

INCORPORATION OF THE DEPARTMENT OF BIOMATERIALS INTO THE DEPARTMENT OF MOLECULAR PATHOBIOLOGY, NEW YORK UNIVERSITY COLLEGE OF DENTISTRY

OVERVIEW

This is a proposal to incorporate the Department of Biomaterials as a Division of Biomaterials within the Department of Molecular Pathobiology (MPB) in NYU College of Dentistry. This will create a single, unified basic science department within NYU Dentistry. MPB faculty will engage in scholarly research in the areas of biomedical science and biomedical engineering. They will contribute to teaching in Doctor of Dental Surgery (DDS), Dental Hygiene, Post-graduate Specialty, and MS and PhD Programs.

This document summarizes the current status of both departments, describes the organization and governance of the expanded department, and discusses the impact of the reorganization on research, education, administration, personnel, finances and allocation of research and office space.

CURRENT STATE OF DEPARTMENTS

Department of Molecular Pathobiology

Faculty, staff, fellows and graduate students. There are 25 faculty with primary appointments, 27 adjunct faculty, 6 administrative staff, 36 research fellows and 3 graduate students.

Primary Faculty

Baker, Eric	Clinical Associate Professor, Vice Chair for Education
Bromage, Timothy	Professor
Bunnett, Nigel W.	Professor and Chair
Cunningham, Elena	Clinical Associate Professor
Di Gregorio, Anna	Associate Professor
Guttenplan, Joseph	Professor
Jeong, Juhee	Associate Professor
Lacruz, Rodrigo S.	Associate Professor
Levy, David N	Associate Professor
Li, Xin	Associate Professor
Liang, Shuang	Clinical Associate Professor
Lopez, Elisabeth	Clinical Assistant Professor
Partridge, Nicola	Professor
Pavlov, Evgeny	Associate Professor
Saint-Jeannet, Jean-Pierre	Professor, Vice Chair for Research
Saxena, Deepak	Professor
Schiff, Joel	Associate Professor
Sitara, Despina	Associate Professor
Spielman, Andrew	Professor
Stefan, Cristian	Clinical Professor
Terracio, Louis	Professor
Thomsen, Alex	Assistant Professor
Warshaw, Johanna	Clinical Associate Professor
Yakar, Shoshana	Professor

Simmons, Glennon Laboratory Manager
Warhadpande, Shruti Assistant Research Scientist

Research. There are 3 research groups in the Department of Biomaterials: Paulo Coelho, John McDevitt, Lukasz Witek. General areas of research include generation of biological scaffolds using 3D printing and biosensors for disease detection.

Teaching. There are 3 faculty with primary responsibility for teaching: Ronaldo Hirata, Dindo Mijares, John Ricci. Lukasz Witek also directs 3 courses. Faculty teach in the DDS, Dental Hygiene, Post-graduate Specialty, and MS and PhD Programs.

Laboratory and office space. Research laboratories and offices are located on the 8th floor, 433 1st Avenue.

ORGANIZATION AND GOVERNANCE OF THE EXPANDED DEPARTMENT

Appendix 1 summarizes the proposed organizational structure of the expanded MPB.

Senior Management Team. The senior management team will oversee all aspects of departmental management. It will include the Director of the Division of Biomaterials*.

Professor Nigel. W. Bunnett, PhD, Chair, MPB

Professor Jean-Pierre Saint-Jeannet, PhD, Vice Chair for Research

Associate Professor Eric Baker, MS, Vice Chair for Education

*Professor Paulo Coelho, DDS, PhD, Director of the Division of Biomaterials

Departmental Committees. Committees in MPB advise the chair and senior management team about mentoring, promotion and tenure; research; research training (team science); and education. The committees will include members of the Division of Biomaterials*. Appointments to committees are usually for two years.

Mentoring, Promotion and Tenure Committee: Jean-Pierre Saint-Jeannet (chair), Deepak Saxena, Cristian Stefan, *John Ricci

Research Committee: Rodrigo Lacruz (chair), Xin Li, Shoshana Yakar, *Paulo Coelho

Research Training Committee: Evgeny Pavlov (chair), Shoshana Yakar, Juhee Jeong, *Lukasz Witek

Education Committee: Elisabeth Lopez (chair), Eric Baker, David Levy, *Ronaldo Hirata

IMPACT ON RESEARCH

Strengthening research in biomedical science and biomedical engineering is a major impetus for the unification of the Departments of Molecular Pathobiology and Biomaterials. The College of Dentistry will develop a single, unified basic science department in which biomedical scientists and biomedical engineers tackle questions of fundamental societal importance. The Department will house the NYU Pain Center that will seek to understand the mechanisms that initiate and sustain chronic pain and to develop new treatments for chronic pain that avoid the unacceptable side effects of opioids. It will include members of the NYU Center for Skeletal and Craniofacial Biology, which aims to understand bone degenerative and developmental disorders and to implement biomedical engineering approaches for

treatment. The department will house researchers studying cell signaling, developmental biology, infectious diseases and disease diagnostics.

The merger will enable reorganization of research laboratories that will foster synergistic interactions and maximize collaborations. Research groups with similar interests will be co-located in a manner that will enhance synergistic interactions amongst biologists, bioengineers and chemists (*e.g.*, co-location of members of the NYU Pain Center with bioengineers using organ-on-chip approaches to model pain in humans and chemical biologists developing tools to analyze pain signaling; co-location of developmental biologists with tissue engineers using stem cells and 3D printing to generate tissues and organs). Such interactions can lead to transformative advances will long lasting impact.

