PCB4522 & MCB6937

Module 1 Bacterial Replicons

Study Objectives and Key Terms

We will learn how DNA is replicated for bacterial chromosomes, plasmids, and some viruses. Included will be a discussion of plasmid conjugation and detailed coverage of the Agrobacterium T-DNA system. We will also cover the role and regulation of proteins involved in DNA replication in bacteria and eukaryotes

Anki Deck for Module-1

Zoom Review Sessions for PowerPoint Files (Jan 2025)

- The Replicon Zoom Review video (Wed, 29 Jan 25)
- Extrachromosomal Replicons Zoom video (Thurs, 30 Jan 25)
- Agrobacterium & Bacterial cell cycle/ColE1 replication Zoom video (Fri, 31 Jan 25)

Activity Calendar Spring 2025: Recorded Lectures

Week 1 spring 2025 (Feb 1-Feb 2)

- Lecture 1 (Jan 13; Early Man 2020 lectures)
    - Lecture-1A Early Man-1
    - Lecture-1B Early Man-2
    - Lecture-1C Early Man-3
- Lecture 2 (Jan 15) The Replicon (2020 lectures)
    - Lecture-2 The Replicon-1
    - Lecture-3 The Replicon-2

Homework Quizzes (complete by Sunday, Jan 19)

- Homework quiz-1 Early man
- Homework quiz-2 The Replicon Part-1
- Homework quiz-3 The Replicon Part-2

PowerPoint Files (Week 1)

- The Exodus of Early Man
- The Replicon

Week 2 spring 2025 (Jan 20-Jan 25)

- Lecture 3 (Jan 20) The Replicon & Extrachromosomal Replicons
    - Lecture-3 Replicon-2 (same as above in Week 1)
    - Review: DnaA binding to oriC
    - Review: DnaA binding to oriC PowerPoint
    - Lecture 4 (Jan 22) Extrachromosomal Replicons
        - Lecture-4A The Replicon-3
        - Lecture-4B Extrachromosomal Replicons-1
        - Lecture-4C Extrachromosomal Replicons-2
        - Review: Adenovirus replication

        - Review: Adenovirus replication PowerPoint

Homework Quizzes: 5, 5B, & 6 (complete by Sunday, Jan 26)

- Homework quiz-4 Mitochondrial DNA replication (skip until Module-2)
- Homework quiz-5 Extrachromosomal replication Part-1: linear vs. rolling circle
- Homework quiz-5B Adenovirus replication
- Homework quiz-6 Extrachromosomal replication Part-2: F plasmid & conjugation

PowerPoint Files (Week 2)

- The Replicon
- Extrachromosomal replication
- (Mitochondrial Replication. NOTE: this material will not be on Exam-1. It is covered more thoroughly in Module-2.)

Week 3 spring 2023 (Jan 22-Jan 28)

- Lecture 5 (Jan 24) Agrobacterium
    - Lecture-5A Agrobacterium-1
    - Lecture-5B Agrobacterium-2
    - Lecture-5C Agrobacterium-3
- Lecture 6 (Jan 26) Cell cycle and ColE1 Replication
    - Lecture- 6A Cell cycle & ColE1 Replication-1
    - Lecture-6B Cell cycle & ColE1 Replication-2
    - Review: ColE1 & repABC as models for oriV function

PowerPoints for Week 3

- Agrobacterium
- Bacterial cell cycle & ColE1 replication (updated Jan 2023)

Homework Quizzes 1-3, 5, 5B, & 6 (complete by Sunday, Jan 29)

- [Homework quiz-4 Mitochondrial replication is not required. Skip.]
- Homework quizzes 7-8 (complete by Monday, Jan 30)
    - Homework quiz-7 Agrobacterium & T-DNA
    - Homework quiz-8 Regulation & Cell cycle, ColE1

Module-1 Review Quiz (complete by Jan 31)

Exam-1 opens Saturday, Feb 1, at 9:00 AM

Exam-1 closes Monday, Feb 3, at 11:55 PM

Located under the blue banners below:

- Learning Objectives and Study Guides
- Key terms
- Readings
- Homework quiz links
- Exam reviews (archived)
- Exodus of Early Man
- The Replicon
- Extrachromosomal Replicons
- Agrobacterium T-DNA
- Bacterial Cell Cycle & ColE1
- Exam Review

Module 2 PCB4522/MCB6937

DNA Polymerases, Helicases, Recombination, Transposons, & Retroviruses

In this module, we will learn the biochemistry of DNA replication and how that process fundamental to all life is exploited in recombination and the movement and maintenance of mobile DNA elements known as "transposons." Also discussed will be the mode of replication of retroviruses in eukaryotes, an RNA-based transposon. We will explore how replication is at the center of all these processes in both bacteria and eukaryotes.

