Washington State University
School of Molecular Biosciences

**MEMORANDUM**

**TO:** Howard Grimes, Dean, The Graduate School

**FROM:** Lisa Gloss, Associate Director, School of Molecular Biosciences (SMB)

**DATE:** March 23, 2010

**SUBJECT:** Reducing the number of graded credits required for a Ph.D. degree

This memo is in response to the policy change of the WSU Graduate School to reduce the required number of graded credits from 34 to 15 credits for a Ph.D. degree. The School of Molecular Biosciences is requesting a reduction to 21 graded credits for the Molecular Biosciences Ph.D. This proposed policy change was formulated by the SMB Graduate Studies Committee; when presented to the faculty, there was a unanimous vote for approval.

The details of this proposal for reducing the required number of graded credits are presented in the attached documents:

1) Summary of the current and proposed requirements
2) Detailed “typical timeline” for the current Ph.D. program
3) Detailed “typical timeline” for the proposed Ph.D. program
4) Major Curricular Change paperwork to create two new courses mentioned in the proposed “typical timeline”

The reduction in graded credits was arrived at by two mechanisms.

First, certain courses (MBioS 541 and 579 seminars and MBioS 593 research proposals) will be converted from graded to S/F credit hours (reduction of 11 hours). One rationale for these changes is that it is difficult for faculty and dissertation committees to establish a uniform grading scale across all students when most faculty members attend and evaluate only a subset of the student performances. In contrast, there is generally a clear consensus in the difference between a passing and failing performance for a proposal defense or seminar presentation. Furthermore, MBioS 541 grading is currently based largely on attendance. Overall, the change from graded to non-graded credits for these three courses will result in the assignment of grades for only didactic coursework. Thus, the resulting grade point average will be more reflective of student academic class room performance.

Second, the required number of electives will be reduced from four courses (10 to 11 graded credits) to two courses (4 to 5 graded credits). This will allow students to complete their didactic coursework within the first two years of graduate study. Students will accelerate their focus on research related to their dissertation while maintaining sufficient discipline- and interdisciplinary training with the core and two elective courses.

**Washington State University**
**MAJOR CHANGE FORM - - REQUIREMENTS**
**(Submit original signed form and TEN copies to the Registrar's Office, zip 1035.)**
*See* https://www.ronet.wsu.edu/ROPubs/Apps/HomePage.ASP *for this form.*

*Submit an additional copy to the Faculty Senate Office, French Administration 338, zip 1038.

**Department Name** School of Molecular Biosciences

**1. CHECK PROPOSED CHANGES.**

*☐ Change department/program name *from* ____________ *to* ____________
*☐ New degree or program *in* ____________
*☐ Change name of degree *from* ____________ *to* ____________
*☐ Drop degree or program *in* ____________
*☐ Extend existing degree or program *to* ____________ campus

☐ New Major *in* ____________
☐ Change name of Major *from* ____________ *to* ____________
☑ Revise Major requirements *in* Ph.D. in Molecular Biosciences
☐ Drop Major *in* ____________
☐ Revise certification requirements for the Major *in* ____________

☐ New Option *in* ____________
☐ Revise requirements for the Option *in* ____________
☐ Drop Option *in* ____________

☐ New Minor *in* ____________
☐ Revise Minor requirements *in* ____________
☐ Drop Minor *in* ____________

☐ New Undergraduate Certificate *in* ____________
☐ Revise Undergraduate Certificate requirements *in* ____________
☐ Drop Undergraduate Certificate *in* ____________

☐ Other ____________

**Effective term/year** Fall 2010

| Dr. Lisa Gloss | 335-5859 | lmgloss@wsu.edu |
|---|---|---|
| **Contact Person** | **Contact Phone No.** | **Contact email** |

**2. GIVE REASONS FOR EACH REQUEST MARKED ABOVE.** *(Attach additional paper if necessary; see reverse side.)* See attached.