The merger will allow co-location of key technologies that will be shared to foster a culture of collaboration. This will include co-location of high-end instrumentation and provision of technical support that will maximize access and use (*e.g.*, co-location of imaging, mass spectrometry facilities). Such co-location will obviate duplication of resources and infrastructure.

The merger will facilitate future recruitments at the interface of biomedical science, bioengineering and chemical biology. Recruitment will provide a critical mass of investigators in key areas, enhance existing programs, and develop new areas of research of emerging importance. The intent will be to recruit outstanding scientists that bridge between biologists, engineers and chemists in MPB and Division of Biomaterials. Areas of recruitment will include Bioengineering (regenerative medicine, organoids, organ-on-chip) and Chemical Biology (nanomedicines, cellular biosensors).

MPB expansion will enhance interactions between the NYU College of Dentistry and the NYU Tandon School of Engineering. Collaborative research programs will be developed between MPB in Dentistry and the Department of Biomedical Engineering and the Department of Chemical and Biomolecular Engineering in the Tandon School. The intent will be to develop a group of collaborating laboratories through a combination of joint recruitment and relocation of existing faculty, all housed in contiguous laboratory space (433 1st Avenue). The Deans of Dentistry and Engineering, and the Chairs of MPB, Biomedical Engineering and Chemical support this initiative. They are currently preparing a blueprint for this initiative at the request of President Hamilton.

IMPACT ON EDUCATION

A detailed analysis of the effects of the proposed merger on all courses within DDS, Dental Hygiene, Post-graduate Specialty, and MS and PhD Programs in MPB and the Department of Biomaterials is provided in **Appendix 2 and 3**. The conclusion of this analysis is that the impact of the merger is only positive, with benefits to the educational missions in both departments.

The major benefits of the merger to the educational mission of MPB will include the provision of additional expertise by faculty of the Department of Biomaterials in areas of dental biomaterials, clinical dentistry, gross anatomy, immunology and bone biology. The major benefits of the merger to the educational mission of the Department of Biomaterials will include the provision of additional expertise by MPB faculty in multiple aspects on biomedical science.

IMPACT ON FACULTY

All faculty in the Department of Biomaterials will be appointed in MPB.

All adjunct faculty in the Department of Biomaterials will be appointed in MPB.

All faculty will retain current titles and ranks.

There will be no impact on tenure track faculty or tenured faculty.

MPB guidelines for mentoring, promotion and tenure will be applied to the Division of Biomaterials. The Mentoring, Promotion and Tenure Committee will establish formal mentorship committees for assistant professors in the Division of Biomaterials (Hirata, Witek). Mentorship committees meet with mentees biannually to guide career development. The Mentoring, Promotion and Tenure Committee will review applications for promotion and tenure and present candidates to MPB faculty for discussion and vote.

IMPACT ON STAFF

All staff in the Department of Biomaterials will be appointed in MPB.

All staff will retain current titles, ranks and position descriptions.

With guidance from Human Resources of NYU Dentistry, the responsibilities of staff will be adjusted within existing position descriptions to provide the most efficient administrative support to the expanded department. The merger will enhance administrative efficiency for education, research, grants management, and faculty affairs.

IMPACT ON FINANCES

MPB will be a single financial unit. There will be no separate budget for the Division of Biomaterials.

All faculty and staff will retain current salaries.

All faculty and staff salaries will be charged to the MPB.

Discretionary funds will be administered by the senior management team, according to the policy established by the Deans' office, with advice from the Research Committee regarding the allocation of funds to support research and education.

IMPACT ON RESEARCH AND OFFICE SPACE

In the short-term (1 year), the allocation of research and office space will be unaffected by the merger.

The expected provision of new or renovated laboratory space at 433 1st Avenue or 345 East 24th Street will allow colocation of research groups with complementary and synergistic research interests.

MPB guidelines for the allocation of research and office space will be applied to the Division of Biomaterials.

FACULTY CONSULTATION

The proposal has been presented to the senior leadership of NYU Dentistry and faculty of the Department of Molecular Pathobiology and the Department of Biomaterials for discussion and vote. The results of the votes are as follows.