Calendar of Activities

Week 4 - DNA Replication Proteins & Recombination-1 (Feb 2-Feb 8)

Lectures:

1. Lecture-7 Mitochondrial DNA Replication (Feb 4)
    - Lecture-7A Mitochondrial DNA Replication
    - Lecture-7B Mitochondrial DNA Replication-2 & Proteins of DNA Replication-1
    - 3D structure: G-quadruplex DNA
2. Lecture-8 The Proteins of DNA Replication (Feb 5)
    - Lecture-8 A (2023)
    - Lecture-8 B (2023)
    - Lecture-8 C (2023)
    - Lecture-8 D (2023)
3. Lecture-9 The Proteins of DNA Replication & Recombination-1 (Feb 6)
    - Lecture-9 A (2023)
    - Lecture-9 B (2023)

Homework quizzes 4 & 9-10 (suggested completion by Feb 9)

- HQ-9 Proteins of DNA replication-A
- HQ-10 Proteins of DNA replication-B

PowerPoint file (week 4):

- The Proteins of DNA replication (2023)

Week 5 - Recombination Parts 1 & 2 (Feb 9-Feb 15)

Lectures:

1. Lecture-10 Recombination-1 & Recombination-2 (Feb 11)
    - Lecture-10 A (2023)
    - Lecture-10 B (2023)
    - Lecture-10-C (2023)
    - Lecture-10 D (2022/2023)
    - Lecture-10 E (Recombination-Part 2) (2020)
    - *Just for fun: I made a model of RecABC (time-lapse video)*
2. Lecture-11 Transposons-1 (Feb 13)
    - Lecture-11 A (2023)
    - Lecture-11 B (2023)

Homework quizzes 11-12 (suggested completion by Feb 16)

- HQ-11

- HQ-12

PowerPoint files (week 5):

- Recombination-2

Week 6 - Bacterial Transposons & Eukaryotic Transposons (Feb 16-Feb 22)
Project Due Feb 18 Gene Structure/Bioinformatics Part-1
Lectures:

1. Lecture-12 Transposons-2 (Feb 18)
    - Lecture-12 A (2023)
    - Lecture-12 B (2023)
    - Lecture-12 C (2023)
    - Lecture-12 D (2023)
    - *Just for Fun: Making myself some ReBCD*
2. Lecture-13 Eukaryotic Transposons-3 (Feb 20)
    - Lecture-13A (2023)
    - Lecture-13B (2023)

Homework quizzes 13-14 (suggested completion by Feb 23)

- HQ-13
- HQ-14

PowerPoint files (week 6):

- Transposons-1 (Bacterial)
- Transposons-2 (Eukaryotic)

Week 7 - Eukaryotic Transposons-Retroelements (Feb 23-Feb 25)
Lectures:

1. Lecture-14 Module 2 Review (Feb 24)
    - Lecture-14A
    - Lecture-14B
    - Lecture-14C
    - Lecture-14D

PowerPoint file (week 7):

- Transposons-3 (retroviruses and other retroelements)

Focus topics videos:

1. P-elements (Feb 21)
2. Retrovirus replication (Feb 23)

Homework quizzes 15-16 (suggested completion by Feb 25)

- HQ-15
- HQ-16

Module-2 Review Quiz (completed by Feb 25)
Note: This quiz is just a random draw from previous Homework quizzes, not a comprehensive review. Taking the quizzes will challenge your retrieval skills and give you an idea of how long it will take for 40 questions. It is not a substitute for studying PowerPoint slides and Key terms etc.
Exam-2 opens Feb 26. To access Exam-2 go to the HonorLock link on the Left Menu.
Study Resources are found under the banners below:

- Learning Objectives & Study Guides

- Key terms
- Readings
- Supplemental videos

Topics:

- DNA Replication Proteins
- Recombination (Part 1)
- Recombination (Part 2)
- Transposons (Part 1)
- Eukaryotic Transposons (Part 2)
- Retrotransposons and Retroviruses (Eukaryotic Transposons-Part 3)

Exam Reviews:

- Spring 2021 (MediaSite, Feb 19, 2021)

Exam 2 (access using the HonorLock link in the Left Menu)

For a more comprehensive study guide, please refer to your lecture notes, key terms, and PowerPoint slides.

Module 3: DNA Repair, Bacterial RNA Polymerase, CAP, & Operons

In this module, we will first learn how the genetic code in bacteria and eukaryotes is protected and restored from changes picked up through mutations and changes due to mistakes in DNA replication. Next, we will explore mechanisms whereby genes are regulated in bacteria at the transcriptional level. The principles illustrated with bacteria will serve as preparation for the last module of the course (Module 4), which covers complex ways that gene expression is controlled in us and all eukaryotes.