**4. SIGN AND DATE APPROVALS.**

L. M. Gloss — Chair Signature/date

3/23/2010 — Dean Signature/date

____________ General Education Com/date

____________ Catalog Subcom/date

____________ Academic Affairs Com/date

____________ Graduate Studies Com/date

____________ Senate/Date

# Summary of Current and Proposed graded credit hours for the Ph.D. in Molecular Biosciences

## Current Program requirements

Didactic graded course work (23 to 24 credits):
MBioS 503 – Molecular Biology I – 3 cr
MBioS 504 – Molecular Biology II – 3 cr
MBioS 513 – General Biochemistry I – 3 cr
Discipline-specific course, either:
- MBioS 514 – (Biochem) General Biochemistry II – 3 cr
- MBioS 501 – (GenCB) Cell Biology – 3 cr
- MBioS 550 – (Micro) Microbial Physiology

Elective coursework – 10 or 11 cr, typically four courses

Non-didactice graded course work (11 credits):
MBioS 541 – Research Seminar – 1cr
MBioS 579 –SMB Seminar – 2 cr for each seminar, total of 6 cr
MBioS 593 – Research Proposal - 2 cr each proposal, total of 4 cr

The balance of the credits will be in MBioS 600 and MBioS 800 – research credits to bring the total program credits to 72 hours.

## Proposed Program requirements

Didactic graded course work (21 credits):
MBioS 503 – Molecular Biology I – 3 cr
MBioS 504 – Molecular Biology II – 3 cr
MBioS 513 – General Biochemistry I – 3 cr
Discipline-specific course, either:
- MBioS 514 – (Biochem) General Biochemistry II – 3 cr
- MBioS 501 – (GenCB) Cell Biology – 3 cr; MBioS 529 – Selected Topics in Cell Biology
- MBioS 550 – (Micro) Microbial Physiology

Elective coursework – 4 to 5 cr, typically two courses

Two new required courses:
*MBioS 507 – Critical Analysis of Scientific Literature – 2 cr
*MBioS 508 – Quantitative Approaches in Molecular Biosciences – 2 cr

*Currently offered as MBioS 568 Advanced Topics in Molecular Biosciences; paperwork to create new courses have been submitted to the Registrar's Office. Copies of the paperwork attached.

The balance of the credits will be in MBioS 600 and MBioS 800 – research credits to bring the total program credits to 72 hours.

*CURRENT*

# TYPICAL TIMELINE FOR PH. D. GRADUATE PROGRAM

Adapted from the October 2009 revision of the SMB Graduate Handbook

## FIRST YEAR

### A. FIRST SEMESTER

- **Course enrollments (total 12 credit hrs)**

| | | |
|---|---|---|
| General Biochemistry | MBioS 513 (graded) | 3 credit hrs |
| Molecular Biology I | MBioS 503 (graded) | 3 credit hrs |
| Mini-Seminar | MBioS 541 (graded) | 1 credit hrs |
| Special Problems | MBioS 600 (S/F) | 4 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | 1 credit hr |

- **Two 8-week lab rotations**; complete rotation evaluation form for each.

### B. SECOND SEMESTER

- **Course enrollments (total 12 credit hrs)**

| | | |
|---|---|---|
| Molecular Biology II | MBioS 504 (graded) | 3 credit hrs |
| Seminar | MBioS 579 (graded) | 2 credit hrs |
| Discipline specific course | MBioS 514 (Biochem),<br>MBioS 501 (GenCB), OR<br>MBioS 550 (Micro) (graded) | 3 credit hrs |
| Special Problems | MBioS 600 (S/F) | 3 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | 1 credit hr |

- **Third 8-week lab rotation;** fourth rotation optional; complete rotation evaluation forms
- **Selection of thesis advisor**: Submit a preference list of two potential thesis advisors by the end of the final rotation
- **Choose thesis committee members** – at least three faculty members in addition to the thesis advisor. Two members must be SMB core faculty.

