

CURRICULUM VITAE

1. NAME: Edward M. Greenfield, Ph.D.
2. BIRTHPLACE: Miami, Fla.
3. ADDRESS: 2109 Adelbert Road
Department of Orthopaedics
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4. EDUCATION:

1978 B.A., Biology, New College, Sarasota, FL; Thesis: Zinc Partitioning and Formation of the Larval Skeleton in the Developing Sea Urchin, Lytechinus variegatus, Mentor: Dr. John Morrill

1981 M.S., Marine Science, University of North Carolina, Chapel Hill, NC; Thesis: Regional Variations in the Rate of Anaerobic Succinate Accumulation in the Mantle of the Euryoxic, Intertidal Bivalve, Mercenaria mercenaria, Mentor: Dr. Miles Crenshaw

1987 Ph.D., Marine Science, University of North Carolina, Chapel Hill, NC; Thesis: In vitro Mineral Induction by Soluble Matrix from Molluscan Shells, Mentor: Dr. Miles Crenshaw

1987-90 Post-Doctoral Fellow, Bone Cell Biology, Department of Pathology, Washington University, St. Louis, MO; Mentor: Dr. Steven Teitelbaum

5. PROFESSIONAL APPOINTMENTS:

1990-1998 Assistant Professor, Department of Orthopaedics, CWRU

1990-1998 Assistant Professor, Department of Pathology (Secondary Appointment), CWRU

1995-1998 Assistant Professor, Department of Physiology and Biophysics (Secondary Appointment), CWRU

1995-Present Faculty Member, Skeletal Research Center, CWRU

- 1998-2004 Associate Professor, Department of Orthopaedics (Secondary Appointments in Pathology and in Physiology and Biophysics), CWRU
- 1999 Award of Tenure, CWRU
- 2004-Present Full Professor, Department of Orthopaedics (Secondary Appointments in Pathology and in Physiology and Biophysics), CWRU
- 2004-Present Director of Research, Department of Orthopaedics, CWRU
- 2006-Present Faculty Member, Comprehensive Cancer Center, CWRU
- 2007-Present Faculty Member, Center for Stem Cell & Regenerative Medicine, CWRU

6. MILITARY SERVICE: None

7. HONORS AND AWARDS: (Grants/fellowships are listed in section 12)

- 1999 William Harris Award, Orthopaedic Research Society: "The role of osteoclast differentiation in aseptic loosening"
- 2003 Kappa Delta Award, American Academy of Orthopaedic Surgeons: "Does Endotoxin Contribute to Aseptic Loosening?"

Awards to Lab Members:

- 1992 Steven Shaw, Kroc Research Fellowship in Diabetes & Endocrine-Related Diseases
Steven Shaw, Hartford Foundation Geriatric Medicine Summer Student Fellowship
- 1993 Michael Banks, Orthopaedics Research and Education Foundation Resident Research Fellowship
Michael Banks, Allen Fellowship
- 1995 Steven Shaw, CWRU Medical School Lepow Research Day Honorable Mention
- 1996 Nicholas Waanders, Orthopaedics Research and Education Foundation Resident Research Fellowship
Ashraf Ragab, Allen Fellowship

- 1998 Ashraf Ragab, Cleveland Orthopaedic Society Resident's Research Contest Second Place Award
- 1999 Ashraf Ragab, Orthopaedic Institute of Cleveland Friedman Resident Research Award
Scott Kaar, CWRU Office of Geriatric Medicine Summer Fellowship
Bob Lowe, Allen Fellowship
- 2000 Scott Kaar, CWRU Orthopaedic Research Day Best Poster Award
Joscelyn Seabold, CWRU Dept. of Physiology & Biophysics Recknagel Graduate Student Research Award for Excellence in Research
Andrew Islam, CWRU Office of Geriatric Medicine Summer Fellowship
- 2001 Joscelyn Seabold, CWRU Orthopaedic Research Day Best Poster Award
Michael Lee, Allen Fellowship
- 2003 Matt Smith, Allen Fellowship
- 2004 Xin Chen, ASBMR Young Investigator Award, Meeting on Advances in Skeletal Anabolic Agents for the Treatment of Osteoporosis
Michelle Beidelscheis, NIH Pre-doctoral Institutional Training Fellowship
Andrew Islam, Allen Fellowship
- 2005 Matt Smith, Cleveland Orthopaedic Society Resident Essay Contest 2nd Place Award
Xin Chen, Orthopaedic Research Society New Investigator Recognition Award Finalist
Chris Utz, CWRU Medical School Lepow Research Day Dean's Poster Presentation Award
Jonathan Keary, CWRU Medical School Crile Summer Research Fellowship
- 2006 Andrew Islam, Cleveland Orthopaedic Society Resident Essay Contest 1st Place Award
Jonathan Keary, CWRU Medical School Lepow Research Day Outstanding Poster Presentation Award
Michelle Beidelschies, Travel Award, Society for Leukocyte Biology/Internal Endotoxin and Innate Immunity Society Joint Meeting