Anki Decks for Downloading

- Kathy Brus (former TA) Module-3 Kaitlynn Brus Study Notes

Activities Calendar

Week 8 - Repair Systems

Lectures:

1. Lecture 15 Repair-1 (Feb 28)
    - Lecture-15 A (2023)
    - Lecture-15 B (2023)
2. Lecture 16 Repair-2 (Mar 2)
    - Lecture-16 A (2023)
    - Lecture-16 B (2023)
    - Lecture-16 C (2023)
    - Lecture-16 D (2023)

Homework quizzes 17-18 (suggested completion by Mar 5)

- HQ-17
- HQ-18

PowerPoint file (week 8)

- Repair-1

Week 9 - Bacterial Transcription

Lectures:

1. Lecture-17 Bacterial Transcription-1 (Mar 7)
    - Lecture-17 A (2023)
    - Lecture-17 B (2023)
    - Lecture-17 C (2022; This section was added after the in-class lecture.)
2. Lecture-18 Bacterial Transcription-2 (Mar 9)
    - Lecture-18 A (2023)
    - Lecture-18 B (2023)
    - Lecture-18 C (2023)
    - Lecture-18 D (2023)
    - 3D tour of bacterial RNA polymerase

Gene Structure/Bioinformatics: Part-1, 1B (Mar 9)

Homework quizzes 19-20 (suggested completion by Mar 12)

- HQ-19
- HQ-20

PowerPoint files (week 9)

- Bacterial transcription-1
- Bacterial transcription-2

Week 10 - Spring Break

Week 11 - Transcription & The Operon

Lectures:

1. Lecture-19 Transcription-3 and Termination (Mar 21)
    - Lecture-19 A (2023)
    - Lecture-19 B (2023)
    - PowerPoint-Termination of Transcription
2. Lecture-20 The Operon (Mar 23)
    - Lecture-20 A (2023)
    - Lecture-20 B (2023)
    - Lecture-20 C (2023)
    - Lecture-20 D (2023)
    - PowerPoint: The Operon
    - PowerPoint: CAP

Focus Topic Videos:

- Lac promoter (Mar 24)
- Ara promoter (Mar 24)

Homework quizzes 21-22 (suggested completion by Mar 26)

- HQ-21
- HQ-22

Week 12 - CAP Regulation & Trp Operon/Attenuation

Gene Structure/Bioinformatics: Part-2 (Mar 23)

Lectures:

1. Lecture-21 (Mar 28) The Operon-The Operon-CAP

- Lecture-21 A (2023)
- Lecture-21 B (2023)
- Focus Topic video: CAP (Mar 29)
- PowerPoint: CAP Focus Topic

2. Lecture-22 (Mar 30) The Operon-trp Operon & Attenuation
    - Lecture-22 A (2023)
    - Lecture-22 B (2023)
    - Lecture-22 C (2023)
    - Lecture-22 D (2023) Mini-review for Module-3

Homework quiz 23A, 23B, & 23C (Apr 2), Module-3 Review Quiz

- PowerPoint: 1-The Tryptophan Operon & Attenuation
- HQ 23A
- HQ 23B
- HQ 23C

Module 3 Review
Exam-3 opens Apr 1st at noon
Exam-3 closes Apr 5 at 11:59 pm
Study Resources

- Repair Systems
- Bacterial Transcription (Parts 1 & 2)
- Bacterial Transcription: Termination (Part 3)
- The Operon (Basic concepts and regulation)
- The Operon (CAP Regulation)
- The Operon (trp operon)

Module 4: Eukaryotic Transcriptional Regulation & Epigenetics

In the last module, we will explore the complicated processes for regulating gene expression in eukaryotes. You will learn about the more than 50 proteins that assemble at the promoter to initiate transcription and the details of how this process is regulated. We will also discuss the mechanisms for controlling both inducible and steady-state transcription in higher organisms. Finally, you will be introduced to regulatory strategies based on epigenetic mechanisms. Under the heading of "Epigenetics," you will learn why certain female cats are calico in coloration and how transposons residing in our own genomes in great numbers are kept silent.