### C. SUMMER

- **First research proposal (MBioS 593)**
  First proposal will be on a research project in the thesis laboratory
- **Prepare the "Program of Study"** (form available on the Graduate School website); have ready for approval and signing by the thesis committee members at the first proposal defense

## SECOND YEAR

### A. THIRD SEMESTER

- **Course enrollment (total of 12 credit hrs)**

| | | |
|---|---|---|
| Research Proposal | MBioS 593 (graded) | 2 credit hrs |
| One or two electives | Must have a minimum 34 graded credits for Ph.D. degree | 2-6 credit hrs |
| Special Problems | MBioS 600 (S/F) | Up to 12 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | 1 credit hr |

- **Oral defense of the first research proposal (MBioS 593) completed by October 30th**
- **Get the "Program of Study" signed** by the thesis committee members at the first proposal defense. Deliver signed document to Graduate program coordinator for approval and signing by the Associate Director of Graduate Studies. The Program of Study will then be filed with the Graduate School for final approval.

### B. FOURTH SEMESTER

- **Course enrollment (total of 12 credit hrs):** Change MBioS 600 to MBioS 800 once the Program of Study is approved by the Graduate School.

| | | |
|---|---|---|
| One or two electives | Complete minimum 34 graded credits for Ph.D. degree | 2-6 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | Up to 12 credit hrs |

## THIRD YEAR

### A. FIFTH SEMESTER

- **Course enrollment (total of 12 credit hrs)**

| | | |
|---|---|---|
| Elective course (if needed) | Complete minimum 34 graded credits for Ph.D. degree | |
| Research Proposal | MBioS 593 (graded) | 2 credit hrs |
| Seminar | MBioS 579 (graded) | 2 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | Up to 8 credit hrs |

- **Prepare Second Proposal (Preliminary Examination)**
  Second Research Proposal will be a continuation of the student's research area (follow the SMB Guidelines for Proposal and Guidelines for Proposal II)

### B. SIXTH SEMESTER

- **Stipend level increased to RAII or TAII** level if student has passed "Preliminary Examination"
- **Course enrollment (total of 12 credit hrs)**

| | | |
|---|---|---|
| Elective course (if needed) | Complete minimum 34 graded credits for Ph.D. degree | |
| Dissertation hours | MBioS 800 | Up to 12 credit hrs |

## FOURTH AND SUBSEQUENT YEARS

- **Course enrollment (total of 12 credit hrs) for each semester**

| | | |
|---|---|---|
| Elective course (if needed) | Complete minimum 34 graded credits for Ph.D. degree | |
| Seminar | MBioS 579 (graded, enroll for one additional semester) | 2 credit hrs |
| Dissertation hours | MBioS 800 | Up to 10 credit hrs |

***PROPOSED*** Changes highlighted in red.

**TYPICAL TIMELINE FOR PH. D. GRADUATE PROGRAM**

## FIRST YEAR

### A. FIRST SEMESTER

- **Course enrollments (total 12 credit hrs)**

| | | |
|---|---|---|
| General Biochemistry | MBioS 513 (graded) | 3 credit hrs |
| Molecular Biology I | MBioS 503 (graded) | 3 credit hrs |
| Critical Analysis… | MBioS 507 proposed (graded) | 2 credit hrs |
| Mini-Seminar | MBioS 541 (S/F) | 1 credit hrs |
| Special Problems | MBioS 600 (S/F) | 2 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | 1 credit hr |

- **Two 8-week lab rotations**; complete rotation evaluation form for each.

### B. SECOND SEMESTER

- **Course enrollments (total 12 credit hrs)**

| | | |
|---|---|---|
| Molecular Biology II | MBioS 504 (graded) | 3 credit hrs |
| Discipline specific course | MBioS 514 (Biochem), MBioS 501 (GenCB), OR MBioS 550 (Micro) (graded) | 3 credit hrs |
| Quantitative Approaches… | MBioS 508 proposed (graded) | 2 credit hrs |
| Seminar | MBioS 579 (S/F) | 2 credit hrs |
| Special Problems | MBioS 600 (S/F) | 1 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | 1 credit hr |

- **Third 8-week lab rotation;** fourth rotation optional; complete rotation evaluation forms
- **Selection of thesis advisor**: Submit a preference list of two potential thesis advisors by the end of the final rotation
- **Choose thesis committee members** – at least three faculty members in addition to the thesis advisor. Two members must be SMB core faculty.

