Esther E. Biswas-Fiss, PhD, MB(ASCP)CM
Department of Medical and Molecular Sciences
University of Delaware - College of Health Sciences
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EDUCATION

Rutgers/UMDNJ; Piscataway, NJ	Ph.D.	Molecular & Cellular Pharmacology
University of Maryland; Baltimore, MD	MS	Biochemistry
University of Washington; Seattle, WA	BS	Chemistry

POSITIONS AND EMPLOYMENT

2016 - present	Professor (tenured) and Chair, Department of Medical and Molecular Sciences, College of Health Sciences, University of Delaware, Newark, DE, 19716
2018 – present	Director of Graduate Programs in the Medical Sciences, CHS, of Delaware, Newark, DE, 19716
2017 – present	Director, Applied Molecular Biology and Biotechnology Program, CHS, of Delaware, Newark, DE, 19716
2014 - 2016	Professor, Department of Bioscience Technologies, Program in Biotechnology/Applied Molecular Technologies, Jefferson College of Health Professions, Thomas Jefferson University, Philadelphia, PA 19107 Secondary appointment in the Department of Ophthalmology, Sydney Kimmel Medical College of Thomas Jefferson University; Philadelphia, PA 19107
2004- 2014	Associate Professor, Department of Bioscience Technologies, Program in Biotechnology/Applied Molecular Technologies, Jefferson School of Health Professions, Thomas Jefferson University; Philadelphia, PA 19107
2006 – Present	Graduate Faculty of Thomas Jefferson University, Full Member
2006 - Present	Adjunct Associate Professor (volunteer appointment), Department of Molecular Biology, Rowan University School of Osteopathic Medicine, Stratford, NJ 08043
2000 - 2016	Program Director of Biotechnology/Applied Molecular Sciences, Jefferson School of Health Professions, Thomas Jefferson University; Philadelphia, PA 19107
1999 - 2004	Assistant Professor and Director of Departmental Research Programs, Department of Bioscience Technologies, Jefferson School of Health Professions, Thomas Jefferson University; Philadelphia, PA 19107
1996 - 1999	Graduate Student, Graduate Programs in Molecular Biosciences, Department of Molecular and Cellular Pharmacology, GSBS Rutgers/UMDNJ, Piscataway, NJ
1995 - 1999	Research and Teaching Associate, Department of Molecular Biology, UMDNJ, Stratford, NJ

CERTIFICATION/LICENSURE

2000 - 2023	Clinical Laboratory Specialist in Molecular Biology, MB (ASCP)CM Certification #: 25355408 (ASCP)
2014 – 2020	Mental Health First Aid, National Council for Community Behavioral Healthcare

OTHER EXPERIENCE AND PROFESSIONAL MEMBERSHIPS

Member, Wills Vision Center at Jefferson, Ophthalmological Genetics Special Interest Group (2014 – present)
Full Member, American Society for Biochemistry and Molecular Biology (ASBMB) (2002-present)
American Society of Clinical Laboratory Scientists (ASCLS) (2016-present)
American Society of Molecular Pathology (AMP) (2014-present)
Member, Sigma Xi Scientific Research Society (2008 – present)
Member, Association of Researchers in Vision and Ophthalmology (ARVO) (1999-present)

AWARDS

1991 Y S Kim Award for Excellence in Research, Dept. of Biochemistry, University of Maryland at Baltimore, Baltimore, MD.
2004 Fight for Sight Research Contribution Award; Annual Meeting of Researchers in Vision and Ophthalmology, Ft. Lauderdale, FL, May 2004
2007 Lindback Award for Distinguished Teaching, Jefferson College of Health Professions, June 2007
2010 Dean's Faculty Achievement Award, Jefferson School of Health Professions; June 2010

UNIVERSITY SERVICE

University of Delaware

2017 – present Member, Biopharmaceutical Initiatives Committee, University of Delaware
2017 – 2018 Member, Pharmaceutical Initiatives Committee, University of Delaware
2017 - present College of Health Sciences STEM Pipeline Initiatives Committee

Thomas Jefferson University

2015 – 2016 Member, MS Program in Genetic Counseling Planning & Development Committee, TJU
2014 - 2016 Member, Jefferson Committee on Research (JCOR)
2006 - 2106 Member JSHP Faculty Affairs Committee (Promotion and Tenure Committee)
- Committee Chair – 2014-2015
- Committee Chair – 2009-2011

2008 - 2016 Member TJU Institutional Animal Care and Use Committee (IACUC) Committee
2013 - 2016 Member JSHP Executive Council
2012 - 2016 Member, Middle States Accreditation Task Force/Self-Study on Assessment of Faculty Development and Engagement in Education, Research and Service
2012 - 2016 Faculty Advisor to Jefferson Science Outreach Network and ASBMB UAN
2012 - 2016 Faculty Advisor to the TJU Chapter of Active Minds
2012 - 2016 Member, TJU PhD Programs Review and Advisory Committee
1999 - 2016 Member JSHP/JCHP Committee on Research
2001 - 2014 Member JSHP/JCHP Longitudinal Study Committee
2007 - 2011 Member Jefferson Schools Research Task Force/Committee
2006 - 2011 Member Jefferson Schools Faculty Advisory Committee
2005 - 2007 Member JCHP Strategic Planning Committees and Pharmacy School Development Group
2004 - 2005 Member Thomas Jefferson Strategic Planning Committee
2003 - 2006 Member JCHP Committee on Education Philosophy and Planning (EP&P) 2005 - 2006 Member of the Middle States Accreditation Task Force/ Research/Facilities/Equipment/IT

CURRICULUM DEVELOPMENT AND TEACHING INNOVATIONS

2019 – Present *De novo* development of the Professional MS programs in Applied Molecular Biology and Biotechnology and Medical Laboratory Science and, University of Delaware

