The DMD/PhD Program
at UMDNJ-New Jersey Dental School
And
The Graduate School of Biomedical Sciences

I. Introduction

Dental research is rapidly changing the face of clinical dentistry. Dental health and biomedical science demand that clinicians today have a thorough understanding of disease mechanisms and the ability to take what is learned in the laboratory and apply it clinically. The combined DMD/PhD program provides an opportunity for interested individuals to receive training in basic biomedical research. The training provides a mechanism for one to pursue a career in dental research in either an academic or industry setting. The goal of the program is to train future generations of oral health scientists. Combining the resources of the New Jersey Dental School with those of the Graduate School of Biomedical Sciences, the program affords a wide variety of research training opportunities to the dental student and provides a connection between clinical dentistry and biomedical research.

The program outlined below will (1) provide an administrative structure to address concerns and develop areas of admissions, curriculum and student affairs; (2) ensure a unified broad based biomedical science curriculum for all DMD/PhD students which will allow the efficient completion of course requirements for the Ph.D. while still permitting some time for enrichment of the core curriculum with electives; (3) coordinate summer research to direct students towards an informed choice of an advisor; (4) ensure that students have selected an advisor in a timely fashion; (5) provide a realistic program structure to complete the DMD/PhD program in seven years; and (6) recognize that DMD/PhD students have different needs with respect to academic scheduling than conventional graduate students and provide mechanisms to deal with these issues.

II. Administrative Structure

A. Description of Responsibilities of DMD/PhD Administrative Positions:

   DMD/PhD Program Director: Coordinate the day-to-day activities, as well as long term development of the program; serves as chair of the program committee.

   DMD/PhD Program Committee: Responsible for all issues related to academic and student affairs, including curriculum, recruiting, and admissions.
The committee is made up of six faculty members of NJDS, who are also members of GSBS.

DMD/PhD Program Faculty: Current NDJS/NJMS/GSBS faculty who have active research programs must apply to the Program Committee to become part of the DMD/PhD program.

The DMD/PhD program director will report to and be monitored by the GSBS Executive Council and NJDS Director of Graduate Studies and/or the Chair of Oral Biology. The GSBS Executive Council will approve all appointment to the DMD/PhD Program Committee. The DMD/PhD Program will follow all of the rules, regulations and policies of GSBS and NJDS.

B. Organizational Structure

Director of the DMD/PhD Program

DMD/PhD Program Committee
(six faculty members)

DMD/PhD Faculty

DMD/PhD Students

III. Admissions

A. Application
Students interested in the D.M.D/Ph.D. program may apply at any time during their first three years in NJDS. Application forms are available from the Admissions Office of the New Jersey Dental School. Completed applications and letters of reference should be submitted directly to the NJDS Admissions Office.

B. Admissions Committee
All DMD/PhD candidates are prescreened by the NJDS Admissions Committee and the DMD/PhD Program Committee, and meritorious
applicants will be invited for interviews at New Jersey Dental School conducted jointly by both committees.

C. Stipend and Tuition Policies
Students accepted into the program are responsible for tuition and fees for the four-year DMD degree. During the GSBS phase of the program, graduate school tuition remission is provided, and the standard GSBS stipend is provided (currently $26,500).

It is expected that each student will apply for an NIH F30 award (NIDCR Individual Predoctoral Dental Scientist Fellowship) during their first year.

If a student continues their career in research immediately following completion of the program, they may be eligible for the NIH loan repayment program (see http://www.lrp.nih.gov/ for details).

D. Student Population
Each year up to two students are anticipated to be accepted into the DMD/PhD Program.

IV. Program Curriculum
A. Years 1 through 3
Students take the curriculum offered by the Dental school and participate in laboratory research rotations during the summers. Courses listed below will also count for credit toward the 40 credits necessary for the Ph.D. degree. Students will also participate in an Oral Biology seminar/journal club throughout their tenure in the Program.

Fall-Spring year 1: Students will complete the standard NJDS didactic curriculum.

Summer year 1: Students will complete two six-week research rotations in the laboratory of a participating DMD/PhD faculty member of the student’s choice as approved by the Director. Students will prepare a summary of their research experience at the end of each rotation to be submitted to the Director.

Fall year-Spring year 2: Students will complete the second year of the NJDS curriculum.

Summer year 2: Students will complete an optional third laboratory rotation or begin work in the laboratory of their thesis advisor. Students may select their thesis advisor with the approval of the Program Committee by the end of the summer of year 2.
Note: Students must maintain the equivalent of a “B” or higher average in their NJDS GPA to maintain good standing in the program and receive their stipend. Students must also successfully complete the National Dental Board Examination Part I in the second year in order to receive a recommendation to continue in the program in an annual evaluation by the Program Committee.

