Molecular Biology of the Gene

By:
Professor Ho Huynh Thuy Duong
Molecular Biology of the Gene

By:
Professor Ho Huynh Thuy Duong

Online:
< http://cnx.org/content/col10799/1.1/ >

CONNEXIONS
Rice University, Houston, Texas
# Table of Contents

1. Course Home ................................................................. 2
2. Letter to Students ........................................................... 5
3. Syllabus .............................................................................. 7
4. Calendar and Readings ......................................................... 9
5. Lecture Notes ..................................................................... 11
6. End-of-topic Assignments ..................................................... 13
7. End-of-course Assignments ................................................... 17
8. Multiple Choice Questions ..................................................... 23
9. Seminar Topics .................................................................... 27
10. Interesting Links .................................................................. 29
11. Course Development Support ............................................... 31
12. Course Feedback ................................................................. 33
13. Attributions ....................................................................... 35
Chapter 1

Course Home

Figure 1.1: The Central Dogma of Molecular Biology (http://elgolemrazonable.blogspot.com/2009/02/el-dogma-central-de-la-biologia.html)

Available for free at Connexions: <http://cnx.org/content/col10799/1.1>.

1This content is available online at <http://cnx.org/content/m30796/1.1/>.
This course introduces basic molecular mechanisms that control cell survival and reproduction. Topics include DNA constancy and variations, gene expression and regulation of gene expression. These topics are presented as lectures notes, readings and assignments.

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 2

Letter to Students

This course covers basic topics in Molecular Biology (Topic 1 to 7) with an additional topic introducing some methods and experimental approaches (Topic 8).

Even though the content seems sometimes overloaded, the main points could be found in the Summary at the end of each topic. End-of-topic Assignments also emphasize the most important ideas to be retained. The End-of-course Assignments is a test for synthetic analysis of information provided all over the course rather than a revision of the course itself.

Please do not forget that this course is more a suggestion than an established scheme:

- Some contents - in particular those which are not mentioned in the Summary and the Assignments - can be bypassed
- Other contents that are briefly mentioned should need more detailed and updated readings
- The course could be partially used to complement other courses

I hope you have some fun to take this course.

Sincerely,

Professor Ho Huynh Thuy Duong

---

1This content is available online at <http://cnx.org/content/m28590/1.1/>.

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 3

Syllabus

3.1 Course Overview
Topics include: organisation of genetic material in prokaryotes and eukaryotes, DNA replication, transcription, translation, regulation of gene expression in prokaryotes and eukaryotes.

3.2 Textbooks

3.3 Pre-requisites
Biochemistry
Genetics

3.4 Grading

<table>
<thead>
<tr>
<th>Activities</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-term exam 1</td>
<td>X/10</td>
</tr>
<tr>
<td>Seminar presentation (optional)</td>
<td>(Y/10)</td>
</tr>
<tr>
<td>Final exam</td>
<td>Z/10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>X + (Y) + 2Z/10</strong></td>
</tr>
</tbody>
</table>

Table 3.1

---

1This content is available online at <http://cnx.org/content/m28701/1.1/>.

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
## Chapter 4

### Calendar and Readings

<table>
<thead>
<tr>
<th>Topics</th>
<th>Key topics Sessions</th>
<th>Key dates</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>VARIATIONS OF DNA</td>
<td>5. DNA mutation and repair (Slide 1 – 14)</td>
<td></td>
<td>MBG, chapter 9, pp. 235-257.</td>
</tr>
<tr>
<td>VARIATIONS OF DNA</td>
<td>6. DNA Recombination (Slide 15 – 27)</td>
<td></td>
<td>MBG, chapter 10 and 11, pp. 239-290 and 293-342.</td>
</tr>
<tr>
<td>VARIATIONS OF DNA</td>
<td>7. DNA Transposition (Slide 28 – 38)</td>
<td></td>
<td>MBG, chapter 10 and 11, pp. 239-290 and 293-342.</td>
</tr>
<tr>
<td>GENE EXPRESSION</td>
<td>8. Transcription in Prokaryotes (Slide 1 – 14)</td>
<td></td>
<td>MBG, chapter 12, pp. 347-361.</td>
</tr>
</tbody>
</table>