2019 – Present	Development of "Green Initiatives for Assessment of Teaching and Learning in MMSC: Exam Soft Based Assessments; Remote Clinical Site Monitoring; Electronic Student Practicum Evaluations, University of Delaware
2018 – Present	*De novo* development of Medical Diagnostics PrePA- Physician Assistant Program Early Assured Admission Articulation Agreement in Collaboration with Arcadia University
2018 – Present	*De novo* development of the minor in Genetic Counseling, University of Delaware
2017 – Present	Internship Coordinator, Applied Molecular Biology and Biotechnology Program, *De novo* development of industry-academic internship partnerships and affiliations. University of Delaware
2017 – Present	Development of AS to BS in Applied Molecular Biology and Biotechnology articulation agreements and pipeline programs with regional community colleges (DelTech, Cecil College and Rowan College of South Jersey)
2017- Present	*De novo* development of online/hybrid Graduate Certificate Program in Molecular Diagnostics, University of Delaware.
2017 – Present	*De novo* development of BS and BS/MS programs in Applied Molecular Biology and Biotechnology, University of Delaware.
2017 – Present	*De novo* development of the MS in Medical Sciences, University of Delaware
2016 – Present	Curriculum revision and update, Ph.D. in Medical Sciences program, University of Delaware
2000 – 2016	Development of AS to BS in Biotechnology articulation agreements and pipeline programs with regional community colleges (Montgomery County College, Bucks County College, Camden County College, Rowan College at Burlington County and Rowan College of South Jersey)
2000 – 2016	Development of Biotechnology Technical Competency Assessment Checklist, Thomas Jefferson University, Philadelphia, PA
2000 – 2016	*De novo* development of the Biotechnology BS, BS/MS and MS level programs, curricula and coursework, Thomas Jefferson University, Philadelphia, PA
2014 - 2015	Development of the "*Interactive Curricula Experience and App (iCE)"* for Research Design courses in collaboration with other JSHP faculty

DIVERSITY, EQUITY AND INCULSION OUTREACH AND COMMUNITY SERVICE

Developed, organized and directed outreach and diversity programs aimed at enhancing awareness of STEM and biomedical science fields and their career opportunities.

2021 – present	Founding Faculty Advisor to DEI Peer Mentor Program, Department of Medical and Molecular Sciences, University of Delaware
2018 – present	Founding Faculty Advisor to Delaware Chapter of Graduate Women in Science (GWIS), University of Delaware
2017 – present	Participant and MMSC liaison for CHS STEM Pipeline Initiatives, including Summer Health Sciences Camp; dual credit college course offerings at local underserved high schools, science demonstrations at regional elementary schools, University of Delaware
2013- 2016	TJU-GSK-Philadelphia Academies *Quest Biotechnology Pipeline Program*, co-developer and coordinator, Thomas Jefferson University
2004 -2016	*Summer Science at Jefferson*, High School Summer Science Program, co-developer and coordinator, Thomas Jefferson University
2013- 2016	Academic advisor to the TJU Chapter of ASBMB Science Outreach Network (Jeff-SON), Thomas Jefferson University
2000 – 2001	Molecular Biotechnology Workshop" June 26-30, 2000. "PCR Technology Workshop" April 5-7, 2001, NCA Review for Molecular Biologist Certification Exam, July 2001.
1995 – 1999	PREP program mentor – summer undergraduate research program at UMDNJ

ADVISORY BOARD MEMBERSHIP

2001 - Present	Member (Chair – 2014 to present) Rowan College at Burlington County (formerly Burlington County Community College) Chemistry and Biotechnology Advisory Council;
2014- 2016	Member, Occupational Advisory Council, Roxborough High School Biotech Academy
2001- Present	Member, Biotechnology Board of Burlington County Community College
2009 - Present	Member, Biotechnology Board of Bucks Country Community College
2001- Present	Member, Biotechnology Board of Montgomery Country Community College
2001- Present	Member, Biotechnology Board of Camden County Community College

CONSULTATIVE AND ADVISORY POSITIONS HELD

Editorial Board Member

2013 – Present	JSM – Biotechnology and Biomedical Engineering

Invited Peer Reviewer for the Following Scientific Journals

2019- Present	*Clinical Laboratory Science*
2019 – Present	*International Journal of Environmental Research and Public Health*
2017 – Present	*MDPI Cancers*
2017- Present	*MDPI Cells*
2017 – Present	*MDPI Viruses*
2013- Present	*ACS Neuroscience*
2012- Present	*BIOCHIMIE*
2012- Present	*Clinical Ophthalmology*
2012- Present	*Clinical Optometry*
2010- Present	*Investigative Ophthalmology and Visual Science (IOVS)*
2006- Present	*Protein and Peptide Letters*
1995- Present	*Biochemistry*
1999- Present	*Journal of Allied Health*

Grant Reviewer

2020	National Science Foundation – STTR/SBIR
2017 – present	University of Delaware – UDRF Program
2011-2016	TJU JSHP/JCHP & JCOR Intramural Grant Programs
2009	The Welcome Trust – External Peer Reviewer, Research Project Grant
2009	NIH Peer Mail Reviewer – ARRA Stimulus Grants
1998	Association for International Cancer Research - External Peer Reviewer, Research Project Grant

Textbook Editorial Review

2012 – Present	*The Cell: A Molecular Approach*, Geoffrey M. Copper and Robert E. Hausman; Sinauer Associates, Inc.

External Reviewer Faculty Promotion and Tenure

2020	St. Louis University, Department of Biology, St. Louis, MO

External Academic Program Reviewer

2012- 2016	National Science Foundation (NSF) TJU Coordinator for Survey of Graduate Students and Post-doctorates in Science and Engineering (GSS)
2013	External Reviewer for Burlington County Community College Chemistry Program December
2009	External Reviewer for State of New Jersey, Middlesex Community College Biotechnology Program

SCHOLARSHIP, RESEARCH AND MENTORSHIP

Current Research Support

Agency: Limelight Bio
Project: Biologic testing contract research – NDA in place
Scope of Work: Functional analysis of bio-therapeutic proteins for use in treatment of visual disease
Role: PI 10/1/2019 – present

Agency: Delaware Bioscience CAT
Title: A Novel Low-Cost Expression System for the Production of Complex Viral Proteins
Scope of Work: Large scale production of SARS-V2/COVID-19 proteins for diagnostic assay platforms and vaccine development
Role: CO-I 08/01/2020 – 08/01/2021

Proposals Under Review

09/01/2021 – 08/31/2026

Agency: NIH/NEI
Project: "Molecular Genetic Analysis of ABCA4 Genetic Variations and Their Role in Age Related Macular Degeneration."
Scope of Work: Assess the structural and functional consequences of genetic variation in the *ABCA4* gene that lead to age related macular degeneration utilizing computational and biological approaches.
Role: PI

07/01/2021 - 06/30/2026

Agency: NIGMS
Project: Bridge to the Baccalaureate at the University of Delaware
Scope of Work: Multifaceted training program aimed at increasing the transfer and academic success of students from local community colleges to the University of Delaware Biotechnology and Medical Laboratory Science programs.
Role: PI

Completed Research Support

1. Completed Research Support
2R15EY013113 Biswas-Fiss (PI) 07/01/2000 – 01/31/2018
NIH/NEI
Project: "Biomolecular Analysis of Proteins in Visual Disease."
Scope of Work: Functional analysis of proteins harboring mutations associated with inherited macular degeneration.
Role: PI

2. Supplemental awards to NEI/NIH grant 2R15EY013113

3R15EY013113-02S1 MARC (Minority Access to Research Careers) Supplement -
NIH/NEI/NIGMS Project Period Begin Date: 07/01/2000
Project Period End Date: 06/30/2005
Role: PI Fellowship support for JSHP student: Kwabena Freempong

3R15EY013113-04S1 MARC (Minority Access to Research Careers) Supplement -
NIH/NEI/NIGMS Project Period Begin Date: 07/01/2000
Project Period End Date: 03/31/2010
Role: PI Fellowship support for JSHP student: Maimonua Bah

3R15EY013113-02S2 Administrative Supplement for "Quantitative Physical Measurements at the Nanoscale" Project Period Begin Date: 07/01/2000
Project Period End Date: 06/30/2005
Role: PI (Supplement to provided funds for acquisition of research grade spectrofluorometer.)