### C. SUMMER

- **First research proposal (MBioS 593)**
  First proposal will be on a research project in the thesis laboratory
- **Prepare the "Program of Study"** (form available on the Graduate School website); have ready for approval and signing by the thesis committee members at the first proposal defense

## SECOND YEAR

### A. THIRD SEMESTER

- **Course enrollment (total of 12 credit hrs)**

| | | |
|---|---|---|
| Research Proposal | MBioS 593 (S/F) | 2 credit hrs |
| One or two electives | Must have a minimum 21 graded credits for Ph.D. degree | 2-6 credit hrs |
| Special Problems | MBioS 600 (S/F) | To total of 12 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | 1 credit hr |

- **Oral defense of the first research proposal (MBioS 593) completed by October 30th**
- **Get the "Program of Study" signed** by the thesis committee members at the first proposal defense. Deliver signed document to graduate program coordinator for approval and signing by the Associate Director of Graduate Studies. The Program of Study will then be filed with the Graduate School for final approval.

### B. FOURTH SEMESTER

- **Course enrollment (total of 12 credit hrs):** Change MBioS 600 to MBioS 800 once the Program of Study is approved by the Graduate School.

| | | |
|---|---|---|
| One or two electives | Complete minimum 21 graded credits for Ph.D. degree | 2-6 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | To total of 12 credit hrs |

## THIRD YEAR

### A. FIFTH SEMESTER

- **Course enrollment (total of 12 credit hrs)**

| | | |
|---|---|---|
| Research Proposal | MBioS 593 (S/F) | 2 credit hrs |
| Seminar | MBioS 579 (S/F) | 2 credit hrs |
| Dissertation hours | MBioS 800 (S/F) | To total of 12 credit hrs |

- **Prepare Second Proposal (Preliminary Examination)**
  Second Research Proposal will be a continuation of the student's research area (follow the SMB Guidelines for Proposal and Guidelines for Proposal II)

### B. SIXTH SEMESTER (NO ELECTIVES OR GRADED CREDIT IN SUBSEQUENT SEMESTERS)

- **Stipend level increased to RAII or TAII** level if student has passed "Preliminary Examination"
- **Course enrollment (total of 12 credit hrs)**

| | | |
|---|---|---|
| Dissertation hours | MBioS 800 | To total of 12 credit hrs |

## FOURTH AND SUBSEQUENT YEARS

- **Course enrollment (total of 12 credit hrs) for each semester**

| | | |
|---|---|---|
| Dissertation hours | MBioS 800 | To total of 12 credit hrs |

Original to the Registrar's office 3/22/10

COPY

**Washington State University**
**MAJOR CURRICULAR CHANGE FORM - - COURSE**
**(Submit original signed form and ten copies to the Registrar's Office, zip 1035.)**
*See* https://www.ronet.wsu.edu/ROPubs/Apps/HomePage.ASP *for this form.*

Required Effective Date: 01/01/2011
**(effective date cannot be retroactive)**

☑ New course ☐ Temporary course ☐ Drop service course
☐ There is a course fee associated with this course
http://www.schedules.wsu.edu/Schedules/Apps/CourseFees.ASP

☐ Variable credit ______
☐ Repeat credit (cumulative maximum ______ hours)
☐ Increase credit (former credit ______)
☐ Lecture-lab ratio (former ratio ______)
☐ Number (former number ______)
☐ Prefix (former prefix ______)
☐ Crosslisting (between WSU departments) **(Must have both departmental signatures)**
☐ Cooperative listing (UI prefix and number ______) taught by: WSU ☐ UI ☐ jointly taught ☐
☐ Conjoint listing (400/500)
☐ S, F grading
☐ Request to meet Writing in the Major [M] requirement **(Must have All-University Writing Committee Approval)**
☐ Request to meet GER in ______ **(Must have GenEd Committee Approval)**
☐ Fulfills GER lab (L) requirement
☐ Professional course **(Pharmacy & Vet Med only)**
☐ Graduate credit **(professional programs only)**
☐ Other (please list request) ______

| course prefix | course no. | title |
|---|---|---|
| MBioS | 507 | Critical Analysis of Scientific Literature |

| credit | lecture hrs per week | lab hrs per week | studio hrs per week | prerequisite |
|---|---|---|---|---|
| 2 | 2 | | | MBioS 503 and MBioS 513 or c//. |