- 2007 Patrick Messerschmitt, Cleveland Orthopaedic Society Resident Essay Contest 1st Place Award
- Patrick Messerschmitt, Barry Friedman Resident Research 2nd Place Award
- Patrick Messerschmitt, Ohio Orthopaedic Society Resident Research Competition 1st Place Award
- Patrick Messerschmitt, Allen Fellowship
- Robert Bookover, American Cancer Society Silber Summer Fellowship
- Lindsay Bonsignore, NIH Pre-doctoral Institutional Training Fellowship
- Dave Shukla, Curtiss Medical Student Summer Fellowship
- 2008 Lindsay Bonsignore, Best Poster Award, CWRU Musculoskeletal Research Day
- Patrick Messerschmitt, Midwest Region OREF Resident Research 3rd Place Award
- Sean Arlauckas, CWRU Stem Cell Center ENGAGE Summer Undergraduate Fellowship
- Andrew Gordon (collaborative project with Wilkinson laboratory, University of Sheffield), McKee Award - Best podium presentation, British Hip Society Annual General Meeting
- Nick Schroeder, CRILE Summer Fellowship

8. LICENSURE AND BOARD CERTIFICATION: Not applicable

9. PROFESSIONAL SERVICE:

Grant Review:

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|-------------------------|--|
| 1986-87, 96, 98, 02, 05 | National Science Foundation External Grant Review |
| 1995-96, 01-02 | VA Merit Review |
| 1996, 99-01 | Ad hoc member, NIH Oral Biology and Medicine-2 study section |
| 1996 | Member, Dept. of Defense Osteoporosis Basic Science Grant Review Panel |

1996-99, 01, 08	Member, NIH Special Emphasis Study Sections
1997	Member, American Heart Association Northeast Ohio/Indiana Study Section
1997-98, 01	Ad hoc member, NIH Orthopaedics & Musculoskeletal study section
1999	Member, NASA Bone Biology Grant Review Panel
2000	U.S. Civilian Research and Development Foundation Grant Review
2000	External reviewer, Yale Core Center for Musculoskeletal Diseases Pilot and Feasibility Proposals
2003	Member, NIH Osteoporosis SCOR Special Review Committee
2003	External reviewer, Yale Pepper Older Americans Independence Center Pilot Proposals
2003-04	External reviewer, Wellcome Trust Programme Grant Proposals
2004-07	Ad hoc member, NIH Skeletal Biology Development & Disease Study Section
2005	Member, Canadian Institutes of Health Research's RFA Peer Review Committee on Microgravity and Bone Cells
2005	Isreal Science Foundation External Grant Review
2005	French National Research Program on Bone and Joint Disease
2006	ASBMR Career Enhancements Grant Awards
2006-07	Kentucky Science & Engineering Foundation Grant Review
2008	Swiss National Science Foundation Systems Biology Grant Review

Manuscript Review:

1991-2008	Journal of Bone and Mineral Research
1991-92, 95, 97-01, 03-08	Journal of Orthopaedic Research

1993, 2007-08	Cytokine
1994, 99-2001	American Journal of Physiology
1994, 96-97, 2001-03, 08	Archives of Biochemistry and Biophysics
1994	Biochemistry and Molecular Biology International
1994	Molecular Endocrinology
1995, 97-98, 2003-04	Endocrinology
1995-96, 2000, 03-08	Journal of Bone and Joint Surgery (American)
1995	Journal of Immunology
1996-97, 2000-01, 03, 05	Bone
1996-97	Journal of Clinical Investigation
1997-2008	Journal of Biomedical Materials Research
1998	Journal of the American Society of Nephrology
1998	European Journal of Oral Sciences
1998	Molecular Medicine Today
1999-2000	Cell Calcium
2000	Clinical Cancer Research
2000-02	Journal of Arthroplasty
2000	Journal of Laboratory and Clinical Medicine
2000	Journal of Experimental Biology
2001	Arthritis Research
2002	Cells Tissues Organs
2002-05, 08	Calcified Tissue International
2003	Journal of Applied Physiology

2003	Life Sciences
2004	Journal of ASTM International
2004, 07	Journal of Cellular Biochemistry
2004	Case Orthopaedic Journal
2005	Biotechniques
2005-08	Clinical Orthopaedics and Related Research
2006	Journal of Interferon and Cytokine Research
2006-07	Arthritis Research & Therapeutics
2007	Experimental Cell Research
2007-08	Journal of Biological Chemistry
2007	Nature Materials
2007-08	Acta Orthopaedica

Society Memberships:

1977-2004	American Association for the Advancement of Science
1983	American Society of Zoologists
1988-Present	American Society for Bone and Mineral Research
1991-1998	American Society for Cell Biology
1991-Present	Orthopaedic Research Society
1993-Present	International Bone and Mineral Society
1998-Present	International Endotoxin and Innate Immunity Society

Other:

1993-96, 99-01, 04-05, 07 Abstract review, Orthopaedic Research Society Annual Meeting

1994	Moderator, Platform Session on Cell Mechanics, Orthopaedic Research Society Annual Meeting
1998	Moderator, Platform Session on Cartilage Matrix Biology, Orthopaedic Research Society Annual Meeting
1999	Member, NIH Long Range Planning Panel on Orthopaedic Research
2000	Moderator, Platform Session on Implant Interface Biology, Orthopaedic Research Society Annual Meeting
2003, 08	Member, Program Committee, American Society for Bone and Mineral Research Annual Meeting
2004	Peer reviewer, Orthopaedic Basic Science, 3 rd edition, American Academy of Orthopaedic Surgeons
2005-2007	Chair of the Infection Topic Committee, Orthopaedic Research Society Annual Meeting
2005	Panelist, NASA Musculoskeletal Summit
2006	Faculty member, Orthopaedic Research Society Grant Writing Workshop
2006-present	Faculty member, U.S. Bone and Joint Decade Young Investigators Initiative
2008	Moderator, Platform Session on Infection and Immunity, Orthopaedic Research Society Annual Meeting