*continued on next page*
<table>
<thead>
<tr>
<th>Chapter Title</th>
<th>Reading</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENE EXPRESSION</td>
<td>9. Transcription in Eukaryotes (Slide 15 - 33)</td>
<td>MBG, chapter 12 and 13, pp. 363-376 and 379-408</td>
</tr>
<tr>
<td>PROTEIN SYNTHESIS</td>
<td>11. Translational process (Slide 17 - 33)</td>
<td>MBG, chapter 14, pp. 411-456.</td>
</tr>
<tr>
<td>REGULATION OF GENE EXPRESSION IN PROKARYOTES</td>
<td>12. Regulation of gene expression in prokaryotes (Slide 1 - 22)</td>
<td>MBG, chapter 16, pp. 483-525.</td>
</tr>
<tr>
<td>REGULATION OF GENE EXPRESSION IN EUKARYOTES</td>
<td>13. Control of gene expression at the level of chromatin structure and transcription (Slide 1 - 16)</td>
<td>MBG, chapter 17, pp. 529-571.</td>
</tr>
<tr>
<td>REGULATION OF GENE EXPRESSION IN EUKARYOTES</td>
<td>14. Control of gene expression at the level of post-translation (Slide 17 - 29)</td>
<td>MBG, chapter 17, pp. 529-571.</td>
</tr>
<tr>
<td>METHODS</td>
<td>15. Some basic methods in Molecular Biology (Slide 1 - 22)</td>
<td>MBG, chapter 20, pp. 647-679.</td>
</tr>
</tbody>
</table>

Table 4.1

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 5

Lecture Notes

Topic 1. Chemistry of the cell (Download)\(^1\)
Topic 2. Constancy of DNA (Download)\(^2\)
Topic 3. Variations of DNA (Download)\(^3\)
Topic 4. Gene expression (Download)\(^4\)
Topic 5. Protein synthesis (Download)\(^5\)
Topic 6. Regulation of gene expression in Prokaryotes (Download)\(^7\)
Topic 7. Regulation of gene expression in Eukaryotes (Download)\(^8\)
Topic 8. Methods (Download)\(^9\)

\(^1\)This content is available online at <http://cnx.org/content/m28596/1.1/>.
\(^2\)See the file at <http://cnx.org/content/m28596/latest/1-CHEMISTRY-OF-THE-CELL.pdf>
\(^3\)See the file at <http://cnx.org/content/m28596/latest/2-CONSTANCY-OF-DNA.pdf>
\(^4\)See the file at <http://cnx.org/content/m28596/latest/3-VARIATIONS-OF-DNA.pdf>
\(^5\)See the file at <http://cnx.org/content/m28596/latest/4-GENE-EXPRESSION.pdf>
\(^6\)See the file at <http://cnx.org/content/m28596/latest/5-PROTEIN-SYNTHESIS.pdf>
\(^7\)See the file at <http://cnx.org/content/m28596/latest/6-REGULATION-OF-GENE-EXPRESSION-IN-PROKARYOTES.pdf>
\(^8\)See the file at <http://cnx.org/content/m28596/latest/7-REGULATION-OF-GENE-EXPRESSION-IN-EUKARYOTES.pdf>
\(^9\)See the file at <http://cnx.org/content/m28596/latest/8-METHODS.pdf>

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 6

End-of-topic Assignments

6.1 Topic 1. CHEMISTRY OF THE CELL

1. What are the main chemical components of a cell?
2. What are the structure levels of a protein?
3. Give an example of the modular characteristic of a protein.
4. What is a “Watson-Crick basepairing”?
5. What are the differences between a DNA and an RNA molecules?
6. What are the main weak chemical bonds existing in living organisms?
7. What are the characteristics of these bonds which determine their functions?
8. What is the chromatin? the chromosome?
9. Why is the eukaryotic genome much more compact than prokaryotic genome?

6.2 Topic 2. CONSTANCY OF DNA

1. Describe some experiences showing that DNA is the genetic material.
2. What is the Central Dogma of Molecular Biology?
3. Describe Meselson & Stahl’s experience about DNA replication in E. coli; what is the meaning of this experience?
4. What is a replicon?
5. What are the factors needed for the initiation of DNA replication in E. coli?
6. How are the two strands of DNA molecule being copied from an origin of replication?
7. What are the problems encountered by the replication machinery at the replication fork? How are these problems resolved?
8. What are the roles of Helicase, Topoisomerase, Primase, SSB proteins, DNA polymerase III, RNase H, DNA polymerase I?
9. What are the problems of finishing DNA replication in prokaryotes? eukaryotes? How are they resolved?