27th January, 2021

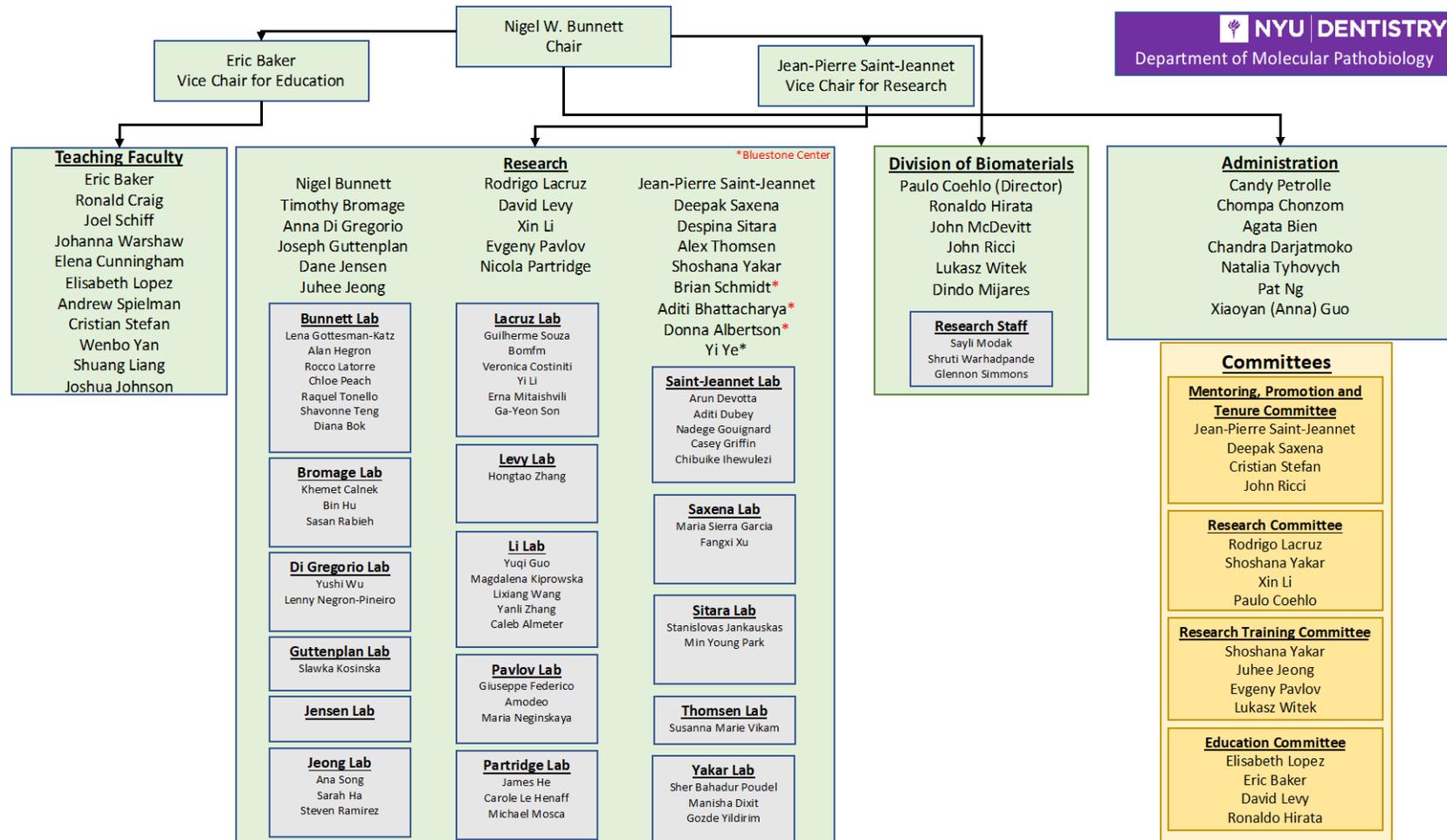
NYU Dentistry Senior Leadership (Deans and Department Chairs): Unanimously in favor of the proposal.

Faculty of Department of Molecular Pathobiology: Unanimously in favor of the proposal (25/25 yes votes).

Faculty of Department of Biomaterials: Unanimously in favor of the proposal (6/6 yes votes).

Appendix 4 is a Memo of Understanding between the Department of Molecular Pathobiology and the Department of Biomaterials regarding the proposed merger.

APPENDIX 1. ORGANIZATION OF THE EXPANDED MPB



APPENDIX 2. IMPACT OF THE MERGER ON THE EDUCATIONAL MISSION OF MOLECULAR PATHOBIOLOGY

Report Prepared by Eric Baker, Clinical Associate Professor, Vice-Chair for Education, Department of Molecular Pathobiology, NYU Dentistry.

INTRODUCTION. The educational mission of MPB at NYU College of Dentistry is multifold. MPB is responsible for teaching foundational biomedical sciences for:

1. Predoctoral DDS program
2. Dental Hygiene program
3. Postgraduate specialty programs
4. Postgraduate MS program, Oral Biology Track.

The educational contributions of MPB to the college curriculum are both in courses run by the department and in multiple courses offered by other departments. Currently, MPB is responsible for 11 predoctoral courses, 1 dental hygiene course, and 3 Masters courses. Additionally, MPB has shared responsibility, with the Department of Oral and Maxillofacial Pathology, Radiology and Medicine (OMPRM), for 2 integrated predoctoral courses. Biomedical subjects covered by MPB faculty within in the college's curriculum include anatomy, biochemistry, bone biology, cell organelles, embryology, genetics, histology, immunology, microbiology, molecular biology, neuroscience, pharmacology, physiology, and virology.