3. Agency: American Health Assistance Foundation
Role: PI
Period: 4-1-03 to 3-31-04
Scope of Work: Analysis of Age-Related Macular Degeneration mutations on protein-protein interactions involving the ABCR gene product.

4. Agency: Fight for Sight
Role: PI
Period: 7-1-99 to 6-30-04
Scope of Work: Cloning, expression and characterization of the nucleotide binding domains of the ABCR gene product, analysis of alterations in nucleotidase corresponding with mutations linked to retinal degenerations.

Undergraduate, Graduate & Post-Doctoral Student Mentorship

Graduate Mentorship at University of Delaware
Jazzlyn Jones, MS, PhD Thesis Advisor, Senem Cevik, MS, - Ph.D. Thesis Advisor 2020-present, Meera Patel[1,2], MS - Ph.D. Thesis Advisor, 2016-2021; Albtool Alturkestani, MS – Ph.D. Thesis Co-Advisor

Undergraduate Research Trainees at University of Delaware
Afoma Mbanefo (INBRE 2017); Nyle Smith (Summer Scholar, 2017); Tyler Findley (Summer Scholar, 2018), Leon Elcock (INBRE, 2018); Emily Hodgkins and Janae Latta (INBRE, 2019), Sarah Brandt (IMBRE, 2020)

MS Research Trainees at Thomas Jefferson University
Stephen Flowers[1,2]2; Ryan Wyanocheck; Mary Jablonski; William Riches[2,]; Shaan Kunwar; Nick Yun[2]; Teresa Pagoa[2]; Margo Puccerelli[2] ; Megan Choicey[2]; Alessandra Gambino[2]; Kwabena Frempong[2,3*]; (**Recipient of a MARC-NIH fellowship**); Jacquline LeGates[3]; Bayan Sajar; Jinadue Oke[2*]; Aline Disimone[2]; Maimouna Bah[2,3] (**Recipient of a MARC-NIH fellowship**); Carina Davis; Kinjaben Joshi[1,2]; Deepa Kurpad[2] ; Gayathri Sivaraman; Patricia Solobnick; Malissa Ha[2]; Krystal Coleman; Teresa Ng; Nissy Thomas; Nada Bawazir ; Yesha Patel; Vaishakhi Patel; Eleonora Samarxhi [2*]

Post-Doctoral Mentorship
2001 - 2003 Tatiana M. Suarez (recipient of a "***Fight for Sight Post-doctoral Fellowship***"[1,2,3]
2003 - 2004 Sujata Khopde[1]

Footnote….
1. Student peer reviewed publication outcome.
2. Student presented abstract at annual research day or other national or international meeting (*indicates student present received an award).
3. Student peer reviewed abstract outcome.

Thesis Committee Mentor/Member

University of Delaware – Joseph Patria (ANFS/Biology, PI – Mark Parcells); Shaili Patel (Biology, PI- Salil Lachke); Natalia Torres (MMSC, PI-Eric Kimec); Brett Sansbury (MMSC, PI-Eric Kimec); Safiyah Mansori (MMSC, PI- Sheau Ching Chai); Ngozi Dom Chima (MMSC – PI Sam Biswas); Ashely Tayolor (ANFS – PI Aditya Dutta)

Rowan University Graduate School of Biomedical Sciences (formerly UMDNJ) – Department of Molecular Biology: Khusbu Patel, MS Thesis Committee Spring 2011-Spring 2013; Gulden Kaplan, Ph.D. Committee 2013-present; Shawna Rotoli, Ph.D. Committee; 2012 – present; Julia Crawford, Ph.D. Committee; 2010-present; Jirayu Kukirtirat, MS Thesis Committee: Spring 2009 - Spring 2010.

INVITED BOOK CHAPTERS OR REVIEWS

1. ***Cascino, E.M., Das, S. Marella, M., Shakarchi, M.***, Biswas-Fiss, E.B. (2020) "Leadership Principals: Past, Present and Future, Invited Chapter in Laboratory Management, Principles and Processes, Fourth Edition, Denise Hammering, Editor, D.H. Publishing & Consulting Inc.

2. ***A. Alturkestani, J.P Jones, J. Korth***, Biswas-Fiss, E.E, ***Affett, S.*** and ***Ha, M.A***. Biswas, S.B. (2018) "ABCA Subfamily of Transporters" in Encyclopedia of Signaling Molecules, Invited Review: Choi, S. Editor, Springer Science Publishers, 2nd Edition.

3. Biswas, E.E, ***Affett, S.*** and ***Ha, M.A***. (2012) "ABCA Subfamily of Transporters" in Encyclopedia of Signaling Molecules, Invited Review: Choi, S. Editor, Springer Science Publishers.

4. Biswas, S. B., Clark, J., ***Kurpad, D. S***., & **Biswas-Fiss E. E**. (2008) Invited Review: Bacterial Replicative DNA Helicases in "*DNA Helicases*", December 2008, Editor, Frank Columbus, Nova Science Publishers, Inc., Hauppauge, NY.

5. **Biswas-Fiss, E.E**. (2007) Biochemical Defects in the Nucleotide Binding Domains of the Retina Specific ABC Transporter, ABCR., in "Ocular Transporters, in Ophthalmic Diseases and Drug Delivery", *Ophthalmology Research*, Invited Review, Tombran-Tink, J. and Barnstable, C., Editors.