10. UNIVERSITY SERVICE:

1990-93	Member, Orthopaedic Research Task Force
1991-92	Chairman, Musculoskeletal Faculty Search Committee
1992-94	Member of Planning Committee and Small-Group Moderator, Department of Orthopaedics Research Retreats
1993	Coordinator, Department of Orthopaedics Resident Research Course
1993-Present	Member, Department of Orthopaedics Research Committee

1994-97	Member, Medical School Faculty Council
1994-99	Coordinator, Orthopaedic Research Conference
1994-2000	Coordinator for Undergraduate Research Opportunities in Orthopaedics
1995-97	Member, Medical School Faculty Nominating Committee
1996-99	Member, Dept of Orthopaedics Education Committee
1996-97	Member, CWRU Faculty Senate Information Resources Committee
1996-97	Ex-officio Member, Medical School Computing and Information Resources Committee
1996-98	Member, Dept of Physiology and Biophysics Graduate Admissions Committee
1998, 2006-07	Judge, Medical School Irwin H. Lepow Student Research Day
1998-2000	Member, Internal study section, Pilot & Feasibility Projects for Proposed CWRU Center for Musculoskeletal Disorders
1999-Present	Member, Steering Committee, CWRU NIH Training Program in Musculoskeletal Research
2000-2001	Member, Dept of Physiology and Biophysics Cellular and Molecular Biology Postdoctoral Recruitment Group
2002, 2005-06	Dept. of Physiology and Biophysics Qualifying Exam Grant Reviewer
2002-2003	Member, Search Committee for the Chair of the CWRU Dept. of Orthopaedics
2002-2005	Chair, CWRU Orthopaedic Basic Science Faculty Search Committee
2002-2003	Member, Dept. of Orthopaedics Committee on Appointments, Promotion and Tenure
2003	Member, Dept of Physiology and Biophysics Ad hoc Website Committee
2003-present	Member, Dept of Orthopaedics Faculty Mentoring Committee: Doug Armstrong , MD
2003-present	Member, Faculty Advisory Committee: Case Orthopaedic Journal

2004-present	Member, Dept of Orthopaedics Faculty Mentoring Committee: Shunichi Murakami, MD, PhD
2004-present	Chair, Dept of Orthopaedics Research Committee
2004-present	Member, Dept of Orthopaedics Management Committee
2005-2007	Co-Director, CWRU NIH Training Program in Musculoskeletal Research
2005-present	Member, NIH K22 Faculty Mentoring Committee: Guang Zhou, PhD
2005	Member, Dept of Physiology Subcommittee on Graduate Student and Post-Doc Education
2006-2007	Member, Dept of Orthopaedics Faculty Mentoring Committee: Zeke Cassinelli, MD
2006-present	Member, Dept of Orthopaedics Faculty Mentoring Committee: Jim Dennis, PhD
2007-present	Director, CWRU NIH Training Program in Musculoskeletal Research
2007	Member, Dept. of Physiology Retreat Planning Committee
2007-08	Judge, Biomedical Graduate Student Symposium
2007	Reviewer, Center for Stem Cell & Regenerative Medicine Pilot Projects

11. INVITED PRESENTATIONS:

- 1983 Ionotropic Nucleation of Calcium Carbonate by Molluscan Matrix. Symposium on Mechanisms of Calcification in Biological Systems at the Annual Meeting of the American Society of Zoologists. Philadelphia, PA.
- 1986 Mineral Induction by the Soluble Matrix from Molluscan Shells. Fifth International Symposium on Biomineralization. Arlington, TX.
- 1987 In Vitro Studies of Matrix Mediated Mineralization. University of North Carolina Dental Research Center Seminar Series. Chapel Hill, NC.
- 1988 Osteoblasts Stimulate Bone Resorption by Osteoclasts. Annual Meeting of the American Society for Gravitational and Space Biology. Washington, DC.

1990 Regulation by Osteoblasts of Bone Resorption. CWRU Department of Orthopaedics Research Conference. Cleveland, OH.

1991 Role of Osteoblasts in Regulating Bone Turnover. Cleveland Orthopaedic Society Continuing Education Program. Cleveland, OH.

Parathyroid Hormone Regulates Osteoblast Cytokine mRNA Expression. Mini-presentation at American Society for Cell Biology Subgroup Meeting on Molecular Mechanisms of Regulation of Bone Cell Gene Expression and Differentiation. Boston, MA.

1992 Parathyroid Hormone Regulates Cytokine mRNA Expression in Osteoblasts. Annual Meeting of the Orthopaedic Research Society. Washington, DC.

The Role of Cytokines in Bone Turnover, Ligand Pharmaceuticals, San Diego, CA.

1993 The Role of Interleukin-6 Production and cAMP Signaling in Stimulation of Bone Resorption by Parathyroid Hormone. Annual Meeting of the Orthopaedic Research Society. San Francisco, CA.

Osteoblast-Derived Cytokines and the Regulation of Bone Resorption. University of Toledo Department of Biology Seminar Series. Toledo, OH.