EXPERTISE OF MOLECULAR PATHOBIOLOGY FACULTY. MPB faculty are educational content experts in the biomedical sciences, and their teaching is related to their areas of expertise. MPB faculty and their primary areas of expertise are (in alphabetical order):

- Baker, Eric. M.Phil. Clinical Associate Professor (anatomy)
- Bromage, Timothy. PhD. Professor (biological anthropology, histology, and microscopy)
- Bunnett, Nigel. PhD. Professor (physiology, mechanisms and treatment of pain)
- Cunningham, Elena. PhD. Clinical Associate Professor (anatomy)
- Di Gregorio, Anna. PhD. Associate Professor (developmental biology)
- Jeong, Juhee. PhD. Associate Professor (craniofacial development)
- Guttenplan, Joseph. PhD. Professor (chemical carcinogenesis)
- Jensen, Dane. PhD. Assistant Professor (neuroscience, cell signaling)
- Lacruz, Rodrigo. PhD. Associate Professor (enamel mineralization, facial growth)
- Levy, David. PhD. Associate Professor (HIV, molecular biology, immunology)
- Li, Xin. PhD. Associate Professor (bone biology, diabetes, cancer)
- Liang, Shuang. PhD. Clinical Assistant Professor (microbiology, immunology)
- Lopez, Elisabeth. PhD. Clinical Assistant Professor (anatomy)
- Partridge, Nicola. PhD. Professor (parathyroid hormone, bone biology, physiology)
- Pavlov, Evgeny. PhD. Associate Professor (mitochondrial physiology, bioenergetics)
- Saint-Jeannet, Jean-Pierre. PhD. Professor (craniofacial development, neuroanatomy)
- Saxena, Deepak. PhD. Professor (molecular biology, microbiology)
- Schiff, Joel. PhD. Associate Professor (physiology)
- Sitara, Despina. PhD. Assistant Professor (bone biology, hematopoiesis)
- Spielman, Andrew. PhD., D.M.D. Professor (biochemistry, mechanisms of taste)
- Stefan, Cristian. M.D. Clinical Professor (biomedical sciences)
- Thomsen, Alex. PhD. Assistant Professor (cell signaling)
- Warsaw, Johanna. PhD. Clinical Associate Professor (anatomy)
- Yakar, Shoshana. PhD. Professor (biochemistry, bone metabolism)
- Yan, Wenbo. PhD. Clinical Assistant Professor (pharmacology, cell biology)

GENERAL TEACHING CONTRIBUTION OF FACULTY. There are 7 teaching-track faculty and 18 tenured/tenure-track research faculty in MPB. All faculty members contribute to the fulfillment of the educational mission of the department. MPB faculty contribute to predoctoral, postgraduate, dental hygiene, and Master of Science courses as needed and based on their area of expertise. Currently, there is only 1 MPB faculty member who is qualified as a dentist; Andrew Spielman is dual degreed (PhD and D.M.D). Over the past 2 years, 3 MPB faculty who were dual degreed have retired.

EDUCATIONAL PROGRAMS AND MERGER IMPACT

Predoctoral College of Dentistry (D1-D4)

Anticipated impact of merger — beneficial. Currently, there are 3 faculty in Biomaterials with dental qualifications. MPB would benefit from the addition of dual degreed faculty. Additional MPB faculty with dental qualifications can assist in the integration of foundational biomedical science content with clinical applications for dental practice. In addition, Jack Ricci is trained as an anatomist; and he would be able to fully participate in the head and neck anatomy course, reducing MPB's dependency on adjuncts in teaching anatomy. Furthermore, John McDevitt is an expert in immunology and as such he would be able to assist in MPB's teaching mission. Also, Biomaterials faculty are experts in bone histology; and as such, they can contribute to the teaching mission of the department.

Postgraduate Programs

Anticipated impact of merger — beneficial. Having 3 additional dentists as members of the faculty of MPB would enable MPB to increase its participation in postgraduate education.

Postgraduate MS, Oral Biology Track

Anticipated impact of merger — beneficial. Currently, the MS in Oral Biology curriculum recommends that students take 4 courses that are offered by the Department of Biomaterials (see Appendix 2). Having these 4 courses as offerings through MPB would improve the integration of the curriculum's content, as well as the administration of the MS program.

Summary of Merger Impact on Molecular Pathobiology Educational Programs. The impact of this merger is only positive. The educational mission of MPB will benefit if the merger goes forward. The advantages to MPB of this merger include: the addition of the clinical expertise of those faculty with dental qualifications, the ability of Jack Ricci to teach anatomy, the immunological expertise of John McDevitt, and the histological (bone biology) knowledge of the biomaterials faculty. All of these will enhance the ability of MPB to meet and excel at its educational mission.

MOLECULAR PATHOBIOLOGY COURSES

Predoctoral Courses

BAS01-DN.1508: Building Blocks of Life (3.0 credits). Building Blocks of Life provides foundational knowledge of the biochemical structures, properties, and function. In addition to providing a foundation for subsequent courses in the dental education curriculum, students learn the relevance and application of biochemistry in developing a differential diagnosis, treatment, and follow up using clinical case studies.

BAS01-DN.1509: Cellular Organelles and Functions (2.6 credits). This course provides a basic understanding of cell structure and function, with an emphasis on the functions of basic organelles. This course provides information on cellular processes such as gene regulation, cell motility, apoptosis, cell adhesion, and signal transduction. In addition, the course provides an understanding of the patterns and processes of Mendelian and molecular genetics and the control of cell cycling, especially as it pertains to tumor biology. This course forms the underlying basis for the Basic Tissues and Body and Disease courses, among others.

BAS01-DN.1511: Embryology and Craniofacial Development (1.4 credits). The Embryology and Craniofacial Development course covers general concepts in human embryology and culminates with in-depth discussions of both prenatal and postnatal craniofacial development. Emphasis is placed upon the oral health implications of concepts in human developmental biology. The course is organized into three units focusing on General Embryology, Prenatal Craniofacial Development, and Postnatal Craniofacial Growth and Development. This course provides a basic understanding of embryology to serve as an introduction to craniofacial development and serves to prepare students to understand aberrations of development that may occur in humans.