Year 3: complete NJDS clinical and didactic courses

Course credits: Students will receive the following GSBS credits for NJDS courses
Year 1: Biochemistry (4), Immunology (4), Neuroanatomy (2) General Pathology (4), Physiology (3) (total=17 credits).
Year 2: Microbiology (4), Oral Biology (2), Systemic Pathology (3), Pharmacology (3) (total=12 credits).

Students will also attend the Oral Biology Seminar course (GSBS course DENT591; 1 credit) each semester.

B. Year 4-5
Upon successful completion of the first three years, students become full-time students in GSBS while maintaining co-matriculation in NJDS. In addition to the courses listed above, students need an additional 11 credits to complete the academic requirements for the Ph.D. degree of 40 credits. This will include two required courses, the GSBS Core Course (5 credits, see appendix 1) and Biostatistics (3 credits, see appendix 2). Elective courses should be selected by the student and thesis advisor based on the individual student’s needs and research program and approved by the Director of the DMD/PhD Program. Since GSBS requires all full-time students to be registered for 10 credits per semester, the students will also be participating in the research towards the Ph.D. degree, and will be granted credits for that. All students are also required to take the Ethics in Science, Research and Scholarship Course (1 credit, taken after passing the qualifying examination). A sample course schedule appears in appendix 3.

Within two months of the completion of GSBS course work, DMD/PhD students must pass the Qualifying Examination for admission to candidacy for the Ph.D. degree. The examination will be based on the preparation (the written component) and oral defense of a research proposal in the student’s area of research interest. Specific requirements for the Qualifying Examination are described in a separate document (see appendix 4).

* Requirements for the Ph.D. degree may be found at: http://www.umdnj.edu/gbsnweb/current_students/degreeReq.htm
During the fourth and fifth years, the students will also complete the clinical requirements for the DMD degree. The scheduling and participation in the specific courses will be determined with the assistance of an ad hoc curriculum subcommittee selected by the program director designed for each student. Clinical activities will be coordinated through the assigned Group Practice Administrator and the faculty mentor. The student will take National Boards Examination Part 2 after year 5, and the North East Regional Board Examination during year 6.

After admission to candidacy for the Ph.D. degree, a Thesis Advisory Committee must be formed to facilitate and evaluate progress of the doctoral dissertation research. The Thesis Advisory Committee consists of the thesis advisor and two other members, on of whom is outside of the student’s primary department. The thesis advisor must be a full member of the GSBS faculty. The Thesis Advisory Committee members should have expertise in the dissertation research field. A research proposal outline should be developed by the student and reviewed by the thesis advisor prior to presentation to the Thesis Advisory Committee. The Thesis Advisory Committee must meet at least twice per year to evaluate the student’s progress.

C. Years 6-7**
Following completion of the requirements for the DMD degree, the students will complete their thesis research as full-time students in GSBS. Following completion of the dissertation research, the student will prepare a thesis in the format specified by the GSBS. In addition, it is expected that two or more manuscripts will be published in the scientific literature as a result of the dissertation research. The Dissertation Examination Committee consists of the Thesis Advisory Committee and three additional members who serve as readers. Readers should have research expertise relevant to the thesis research. At least one reader must be from outside the primary department and one reader must be from outside the UMDNJ Newark campus. The student dissertation defense consists of an oral public presentation in a seminar format, followed by an oral examination by the Dissertation Examination Committee.

**Note: It is recognized that doctoral-level research is not easily completed in a 36-month period, and may require extra time due to required experimentation. Upon request of the student, with the approval of the mentor and program committee, an extra year of research can be allowed, with full stipend provided by the mentor.
Appendix 1.

GSBS Core Course Syllabus

Module 1 (Systems biology):
Endocrine System
   Reproductive system (long distance signaling, receptors, ligands, mitosis/meiosis, cell death)
   Homeostatic Mechanisms (feedback, sensing, controller, adaptation)
Immune System
   Cell Development (amplification, selection, specificity)
   Receptors and pathogen recognition (cell-cell interactions, protein-protein interaction/specificity)
   Cell Migration (chemotaxis, cell adhesion, motors)
Cardiovascular System
   Organ Structure and Function
   Vectorial Processes (metabolite movement and exchange)
   Long-distance communication (chemical signaling, electrical signaling)
Nervous and Musculoskeletal Systems
   Peripheral Nervous System (sensory/motor systems)
   Autonomic Nervous System (homeostatic regulation of organs)
      Chemical Signaling, Electrical Signaling
   Central Nervous System (sensory systems, control of behavior)

Module 2 (Molecular Function):
   Molecules (Amino Acids, Lipids; Nucleotides)
   Protein Structure
   Ligand binding
   Enzyme Kinetics
   Anabolic/Catabolic pathways: Emphasis on interrelatedness, control and feedback