Regulation of Bone Resorption by Osteoblast-Derived Cytokines. St. Louis University Department of Cellular and Molecular Biology Monsanto Lectureship. St. Louis, MO.

Stimulation of Bone Resorption by Parathyroid Hormone Requires cAMP Signaling and Interleukin-6 Production. Washington University Bone Research Seminar Series. St. Louis, MO.

Interleukin-6 Production is Required for Stimulation of Bone Resorption by Parathyroid Hormone. Plenary Poster Session, Annual Meeting of the American Society for Bone & Mineral Research. Tampa, FL.

Interleukin-6 Mediates Parathyroid Hormone-Induced Bone Resorption (presentation given by S. Shaw). Annual Meeting of the American Geriatrics Society. New Orleans, LA.

1994 Marrow Cells Produce a Soluble Factor that Inhibits Bone Resorption (presentation given by J. Ninomiya). Annual Meeting of the Orthopaedic Research Society. New Orleans, LA.

Role of Cytokines in Regulation of Bone Resorption. University of North Carolina Dental Research Center Seminar Series. Chapel Hill, NC.

- 1995 Mechanisms Underlying the Requirement for Interleukin-6 during Stimulation of Bone Resorption by Parathyroid Hormone. Annual Meeting of the Orthopaedic Research Society. Orlando, FL.
- Cell-Cell Interactions that Regulate Bone Turnover. New College Morrill Symposium, Sarasota, FL.
- Cytokine Receptors. Metro Health Medical Center Basic Science Lecture Series. Cleveland, OH.
- The Role of Interleukin-6 in Stimulation of Bone Resorption by Neuropeptides. International Conference on the Biological Mechanisms of Tooth Movement and Craniofacial Adaptation. Danvers, MA.
- 1996 Mesenchymal Cells Promote Osteoclast Differentiation by Producing an Ascorbic Acid Dependent Extracellular Matrix (presentation given by A. Ragab). Annual Meeting of the Orthopaedic Research Society. Atlanta, GA.
- Osteoblast-Osteoclast Interactions that Regulate Bone Resorption. International Program on Vertical and Horizontal Integration of Bone Biology: Structure and Dynamics. Bethesda, MD.
- 1997 Regulation of Production of Cytokines that Control Bone Turnover. MetroHealth Medical Center Rammelkamp Research Conference Seminars. Cleveland, OH.
- Mesenchymal Cells Promote Osteoclast Differentiation by Producing both Cell Surface and Extracellular Matrix Molecules. Mini-presentation at NIH Workshop on Bone and the Hematopoietic and Immune Systems. Bethesda, MD.
- Mesenchymal Cells Promote Osteoclast Differentiation by Producing both Cell Surface and Extracellular Matrix Molecules. Midwest Connective Tissue Workshop. Cleveland, OH.
- Osteoblast-Osteoclast Interactions that Regulate Bone Resorption. Osiris Therapeutics, Baltimore, MD.
- 1998 Mechanisms of Biological Response to Orthopaedic Wear Debris. Annual Meeting of the Biomedical Engineering Society, Cleveland, OH.
- 1999 The Role of Adherent Endotoxin in Stimulation of Osteoclast Differentiation by Orthopaedic Wear Particles. Annual Meeting of the Orthopaedic Research Society. Anaheim, CA.
- The Role of Adherent Endotoxin on Orthopaedic Wear Particles in Stimulation of Osteoclast Differentiation and Cytokine Production. Semi-annual Meeting of the NSF/Industry/University Cooperative Research Center for Biosurfaces. Memphis, TN

- 2000 In vitro and in vitro studies of adherent endotoxin in orthopaedic wear particle-induced osteolysis. Annual Meeting of the Orthopaedic Research Society. Orlando, FL.
- Bone resorptive cytokines produced in response to wear particles induce osteoclast differentiation by stimulating ODF/OPGL expression by mesenchymal support cells (presentation given by R. Lowe). Annual Meeting of the Orthopaedic Research Society. Orlando, FL.
- The Role of Adherent Endotoxin in Aseptic Loosening Induced by Wear Particles. Annual Meeting of the American Academy of Orthopaedic Surgeons. Orlando, FL.
- Cell-Cell Interactions Responsible for Hormonal Regulation of Bone Resorption. Dept. of Biological Sciences, Univ. of Delaware, Newark, DE.
- Regulation of Bone Turnover in Health and Disease, Dept. of Biology Lecture Series, Oberlin College, Oberlin, OH.
- 2001 Mechanisms of cell-cell interactions that regulate bone turnover, Dept. of Biochemistry and Molecular Pathology Seminar Series, Northeastern Ohio Universities College of Medicine, Rootstown, OH.
- The role of ODF/OPGL in stimulation of osteoclast differentiation by TNF- α (presentation given by J. Nalepka). Annual Meeting of the Orthopaedic Research Society. San Francisco, CA.
- Use of Phage Display to Identify Peptides that Inhibit Osteoclast Differentiation (presentation given by P. He). Plenary Poster Session, Annual Meeting of the American Society for Bone & Mineral Research. Phoenix, Arizona.
- Transient Induction of Immediate-Early Genes by PTH, Workshop on Receptor-Ligand Interactions, Annual Meeting of the American Society for Bone & Mineral Research. Phoenix, Arizona.
- Cell-cell interactions that regulate bone turnover, Dept. of Biology, Allegheny College, Meadville, PA.
- 2002 Use of phage display to identify peptides that inhibit osteoclast differentiation, Eli Lilly Company, Indianapolis, IN.
- Osteoblast-osteoclast interactions during hormonal regulation of bone turnover, NIH Craniofacial & Skeletal Diseases Branch Seminar Series, Washington, DC.
- 2003 Does Endotoxin Contribute to Aseptic Loosening?, Kappa Delta Award, American Academy of Orthopaedic Surgeons/Orthopaedic Research Society, New Orleans, LA.