BAS01-DN.1608: Head and Neck Anatomy (5.5 credits). Head and Neck Anatomy provides a critical experience in the study of human structure, which is fundamental to the practice of dentistry. Much of the rationale for the understanding of function and disease, diagnostic skills and clinical practice is based on the language and knowledge of anatomy. This course presents the detailed structures of the head and neck in their structural and functional relationships, enabling students to recognize the application of anatomical information in dental practice. In addition, it provides students with a basis for understanding other basic clinical sciences and prepares students for future postgraduate courses

BAS01-DN.1510: Basic Tissues (2.0 credits). Basic Tissues presents the traditional microscopic anatomy, as well as biochemical, molecular, physiological, and pathological aspects of tissues by focusing on epithelium, soft connective tissue, cartilage, bone, muscle, blood and bone marrow, and aspects of clotting. Correlations with clinical dentistry are stressed in the areas of tissue structure and function.

BAS01-DN.1612: Introduction to Neuroscience (1.0 credits). The Neuroscience course provides students with the fundamentals of how the nervous system is organized and works in health and disease. The course brings together neuroanatomy, neurohistology, neurophysiology, and an introduction to the neurological examination and neurological disorders. Discussions and applications place the emphasis on analytical skills, integration, critical thinking and problem solving with clinical relevance. This course is foundational to advanced courses in the curriculum where neuroscience is taught.

BAS01-DN.1613: Craniofacial Biology (2.1 credits). Craniofacial Biology presents the cell and molecular biology, histology and physiology of oral tissues that have direct relevance to the understanding and practice of dentistry. The course builds upon the concepts presented earlier in the first-year basic science curriculum and serves as a bridge to courses in pathology and clinical sciences that follow in the DDS curriculum. Topics include oral cavity, saliva and salivary glands; tooth formation, enamel and dentin; root formation, periodontal and ulpal tissues; muscles of mastication, swallowing and temporomandibular joint (TMJ).

BAS01-DN.1610: Principles of Pharmacology (1.0 credits). The Principles of Pharmacology course provides a basic understanding of drug administration, pharmacokinetics, pharmacodynamics, drug interactions

and adverse drug reactions. Pharmacology is a subject that is highly integrated with material from other basic sciences. Consequently, the course relies on a working knowledge of physiology, pathology, biochemistry, histology, and anatomy. And the course is foundation for future courses that focus on pharmacological applications to the clinical practice of dentistry.

BAS01-DN.1614: Microbiology (3.0 credits). The Microbiology course serves as an introduction to the microbial organisms that cause most of the infections in humans, by focusing on bacteria, viruses, fungi, and the methods used for their identification in the clinical lab. The course presents the general properties, genetics and metabolism of these organisms, and the antimicrobial agents utilized for treating infections. In addition, this course addresses virulence factors of microbial agents that enable them to cause disease in humans. Modes of transmission are described, as well as treatment and prevention.

BAS06-DN.2510: Body and Disease 1*. The Body and Disease (B&D) course emphasizes basic mechanisms in systemic physiology, systemic pathology and therapeutics and its integration and implications for dental practice. This course is divided into vertical integrated units (VIUS) by organ system. There are physiological and pharmacological/therapeutics components for each organ system. The course thus covers common diseases within the range of the major organ systems: cardiovascular, hematology, pulmonary, endocrine, gastrointestinal, immunology, reproductive, renal, skeletal, nervous, and skin. The knowledge taught in this course applies to all the clinical disciplines.

***Note:** this course is administered jointly with the Department of Oral and Maxillofacial Pathology, Radiology and Medicine.

BASCI-DN. 2610: Body and Disease 2* . The Body and Disease course 2 is the continuation of B&D 1. It emphasizes basic mechanisms in systemic physiology, systemic pathology and therapeutics and its integration and implications for dental practice. This course is divided into vertical integrated units (VIUS) by organ system. There are physiological and pharmacological/therapeutics components for each organ system. The course thus covers common diseases within the range of the major organ systems: cardiovascular, hematology, pulmonary, endocrine, gastrointestinal, immunology, reproductive, renal, skeletal, nervous, and skin. The knowledge taught in this course applies to all the clinical disciplines.

***Note:** this course is administered jointly with the Department of Oral and Maxillofacial Pathology, Radiology and Medicine.

BAS01-DN.1617: Comprehensive Exam Preparation 1 (0.75 credits). The goal of the course is to help first year predoctoral students retain foundational knowledge from completed courses and learn to critically access clinical scenarios and appropriately apply foundational knowledge to these cases.

BAS01-DN.2517: Comprehensive Exam Preparation 2 (0.5 credits). The goal of the course is to help second year predoctoral students retain foundational knowledge from completed courses and learn to critically access clinical scenarios and appropriately apply foundational knowledge to these cases.

Dental Hygiene Courses

DHYG1-UD.124: Oral Embryology and Histology (2.0 credits). The Oral Embryology and Histology course provides an understanding of embryology and orofacial development, histology, and the cellular and molecular mechanisms underlying tooth formation. Topics include the oral cavity, general principles of human embryogenesis, orofacial and tooth development, the developmental properties of enamel, dentin, periodontal tissues and alveolar bone. In addition, the eruption and exfoliation of teeth, and the biology of dental pulp, salivary glands and TMJ are discussed. At the conclusion of the course, the student

should understand the rationale that constitutes current therapies in dental hygiene. The student should also have knowledge in oral biology to be successful in those areas of the National Board Examinations.