6.3 Topic 3. VARIATIONS OF DNA

1. What are the main causes of DNA variation? What are their roles in the living world?
2. How are the mutations being repaired during and shortly after the end of the replication process?
3. What are the main repair systems used by the cell to repair DNA damages between two replication processes?

1This content is available online at <http://cnx.org/content/m28513/1.1/>.
Available for free at Connexions <http://cnx.org/content/col10799/1.1>
CHAPTER 6. END-OF-TOPIC ASSIGNMENTS

4. What are the differences between homologous and site-specific DNA recombination?
5. What are the biological roles of homologous recombination? site-specific recombination?
6. Describe the Holliday model used to explain DNA homologous recombination.
7. Compare the Holliday model and the Double-Stranded Break (DSB) model of recombination.
8. What are the functions of RecBCD complex, RecA, RuvAB and RuvC in the homologous recombination in E. coli?
9. What are the functions of SSR recombinases in site-specific recombination?
10. What are transposons? How are they being classified?
11. What are the differences between replicative and non-replicative transposition?
12. How does a polyA retrotransposon transpose?
13. How is a retroviral-like retrotransposon transpose?

6.4 Topic 4. GENE EXPRESSION – TRANSCRIPTION

1. What are the characteristics of transcriptional process that distinguish it from DNA replication?
2. What are the components of prokaryotic RNA polymerase? What are their functions?
3. What are the structure and functions of a promoter?
4. How does the RNA polymerase initiate the transcription?
5. How is the RNA molecule being elongated?
6. What are the mechanisms of transcription termination?
7. What are the eukaryotic RNA polymerases? What are their functions?
8. What are the DNA sequences involved in transcription initiation by RNA polymerase II?
9. How does RNA polymerase II function during transcription?
10. What are the post-transcriptional mRNA processing’s?
11. Why is RNA splicing a crucial step in gene expression in eukaryotes?
12. What is a spliceosome? How does it function during splicing process?

6.5 Topic 5. PROTEIN SYNTHESIS

1. What are the characteristics of the Genetic Code?
2. What is the Wobble concept?
3. What are the disadvantages of translational compared to replicational and transcriptional processes?
4. What are the roles of tRNA, rRNA, mRNA?
5. What is an ORF? What are the criteria used to define it?
6. What is the 5’ end structure of a prokaryotic (and eukaryotic) mRNA necessary to its translation?
7. What are the functions of a ribosome?
8. What are the structural characteristics of a tRNA?
9. How is an amino acid attached to a tRNA? What determines the specificity of the reaction?
10. How is the translational process initiated in prokaryote? in eukaryote?
11. What are the main steps of translational elongation?
12. How is the translational process terminated?

6.6 Topic 6. REGULATION OF GENE EXPRESSION IN PROKARYOTES

1. What are the purposes of the regulation of gene expression in prokaryotes? in eukaryotes?
2. What are the main mechanisms of gene expression regulation in prokaryotes? in eukaryotes?
3. What do you think which determine the differences in the regulation of gene expression between these two groups?
4. What is a positive control of gene expression? a negative control
5. What are the structural and functional characteristics of an operon?
6. What is a catabolite repression?
7. What is “attenuation” in terms of regulation of gene expression?
8. How does the alternative use of σ factors fit the purpose of the regulation of gene expression in prokaryote?

6.7 Topic 7. REGULATION OF GENE EXPRESSION IN EUKARYOTES

1. What are the structural characteristics that determine different levels of the control of gene expression in eukaryotes?
2. What is an epigenetic inheritance? What are the basic mechanisms underlying epigenetic inheritance?
3. Give an example for epigenetic inheritance through histone modifications and DNA methylation?
4. What are the roles of TRANS proteins and CIS sequences in the control of transcriptional initiation?
5. What are the respective roles of general and specific transcription factors in initiating the transcription process?
6. What are the common modules of transcription factors?
7. How can alternative splicing generate more than one transcript from one gene?
8. How can transcription factors act at distance?
9. What are the determinants of mRNA stability?
10. What are the main mechanisms of post-translational control?
11. What are siRNAs? miRNAs? What are their roles in the control of gene expression?