<u>Contribution to Science and Areas of Interest</u>

1. The ABCA4 gene has been linked through genetic studies to a broad spectrum of blinding retinal degenerations, including Stargardt macular dystrophy and cone-rod dystrophy. Over 1000 disease associated mutations have been identified to date. The ABCA4 gene encodes a retina specific ATP binding cassette (ABC) transporter localized primarily to the rod and cone outer segment disc membranes. Each half of the bipartite ABCA4 protein contains a transmembrane domain (TMD) followed by a cytoplasmic or soluble domain (NBD), which harbors the Walker nucleotide binding motifs. In addition, each ABCA4 half transporter possesses a large extra-lumenal loop (ECD), characteristic of the ABCA subfamily. Historically, studies using purified and reconstituted bovine or hABCA4 expressed in mammalian cell lines were used as experimental systems to probe ABCA4 function. However, whole molecule studies have their limitations. In a multifunctional protein, such as ABCA4, it is difficult to assign the true raison d'être of each domain using this approach. ***My laboratory has developed a platform for the assessment of individual functional domains of ABCA4 as well as the consequences of disease associated genetic variations.*** This work has provided opportunities for undergraduate, graduate and post-doctoral researchers, several of whom have earned co-authorship on publications. I have served as the primary investigator on all of these studies.

1. Biswas E.E. and Biswas, S.B. (2000) The C-terminal Domain of the Human ABCR Protein is a Functional ATPase, *Biochemistry,* **39**, 15879-15886. PMID: 11123914 [PubMed - indexed for MEDLINE]
2. Biswas, E.E. (2001) The Nucleotide Binding Domain 1 of the Human Retinal ABC Transporter Functions as a General Ribonucleotidase. *Biochemistry*, 40, 8181-8187. PMID:11444963 [PubMed - indexed for MEDLINE]
3. **<u>Suarez, T. C.,</u>** Biswas S. B., and Biswas, E. E. (2002) Biochemical Defects in Human ABCR Nucleotide Binding Domain 1 Mutants Associated with Macular Degeneration. *Journal of Biological Chemistry*, **277**, 21759-21767. PMID: 11919200 [PubMed - indexed for MEDLINE]
4. Biswas-Fiss, E. E. (2003) Molecular Basis and Functional Consequences of Genetic Mutations in Human ABCR Nucleotide Binding Domain 2, *Biochemistry*, 42, 10683-10696. PMID:12962493 [PubMed - indexed for MEDLINE]
5. ***Patel MJ***, Biswas SB, Biswas-Fiss EE. (2019) Functional significance of the conserved C-terminal VFVNFA motif in the retina-specific ABC transporter, ABCA4, and its role in inherited visual disease. *Biochem Biophys Res Commun*., 519(1):46-52. doi: 10.1016/j.bbrc.2019.08.121. Epub 2019 Aug 31

2. The systematic analysis of the structure and function of individual domains of the retina specific ABC transporter ABCA4 has proven to be a highly viable and specific approach, as demonstrated in our studies with the NBD1/NBD2 and ECD1/ECD2 domains of ABCA4. ***Specifically, our studies have allowed us to pinpoint the region of ABCA4 which interact with the retinoids, 11-cis and all-trans retinal, as well to determine the consequences of disease associated mutations in these domains. Our work supports the notion that ABCA4 functions as an 11-cis retinal importer as well as an all-trans retinal exporter.*** This work has provided opportunities for undergraduate, graduate and post-doctoral researchers, several of whom have earned co-authorship on publications. I have served as the primary investigator on all of these studies.

1. Biswas-Fiss, E.E***, Kurpad, D.S.,*** and ***Joshi, K.*** (2010**)** Interaction of Extracellular Domain 2 of the Human Retina-Specific ABC Transporter (ABCA4) With All-*Trans* Retinal**.** *Journal of Biological Chemistry*, 285, 19372-83. PMID: 20404325 [PubMed – indexed for MEDLINE]
2. Biswas-Fiss, E.E, ***Affet S,*** and ***Ha, M.*** (2012) Retinoid binding properties of nucleotide binding domain 1 of the Stargardt disease-associated ATP binding cassette (ABC) transporter, ABCA4. *Journal of Biological Chemistry*, 287, 44097-107. PMID:23144455 [PubMed - in process]
3. Biswas, E.E, ***Jones, J., Alturkestani, A., Korth, J***. ***Affett, S***. and ***Ha, M.A***. (2017) "ABCA Transporters" in Encyclopedia of Signaling Molecules, 2nd Edition, pp. 21-28, Choi, S. Editor, Invited Review Springer Science Publishers.

3. The identification of genes and mutations associated with visual disease has led to routine genetic testing as a part of diagnosis, yet often such testing provides limited information on prognosis in the case of ABCA4 associated disease. ***Our ABCA4 analysis platforms allows for "reverse translation" of patient genotype-phenotype clinical profiles to their corresponding biochemical genotype-phenotype profiles.*** This is an exciting concept that may help to ultimately develop a predictive model for the clinical course of a specific genotype. Our work involves collaborations with the Wills Eye Hospital in Philadelphia and more recently, with the Wilmington VA Medical Center in Delaware. This work has provided opportunities for undergraduate, graduate and post-doctoral researchers, several of whom have earned co-authorship on publications. I have served as the primary investigator on all of these studies.

1. Biswas-Fiss, E.E. (2006) Interaction of the Nucleotide Binding Domains and Regulation of the ATPase activity of the human retina specific ABC transporter, ABCR. *Biochemistry*, **45**, 3813-3823. PMID: 16533065 [PubMed – indexed for MEDLINE]
2. Biswas-Fiss, E.E. (2007) Biochemical Defects in the Nucleotide Binding Domains of the Retina Specific ABC Transporter, ABCR., in "Ocular Transporters, in Ophthalmic Diseases and Drug Delivery", *Ophthalmology Research*, Invited Review, Tombran-Tink, J. and Barnstable, C., Editors.
3. **Wangtiraumnuay, N.,** Capasso, J., ***Tsukikawa, M***, . Levin, A. V., Biswas-Fiss, E. E. Novel ABCA4 Mutation Leads to Loss of a Conserved C-Terminal Motif: Implications for Predicting Pathogenicity Based on Genetic Testing. (2017) *European Journal of Ophthalmology*, 2018 January;28(1):123-126. PubMed PMID: 28885670.
4. ***Cevik, S. ,*** **Wangtiraumnuay, N., Van Schelvergem, K.,** ***Korth, J. , Tsukikawa, M.*** , Capasso, J, Subhasis B. Biswas, Biswas-Fiss, E., Boydt, B, Levin, A.V. (2021) Bioinformatic Analysis of ABCA4 Protein in Ocular Genetic Disease, *Manuscript under review*.

4. My early publications directly addressed the initiation of DNA replication, with an emphasis on DNA helicases and sequence specific DNA binding proteins. Such work formed a basis for later collaborative studies on emerging drug resistant and select agents, and oncogenic viruses such as *S. aureus*, B. *anthracis,* human *papillomavirus* virus. **Our studies provide evidence for the use of replication initiation proteins as targets for novel antimicrobials or antiviral pharmaceuticals.** I have served as a co-investigator on all of these studies.

