# Bio 4337 Seminal Papers in Biology

## Vincent P. Cirillo

## Spring, 2013 Monday and Wednesday, Room FO 3.222,

**Seminal Papers is a history course with a term paper that satisfies the University writing requirement. Selected theoretical and experimental papers in the early history of Molecular Biology from 1944 to 1963 are assigned to be read by all students. They are discussed and analyzed in class. The topics are covered roughly in the order in which they are discussed by Horace Freeland Judson in The Eighth Day of Creation: Maker's of the Revolution in Biology" (1996 Edition, Cold Spring Harbor Press). Judson's book, a widely acclaimed history of molecular biology, is based on the interviews of 111 scientists. The first Edition was published in 1978, the twenty fifth anniversary of the Watson and Crick papers on the structure of DNA. In his 1988 book, "What Mad Pursuit", Francis Crick stated that in comparison with other accounts, The Eighth Day of Creation "is more vivid, since it contains lengthy *verbatim* quotations from most of the participants. His story begins nearer in time to the discovery of the double helix and continues for another dozen years or so until the genetic code was unraveled ….. provid[ing] the most complete and the most balanced accounts so far of the beginnings of classical molecular biology". Readings in Judson serve as a background narrative for the selected papers. The 1996 edition has important additions: an Epilogue, "On the transformation of Molecular Biology, 1970-1995, an Afterword I, "In defense of Rosalind Franklin", and Afterword II, "What Did Erwin Chargaff Contribute?"**

**Most papers are covered in two sessions: the first session is devoted to background readings in Judson and the second to reading of the seminal papers. Outlines are provided for both readings as Learning Modules.**

### Topics to be covered

**DNA**

**The genetic material (DNA): (Avery, MacLeod and McCarty)**
**DNA Replication (Delbrück; Meselson and Stahl)**

**Protein Synthesis**

**Cell-free protein synthesis: tRNA (Zamecnick, Hoagland et al.)**
**Adaptor hypothesis: tRNA (Crick)**
**Messenger RNA: (Brenner, Jacob and Meselson**
**The genetic code is a triplet: Crick, Barnett, Brenner and Watts-Tobin**
**The letters of the code: Nirenberg and Matthaei; Nirenberg and Leder**

**Regulation:**

**Protein synthesis: The *lac* Operon (Jacob and Monod)**
**Enzyme function: Allostery: (Monod, Changeux and Jacob)**

## Format, Student Participation and Grading

**Text Book:** **The Eighth Day of Creation, Makers of the Revolution in Biology, Horace F. Judson, 1996, Cold Spring Harbor Laboratory Press.**

**Seminal Papers and Books:** **eJournals and Library Reserve. (Passwords will be given in class)**

**Attendance and Class Participation:** **In a small class attendance and class participation are essential. The readings should be completed before class. Come on time and be prepared!**

**Term paper:** **A paper on an approved topic within the historical scope of the course which will meets the University writing requirement: 1,000 words *not counting figure legends, tables and references.* The class will be divided into two, 15 student groups, A and B; the deadlines for the first submission for each group are shown in the Assignment Schedule. It will be returned within a week to 10 days with corrections and comments. The grade on the term paper represents 15 % of the course grade. The first submission is graded on the basis of a maximum of 12 points; the final 3 points are based on the corrections in a final submission.**

> **All term papers must be checked for originality by Turitin or other plagiarism detection service. Plagiarism will be reported to and adjudicated by the Judicial Affairs Office. Plagiarism will result in a zero for the term paper and, as a consequence. an F for the course.**

**Student oral presentations:** **Each student will present a 10 minute power point, document camera or overhead presentation on the topic of the term paper with a handout. I will give a sample presentation.**

**Exams:** **There will be two, non-cumulative exams.**

**Course grade: Determined as follows:**

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|---|---|
| **1) Exams 2 x 37.5 % each:** | **75 %** |
| **2) Term paper:** | **20 %** |
| **3) Student presentations:** | **5 %** |

**E-mail communication: I tend to send many e-mails with comments on the readings or reminders of upcoming deadlines. Please read your e-mails.**

## Assignment Schedule

| Date | | Day | Exams<br>Term Paper | Reading Assignments<br>Judson (pp.)/Seminal Paper |
|---|---|---|---|---|
| January | 14 | M | | Introduction: Syllabus, Course Format |
| | 16 | W | | 1. DNA is the hereditary material, pp. 11-24 |
| | 23 | W | | *Avery, McCleod and McCarty paper* |
| | 28 | M | | 2. The alpha helix, pp. 51-65. |
| | 30 | W | | *Pauling, Corey and Branson: JACS and PNAS papers* |
| February | 4 | M | | 3. Double Helix, I pp. 77 - 97 |
| | 6 | W | | II pp. 97-123 |
| | 11 | M | | …. III pp. 125-150 |
| | 13 | W | | *Watson and Crick papers* |
| | 18 | M | Exam I | Topics 1-3 |
| | 20 | W | | 4. DNA Replication, pp. 161-166 |
| | 25 | M | | *Meselson and Stahl paper* |
| | 27 | W | | *5.*Protein synthesis.236-248; 312-313, 333-336 |
| March | 4 | | | Adaptor, italicized paragraphs, pp. 287-295 |
| | 6 | W | | *Hoagland, Stephenson and Zamecnik, 1957; Hoagland, 1989* |
| | 18 | M | Term Paper A | 6.The *lac* Operon I pp. 369-374, 390-39 |
| | 20 | W | | II pp. 400-403 |
| | 25 | M | | *Jacob and Monod Review* I |
| | 27 | W | | *Jacob and Monod Review* II |
| April | 1 | M | Exam II | *Topics 4-6* |
| | 3 | W | | 7. Messenger RNA, 418-432; |
| | 8 | M | | Brenner, Jacob and Meselson paper |
| | 10 | W/W | | 8. Triplet code 465-468; *Crick, Barnett, Brenner and Watts –Tobin* |
| | 15 | M | | *9.* UUU is Phenylalanine, *453-464* |
| | 17 | W | | *Nirenberg and Matthaei paper* |
| | 22 | M | | 10. Allostery, "Second secret of life",545-557 |
| | 24 | W | | *Monod, Changeux and Jacob* Review |
| | 29 | M | Term Paper B | *Monod, Changeux and Jacob Review* |
| May | 1 | W | | Student Presentations |
| | 6 | M | | Student Presentations |
| | 8 | W | | Student Presentations |
| | 13 | M | | Student Presentations |
| | 15 | W | | Student Presentations |
| Finals week | | | Exam III | Topics 7-10 |