6.8 Topic 8. METHODS

1. What are the main steps of a nucleic acid extraction protocol?
2. What is electrophoresis used for?
3. How can one determine the concentration of a double-stranded DNA by spectrophotometric analysis?
4. What are the enzymes used for PCR technique? What are their characteristics?
5. What are the principles of quantitative PCR based on the use of Taqman probe?
6. What are Molecular cloning techniques used for?
7. What is a vector? What are its characteristics?
8. What are the main steps of Molecular cloning protocols?
9. How is a PCR performed?
10. What are the main steps of Southern blotting?
11. What is the principle of Dideoxy sequencing? How is it applied in automatic sequencing?
13. How can Bioinformatics be used to predict gene function from their structures?
14. What are microarrays used for?
15. What is the principle of the Yeast Two-hybrid system?

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 7

End-of-course Assignments

7.1 Topic 1. CHEMISTRY OF THE CELL

Problem 1
During a process called apoptosis that leads to natural cell death, genomic DNA is hydrolyzed into multiple fragments having 180 bp and n x 180 bp-length. The results could be analyzed by agarose gel electrophoresis (Figure 1).

Agarose gel electrophoresis of DNA extracted from cultured cells

![Agarose gel electrophoresis of DNA](image)

Figure 7.1: 1. Non treated cells, 2. Heat-killed cells, 3. DNA molecular size marker, 4. Cells collected after 24 h induction to apoptosis

1.1. How could you explain these results?

1This content is available online at <http://cnx.org/content/m28504/1.1/>.

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
1.2. If you collect and analyze cells induced to apoptosis at 48 h after induction, what image do you expect to obtain after electrophoresis? Why?

**Problem 2**
Compared to DNA extraction from cell, RNA extraction requires much more care to obtain intact RNA. What could be the reasons of this difference?

**Problem 3**
Before a RNA solution is loaded in an agarose gel for electrophoresis, it must be heated 10 minutes at 65 °C. What could be the reason?

**Problem 4**
You need two proteins having the capacity to bind to the same region in genomic DNA but one is regulated by thyroid hormone whereas the other is regulated by glucocorticoid hormone. The protein regulated by thyroid hormone represses the expression of genes it binds to whereas the other activates these same genes. How could you produce genes encoding these proteins?

**Problem 5**
Nucleic acids absorb UV radiation with maximum absorption at 260 nm wavelength. This absorption is mainly due to peripheral electrons of purines and pyrimidines and can be measured as optical density values.

A student measures the optical density of a nucleic acid solution before and after boiling and obtains the following values:
- $\text{OD}_{260}$ before boiling = 0.846
- $\text{OD}_{260}$ after boiling and rapid re-cooling (placing on ice) = 0.123

How can you explain these results?

**Problem 6**
Analysis of base percentage of a nucleic acid extracted from an unidentified organism shows that this nucleic acid is composed of 30% A, 15% C, 35% G and 20% T. What conclusion can you make about this organism?

**Problem 7**
You are assigned the analysis of two samples, DNA and RNA extracts. The labels are unfortunately lost. How could you distinguish them?

**Problem 8**
The following graphs show the reassociation rate of two genomic DNA samples, one from a bacteria and the other from a mammal. The genomic DNAs are denatured by boiling and are let to renature by slow cooling.
How could you explain these results?

7.2 Topic 2. DNA REPLICA TION

**Problem 9**
A student set up two reactions:
- Reaction I: enzyme buffer + DNA polymerase + 350 bp-DNA fragment + dNTP + a non-identified solution
- Reaction II: enzyme buffer + DNA polymerase + 350 bp-DNA fragment + dNTP

After 1h-incubation at 37 °C, agarose gel electrophoresis analysis shows:
- A 350 bp-band from the reaction I
- No band observed from the reaction II

How could you explain these results?

**Problem 10**
Cloning techniques aim at amplifying a specific gene ligated to a vector. The vector containing the inserted gene, called recombinant vector, is introduced into a host cell. Inside the cell, recombinant vectors replicate to give rise to multiple copies.

What is (are) the structural characteristic(s) of these vectors which allow this amplification?

**Problem 11**
The structure of 16S rRNA gene of some eubacteria is shown in the following schema:
A scientist wants to: (1) detect all these eubacteria in the first step, and (2) specifically detect each of these species in clinical samples in the second step. He uses PCR (Polymerase Chain Reaction) technique which allows the in vitro amplification of DNA fragments.

How could he manage to do the first step? the second step?