Systemic endotoxin and titanium induced osteolysis (presentation given by J. Seabold). Annual Meeting of the Orthopaedic Research Society, New Orleans, LA.

Polyethylene Particles Induce Osteolysis in Calvaria of Wild-type and Immunodeficient Mice (presentation given by N. Taki). Annual Meeting of the Society For Biomaterials, Reno, Nevada.

The Role of Interleukin-1 in Titanium Particle-Induced Osteolysis in vivo (presentation given by N. Taki). Annual Meeting of the Society For Biomaterials, Reno, Nevada.

PKI γ Knock Down Inhibits Termination of Immediate-Early Gene Expression Induced by PTH (presentation given by X. Chen). Plenary Poster Session, Annual Meeting of the American Society for Bone & Mineral Research, Minneapolis, MN.

Inhibition of PTH signaling by Protein Kinase Inhibitor, Midwest Connective Tissue Workshop. Chicago, IL.

2004 Nuclear Import/Export of PKI/PKA Regulates Immediate Early Gene Expression, Cleveland Cell Biology Symposium: Regulation of Nuclear Functions. Cleveland, OH.

Regulation of PKA signaling by endogenous Protein Kinase Inhibitor, Dept. of Pediatrics, Medical College of Wisconsin, Milwaukee, WI.

2005 The PI3K/Akt pathway mediates the biological activity of titanium particles, Residents' Essay Contest (presentation given by Matt Smith), Cleveland Orthopaedic Society, Cleveland, OH.

Endogenous PKI γ regulates immediate-early gene expression induced by PTH in osteoblasts, New Investigator Recognition Award Poster Session (presentation given by Xin Chen), Annual Meeting of the Orthopaedic Research Society, Washington, DC.

Meet-The-Professor: Osteoclast Biology, Annual Meeting of the American Society for Bone & Mineral Research, Nashville, TN

2006 Endotoxin accumulation during particle-induced osteolysis is due to systemic endotoxin rather than surgical contamination, Annual Meeting of the Orthopaedic Research Society, Chicago, IL

Adherent endotoxin increases activation of transcription factors by titanium particles (presentation given by Michelle Beidelschies), Annual Meeting of the Orthopaedic Research Society, Chicago, IL

Adherent endotoxin inhibits attachment and proliferation of MC3T3-E1 pre-osteoblasts on titanium alloy surfaces, Short Talk, Annual Meeting of the Orthopaedic Research Society, Chicago, IL

Interpreting the pink sheets, Grant Writing Workshop, Annual Meeting of the Orthopaedic Research Society, Chicago, IL

Protein Kinase Inhibitor γ (PKI γ) Inhibits Anabolic Effects of PTH on Osteoblasts (presentation given by Xin Chen), Bone Innovation Summit 2006, Cleveland, OH

Toll-like receptors: soluble ligands, bacteria, and orthopaedic wear particles, Translational biomedical Research Seminar Series, Univ. of Illinois, Urbana-Champaign, IL

Osteosarcoma, Dept. of Biology, Allegheny College, Meadville, PA.

2007 Comparison of the roles of IL-1, IL-6, and TNF α in cell culture and murine models of aseptic loosening, Annual Meeting of the Orthopaedic Research Society, San Diego, CA

Biological factors that contribute to osteolysis, American Academy of Orthopaedic Surgeons 2007 Workshop on Osteolysis and Implant Wear, Austin, TX

2008 Elements of an NIH/CIHR proposal: Preliminary Studies, US Bone & Joint Decade Young Investigators Initiative Workshop, Chicago, IL

12. RESEARCH SUPPORT:

Previous:

- 1982-84 Principal Investigator (100% effort), NSF Doctoral Dissertation Research Improvement Grant. Ecophysiological Significance of Metabolic Zonation in the Mantle of an Intertidal Euryoxic Bivalve. TDC: \$2,840/ 2 years.
- 1988-90 Principal Investigator (100% effort), NASA Biology Research Associateship. Regulation of Osteoclastic Bone Resorption by Osteoblasts. TDC: \$37,000/ 2 years.
- 1990-92 Principal Investigator (Grant declined due to overlap with Arthritis Foundation Fellowship), NIH Post-Doctoral Fellowship. An Osteoblast Factor that Stimulates Bone Resorption. TDC: \$52,000/ 2 years.
- 1990-93 Principal Investigator (50% effort), Arthritis Foundation Fellowship. Characterization of an Osteoblast-Derived Bone Resorption Stimulating Factor. TDC: \$75,000/ 3 years.
- 1991 Principal Investigator (10% effort), Ohio Board of Regents Research Initiation Grant. Osteoblast Cytokine Production. TDC: \$5,000/ 1 year.

