion with the rest of the students. The EC for this presentation will add up to **5% to your final grade**. If you are interested in doing this presentation you have to proceed as follows: i) identify a paper you would like to present, ii)

check with professor that the paper is suitable for discussion in class, iii) request a date for the presentation in class.

### Incomplete Grades

An incomplete grade will be delivered under very exceptional documented circumstances such as major sudden and unexpected serious health problem of the student or his/her family. Other excuses will not be accepted to provide an incomplete grade.

### Letters of Recommendation

Letters of recommendation will only be written for the **top 5 students in the class**, based on the final numeric grade and as long as they fulfill the following requirements:

- 1) They must **have a grade = A**
- 2) They must **complete ALL four assessments activities (including extra credit) as detailed above.**

### How to Succeed in this Course

Utilize Your Resources. Make sure that you come to class and that you follow my class lectures, which are the guiding thread of the present course. In addition, I will provide you with online materials and other resources so you can work on your own. All these materials will be available for you in **blackboard**.

**Participate.** This course will not be any good to you or your future if you don't take an active part on it. First, I want you to be excited and happy about the course, so you can loosen up and start participating. I know sometimes is tough to speak up in front of everybody but guess what, everybody is as frighten as you are, so relax. The key for that is to know what you're talking about, so prepare the class in advance of the in person session.

**Communicate.** We will see each other in person quite often, so we will have the chance of discussing and clarifying all your questions. Don't let that opportunity go to waste, come to me and ask all questions you have. You should let me know what ideas and tools are challenging to you and how you are doing in the class. If you start this habit early in the semester, then I will be able to better tailor our activities to help you learn.

**Have Fun.** I don't want to get external distractions, prejudices or invisible barriers in our way to knowledge, so we'll get rid of those right away from the very beginning. In my experience, being relaxed, friendly, funny and close to each other is a great way to do so. I guarantee you that if you do that, you will be having tons of fun and you will be making the most of this learning process. Follow this Buddhist proverb: happy face, happy life.

### GRADING

Grade	% total
A	93.00 – 100.00 %
A	90.00 – 92.99 %
B+	87.00 – 89.99 %
B	83.00 – 86.99 %
B-	80.00 – 82.99 %
C+	77.00 – 79.99 %
C	70.00 – 76.99 %
D	60.00 – 69.99 %
F	< 60.00 %

### COURSE CALENDAR *(example for Spring semester)*

Date	Me	Topic	Paper Discussions
01/12	MMC	01. Overview	

01/19	BBC	02. DNA Methylation	
01/26	MMC	03. Chromatin Structure	Paper 01 (Due 02/02 12pm)
02/02	BBC	04. Histone Variants	
02/09	MMC	05. Histone Modifications	Paper 02 (Due 02/16 12pm)
02/16	BBC	06. Germ Chromatin	
02/23	MMC	07. Chromatin Evolution	Paper 03 (Due 03/02 12pm)
<b>03/02</b>	<b>MMC</b>	<b>Exam 01</b>	
03/09	BBC	08. RNAi Heterochromatin	
<b>03/16</b>	<b>NO CLASS (SPRING BREAK)</b>		
03/23	MMC	09. Dosage Compensation	Paper 04 (Due 03/30 12pm)
03/30	BBC	10. Genomic Imprinting	
04/06	MMC	11. Stem Cells	Paper 05 (Due 04/13 12pm)
04/13	BBC	12. Epigenetics and Disease	
04/20	MMC	13. Environmental Epigenetics	Paper 06 (Due 04/27 12pm)
<b>04/27</b>	<b>BBC</b>	<b>Exam 02</b>	

### Papers selected for discussions (available in Blackboard)

#### Paper 01. Overview

Feil, R., and M. F. Fraga. 2012. Epigenetics and the environment: emerging patterns and implications. *Nature Reviews in Genetics* **13**:97-109.

#### Paper 02. DNA Methylation

Jenkins, T. G., K. I. Aston, C. Pflueger, B. R. Cairns, and D. T. Carrell. 2014. Age-associated sperm DNA methylation alterations: possible implications in offspring disease susceptibility. *PLoS Genetics* **10**:e1004458.

#### Paper 03. Germ Chromatin

Tang, W. W. C., T. Kobayashi, N. Irie, S. Dietmann, and M. A. Surani. 2016. Specification and epigenetic programming of the human germ line. *Nature Reviews in Genetics* **17**:585-600.

#### Paper 04. RNAi and Heterochromatin formation

Chen, Q., and E. Duan. 2016. Epigenetics inheritance of acquired traits through sperm RNAs and sperm RNA modifications. *Nature Reviews in Genetics* **17**:733-743.

#### Paper 05. Genomic Imprinting

Susiarjo, M., I. Sasson, C. Mesaros, and M. S. Bartolomei. 2013. Bisphenol a exposure disrupts genomic imprinting in the mouse. *PLoS Genetics* **9**:e1003401.

#### Paper 06. Epigenetics and Disease

Nestler, E. J., C. J. Peña, M. Kundakovic, A. Mitchell, and S. Akbarian. 2016. Epigenetic basis of mental illness. *The Neuroscientist* **22**:447-463.