Problem 12
Draw two replicons in the process of being replicated

Problem 13
Draw a scheme representing DNA replication by rolling circle to give rise to double-stranded DNA

7.3 Topic 3. DNA VARIATIONS

Problem 14
Sickle cell disease is expressed as abnormality of red blood cell shape (sickled-shape) due to abnormality of \(\beta\)-globin (a constituent of haemoglobin). Thalassemias are diseases caused by an abnormal low amount of globin proteins.

How can you tell about the possible causes of these diseases?

Problem 15
Explain how the Ames test can be used to detect mutagens

Problem 16
Taq polymerase used in PCR is a thermostable DNA polymerase which synthesizes DNA with a high error rate whereas Pfu polymerase has a low error rate. What makes this difference between the two enzymes?

Problem 17
Multiresistance to antibiotics in bacteria is due to transposition rather than mutations. Explain how a bacterium can become resistant to many antibiotics.

Problem 18
Present a scheme showing the structure of a protein encoding DNA fragment, the related mRNA and polypeptide

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Problem 19
Explain how the consensus sequences within bacterial promoters are established and how can one demonstrate that the promoter sequence is necessary for transcription initiation?

Problem 20
To fight against some pathogens, people try to inhibit the production of pathogenic proteins inside the cell. Explain how could it be done?

7.4 Topic 5. PROTEIN SYNTHESIS

Problem 21
What are the peptides that could be synthesized from the following DNA strand in vitro under nonstringent conditions: 5' TTGACGAGTAA 3'

Problem 22
Puromycin is an antibiotic which inhibits the translational process. It can bind to the A site of the ribosome. Explain the mechanism of action of this antibiotic.

7.5 Topic 6. REGULATION OF GENE EXPRESSION

Problem 23
What will happen if a mutation occurs in the coding region of the inhibitor gene of the lac operon leading to incapacity to bind lactose of the repressor, in the presence and absence of lactose?

Problem 24
An E. coli becomes insensitive to catabolite repression for lac operon. Give possible reasons for this.

Problem 25
Could regulation by attenuation occur in a eukaryote? Why?
Chapter 8

Multiple Choice Questions

1. One can distinguish prokaryotic chromosomes from eukaryotic chromosomes by determining:
   - a. Nucleotide sequence
   - b. Chromosome-linked proteins
   - c. Base composition
   - d. Secondary structure

2. In E. coli DNA replication, primer is:
   - a. A deoxyribonucleotide short sequence
   - b. A short RNA annealing to the 3' end of the template strand
   - c. A short RNA complementary to the 5' end of the leading strand
   - d. Synthesized by DNA polymerase I

3. Shine-Dalgarno sequence is:
   - a. Found at the 3' end of a prokaryotic gene
   - b. Found in 16S rRNA
   - c. Complementary to an mRNA sequence
   - d. Located upstream of the AUG initiation codon of a prokaryotic mRNA

4. If the uracil content is exhausted, the following process will immediately stop:
   - a. Reverse transcription
   - b. Transcription
   - c. Replication
   - d. Translation

5. The promoter is:
   - a. A factor involving in translational process
   - b. Associated with repressor in an inducible operon
   - c. A sequence located at the 3' end of a gene
   - d. The binding site for RNA polymerase

6. Proofreading activity of DNA polymerase III relies on:
   - a. The Mut S, H, L repair system recognizing parental DNA methylation
   - b. 3'-5' exonuclease function of DNA polymerase
   - c. RNase H activity
   - d. The UvrABC repair system

7. The difference on the regulation of gene expression in prokaryotes and eukaryotes is partly due to:

---

1This content is available online at <http://cnx.org/content/m28615/1.1/>. Available for free at Connexions <http://cnx.org/content/col10799/1.1>
CHAPTER 8. MULTIPLE CHOICE QUESTIONS

- a. Different environmental conditions
- b. Different cell components
- c. Different cell structural features
- d. Different cell numbers

8. The enzyme catalyzing the binding of Alanine to its tRNA is called:
- a. Alanine-tRNA polymerase
- b. Alanine-tRNA transferase
- c. tRNA-Alanyl polymerase
- d. Alanyl-tRNA synthetase

9. Microarray analysis can be used to:
- a. Determine the intron-exon organization of a gene
- b. Determine the concentration of a protein in a cell
- c. Determine the stage-specific expression of a gene
- d. Determine the presence of a DNA sequence in a cell

10. Hyperchromicity (increased OD value) results from:
- a. Increased light absorbance by double-stranded DNA when it is denatured
- b. Increased light absorbance by double-stranded DNA when it is hydrolyzed
- c. Increased light absorbance by double-stranded DNA contaminated by RNA
- d. Increased light absorbance by double-stranded DNA when it is renatured