1. Aiello D, Barnes MH, Biswas EE, Biswas SB, Gu S, Williams JD, Bowlin TL, Moir DT. (2009) Discovery, Characterization and Comparison of Inhibitors of *Bacillus anthracis* and *Staphylococcus aureus* Replicative DNA Helicases. (2009) *Bioorganic & Medicinal Chemistry*, **17**, 4466-76. PMID: 19477652 [PubMed - indexed for MEDLINE]
2. Biswas E.E., Barnes, M.H. , Moir, D.T., and Biswas, S.B (2009) An Essential DnaB Helicase of Bacillus Anthracis: Identification, Characterization, and Mechanism of Action. *J. Bacteriol.* 1, 249-60. PMID: 18931108
3. Biswas-Fiss, EE, ***Kukiratirat J***, Biswas S.B. (2012) Thermodynamic analysis of DNA binding by a Bacillus single stranded DNA binding protein, *BMC Biochem.*, 13, 10-14. PMCID 3464605
4. ***Rotoli, S. M.***, Biswas-Fiss, E.and Biswas, S. B. (2012) Quantitative analysis of the mechanism of DNA binding by Bacillus DnaA protein. *Biochemie*, 94, 2764-75. PMCID 22974984
5. ***Patel MJ, Bhatia L, Yilmaz G***, Biswas-Fiss EE, **Biswas SB**. (2016) Multiple conformational states of DnaA protein regulate its interaction with DnaA boxes in the initiation of DNA replication. *Biochemi. Biophys. Acta.* 9, 2165-2174. doi: 10.1016/j.bbagen.2017.06.013. [Epub ahead of print]

Bold/italics indicates undergrad, BS/MS, MS, Ph.D. or Medical student co-authors. **Bold underlined** indicates post-doctoral co-author.

Peer-Reviewed Publications

1. ***Patel, M***. and Biswas-Fiss, E. (2021) Virus-Like Particles: A Powerful and Promising Tool for Diverse Biomedical Applications, Manuscript under review.
2. ***Cevik, S. ,*** **Wangtiraumnuay, N., Van Schelvergem, K.,** ***Korth, J.*** **,** ***Tsukikawa, M.*****,** Capasso, J, Subhasis B. Biswas, Biswas-Fiss, E., Boydt, B, Levin, A.V. (2021) Bioinformatic Analysis of ABCA4 Protein in Ocular Genetic Disease, *Manuscript under review*
3. ***Patel, M. J.*****,** Biswas S. B., & **Biswas-Fiss, E.E.** (2020) Integrated approaches to understanding novel genetic variants identified through molecular diagnostic testing. *ASCLS Today*, 34(4).
4. ***Patel, M. J.*****,** Biswas S. B., & **Biswas-Fiss, E.E.** (2019) Functional significance of the conserved C-terminal VFVNFA motif in the retina-specific ABC transporter, ABCA4, and its role in inherited visual disease. *Biochem Biophys Res Commun*., 519(1):46-52. doi: 10.1016/j.bbrc.2019.08.121. Epub 2019 Aug 31
5. ***Patel, M. J.,*** Yilmaz, G., Bhatia, L., Biswas-Fiss, E. E., & Biswas, S. B. (2018). Site-Specific Fluorescence Double-Labeling of Proteins and Analysis of Structural Changes in Solution by Fluorescence Resonance Energy Transfer (FRET). *MethodsX*. PMID: 30013941
6. ***Wangtiraumnuay N****,* Capasso J, ***Tsukikawa M***, Levin A, **Biswas-Fiss E.** Novel ABCA4 mutation leads to loss of a conserved C-terminal motif: implications for predicting pathogenicity based on genetic testing. *European Journal of Ophthalmology*. 2018 January;28(1):123-126. PubMed PMID: 28885670.
7. **Yilmaz G, Biswas-Fiss E.E.** , & Biswas S.B. (2018) Genetic Variations in the DNA Replication Origins of Human Papillomavirus (HPV) Family Correlate with Their Oncogenic Potential. *Biochimica et Biophysica Acta,* 1862, 979-990.
8. ***Patel MJ, Bhatia L, Yilmaz G***, **Biswas-Fiss EE**, Biswas SB. (2017) Multiple Conformational States of DnaA Protein Regulate Its Binding to DnaA Boxes in the Initiation of DNA Replication. *Biochimica et Biophysica Acta*, 1861, 2165-2174.
9. **Biswas-Fiss, E.E**, ***Affet S,*** and ***Ha, M.*** (2012) Retinoid binding properties of nucleotide binding domain 1 of the Stargardt disease-associated ATP binding cassette (ABC) transporter, ABCA4. *Journal of Biological Chemistry*, 287, 44097-107. PMID: 23144455
10. **Biswas-Fiss, EE**, ***Kukiratirat J***, Biswas S.B. (2012) Thermodynamic analysis of DNA binding by a Bacillus single stranded DNA binding protein, *BMC Biochem*., 13, 10-14. PMCID 3464605
11. Rotoli, S. M., **Biswas-Fiss, E.**and Biswas, S. B. (2012) Quantitative analysis of the mechanism of DNA binding by Bacillus DnaA protein. *Biochemie*, 94, 2764-75. PMCID 22974984
12. **Biswas-Fiss, E.E**, ***Kurpad, D.S.,*** and ***Joshi, K***. (2011**)** Interaction of Extracellular Domain 2 of the Human Retina-Specific ABC Transporter (ABCA4) With All-*Trans* Retinal**.** *Journal of Biological Chemistry*, 285, 19372-83. PMID: 20404325
13. **Biswas E.E**., Barnes, M.H. , Moir, D.T., and Biswas, S.B (2009) An Essential DnaB Helicase of *Bacillus Anthracis*: Identification, Characterization, and Mechanism of Action. *J. Bacteriol.* 1, 249-60. PMID: 18931108.
14. Biswas SB, ***Wydra E***, **Biswas EE**.(2009) Mechanisms of DNA binding and regulation of Bacillus anthracis DNA primase. *Biochemistry,* **48**, 7373-82. PMID:19583259
15. Aiello D, Barnes MH, **Biswas EE**, Biswas SB, Gu S, Williams JD, Bowlin TL, Moir DT. (2009) Discovery, Characterization and Comparison of Inhibitors of Bacillus anthracis and Staphylococcus aureus Replicative DNA Helicases. (2009) *Bioorganic & Medicinal Chemistry*, **17**, 4466-76. PMID: 19477652
16. **Biswas-Fiss, E.E.** (2006) Interaction of the nucleotide binding domains and regulation of the ATPase activity of the human retina specific ABC transporter, ABCR. *Biochemistry*, **45**, 3813-3823. PMID:20404325
17. Biswas, S.B. and **Biswas-Fiss, E.E.** (2006) Quantitative analysis of binding of single-stranded DNA by