Master of Science, Oral Biology Track Courses

BASCI-DN.8048: Integrative Seminars in Oral Biology I: Oral Systemic Connections (3.0 credits). This course provides an introduction to current topics in oral biology primarily focusing on the connection between oral disease and other systemic diseases and medical conditions. Topics include various aspects relating to etiology of dental caries, periodontal diseases, oral facial pain, oral infections (oral biofilm, oral microbiome, HIV), metabolism of tobacco carcinogens by human oral tissue, squamous cell carcinomas, mechanisms of host-pathogen interactions, and correlations between oral pathogens and chronic systemic inflammatory diseases.

BASCI-DN.8049: Integrative Seminars in Oral Biology II: Bone Biology and Craniofacial Development (3 credits). This course provides an introduction to up-to-date knowledge of skeletal and bone biology, molecular, cellular, and oral biology. Topics cover both basic and clinical aspects of bone metabolism, skeletal biology, craniofacial development, bone and soft tissue remodeling, bisphosphonate-related osteonecrosis of the jaw, and chronic systemic inflammatory disease and osteoporosis.

BASCI-DN.8050: Directed Individual Research in Oral Biology (1-4 credits). This course provides the opportunity for students to work with a faculty member at NYU College of Dentistry on his/her current research project, including laboratory research or library research (readings, literature reviews).

Biomaterials courses recommended for students in Master of Science, Oral Biology Track

BIOM-GA.1003: Bioceramics (3.0 credits)

BIOM-GA.1005: Biomaterials Tissue Interface I (3.0 credits).

BIOM-GA.1008: Introduction to Electron Microscopy (3.0 credits).

BIOM-GA.1016: Imaging Science (4.0 credits)

APPENDIX 3. IMPACT OF THE MERGER ON THE EDUCATIONAL MISSION OF BIOMATERIALS

Report Prepared by John Ricci, PhD, FBSE, Associate Professor, Department of Biomaterials, Director, MS Program in Biomaterials Science, NYU College of Dentistry, Director, PhD Training Track in Biomaterials Science, Vilcek Institute at NYU Grossman School of Medicine

INTRODUCTION. The educational mission of the Department of Biomaterials at NYU College of Dentistry is threefold. Our department is responsible for teaching biomaterials science for:

1. The predoctoral College of Dentistry DDS program
2. Postgraduate specialty programs at the College of Dentistry
3. Postgraduate MS Biomaterials program (College of Dentistry) and PhD Biomaterials program (Vilcek Institute at NYU Grossman School of Medicine)

The contributions of Biomaterials to the dental school curriculum are for the most part, integrated into multiple courses. There is no single dental biomaterials course. Materials and subjects covered range from dental impression materials to various restorative materials, adhesives, crown and bridge materials, implants, and biocompatibility.

THE EXPERTISE OF OUR FACULTY. Our faculty specialize in research in specific areas and are very diverse. Their teaching is always related to their areas of expertise. They are (in alphabetical order):

- Tim Bromage, PhD (primary appointment in MPB, adjunct appointment in Biomaterials) — Bone and tooth imaging and analysis. Chemical analysis of materials ranging from fossilized teeth to seawater.
- Paulo Coelho, DDS, PhD — Bone response to implants, bone grafting biomaterials, and 3-D printed bone grafts. Surgical applications of bone repair techniques and materials. Note: Paulo is currently on sabbatical.
- Ronaldo Hirata, DDS, PhD — Dental restorative materials, composites, and adhesives. Extensive expertise in predoctoral dental education.
- John McDevitt, PhD — Lab-on-a-chip diagnostic design and implementation, polymer chemistry and processing, immunology.
- Dindo Mijares, MS, DDS — Materials characterization of bone and tooth mineral, ceramic, and other materials using x-ray diffraction, electron microscopy, surface chemistry analysis.
- John L. Ricci, PhD FBSE — Cell and tissue response to microstructured implant surfaces, development of implant surfaces and bone grafting materials, bone response to 3-D printed grafts. Administration of MS and PhD programs and student mentoring.
- Lukasz Witek, PhD — 3-D printing technology including design and chemical engineering of specialized printer inks, bone response to 3-D bone grafts, surgical models for testing for implant and graft testing.

GENERAL TEACHING CONTRIBUTION OF FACULTY. Of our faculty, Dr. Hirata contributes a tremendous amount of teaching (his specialty) to the predoctoral dental program. Drs. Witek, Ricci, and usually Coelho (currently on sabbatical) all contribute significantly to predoctoral teaching as well. Drs. Hirata and Ricci contribute significantly to postgraduate teaching. All Biomaterials faculty except Dr. Hirata contribute to postgraduate MS/PhD teaching.

EDUCATIONAL PROGRAMS AND MERGER IMPACT

Predoctoral College of Dentistry (D1-D4) Biomaterials teaching contribution is integrated into, and is limited to basic dental biomaterials science in these courses:

- D1 General Pathology
- D1 Single Tooth Restoration
- D2 General Dental Simulation II-Restorative Dentistry
- D2 Simulation — Fixed and Implant Prostheses
- D2 Diagnosis and Treatment of Oral Disease
- D3 Advanced Restorative and Biomaterials

Anticipated impact of merger — no impact.