11. The repair system acting just after the replication finishes is based on:
- a. The elimination of methylated bases
- b. The activities of Methylases
- c. The recognition of hemimethylated DNA strands to be repaired
- d. The excision of the oligonucleotide bearing the mismatch

12. The control of gene expression through an operon aims at:
- a. Regulating different gene networks depending on the external stimuli
- b. Regulating stepwise expression of a gene
- c. Exerting a synchronous and fast regulation of genes belonging to one metabolism process
- d. Producing different concentration of proteins of a metabolism process

13. Muscle, skin, liver cells differ from each other due to:
- a. Different mutations arisen in each cell type
- b. Different expression of genes in each cell type
- c. Different genes present in different cell types
- d. Different location of cell types in the organism

14. Automatic sequencing is based on:
- a. The utilisation of fluorescent labeling
- b. The utilisation of four types of dideoxynucleotide
- c. The utilisation of DNA polymerases
- d. All of the above items

15. Which of the following processes is involved in DNA repair:
- a. Conjugation
- b. Reversion of mutation
- c. Transposition
- d. Homologous recombination

16. Which of the following processes is characteristic to eukaryotic gene expression control:
- a. Alternative splicing
• b. Alternative use of $\sigma$ factor
• c. Transcription initiation
• d. Catabolite repression
Chapter 9

Seminar Topics

1. Present arguments for an “RNA world”
2. With recent discoveries in molecular biology does the “one gene - one polypeptide” concept still hold true?
3. Make the argument that prokaryotes are more highly evolved than eukaryotes.

1This content is available online at <http://cnx.org/content/m28676/1.1/>.

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 10

Interesting Links

10.1

<table>
<thead>
<tr>
<th>Website URL</th>
<th>Description and purpose of the website</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA from the Beginning <a href="http://www.dnaftb.org/dnaftb/">http://www.dnaftb.org/dnaftb/</a></td>
<td>Discover the concepts and experiments that define the fields of genetics and molecular biology.</td>
</tr>
<tr>
<td>DNA Interactive <a href="http://www.dnai.org/">http://www.dnai.org/</a></td>
<td>A large collection of videos and interactive 3-D animations for the discovery of the DNA structure and the development of &quot;DNA science.&quot;</td>
</tr>
<tr>
<td>BioStudio <a href="http://www.biostudio.com/a_sitemap.html">http://www.biostudio.com/a_sitemap.html</a></td>
<td>BioStudio has designed and developed science animations, over 100 to date, for flagship life sciences textbooks, including Molecular Cell Biology (Lodish et al.) and An Introduction to Genetic Analysis (Griffiths et al.).</td>
</tr>
<tr>
<td>- Chapter 15 “Genes and How They Work” <a href="http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter15/library.html">http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter15/library.html</a></td>
<td></td>
</tr>
<tr>
<td>- Chapter 18 “Control of Gene Expression” <a href="http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter18/library.html">http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter18/library.html</a></td>
<td></td>
</tr>
</tbody>
</table>

Table 10.1

\[\text{This content is available online at } <\text{http://cnx.org/content/m28437/1.1}/>\.

\[\text{http://www.dnaftb.org/dnaftb/}\]

\[\text{http://www.dnai.org/}\]

\[\text{http://www.biostudio.com/a_sitemap.html}\]

\[\text{http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter14/}\]

\[\text{http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter15/animations.html}\]

\[\text{http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter18/animations.html}\]

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 11

Course Development Support¹

Vietnam Ministry of Education and Training
Vietnam Education Foundation
Garland Science, Taylor and Francis, LLC
Instructional Design Team Reviewer, Syracuse University
Dr. Douglas Burks, Faculty Reviewer, Wilmington College

¹This content is available online at <http://cnx.org/content/m28499/1.1/>. Available for free at Connexions <http://cnx.org/content/col10799/1.1>
Chapter 12

Course Feedback

<table>
<thead>
<tr>
<th>Course Name: ___________________________</th>
<th>Location: _______________</th>
<th>Date: ________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor (s) __________________________</td>
<td>Your name (optional) ---</td>
<td></td>
</tr>
</tbody>
</table>

Please take a moment to complete this feedback form. Your comments will be carefully reviewed and used to improve the quality of the course.