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32. **Biswas, E. E**. and Biswas, S. B. (1999) Mechanism of DNA Binding by the DnaB Helicase of Escherichia coli: Analysis of the Roles of Domain Gamma in DNA Binding. *Biochemistry*, **38**, 10929-10939.
33. **Biswas, E. E**. and Biswas, S. B. (1999) Mechanism of DnaB helicase of Escherichia coli: Structural Domains Involved in ATP Hydrolysis, DNA Binding, and Oligomerization. *Biochemistry*, **38**, 10919-10928.
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47. **Biswas, E. E**., & Biswas, S. B. (1988) Replication of Single-Stranded DNA Templates by Primase-Polymerase Complexes of the Yeast, *Saccharomyces cerevisiae, Nucleic. Acids Res., 16*, 14A:6411-6426.
48. **Biswas, E. E**., Joseph, P., & Biswas, S. B. (1987) The Yeast DNA Primase is Encoded by a 59 KiloDalton Polypeptide: Purification and Immunochemical Characterization, *Biochemistry, 26*, 5377-5382.
49. Biswas, S. B., & **Biswas, E. E**. (1987) Regulation of *dna*B Function in DNA Replication in *Escherichia coli* by *dna*C and λP Gene Products, *J. Biol. Chem. 262*,7831-7838.
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(Bold and italics refer to student or post-doctoral co-authored publications)

Peer Reviewed Scientific and Scholarly Presentations

1. Learning Management Systems and Remote Assessment: Challenges and Opportunities? ASCLS Clinical Laboratory Educators, **Biswas-Fiss, E.E**. and Biswas, S.B. Conference ASCLS Clinical Laboratory Educators Conference (CLEC), February 26, 2021, Virtual Conference

2. Applied Molecular Biology and Biotechnology: New Technology Based Programs at the University of Delaware**,** , **Biswas-Fiss, E.E**. and Biswas, S.B. Conference ASCLS Clinical Laboratory Educators Conference (CLEC), February 22, 2020, Orlando, FL

3. Novel Translational Approaches to Studying the Retina-Specific ABCA4 Transporter and Its Macular Dystrophy-Associated Genetic Variants: Genotype-Phenotype Correlations (oral). **Patel, M.J.,** Biswas, S., Biswas-Fiss, E. 2019 Graduate Student Forum, April 26, 2019. **University of Delaware, Newark, DE.** *Prize winner for outstanding poster presentation. Accepted and presented by M. Patel.*

4. Creating the Next Generation of Clinical Laboratory Educators, ASCLS Clinical Laboratory Educators, **Biswas-Fiss, E.E**. and Biswas, S.B. Conference (CLEC), February 21, 2019, Baltimore, MD

5. Genetic Variants in the C-Terminal Domain of the Retina-Specific ABCA4 Protein Lead to Inherited Visual Diseases (oral). ***Patel, M.J.,*** Biswas, S., Biswas-Fiss, E. College of Health Sciences Research Day, February 1, 2019. **University of Delaware, Newark, DE.** *Accepted and presented by myself M. Patel.*
6. Fluorescence Resonance Energy Transfer (FRET) as a Tool for Assessing Disease Associated Mutations in the Retina Specific ABC Transporter, ABCA4 (oral). ***Mbanefo, A., Patel, M. J.,*** Biswas-Fiss, E. Eighth Annual Undergraduate Research and Service Celebratory Symposium, August 11, 2017. **University of Delaware, Newark, DE.** *Accepted and presented by summer undergraduate student A. Mbanefo.*
7. Conformational Dynamics of DnaA Protein Drive the Switch Promoting Initiation of DNA Replication in Bacillus anthracis (oral). ***Patel, M. J.***, Biswas, S., Biswas-Fiss, E. Fifth Annual Microbial Systems Symposium, February 11, 2017. **University of Delaware, Newark, DE.** *Prize winner for best poster presentation. Accepted and presented by M. Patel.*
8. ASBMB Special Symposia, Student Centered Education in the Molecular and Life Sciences, August 5, 2013, Seattle, WA 98122. "Biotechnology: Science of the New Millennium - Technology Based Programs at Thomas Jefferson University."
9. Annual Meeting of Association for Research in Vision and Ophthalmology, May 7, 2012, Ft. Lauderdale FL. "Heterologous Expression Of The Human Retina Specific ABC Transporter, ABCA4, in Virus-Like Particles"
10. Annual Meeting of Association for Research in Vision and Ophthalmology, May 1, 2011, Ft. Lauderdale FL. "Retinoid Binding Properties of the Nucleotide Binding Domains of Human ABCA4 Protein"
11. Annual Meeting of Association for Research in Vision and Ophthalmology, May 2, 2010, Ft. Lauderdale FL. "Disease Mutations in the Second Extracellular Loop of the Human Retina Specific ABC Transporter, ABCA4, Impart Structural Defects in This Domain"
12. Annual Meeting of Association for Research in Vision and Ophthalmology, May, 7 2009, Ft. Lauderdale FL. "Two Hybrid Analysis of Protein Interaction with the Extracellular Domains of Human ABCR"
13. Annual Meeting of Association for Research in Vision and Ophthalmology, May 2007, Ft. Lauderdale FL. Unique and Stable Structure of the Extracellular Domains of the Retina Specific ABC Transporter, ABCR
14. Annual Meeting of Association for Research in Vision and Ophthalmology, May 2006, Ft. Lauderdale FL. Interaction of the Nucleotide Binding Domains and Regulation of the ATPase Activity of the Human Retina Specific the Human Retina Specific ABC Transporter, ABCR
15. Annual Meeting of Association for Research in Vision and Ophthalmology, May 2005, Ft. Lauderdale FL. Analysis of Intra–Protein Interactions in the Retina Specific ABC Transporter, ABCR
16. Meeting of Association for Research in Vision and Ophthalmology, May 2004, Ft. Lauderdale FL. Heterologous Expression of the Human Retina Specific ABC Transporter, ABCR, In The Yeast Saccharomyces Cerevisiae.
17. Annual Meeting of Association for Research in Vision and Ophthalmology, May 2002, Ft. Lauderdale FL. "Structure-Function Analysis of Macular Dystrophy Associated Mutations Influencing the Second Nucleotide Binding Domain of the Human Retinal ABC Transporter"

ABSTRACTS, Poster

1. **E. E. Biswas-Fiss, T. Otubu, K. Patel, S. Affet and S.Biswas,** Heterologous Expression Of The Human Retina Specific ABC Transporter, ABCA4, in Virus-Like Particles, *Invest. Ophthalmol. Vis. Sci.* 2011;52: E-Abstract 51.
2. E. E. Biswas-Fiss, ***M.A. Ha, D. S. Kurpad*** and *S.B. Biswas*, Retinoid Binding Properties of the Nucleotide Binding Domains of Human ABCA4 Protein, *Invest. Ophthalmol. Vis. Sci.* 2011;52: E-Abstract 51.
3. E. E. Biswas-Fiss, *D.* ***S. Kurpad, K. Joshi*** and ***B. Sajer***, Disease Mutations in the Second Extracellular Loop of the Human Retina Specific ABC Transporter, ABCA4, Impart Structural Defects in This Domain *Invest Ophthalmol Vis Sci* 2010;51: E-Abstract 1093.
4. **E. E. Biswas-Fiss**, ***M. B. Bah***, and S. B. Biswas, Two Hybrid Analysis of Protein Interaction with the Extracellular Domains of Human ABCR, Invest. Ophthalmol. Vis. Sci. 2009 50: E-Abstract 5426.