# Papers on eReserve

**The following papers are on eReserve. Registered students will be provided with a password. The titles in red are required seminal papers. The titles in black were seminal papers in previous years – they may be useful for reference.(The papers are listed in the order in which they will be read.)**

**Avery, Oswald, T., Colin M. MacLeod and Maclyn McCarty 1944 Studies on the chemical nature of the substance inducing transformation of pneumococcal types. Induction of transformation by a desoxyribonucleic acid fraction isolated from Pneumococcus Type III. Journal of Experimental Medicine, 79, 137-158.**

**Alfred Hershey and Martha Chase 1952 Independent function of the viral protein and nucleic acid fraction in growth of bacteriophage. The Journal of General Physiology, 36, 39-56.**

**Chargaff, Erwin 1950 Chemical specificity of nucleic acids and mechanism of their enzymatic degradation. Experientia, 6, 201-209.**

**Pauling, Linus and Robert B. Corey 1950 "Two Hydrogen Bonded Spiral Configuratons of the Polypeptide Chain. Journal of the American Chemical Society 72, 5349**

**Pauling, Linus, Robert Corey and H. R. Branson 1951 The structure of proteins: Two hydrogen-bonded helical configurations of the peptide chain. Proceedings of the National Academy of Sciences, USA, 37, 205-211.**

**Pauling, Linus and Robert Corey 1951 The pleated sheet, a new layer configuration of polypeptide chains. . Proceedings of the National Academy of Sciences, USA, 37, 251.**

**Watson, James, D. and Francis H. C. Crick 1953, Molecular structure of nucleic acids. Nature 171, 737-738. Note: in Judson: pp. 170-171**

**Watson, James, D. and Francis H. C. Crick 1953, Genetical implications of the structure of deoxyribonucleic acid. Nature, 171, 964-967 Note: in Judson: pp. 171-173**

**Meselson, Mathew and Franklin W. Stahl 1958, The replication of DNA in Escherichia coli, Proceedings of the National Academy of Sciences, USA, 44, 671-682.**

**Hoagland, Mahlon B. , Paul C. Zamecnik and Mary L. Stephenson 1957, Intermediates in protein synthesis, Biochimica et Biophysica Acta, 24, 215-216.**

**Hoagland, Mahlon B, 1989, Commentary (on 1957 paper)**

**Biochimica et Biophysica Acta, 1000, 103-105.**
***Hoagland* MB, *Stephenson* ML, *Scott* JF, *Hecht* LI and Zamecnik PC *1958*, A soluble ribonucleic acid intermediate in protein synthesis, *J.* Biol. Chem. *231*, 241–57.**

**Zamechik, Paul C., 1969, An historical account of protein synthesis with current overtones – a personalized view. Cold Spring Harbor Symposium on Quantitative Biology, 7, 1-16.**
**Chapeville, Francois, Fritz Lipmann, Gunter von Ehrenstein, Bernard Weisblum, William J. Ray, Jr., and Seymour Benzer 1962, Proceedings of the National Academy of Sciences, USA, 48, 1086-1092.**

**Brenner, Seymour, Francois Jacob and Mathew Meselson 1961, An unstable intermediate carrying information from genes to ribosomes for protein synthesis. Nature 190, 576-581.**

**Crick, F.H., Leslie Barnett, Sidney Brenner and R. J. Watts-Tobin 1962, General Nature of the Genetic code for proteins. Nature 192, 1227-1232.**

**Nirenberg, Marshall, W., and J. Heinrich Mattaei 1961, The dependence of cell-free protein synthesis in E. coli upon naturally occurring or synthetic polyribonucleotides. Proceedings of the National Academy of Sciences, USA, 47, 1588-1602.**

**Jacob, Francois, David Perrin, Carmen Sanchez and Jacques Monod 1960, Compte Rendus des Seances de l'Academie des Sciences, 250, 1727-1729.**
**(Translated from the French)**

**Jacob, Francois and Jacques Monod 1961, Genetic regulatory mechanisms in the synthesis of proteins. Journal of Molecular Biology 3, 318-356.**

**Monod, Jacques, Jean-Pierre Changeux and Francois Jacob 1963, Allosteric proteins and cellular control systems. Journal of Molecular Biology, 6, 306-329.**