Description (**20 words or less**) In-depth dissection and discussion of current molecular bioscience papers to foster development of critical reading of primary literature

**Instructor:** Pat Hunt  Phone number: 335-4954  Email: pathunt@wsu.edu
**Contact:** Kelly McGovern  Phone number: 335-4566  Email: mcgoverk@wsu.edu

- Please attach rationale for your request, a detailed course outline/syllabus and explain how this impacts other units in Pullman and other branches (if applicable).
- Secure all required signatures and provide 10 copies to the Registrar's Office.

17 Mar 2010 | 3/17/10

**Chair/date** | **Dean/date** | **General Education Com/date**

**Chair (if crosslisted/interdisciplinary)*** | **Dean (if crosslisted/interdisciplinary) *** | **Graduate Studies Com/date**

**All-University Writing Com/date** | **Academic Affairs Com/date** | **Senate/date**

***If the proposed change impacts or involves collaboration with other units, use the additional signature lines provided for each impacted unit and college.**

**MBioS 507 - Critical Analysis of Scientific Literature**

**Rationale:**

The genesis of MBioS 507 recognizes the need to provide structured, mentored training in the critical analysis of scientific literature to first year graduate students in the School of Molecular Biosciences (SMB). The advantages (and necessity) of such a course as well as its format was discussed by the SMB Graduate Studies Committee, and the proposed course was approved unanimously at an SMB faculty meeting.

The course will be offered each fall semester, targeted toward graduate students in their first semester. As described in the attached syllabus, the format of the course will be centered around lengthy, in-depth analyses of recent papers spanning an interdisciplinary continuum of topics. The syllabus also addresses the objectives of the course and expectations of the students enrolled in the course. In short, this course will prepare first year graduate students for their transition from guided learning from textbooks to self-education from the primary literature. The immediate tangible benefits of the course will be the enhanced preparation of SMB students to surmount two specific hurdles in their early graduate career: 1) critical evaluation in choosing a paper to present for their first seminar in the spring semester of their first year, and 2) dissection of the relevant literature in the development and defense of their First Proposal (based on their proposed thesis/dissertation research) in the first semester of their second year.

This course was offered on an initial trial basis in the Fall 2009 semester as an MBioS 568 Special Topics course. The response from the faculty and students participating in the course was enthusiastically positive. Given this positive response, subsequent offerings will expand on the basic design of the course, and SMB is requesting the formal establishment of this course offering under its own specific course number and description.

**Impact:** No impact on other academic units is expected; instruction will be provided exclusively by SMB faculty, and enrollment will be primarily SMB graduate students.

# MBioS 568

**Advanced Topics in Molecular Biosciences:**
**Critical Analysis of Scientific Literature**

Fall 2009

Faculty: Hunt
Hassold
Davis
Black

**(Note: This course is based on a similar course (L523) that is offered at Indiana University. Anything that goes right with MBioS S541 is due to the organizational skills of Bill Saxton, the original course director of L523).**

# Critical Analysis of Scientific Literature (paper bashing)

We do experiments to learn something that we don't know. This seems like a ridiculously simple statement, but it includes assumptions that biologists use but don't often discuss formally.

**Assumption 1: Experiments are designed to answer questions.** The basic plan of a research project is to formulate a question and design/execute experiments that answer it. The overall thrust of work in a lab is aimed at "large" questions; individual projects focus on a smaller question that helps address the larger ones; and each experiment asks a smaller, very specific question.

> Large Question (overall lab goal)
>
> How does maternal age affect segregation of human chromosomes?
>
> Smaller Question (project)
>
> Are abnormalities in meiotic crossing-over important in maternal age-dependent nondisjunction?
>
> Specific Question (experiment)
>
> Among cases of trisomy 21 of maternal origin, is there a difference in recombination patterns in individuals whose mothers were over 40 years of age at the time of conception?