Postgraduate Programs

- Fundamental of Prosthodontics — Prosthodontic Biomaterials
- Clinical Advances and Applications in Wound Healing

Anticipated impact of merger — A positive impact is anticipated in the Clinical Advantages and Applications in Wound Healing course. This is a biology-based course and would benefit from the advanced biomolecular and therapeutic perspective that would be available from MPB faculty.

Postgraduate MS/PhD Programs:

- Principles of Biomaterials Science
- Introduction to Biomaterials Research
- Biomaterial-Tissue Interface I and II
- Biostatistics
- Metal and Ceramic Biomaterials
- Polymers and Biopolymers
- Complex Biomaterials
- Research in Biomaterials
- Readings in Biomaterials
- Introduction to Electron Microscopy
- Imaging Science
- Physical and Chemical Methods in Biomaterials
- Independent Projects in Biomaterials Science

Anticipated impact of merger — A positive impact is anticipated on the Biomaterial-Tissue Interface I and II course. This is a biology-based course that examines cell and tissue response to biomaterials. This is based on wound healing which is closely related to embryology. Thus, this course would benefit from the expertise available from MPB faculty studying stem cell and developmental biology.

Summary of Merger Impact on Biomaterials Educational Programs. My analysis of our educational mission, based on my familiarity with the subject and discussions with our faculty indicate the following: Our Biomaterials faculty and I agree that there is no negative aspect to this merger, and our materials-based educational mission will not change. However, all Biomaterials programs tend to be heavy on the “materials” side and light on the “bio” side of the equation. The advantages of this merger are that the “bio” aspects of our educational mission will benefit from the added expertise of the MPB biomedical scientists.

A Note About Additional Benefits of the Merger. MPB has no Biomaterials component, and access to that component will result in collaboration that will benefit all of our research and teaching. Two examples of collaborations would comprise the use of 3-D printing of rigid and flexible matrices for 3-D culture of organoid experimental models, and use of controlled solubility biomaterials surfaces, microparticles, and nanoparticles as bioactive molecule delivery systems. An additional positive aspect of this merger involves the availability of PhD projects for the Vilcek Biomaterials PhD students. Collaborations between Biomaterials and MPB faculty will lead to increased numbers and variety of available PhD projects for these students.

BIOMATERIALS COURSES

Predoctoral Dental. The contributions of Biomaterials to the predoctoral dental school curriculum are integrated into multiple courses. There is no single Dental Biomaterials course. Contributions range from one lecture to most of some courses. Materials and subjects covered range from dental impression materials to various restorative materials, adhesives, crown and bridge materials, implants, FDA regulation, biocompatibility, and bioactivity.

D1 (First Year Dental)

General Pathology: BAS06-DN 1608. This course covers general pathology information necessary for the practicing dentist. Biomaterials contribution is minimal: one lecture on osseointegration of dental implants as a pathologic process.

Single Tooth Restoration: PCL03-DN 1608. This covers the different methods for restoring single teeth. Biomaterials contribution is significant and covers composite restorative materials as well as the variety of buildup materials, adhesives, and other materials involved in this process.

D2

General Dentistry Simulation II — Restorative Dentistry: PCL03-DN 2611. This is a basic, hands-on simulation course that teaches general dental procedures. Biomaterials contribution is significant as this covers many of the basic dental procedures from impressions to tooth restorations.

Simulation — Fixed and Implant Prostheses: PCL11-DN 2509. This simulation course covers crown and bridge technology as well as implant supported prostheses. Biomaterials contribution is significant, as this course is biomaterials intensive and involves a variety of metals and technologies as well as ceramics and other types of restorations.

Diagnosis and Treatment of Oral Disease: DGS03-DN 2610. This course covers the basics of diagnosis and treatment of a variety of diseases of the oral cavity. The Biomaterials contribution is moderate as some of these conditions require knowledge of restorative procedures involving biomaterials.

D3

Advanced Restorative Dentistry and Biomaterials: PCL02-DN 3511. This course covers more advanced techniques for dental restoration, most of which involve biomaterials. Biomaterials contribution is very significant (roughly half of the course).

Postgraduate Dental

Fundamentals of Prosthodontics: Prosthodontic Materials: BEHSC-DN 9305. This course is part of the prosthodontics curriculum, which is very biomaterials based. Biomaterials contributes most of the course.

Clinical Applications of Advances in Wound Healing: BASCI-DN 8043. This is a biology-based minicourse consisting of approximately 8-9 lectures: three on soft tissue (gingival) healing and grafting, three on bone

healing, bone integration of implants, and bone response to graft materials, and 2-3 lectures on complications. This course is generally taught to Prosthodontics, Periodontics/Implantology, and Endodontics postgraduate students. Biomaterials contribution is roughly one third of the course (bone related topics).

Postgraduate MS/PhD

These postgraduate courses are used for both the MS Biomaterials degree through the College of Dentistry, and the PhD Training Track in Biomaterials through the Vilcek Institute. Students who graduate from the MS in Biomaterials and are accepted in the Vilcek PhD program may transfer most of their credits from the MS degree. Students at the Vilcek Institute, from areas other than Biomaterials, but whose research involves aspects of biomaterials, may take these courses as electives. Courses indicated by an asterisk (*) are required for the MS in Biomaterials Science.