- 1991-93 Principal Investigator (40% effort), Orthopaedics Research and Education Foundation Research Grant. Regulation of Osteoblast Cytokine Production by Osteotropic Hormones. TDC: \$80,000/ 2 years.
- 1993-94 Principal Investigator (10% effort), American Cancer Society-Cuyahoga County Unit Pilot Study Grant. Regulation of Bone Resorption in Humoral Hypercalcemia of Malignancy. TDC: \$13,604/ 1 year.
- 1993-95 Principal Investigator (10% effort), March of Dimes Birth Defects Foundation Basic Research Grant. Regulation of Bone Resorption in Osteopetrosis. TDC: \$86,220/ 2 years.
- 1993-97 Principal Investigator (50% effort), NIH FIRST Grant. Role of Cytokines in Regulation of Bone Turnover. TDC: \$274,346/ 4 years.
- 1996-97 Co-Principal Investigator (10% effort), Musculoskeletal Transplant Foundation. In vitro and in vivo evaluation of processing of allogeneic bone. TDC: \$43,206/ 1 year.
- 1996-97 Principal Investigator (5% effort), NIH Pepper Older Americans Independence Center Pilot Project. Stimulation of Cell Culture Bone Formation by PTH. TDC: \$9,000/ 1 year.
- 1996-2000 Principal Investigator (40% effort). NIH RO1. Cellular Mechanisms of Implant Loosening. TDC: \$631,600/ 4 years.
- 1999-2001 Principal Investigator (5% effort). Arthritis Foundation Chapter Grant. Mesenchymal cell surface molecules that support osteoclast differentiation. TDC: \$50,000/ 2 years
- 1999-2003 Principal Investigator (40% effort). NIH RO1. Role of Cytokines in Regulation of Bone Turnover by PTH. TDC: \$729,275/ 4 years.
- 2001-2004 Principal Investigator (20% effort, grant terminated in 2002 due to overlap with NIH RO1). March of Dimes. Regulation of osteoclast differentiation in osteopetrosis. TDC: \$175,713/ 3 years.
- 2000-2005 Principal Investigator (30% effort). NIH RO1. Cellular Mechanisms of Implant Loosening. TDC: \$700,000/ 4 years.
- 2002-2006 Principal Investigator (20% effort). NIH RO1. Support of osteoclast differentiation by mesenchymal cells. TDC: \$637,000/ 4 years.
- 2003-2007 Principal Investigator (20% effort). NIH RO1. Termination of PTH responses in osteoblasts. TDC: \$792,000/ 4 years.

- 2005-2007 Co-Principal Investigator (10% effort). NIH T32. Training Program in Musculoskeletal Research. TDC: \$287,146/ 1 year
- 2008 Principal Investigator (10% effort). CCF Musculoskeletal Core Center Pilot Project. A murine model of implant osseointegration. TDC: \$15,000/ 1 year

Current:

- 2005-2008 Co-Principal Investigator (15% effort). Sulzer Settlement Trust Fund. Basic Science Research Related to Orthopaedic Implant Loosening. TDC: \$626,803/ 3 years
- 2007-2012 Principal Investigator (10% effort). NIH T32. Training Program in Musculoskeletal Research. TDC: \$1,923,194/ 5 years
- 2007-2009 Principal Investigator (10% effort). NIH R21. In vivo Regulation of cAMP/PKA Signaling by PKI γ . TDC: \$275,000/ 2 years

Approved:

- 2008-2009 Co-Principal Investigator (10% effort). Zimmer Medical Research Fund. Effect of Endotoxin on Osseointegration of Orthopaedic Implants. TDC: \$97,000/ 1 year
- 2005-2008 Co-Principal Investigator (15% effort). Sulzer Settlement Trust Fund. Basic Science Research Related to Orthopaedic Implant Loosening. TDC: \$838,565/ 3 years

13. PUBLICATIONS:

Journal Articles:

1. Ahmad F, Ahmad P, Dickstein R, & **Greenfield E**, 1981, Detection of ligand induced perturbations affecting the biotinyl group of mammalian acetyl CoA carboxylase, *Biochem J* 197: 95-104.
2. **Greenfield E**, & Crenshaw M, 1981, Variations in the rate of anaerobic succinate accumulation within the central and marginal regions of an euryoxic bivalve mantle, *Mar Ecol* 2: 353-362.
3. **Greenfield E**, Wilson D, & Crenshaw, M, 1984, Ionotropic nucleation of calcium carbonate by molluscan matrix, *Amer Zool* 24: 925-932.