**Assumption 2: We will recognize the correct answer when we see it.** If we don't already *know* the answer to the question how can we tell if a putative answer is correct? For this we must rely on related information and background knowledge. That is, to interpret an experimental result correctly, we must be armed with a body of independent data/knowledge that provides context.

**Assumption 3: We know how to go about getting an answer to our question.** Although we may have a very specific question in mind, we may design an experiment that can't answer it. There are many reasons why this might happen: There might be technical problems (e.g., the equipment is not sufficiently sensitive to measure the effect), or biological problems (e.g., an unknown protein has no methionine in it, so $^{35}$S-methionine cannot be used to label it), or we may simply have made a mistake (e.g., the gene fusion is in the wrong reading frame due to a calculation error). Perhaps the most common error (which we can only see retrospectively) is that we didn't know enough at the time the experiment was designed to design it well.

For each experiment - flawed or not - we *always* get a result. Something happens. Whether we see this something as a significant result, or as an "artifact" depends on two things. One is our background knowledge (against which we compare the result) and the other is our ability to reason accurately (to make the comparison). Your courses, your thesis proposal defense, journal clubs and seminars and, most importantly, the scientific literature available to you, provide access to the store of knowledge. Our purpose in this course is not only to increase your knowledge of how cells and biomolecules work, but to gain insight into the process of scientific reasoning, so that you can use the store of knowledge to design good experiments and critically assess their results.

*Your scientific reasoning ability is the most important tool for your career: It is necessary in interpreting the experiments of others and absolutely vital in interpreting your own. Because someone published it in Cell or because you did it yourself doesn't mean that an experiment/interpretation is a good one. Therefore, it is worth investing a substantial amount of effort in learning and practicing the critical examination of experiments.*

## Some issues for consideration

***What is important to remember from a paper or from a seminar?***

There is a temptation to remember the conclusion, the bottom line, the take-home message, the Answer. After all, this is the most important part..........the experiments were designed to answer a question. But suppose we were to remember *just* the conclusions of papers and seminars. We would be in a good position to describe them to someone else, to write about them on an exam, to correlate them with our own work. All of this is important, so we must, indeed, remember the conclusions. But what if we later learn that the interpretations of the experiments were flawed and the conclusions were invalid? It has been estimated that the half-life of a hypothesis is less than 5 years; at this rate, half of the exciting new "conclusions" you learn in graduate school will have been either modified or replaced with different ones by the time you finish your postdoc.

A major message of "Critical Analysis" is that *we should always learn the conclusions only in the context of the experiments that "prove" them.* The conclusions may be wrong but the experimental techniques and results are real (barring outright fraud). As noted above, for every experiment *something* happens. The work is valid – but sometimes the interpretations are wrong. If we remember not only the conclusions but also the experiments and their results, we need only add a bit of re-interpretation to integrate the new information with the old. By adopting this deeper approach to your study of the literature, you can build continuously on a store of knowledge that becomes more integrated with time. It will not require much restructuring as new improved conclusions come along.

***What should you believe?***

Throughout your education, you have been taught that the Teacher or the Book provides the True Facts. This is graduate school, and that is no longer true. We, and the literature, will offer you data and interpretations but *you must think critically about it yourself, and not simply accept our interpretations as "truth."* Simply accepting and memorizing interpretations as "facts" is not a viable option for a biologist!

One purpose of the critical analysis format is to help you make the transition—if you have not already done so—from "undergraduate mode" to "graduate mode"; to help you challenge other peoples' "knowledge," and to help you change your approach to studying "scientific facts." Please view MBioS568 as a safe testing ground in which you can hone your critical thinking skills and come to class prepared to *think* and *actively participate*.

## Course Format

For each class we will read one, two or even three papers. In class, we will dissect them. If everyone is prepared and we don't get sidetracked, the discussion should last for less than 2 hours. It may not though, so don't plan on going home early.