5. **E. E. Biswas-Fiss** and S. B. Biswas, Unique and Stable Structure of the Extracellular Domains of the Retina Specific ABC Transporter, ABCR, Invest. Ophthalmol. Vis. Sci. 2007 48: E-Abstract 598.
6. **E.E. Biswas–Fiss** and S.B. Biswas, Interaction of the Nucleotide Binding Domains and Regulation of the ATPase Activity of the Human Retina Specific the Human Retina Specific ABC Transporter, ABCR
7. Invest. Ophthalmol. Vis. Sci. 2006 47: E-Abstract 2023.
8. **E.E. Biswas–Fiss**, S. Biswas, ***K. Frempong***, and ***J. LeGates***, Analysis of Intra–Protein Interactions in the Retina Specific ABC Transporter, ABCR, Invest. Ophthalmol. Vis. Sci. 2005 46: E-Abstract 1702.
9. E.E. Biswas, Heterologous Expression Of The Human Retina Specific ABC Transporter, ABCR, In The Yeast Saccharomyces Cerevisiae., Invest. Ophthalmol. Vis. Sci. 2004 45: E-Abstract 1250.
10. **EE Biswas** and SB Biswas, Structure-Function Analysis of Macular Dystrophy Associated Mutations Influencing the Second Nucleotide Binding Domain of the Human Retinal ABC Transporter, Invest. Ophthalmol. Vis. Sci. 2002 43: E-Abstract 1401.
11. ***TM Suarez-Cortes***, **EE Biswas**, and SB Biswas, Biochemical Analysis Of Genetic Mutations Related To Visual Disorders In The NBD1 Domain Of ABC Transporter (ABCR), Invest. Ophthalmol. Vis. Sci. 2002 43: E-Abstract 1402.

(Bold and italics refer to student co-authored publications)

Invited Presentations

1. COVID-19: Vaccines and Variants, Panel Roundtable Discussion, University of Delaware, March 10, 2021
2. Squamous Cell Carcinoma STEM Group, Sidney Kimmel Cancer Center, "Genetic Variations in Human Papillomavirus Affecting Carcinogenicity & Diversity of the Global HPV Infections & Disease'. Thomas Jefferson University, March 3, 2021
3. University of Delaware, Delaware Life Science Forum; Panel Moderator, April 24, 2019
4. Burlington County College; Keynote Speaker Burlington County College Undergraduate Research Symposium; "You've Come a Long Way Baby"; April 2015, Mt. Laurel, NJ.
5. Montgomery County Community College; Biotechnology Career Day; Panel Presentation, April 2015
3. Bucks County College; "Biotechnology Science of the New Millennium" – Invited Presentation; March 2015
4. Burlington County College; "Molecular Approaches to Understanding Inherited Visual Disease"; February 2015; October 2014
5. Wills Eye Vision Center Symposium; April 25, 2014 "Genetic Mechanisms of Inherited Retinal Degenerations."
6. Burlington County College, Mt. Laurel, NJ. November 29, 2012, Undergraduate Research Initiative Symposium, Keynote Speaker.
7. Bucks County College, Newtown, PA, November 7, 2012, Keynote Speaker for Women in Technology and Science Symposium.
8. Health Career Fair Speaker, 1199c Training and Development Center, Philadelphia, PA; November 14, 2012,
9. Camden County College, Blackwood, NJ, October 2012, March 2011, October 2010, February 2009, "Molecular Approaches to Understanding Inherited Visual Diseases."
10. Burlington County Community College, Mt. Laurel, NJ. March 2013, October 2012, October 2011, April, 2011, November 2010, March, 2010 and November, 2009; "Molecular Approaches to Understanding Inherited Visual Diseases."
11. New Jersey Biotechnology Education Consortium, DVIN, May 11, 2009, "Development of Hands-On Programs in Biotechnology at Thomas Jefferson University"; Mercer County College Conference Center, Lawrenceville, NJ.
12. Mercer County Community College, Lawrenceville, NJ. February 2009, Keynote Lecture Series, "Biotechnology – Science of the New Millennium."
13. Camden County College, Blackwood, NJ, February 2009, "Biotechnology Approaches to the Development of Novel Antimicrobials."

14. Medical Diagnostic Laboratories, LLC, Hamilton, NJ, May 2008 "DNA Replication Proteins of *B. Anthracis* as Targets for the Development of Novel Antimicrobials".
15. BioMann 2006 Biotechnology Workforce Education Conference; NHCC Technical College, Worcester, NH. July 2006, Panel Speaker – "Biotechnology Science of the New Millennium – Development of Skills Based Educational Programs with Consortium Collaborations."
16. Burlington County Community College, Mt. Laurel, NJ. May 2006 "Biotechnology Forum." Panel Speaker on Challenges and Demands of Biotechnology Education.
17. Biotechnology Institute – Conference in Biotechnology Education; May 2005, Thomas Jefferson University; Best Practices in Education Speaker – "Development of Skills Based Educational Programs Designed to Meet Workforce Needs."
18. University of Pennsylvania, Department of Ophthalmology, November 2003, "Biochemical Analysis of Genetic Mutations in ABCR."
19. Montgomery County Community College, Blue Bell, PA.. October 2003,04,05,06,07 "Molecular Approaches to Understanding Inherited Visual Diseases."
20. Burlington County Community College, Mt. Laurel, NJ. October 2003,04,05,06,07 "Molecular Approaches to Understanding Inherited Visual Diseases."
21. Camden County Community College, Blackwood, NJ.. March October 2003,04,05,06,07 "Molecular Approaches to Understanding Inherited Visual Diseases."
22. University of Scranton, Institute of Molecular Biology, Scranton, PA. December 2002 "Structure and Function of the DnaB Helicase of *E. coli*."
23. Burlington County Community College, Mt. Laurel, NJ. September, 2002 "Molecular Approaches to Understanding Inherited Visual Diseases."
24. Burlington County Community College, Mt. Laurel, NJ. February 2002, "Biotechnology – Science of the New Millennium."
25. Burlington County Community College, Mt. Laurel, NJ. October 2002, "The Human Genome Project and Its Implications on Molecular Approaches to Disease."