4. Miyauchi A, Hruska K, **Greenfield E**, Duncan R, Alvarez J, Barattolo R, Colucci S, Zambonin-Zallone A, Teitelbaum S, & Teti A, 1990, Osteoclast cytosolic calcium, regulated by voltage operated calcium channels and extracellular calcium, controls podosome assembly and bone resorption, *J Cell Biol* 111: 2543-2552.
5. Alvarez J, Teitelbaum S, Blair H, **Greenfield E**, Athanasou N, & Ross F, 1991, Generation of avian osteoclast-like cells from mononuclear precursors, *Endocrinology* 128: 2324-2335.
6. Miyauchi A, Alvarez J, **Greenfield E**, Teti A, Grano M, Colucci S, Zambonin-Zallone A, Ross F, Teitelbaum S, Cheresch D, & Hruska K, 1991, Recognition of osteopontin and related peptides by an $\alpha_v\beta_3$ integrin stimulates immediate cell signals in osteoclasts, *J Biol Chem* 266: 20369-20374.
7. Alvarez J, Ross F, Athanasou N, Blair H, **Greenfield E**, & Teitelbaum S, 1992, Osteoclast precursors circulate in avian blood, *Calcif Tiss Int* 51: 48-53.
8. **Greenfield E**, Alvarez J, McLaurine E, Oursler M, Blair H, Osdoby P, Teitelbaum S, & Ross F, 1992, Avian osteoblast conditioned media stimulate bone resorption by targeting multinucleating osteoclast precursors, *Calcif Tiss Int* 51: 317-323.
9. **Greenfield E**, Gornik S, Horowitz M, Donahue H, & Shaw S, 1993, Regulation of cytokine expression in osteoblasts by parathyroid hormone: rapid stimulation of interleukin-6 and leukemia inhibitory factor mRNA, *J Bone Min Res*, 8: 1163-1171.
10. **Greenfield E**, Shaw S, Gornik S, & Banks M, 1995, Adenyl cyclase and interleukin-6 are downstream effectors of parathyroid hormone resulting in stimulation of bone resorption, *J Clin Invest*, 96: 1238-1244.
11. **Greenfield E**, Horowitz M, & Lavish S, 1996, Stimulation by parathyroid hormone of interleukin-6 and leukemia inhibitory factor expression in osteoblasts is an immediate-early gene response induced by cAMP signal transduction, *J Biol Chem*, 271: 10984-10989.
12. Pollock J, Blaha M, Lavish S, Stevenson S, & **Greenfield E**, 1996, In vivo demonstration that parathyroid hormone and parathyroid hormone-related protein stimulate expression by osteoblasts of interleukin-6 and leukemia inhibitory factor, *J Bone Min Res*, 11: 754-759.
13. Ragab A, Lavish S, Banks M, Goldberg V, & **Greenfield E**, 1998, Osteoclast differentiation requires ascorbic acid, *J Bone Min Res*, 13: 970-977.
14. Ninomiya J, Bi Y, Banks M, Lavish S, Goldberg V, & **Greenfield E**, 1999, Bone marrow cells produce soluble factors that inhibit osteoclast activity, *J Orthop Res*, 17:51-58.
15. Ragab A, Van De Motter R, Lavish S, Goldberg V, Ninomiya J, Carlin C, & **Greenfield E**, 1999, Measurement and removal of adherent endotoxin from titanium particles and surfaces, *J Orthop Res*, 17:803-809.

16. Bi Y, Seabold J, Kaar S, Ragab A, Goldberg V, Anderson J, & **Greenfield E**, 2001, Adherent endotoxin on orthopaedic wear particles stimulates cytokine production and osteoclast differentiation, *J Bone Min Res*, 16: 2082-2091.
17. Bi Y, Van De Motter R, Ragab A, Goldberg V, Anderson J, & **Greenfield E**, 2001, Titanium particles stimulate bone resorption by inducing differentiation of murine osteoclasts, *J Bone Joint Surgery Am*, 83A: 501-508.
18. Kaar S, Ragab A, Kaye S, Kilic B, Jinno T, Goldberg V, Bi Y, Stewart M, Carter J, & **Greenfield E**, 2001, Rapid repair of titanium particle-induced osteolysis is dramatically reduced in aged mice, *J Orthop Res*, 19: 171-178.
19. Bi Y, Collier TO, Goldberg V, Anderson J, & **Greenfield E**, 2002, Adherent Endotoxin Mediates Biological Responses of Titanium Particles without Stimulating Their Phagocytosis, *J Orthop Res*, 20: 696-703.
20. Chen X, Dai JC, & **Greenfield E**, 2002, Termination of immediate-early gene expression after stimulation by parathyroid hormone or isoproterenol, *Amer J Physiol-Cell Physiol*, 283: C1432-1440.
21. Ragab A, Nalepka, JL, Bi Y, & **Greenfield E**, 2002, Cytokines synergistically induce osteoclast differentiation: support by immortalized or normal calvarial cells, *Amer J Physiol Cell Physiol*, 283: C679-687.
22. Nalepka J & **Greenfield E**, 2004, Detection of bacterial endotoxin in human tissues, *Biotechniques*, 37:413-417.
23. Chen X, Dai JC, Orellana, SA, & **Greenfield E**, 2005, Endogenous PKI γ terminates immediate-early gene expression induced by PKA signaling: termination depends on PKA inactivation rather than PKA export from the nucleus, *J Biol Chem*, 280:2700-2707.
24. Taki N, Seabold J, Nalepka J, Togawa D, Goldberg V, Rimnac C, & **Greenfield E**, 2005, Polyethylene and titanium particles induce osteolysis by similar, lymphocyte-independent, mechanisms, *J Orthop Res*, 23:376-383.
25. Bi Y, Nielsen KL, Kilts T, Karsdal M, **Greenfield E**, Heegaard AM, & Young MF, 2006, Biglycan deficiency increases osteoclast differentiation and activity due to defective osteoblasts, *Bone*, 38:778-786.
26. Dai JC, He, P, Chen X, & **Greenfield E**, 2006, TNF α and PTH utilize distinct mechanisms to induce IL-6 and RANKL expression with markedly different kinetics, *Bone*, 38:509-520.
27. Fan X, Rahnert JA, Murphy TC, Nanes MS, **Greenfield E**, & Rubin J. 2006, Mechanical strain regulates effectors of both formation and resorption in an immortalized osteoblast cell line, *J Cell Physiol*, 207:454-60.