During the semester we will discuss several papers that are examples of great science; the ones you should try to emulate. However, several others have mistakes that you should try to avoid. The purpose of the discussion is to go through each experiment in detail, to discuss exactly what was done, and why the interpretations are or are not valid.

## Discussion Format

Some papers are pretty easy to follow. Others are not. For some of you, one or more of the papers will seem confusing and way beyond your current background. Hopefully, during class, we will be able to discuss the material well enough to bring everyone to an understanding of the points that need to be stressed with that paper. If you get lost, don't give up. *Please* ask questions, even if only to say "Wait a minute, I don't understand." Developing the **courage** to ask questions or to admit confusion is an extremely important element of your growth as a scientist.

**Rule # 1: If you're confused, say so.**
**Corollary of rule #1: If you are confused, others are confused too.**

We have tried to figure out how to make discussions work in a group of this size. Obviously, there is the opportunity for some people to sit quietly while others do all the discussing. Unfortunately, the more quiet listeners there are, the less interesting the discussion is. If you are shy, you must work to overcome it. If you have trouble speaking English, talk anyway. We don't care if it takes several tries to get your idea or question understood. COURAGE! One device we will use to try to get everyone involved and focus the discussion is to illustrate things on the board. For this, one person "volunteers" to wield the chalk. The chalk wielder, once so volunteered, will be *immune* from having to say anything.

**Rule # 2: The person with the chalk has only to listen and write what everyone else tells him or her to write, and is not required to talk.**

As noted above, the professor doesn't have all the answers, and you will be expected to act as peers and colleagues of everyone in the department very soon. To foster this, the discussion should be held among the entire group, not as a question-answer session with the professor. Ideally the faculty will be guides; trying to keep the discussion going in productive directions, but you are the discussants.

**Rule # 3: Look at the group when speaking; do not look exclusively at the faculty—unless you are asking a personally-directed question.**

We will approach each paper, and each experiment in a common fashion. Here is the outline we will follow:

**I. The BIG question:** Each paper is usually part of a larger effort to understand some central aspect of biology. What is that central issue? We will discuss this and write a consensus opinion on the board. Come to class with your own opinion written as a concise simple sentence.

**II. The question addressed by the paper:** What is the specific smaller question that the research presented in the paper tries to answer? Sometimes it is surprisingly difficult to figure this out, but write out your best guess in your notes. We will share our opinions, discuss them, and the chalk wielder will write a consensus "question" on the board.

**III. Background:** Background information is almost always needed to understand the significance of the question: to put it in context. Background is also needed to understand the logic used to design the experiments and to interpret their results. In preparing for class, you should make a short outline of the background topics that you would cover if you were presenting this paper in a journal club. We will make a list of those topics on the board and discuss them to ensure that everyone understands the question and approach.

**IV. General Approach:** This will be (hopefully) a concise sentence that summarizes the strategy or strategies that the authors used to address the question (**II.** above). It is a very important element of a good Journal Club presentation. Write the general approach sentence in your notes, being careful to avoid experimental details. It usually takes a good deal of thought and several tries to get a good sentence. (More about "Approach" below).

**V. Experiments:** This is the heart of our discussion. We will go through the major experiments presented in the paper: usually the experiments responsible for the results presented in the paper as figures or tables. We will have PowerPoint slides of the figures during the discussion, and will insist that we discuss the data as we would like to see it presented in a seminar. It is important to present data clearly and accurately; this is one of the few times that you will get advice on how to do so.

We will follow a set pattern for describing each experiment. (This same pattern is excellent for use in your seminars, term papers, and publications.) We will discuss, and write on the board in sequence:

- **A.** The **Question** that the specific experiment addresses.
- **B.** The **Approach** used to address the question.
- **C.** The **Experiment** itself; (the details of how the experiment was done).
- **D.** The **Result.**
- **E.** The **Literal Interpretation** of the Result.
- **F.** The **Author's Interpretation** of the Result.

We will then discuss differences between the Literal and the Authors' interpretations, and assess whether or not the authors actually answered the question. With surprising frequency, they didn't.