Principles of Biomaterials Science: BIOMS-DN 1000. [Course Directors: L. Witek, P. Coelho]. This course covers the scientific principles underlying the area of materials science, including concepts of kinetics, thermodynamics, diffusion, and quantum mechanics, etc., as they relate to their structure and properties of materials.

Introduction to Research: BIOMS-DN 2001 [Course Director: D. Mijares]. This course offers much of the necessary information for thesis research and preparation. The final project is preparation and presentation of a research proposal.

Metal and Ceramic Biomaterials: BIOMS-DN 1001. [Course Director: L. Witek]. Metals and ceramics are widely used in dental, biomedical, and an array of engineering applications. This course offers graduate students a comprehensive study of the structure and properties of metals and ceramics, as well as their criteria for practical applications.

Polymers and Biopolymers: BIOMS-DN 1002. [Course Director: J. McDevitt]. This course covers the chemistry, structure, and properties of polymers used in dentistry and medicine, both inorganic and organic.

Complex Material Systems: BIOMS-DN 1017 [Course Director: L. Witek]. This course offers graduate students a comprehensive study of structure-function-property relationships in composite materials across a range of applications. A background in composite materials design is provided, including multiphase metal, ceramic and polymer systems.

Biomaterials-Tissue Interface I, I:I BIOMS-DN 1005, 1006 [Course Director: J. Ricci]. This course provides background knowledge on the response of cells *in vitro* and tissues *in vivo* to different types of biomaterials used in dentistry and medicine.

Biostatistics I: BIOMS-DN 1012. [Course Director: M. Janal, Epidemiology and Health Promotions Department]. This course covers mathematical and statistical tools that are useful in all research including biomaterials research. Students are trained to (1) evaluate the technical and economic feasibility of a study; (2) design research protocols taking into account required statistical power and sample size; (3) use appropriate statistical analysis tools; and (4) interpret the significance of the experimental results.

Introduction to Electron Microscopy: BIOMS-DN 1008. *Lecture and laboratory. [Course Directors: D. Mijares, J. Ricci, T. Bromage].* This course covers the use of the scanning electron microscope, and the theory behind its use for different types of analysis. The course provides hands on experience.

Imaging Science: BIOMS-DN 1016. *Lecture and laboratory. [Course Director: T. Bromage,].* This course highlights basic principles of preparation and imaging relevant to biomaterials research, particularly as they relate to 2D and 3D transmitted and reflected light microscopy, as well as scanning electron microscopy of bone and tooth microanatomy.

Physical and Chemical Methods in Biomaterials: BIOMS-DN 1011. *Lecture and Laboratory. [Course Directors: D. Mijares, J. Ricci].* This course introduces students to the principles and techniques used in the study of materials and hard tissues, including x-ray diffraction, infrared spectroscopy, inductive coupled plasma, and mechanical testing, as well as other techniques.

Readings in Biomaterials: BIOMS-DN 2000. *[Course Director: Department Faculty].* This course reviews scientific literature related to biomaterials as approved by a faculty mentor. Students are required to prepare an extensive review of a selected biomaterials topic.

Research in Biomaterials: BIOMS-DN 3000. *[Course Director: Department Faculty]* The student may use variable credits each semester for research. Note: This course is required for Thesis Option students.

Independent Project in Biomaterials: BIOMS-DN 3001. *[Course Directors: Department Faculty].* This course requires an independent project that can be a thorough review of an advanced literature topic, evidenced based review, or a researched subject resulting in a publication-length manuscript on a biomaterials-related topic previously accepted by the department. Note: This course is required for Non-Thesis Option students.

APPENDIX 4. MEMO OF UNDERSTANDING

The Department of Biomaterials will be incorporated as a Division of Biomaterials into the Department of Molecular Pathobiology (MPB) in NYU College of Dentistry. This will create a single, unified basic science department within NYU Dentistry.

Faculty of the Division of Biomaterials will be appointed to the senior management team and to committees of MPB to ensure divisional representation at all levels.

MPB faculty will engage in scholarly research in the areas of biomedical science and biomedical engineering. The merged department will provide a critical mass of scientists capable of tackling problems of major societal importance. Colocation of groups in areas of biomedical science, biomedical engineering and chemical biology will facilitate synergistic interactions. The merged MPB department will develop collaborative links to the Tandon School of Engineering.

MPB faculty will contribute to teaching in Doctor of Dental Surgery (DDS), Dental Hygiene, Post-graduate Specialty, and MS and PhD Programs.

Faculty and adjunct faculty of the Department of Biomaterials will be appointed in MPB. Faculty will retain current titles and ranks. There will be no impact on tenure track faculty or tenured faculty.

Staff in the Department of Biomaterials will be appointed in MPB. Staff will retain current titles, ranks and position descriptions.

MPB will be a single financial unit. There will be no separate budget for the Division of Biomaterials. Faculty and staff will retain current salaries. Faculty and staff salaries will be charged to the MPB.

In the short-term (1 year), the allocation of research and office space will be unaffected by the merger. The expected provision of new or renovated laboratory space at 433 1st Avenue or 345 East 24th Street will allow colocation of research groups with complementary and synergistic research interests.

MPB guidelines for mentoring, promotion and tenure, for allocation of discretionary funds, and for allocation of research and office space will be applied to the Division of Biomaterials in accordance with NYU Dentistry's policies and procedures.