TEACHING AND COURSE DEVELOPMENT

University of Delaware
MMSC 425/625 *Basic Molecular Techniques; Course Director (4.0 credits)* – **Designed** and oversee this course on basic molecular biology techniques. (Annually, Fall semesters AY 2016- course responsibility assigned to other departmental faculty 2017 - present).
MMSC 408/608 *Molecular Preparatory Techniques; Course Director (2.0 credit)* – **Designed and teach (sole instructor**) this laboratory/lecture course on preparatory techniques required to carry-out molecular biology laboratory procedures. (Annually, Fall semesters AY 2016- present)
MMSC 491/691 *Human Molecular Genetics*. Designed this online course in basic human genetics. (Annually, Spring semesters AY 2018 – present.)
MMSC 425/625 *Protein Purification and Characterization (3.0 credits);* Course Director - Designed and oversee the teaching (3 credit course) of laboratory-based course in basic techniques and principals of protein purification and current methods of characterization. (Annually, Spring semesters AY 2017-present; course assigned to other faculty in the department)
MMSC 492/692 and 493 *Molecular Diagnostic Techniques (2.0 – 3.0 credits);* Course Director - Designed and oversee the teaching of **(3 credit course)** this laboratory/lecture course on molecular diagnostic techniques. (Annually, AY 2017 -present, responsibility assigned to other faculty).
MMSC 605 *Regulatory and Fiscal Issues in Laboratory Management (3.0 credits)*; **Assisted in the development and participate** in this graduate level team-taught course which covers various regulatory and financial issues encountered in research and clinical laboratories. (Annually, Spring semesters AY 2018, course responsibility assigned to other departmental faculty 2017 - present).
MMSC 411/611, 412/612, 443/643, 444,644 *Biotechnology Practicum (Variable 2-4 credits);* Course Director - Coordinate and Administer this course in which biotechnology students rotate out to various laboratories to gain practical laboratory experience. Annually, all semesters; 2017-present.

MMSC 800 – *Writing Research Proposals*. Revised, updated and teach core course on proposal writing and presentation for second year Ph.D. in Medical Sciences students.

Thomas Jefferson University

PAST 530 *Clinical Skills Course – Microbiological Skills I & II (3.0 credits)* Developed and delivered two lectures on clinical microbiology for students in the Physician Assistant Program, Fall 2014.

LS301/501 *Molecular Biology; Course Director/sole lecturer (3.0 credits)* – **Reorganized, updated** and serve as sole lecturer for this lecture course on basic molecular cell biology and biochemistry. (Annually, AY 1999-00-present).

LS303/503 *Fundamentals of Clinical and Experimental Techniques; Course Director (3.0 credits)* - departmental team-taught course on basic laboratory techniques. (Annually, Fall semesters, AY 1999-present).

BT310/510 *Basic Molecular Techniques; Course Director (4.0 credits)* – **Designed** and oversee this course on basic molecular biology techniques. (Annually, Fall semesters AY 2000-01- course responsibility assigned to other departmental faculty 2002 - present).

BT303/503 *Molecular Preparatory Techniques; Course Director (1.0 credit)* – **Designed and teach (sole instructor**) this laboratory/lecture course on preparatory techniques required to carry-out molecular biology laboratory procedures. (Annually, Fall semesters AY 2000-01-present).

BT 320/520 *Cell and Tissue Culture Techniques; Course Director (4.0 credits)* - **Designed, direct and participate in the team teaching** of this laboratory/lecture course dealing with cell growth and protein expression in cell systems such as: *E. coli*, yeast, insect (baculovirus), plant and mammalian cell lines. (Annually, Spring semesters, AY 2000-- present).

BT 405/605 *Microbial Genetics (3.0 credits);* - Designed, directed and participated in the teaching of this lecture/seminar based course on current as well as classical topics in microbial genetics. (Annually, Fall semesters AY 2000 to AY 2002; course responsibility assigned to adjunct faculty 2002 – present).

BT 411/611 *Protein Purification and Characterization (3.0 credits);* Course Director - Designed and participate in the teaching (1.5 credits of a 3 credit course) of laboratory based course in basic techniques and principals of protein purification and current methods of characterization. (Annually, Spring semesters AY 2003-present)

LS 440 *Current Research in Bioscience Technologies (3.0 credits);* Course Director - Developed, serve as course director and participate in this team taught course in which students review, critique and report on recent primary literature in a small group session/case study format. (Annually AY 2003-present)

BT410/610 *Molecular Diagnostic Techniques (4.0 credits);* Course Director - Designed, direct and teach (sole instructor) this laboratory/lecture course on molecular diagnostic techniques. (Annually, AY 2001-present).

BT 403/603 *Human Genetics*. Designed this course in basic human genetics. (Annually, Spring semesters AY 2003; course responsibility assigned to adjunct faculty 2003 - present).

BT 401/601 *Systems Biology;* Course Director *(2.0 credits)* - Coordinate **and participate (1.0 credit of 2 credits)** in this course which utilizes a systems approach to current problems in biomedical science; topics include flow cytometry, bioinformatics, proteomics and genomics. Annually Spring semesters, 2002-present.

BT 412, 422, 432 442, BT 812, 813, 814, and 815 *Laboratory Practicum (Variable 2-4 credits);* Course Director - Coordinate and administer this course in which biotechnology students rotate out to various laboratories to gain practical laboratory experience. Annually, all semesters; 2000-present.

LS610 *Regulatory and Fiscal Issues in Laboratory Science (3.0 credits)*; **Assisted in the development and participate** in this graduate level team-taught course which covers various regulatory and financial issues encountered in research and clinical laboratories. (Annually, Spring and Summer semesters AY 2001-2016).

LS603 *Research Design (3.0 credits)*, **Assisted in the development and participate** in this graduate level team-taught course which covers fundamental concepts in basic and clinical research. (Annually, Fall semesters, AY 2001-present).

LS801/802 *Master Research Project (3.0 credits)*; **Assisted in the development and participate in** this course in which BST students complete their Master's research projects. (Annually, all semesters, AY 2001-2016).

BT302 *Molecular and Immunological Techniques (3.0 credits)* - Taught the molecular biology half of an upper-division undergraduate course in molecular and immunological techniques. AY 1999-0.