It is hard work to think critically about every experiment; to address formally each of the topics above. If you take one of the papers that we will discuss in detail, and write out the six things listed above for each major experiment, you will fill a number of pages. *This is an essential part of preparation for class;* if you don't do it, you will not be contributing or learning at your full potential.

To help you understand the steps listed in the outline a series of definitions of the various terms is provided below.

## Definitions of Terms

The Question

The gap in knowledge that the overall paper or an individual experiment seeks to fill.

The Background

The context for the question. Without this, it is usually difficult to understand the question, why the question is interesting, or what the results mean.

The Approach

A one or two sentence statement, in simple terms, of how this particular paper or experiment goes about answering the question. This may also be called the Logic of the experimental design. It should be phrased in terms that "anyone" can follow, whether they know the techniques that were used or not. This overview is particularly important in presenting seminars.

The Experiment

The actual, detailed description of what was done. This need not be as detailed as the protocol of the experiment (with buffer concentrations etc.) but it does need to illuminate the "important details" and the fundamental design. We will use flow diagrams to deal with this.

The Result

The actual, observed result of the experiment. NOT TO BE CONFUSED WITH THE INTERPRETATIONS!!! When you do an experiment, *something* happens. This is that something. The photograph, the histogram, the bands on a gel, the numbers, etc. We will work on presenting this in seminar style, and avoid mixing it with interpretations.

The Literal Interpretation of the Result

An accurate interpretation of what the result means. Or, a description of what the experiment actually demonstrates. Often, the experiment will demonstrate only one thing unambiguously. It *may* help demonstrate something more grand when combined with the results from other experiments, but that is more than is asked for here.

The Author's Interpretation of the Result

What the authors say the experiment demonstrated. Often, the authors have some particular model in mind when they do an experiment. The result may be consistent with the model, and they may choose to say that the result proves the model. In doing so, they often go beyond what the experiment actually demonstrates.

Distinctions among terms:

People often confuse the Approach with the Experiment. Others suggest that if one is going to present the Experiment, one doesn't need to give the Approach. After all, the logic of the approach will become evident as the experiment is described. WRONG! The reason for discussing both of them will be painfully clear in journal clubs, seminars, and grant proposals. Quite simply, the audience needs to know the basic framework of logic in advance, to help them understand the details of the experiment.

Another difficulty is the distinction between the Result and the Interpretation. The result is What Happened, no more, and no less. If the experiment gave bands on a gel, the result is *which* bands and where they are. If the experiment gave plates with bacterial colonies, the result is the numbers of colonies on the different plates. Clear thinking proceeds best when the result and the interpretation are kept separate.

**Preparation for Class**

Please come to class with your notes, and prepared to discuss the chosen paper in detail. Obviously, there are more things to think about (e.g., *why* the authors' interpretation might differ from the literal interpretation); make notes on these things, too. If you are particularly wordy in your note taking, you can manage to stretch them out to 20 pages. Don't do this. Most of the six critical elements listed in **V.** above (except for the Experiment) can be stated in a single sentence. Indeed, it will help sharpen your thoughts to force the Question and Approach into one sentence each. An interpretation is also usually best stated as a single sentence. For the Experiment, where there may be multiple steps involved, as noted above, a flow diagram is usually the most efficient way to describe it.

**A word about grades**

This class is a lot of work for a one-credit course. However, if you prepare for class by reading the papers and making notes about the six critical elements, and you participate in class, you will ace the course. One word of caution: The class will only meet 5 times during the semester but attendance is *mandatory* - each class you miss will lower your grade substantially.

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Papers for each class will be posted on the Hunt/Hassold website (http://machassold.chem.wsu.edu/~hnhlab/MBIOSclasses/MBIOS568.html) or you may download them yourself from WSU e-journal (http://lib6.wsulibs.wsu.edu:8888/sfx_local/a-z/default).

**For our first class, be prepared to discuss:**

Page et al., Cell 51: 1091 (1987). The sex-determining region of the human Y chromosome encodes a finger protein.

Koopman, P., J. Gubbay, N. Vivian, P. Goodfellow, and R. Lovell-Badge, Nature 351: 117-122 (1991). Male development of chromosomally female mice transgenic for Sry.