Module 3 (Information Transfer):
   Genetics:
      - transmission genetics; genes and the basis of disease
      - recombination, transgenics and knockout mice
   DNA Structure and Synthesis (emphasis on structure and its importance)
   RNA Synthesis & Processing
   Protein Translation, Modification & Turnover
   Bioinformatics

Module 4 (Cell Function):
   Cell Structure
   Membranes, Ion and Solute Transport, Electrochemical Gradients
   Energy Metabolism (mitochondria, etc.)
   Intracellular Communication (eg. signaling)
   Protein Trafficking/Translocation (including protein exocytosis)
Module 5. Alternative Learning Sessions

Groups of 4 students will be assigned a current unsolved research problem or challenge within one of the systems from Module 1 (alternatively, the research problem could be assigned from an area that would promote integration of concepts learned in the course; eg. metazoan development, cancer, etc.). Students will be asked to develop a testable hypothesis and to design experiments to test that hypothesis. Upper level GSBS students will serve as TAs. 20 minute oral presentations by groups with 5 minutes of questions (10% of grade for the course).
Appendix 2.
Biostatistics for the Biological Sciences - Syllabus

Introduction
This course is open to laboratory, basic and clinical scientists who require review and guidance in the application and interpretation of statistical methods in biological and biomedical applications. The course is applied in nature, with a basic introduction to underlying probability and statistical models.

Topics include basic graphical techniques and data analysis, basic probability models and distributions, t-tests, non-parametric tests, chi-square tests, linear regression methods, association, correlation, 1-way and 2-way ANOVA, interaction, introduction to nonlinear regression, dose response. All methods are motivated by real world applications.

The student will utilize the Minitab package for most calculations (available at a student discount from www.minitab.com), with some usage of the R package (freely available). All computational aspects will be reviewed in class. Throughout the focus is on understanding the context and application of the various statistical methods and models. At the end of this course the student will be able to analyze most standard data arising in clinical and biomedical research settings.

Prerequisite
Students should have taken an introductory course in probability or statistics. Students should be able to manipulate the Excel package and have a basic familiarity with the collection and manipulation of data.

Goals
At the end of the course, the student will be able to analyze a wide range of commonly occurring biological, biomedical and clinical data using standard statistical methods.

Grading
There will be 4-5 assignments (75%) and a take home final exam (25%).

Books
The text for the course is Principles of Biostatistics by Pagano and Gavreau (may change to a more basic science oriented text), and the lecture notes themselves. Handouts will also be distributed as necessary. The Minitab software manual (e-version comes with package) is also helpful. The R package reference book will be placed on reference in library.
Course Outline

Data Analysis
1. Data Analysis (basic statistics and graphics)
2. Review of Basic Design concepts (randomization, bias, control and causation)
3. Basic rules regarding re-scaling and presentation of data (log transformations, 1-1 transformations, variance stabilizing transformations).

Basic Concepts of Statistical Inference
4. Introduction to Basic Probability
5. Probability and Statistical Models
6. Central Limit Theorem (CLT) and statistical inference
7. Estimation of Parameters (confidence intervals)
8. Testing of Hypotheses (p-values, t-tests, chi-square tests etc..)
9. One and two-sample t-tests, non-parametric tests, chi-square tests for difference in proportions
10. The principle of likelihood; Likelihood ratio tests, MLE estimation, Introduction to Bayesian methods
11. Accuracy, power and sample size issues

Predictive Linear Models
12. Simple regression
13. Multivariate regression
14. Correlation and Introduction to Clustering (Principal components).

ANOVA
15. 1-way ANOVA
16. 2-way ANOVA
17. Replication
18. Interaction
19. Random Effects Interpretation (Mixed Models)

More Advanced Models
20. Introduction to Nonlinear Regression
21. Dose Response and Bioassay
22. Introduction to Basic Survival Analysis (Time to Event Models).
Appendix 3.

Sample course schedule for DMD/PhD students, year 4.

Fall semester

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<td>Cellular Pathology (PATH5100)</td>
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Spring semester

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<tr>
<td>Oral Biology Seminar (DENT5910)</td>
<td>1</td>
</tr>
<tr>
<td>Molecular Virology (MICR 5231)</td>
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</tbody>
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Other typical courses:

- Structural Bioinformatics (GINF5003)
- Stem Cell Biology and Applications (MSBS5130)
- Biochemistry of Nucleic Acids (BIOC5070)
- 21st Century Pathogens (MICRO5620)
- Microbial Biofilms (PHMS5025)
- Signaling Mechanisms in Biological Systems (BIOC5220)
- Developmental Biology (CBMM5020)