**OVERALL**

1. Rate your overall satisfaction with the course.
   - _____ Very Satisfied
   - _____ Satisfied
   - _____ Neutral
   - _____ Dissatisfied
   - _____ Very Dissatisfied

2. Rate the course in terms of meeting your educational needs.
   - _____ Very Satisfied
   - _____ Satisfied
   - _____ Neutral
   - _____ Dissatisfied
   - _____ Very Dissatisfied

3. Based on the knowledge/skill you require to do your job, how would you change this course?

   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

**COURSE CONTENT**

1. Rate the course in terms of meeting the stated objectives.
   - _____ Very Satisfied
   - _____ Satisfied
   - _____ Neutral
   - _____ Dissatisfied
   - _____ Very Dissatisfied

2. Rate the course content (e.g., relevancy, structure, level of detail).
   - _____ Very Satisfied
   - _____ Satisfied
   - _____ Neutral
   - _____ Dissatisfied

---

1This content is available online at <http://cnx.org/content/m28501/1.1/>.

Available for free at Connexions <http://cnx.org/content/col10799/1.1>
CHAPTER 12. COURSE FEEDBACK

3. Rate the participative activities (e.g., assignments, seminar topics).
   _____ Very Satisfied
   _____ Satisfied
   _____ Neutral
   _____ Dissatisfied
   _____ Very Dissatisfied

4. Rate the course materials (e.g., lecture notes).
   _____ Very Satisfied
   _____ Satisfied
   _____ Neutral
   _____ Dissatisfied
   _____ Very Dissatisfied

5. What topics did you like best? Why? _____________________________________________________________________________________
   _____________________________________________________________________________________
   _____________________________________________________________________________________

6. What topics did you like least? Why? _____________________________________________________________________________________
   _____________________________________________________________________________________
   _____________________________________________________________________________________

7. Course content comments: _____________________________________________________________________________________
   _____________________________________________________________________________________
   _____________________________________________________________________________________

INSTRUCTION

1. Rate the instructor’s subject knowledge.
   _____ Very Good
   _____ Good
   _____ Barely Acceptable
   _____ Poor
   _____ Very Poor

2. Rate the instructor’s effectiveness (e.g., question handling, presentation, and ability to explain ideas).
   _____ Very Good
   _____ Good
   _____ Barely Acceptable
   _____ Poor
   _____ Very Poor

3. Instruction comments: _____________________________________________________________________________________
   _____________________________________________________________________________________
   _____________________________________________________________________________________

Thank you for your comments.
Attributions

Collection: Molecular Biology of the Gene
Edited by: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/col10799/1.1/
License: http://creativecommons.org/licenses/by/3.0/

Module: "Course Home"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m30796/1.1/
Pages: 2-3
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Letter to Students"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28590/1.1/
Page: 5
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Syllabus"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28701/1.1/
Page: 7
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Calendar and Readings"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28311/1.1/
Pages: 9-10
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Lecture Notes"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28596/1.1/
Page: 11
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "End-of-topic Assignments"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28513/1.1/
Pages: 13-15
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/
Module: "End-of-course Assignments"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28504/1.1/
Pages: 17-21
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Multiple Choice Questions"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28615/1.1/
Pages: 23-25
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Seminar Topics"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28676/1.1/
Page: 27
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Interesting Links"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28437/1.1/
Page: 29
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Course Development Support"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28499/1.1/
Page: 31
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/

Module: "Course Feedback"
By: Professor Ho Huynh Thuy Duong
URL: http://cnx.org/content/m28501/1.1/
Pages: 33-34
Copyright: Professor Ho Huynh Thuy Duong
License: http://creativecommons.org/licenses/by/3.0/
About Connexions
Since 1999, Connexions has been pioneering a global system where anyone can create course materials and make them fully accessible and easily reusable free of charge. We are a Web-based authoring, teaching and learning environment open to anyone interested in education, including students, teachers, professors and lifelong learners. We connect ideas and facilitate educational communities.

Connexions’s modular, interactive courses are in use worldwide by universities, community colleges, K-12 schools, distance learners, and lifelong learners. Connexions materials are in many languages, including English, Spanish, Chinese, Japanese, Italian, Vietnamese, French, Portuguese, and Thai. Connexions is part of an exciting new information distribution system that allows for Print on Demand Books. Connexions has partnered with innovative on-demand publisher QOOP to accelerate the delivery of printed course materials and textbooks into classrooms worldwide at lower prices than traditional academic publishers.