Anki Decks for Downloading

Activity Calendar 2023
Week 13 - Chromatin & Histones (April 2-8)
(Note: due to Exam-3, this week is very crowded with activities. You may get a little behind, but you should be able to catch up during Week 14.)
Lectures:

1. Lecture-23 (Apr 4) Histones & Nucleosome Assembly
    - Lecture-23 A (2023) Nucleosome Assembly
    - Lecture-23 B (2023) Nucleosome Assembly
2. Lecture-24 (Apr 6) Chromatin
    - Lecture-24 A (2023) Nucleosome Assembly & Chromatin
    - Lecture-24 B (2023) Chromatin
    - Lecture-24 C (2023) Chromatin
    - Lecture-24 D (2023) Chromatin

Gene Structure/Bioinformatics: Part-3 (Apr 6)

PowerPoints:

- Nucleosome Assembly
- Chromatin

Homework Quizzes 24-26 (Apr 9)

- HQ-24
- HQ-25
- HQ-26

Week 14 - Eukaryotic Transcription: Building the PIC Basics to TFIID (Apr 9-15)

Lectures:

1. Lecture-X Histones & Nucleosomes (Use the Spring 2022 lecture)
    - Lecture-X Histones & Nucleosomes Part-A (2022)
    - Lecture-X Histones & Nucleosomes Part-B (2022)
2. Lecture-25 (Apr 11) Eukaryotic Transcription-1
    - Lecture-25 A (2023)
    - Lecture-25 B (2023)

PowerPoints:

- Histones & Nucleosomes
- Eukaryotic Transcription-1

Video Tutorials:

- Explaining how to determine the direction of Transcription

Lectures: 3. Lecture-26 (Apr 13) Eukaryotic Transcription-2 - Lecture-26 A (2023) Eukaryotic Transcription-1 cont. - Lecture-26 B (2023) Eukaryotic Transcription-2 - Lecture-26 C (2023) Eukaryotic Transcription-2 - Lecture-26 D (2023) Eukaryotic Transcription-2

Homework Quizzes 27-30 (complete by Apr 16)

- HQ-27 Eukaryotic Transcription-1
- HQ-28 TBP Drill-Direction of Transcription
- HQ-29 Eukaryotic Transcription-2
- HQ-30 TFIID Structure
- HQ-30B SAGA Structure

PowerPoint:

- Eukaryotic Transcription-2 (updated April 18, 2023)

Week 15 - Eukaryotic Transcription: TFIIH & Mediator (Apr 16-22)

Lectures:

1. Lecture-27 (Apr 18)
    - Lecture-27 A (2023)

- Lecture-27 B (2023)

2. Lecture-28 (Apr 20)
    - Lecture-28 A (2023)
    - Lecture-28 B (2023)
    - Lecture-28 C (2023)
    - Lecture-28 D (2023)

PowerPoints:

- Eukaryotic Transcription-4 TFIIF, TFIIE, & TFIIE (updated Apr 21, 2023)
- Eukaryotic Transcription-5 Mediator, Chromatin Remodelers (updated April 25, 2023)

Video:

- TFIIH and the +1 Nucleosome

Homework Quizzes 31-32 (completed by Apr 22)

- HQ-31
- HQ-31B
- HQ-32

Week 16 - Eukaryotic Transcriptional Regulation (Apr 23-25)

Lectures:

1. Lecture-29 (Apr 25)
    - Lecture-29 A (2023)
    - Lecture-29 B (2023)

PowerPoint:

- Eukaryotic Regulation

Homework Quizzes 33-34 (completed by Apr 28)

- HQ-33
- HQ-34

Module-4 Review Quiz (Apr 29)

Week 17 - Exams & Loose Ends (May 1-May 5)

Exam-4 opens Apr 29

Exam-4 closes May 3 (Canvas will automatically stop all exams and submit at 11:59 PM)

Optional Re-take Final (May 3-5)

You may retake your lowest-scoring exam again after completing Exam-4. Contact your TA to authorize your second attempt. You do not have to wait until May 4th.

COVID-19 Extra Credit (May 5)

Study Topics:

- Chromosomes
- Histones and Nucleosomes
- Eukaryotic Transcription (Part 1)
- Eukaryotic Transcription (Part 2)
- Eukaryotic Transcription (Part 3) TFIID
- Eukaryotic Transcription (Part 4) TFIIH
- Eukaryotic Transcription (Part 5) Mediator
- Eukaryotic Transcription Regulation

- Epigenetics (This PowerPoint will not be covered on Exam 4.)

Module 4 Practice Exam

Exam 4 Images (PowerPoint file)

Video Tutorials:

- Help with how to determine the direction of transcription can be found in the five videos with links below:
    - Video-1: TBP Drill Video

Anki Decks (Module 4)

- Exam 4 Review 2019
- Exam 4 TA-Made Figure Study Guide PowerPoint
- Exam 4 TA Made Study Guide Questions (pptx and pdf)
- Exam 4 TA Made Study Guide Questions - Answer Key (pptx and pdf