28. Nalepka J, Lee M, Kraay M, Marcus R, Goldberg V, Chen X, & **Greenfield E**, 2006, Lipopolysaccharide Found in Aseptic Loosening of Inflammatory Arthritis Patients, *CORR*, 451:229-235.
29. Rubin J, Murphy TC, Rahnert J, Nanes MS, **Greenfield E**, Jo H, & Fan X, 2006, Mechanical inhibition of RANKL expression is regulated by H-Ras-GTPase, *J Biol Chem*, 281:1412-8.
30. Chen X, Song IH, Dennis JE, & **Greenfield E**, 2007. Endogenous PKI γ inhibits the anti-apoptotic effects of PTH and β -adrenergic agonists in osteoblasts, *J Bone Min Res*, 22:656-64.
31. Smith M, Lee M, Islam A, Rohrer J, Goldberg V, Beidelschies M, & **Greenfield E**, 2007, Inhibition of the PI3K/Akt pathway reduces TNF α production in response to titanium particles in vitro, *J BJS Am*, 89:1019-27 (reprinted in *Case Ortho J* 4:76-84).
32. Taki N, Tatro JM, Lowe R, Goldberg VM, & **Greenfield E**, 2007, Comparison of the roles of IL-1, IL-6, and TNF α in cell culture and murine models of aseptic loosening, *Bone*, 40:1276-83.
33. Tatro J, Taki N, Islam AS, Goldberg VM, Rinnac CM, Doerschuk CM, Stewart MC, & **Greenfield E**, 2007, The balance between endotoxin accumulation and clearance during particle-induced osteolysis in murine calvaria, *J Orthop Res*, 25:361-9.
34. Beidelschies MA, Huang H, McMullen MR, Goldberg VM, Smith M, Islam A, Nagy LE, & **Greenfield E**, 2008, Stimulation of TNF α production by orthopaedic wear particles requires activation of the ERK1/2/Egr-1 and NF- κ B pathways but is independent of p38 and JNK, *J Cell Physiol*, in press
35. Islam AS, Beidelschies MA, Huml A, & **Greenfield E**, 2008, Titanium particles activate Toll-like Receptor-4 independently of lipid rafts, submitted.
36. Feng JQ, Lu X, Rios HF, Jiang B, Xing L, Hu Y, Barnes EL, Sharma SM, Kadlcek R, **Greenfield E**, Luo G, 2008, A novel spontaneous osteopetrosis mouse strain with a unique defect in tooth root formation, submitted
37. Messerschmitt PJ, Rettew AN, Brookover RE, Garcia RM, Getty PJ, Greenfield E, 2008, Specific tyrosine kinases regulate human osteosarcoma cells in vitro, *CORR*, in press

Reviews/Book Chapters/Conference Proceedings:

1. **Greenfield E**, & Crenshaw, M, 1989, Mineral induction by the soluble matrix from molluscan shells. In: *Origin, Evolution, and Modern Aspects of Biomineralization in Plants and Animals*, ed: R. Crick, Plenum Press, New York, pp.303-308.

2. Miyauchi A, Alvarez J, **Greenfield E**, Teti A, Grano M, Colucci S, Zambonin-Zallone A, Ross F, Teitelbaum S, Cheresch D, & Hruska K, 1993, Binding of osteopontin to the osteoclast integrin $\alpha_v\beta_3$, *Osteoporosis Int* 3:S1:132-135.
3. **Greenfield E**, 1996, The role of interleukin-6 in stimulation of osteoclast differentiation and activity by neuropeptides and other bone resorptive agents, In: *Biological Mechanisms of Tooth Movement & Craniofacial Adaptation*, Eds: Z Davidovitch & L Norton, EBSCO Press, Birmingham, pp. 301-307.
4. **Greenfield E** & Goldberg V, 1997, The genetic determination of bone mass, *Lancet*, 350: 1263-1264.
5. **Greenfield E**, 1998, The role of interleukin-6 in stimulation of bone resorption by parathyroid hormone, *Cells and Materials*, 7: 301-312.
6. **Greenfield E**, Bi Y, & Miyauchi A, 1999, Regulation of osteoclast activity, *Life Sciences*, 65: 1087-1102.
7. **Greenfield E**, Bi Y, Ragab A, Goldberg V, & Van De Motter R, 2002, The role of osteoclast differentiation in aseptic loosening, *J Orthop Res*, 20: 1-8.
8. **Greenfield E** & Einhorn T, 2002, Calcium homeostasis, In: *Orthopaedics*, Eds: R.H. Fitzgerald, H. Kaufer, and A. Malkani, Mosby Press, London, pp. 195-200.
9. Kadlcek R, Ragab A, and **Greenfield E**, 2004, Ascorbate is essential for osteoclastogenesis, *Case Orthop J*, 1:59-60.
http://ortho.uhhs.com/download/common/coj_v1_1.pdf
10. Keenan E, Chen X, and **Greenfield E**, 2004, Regulation of PKA signaling by PKI in osteoblasts, *Case Orthop J*, 1:61-64. http://ortho.uhhs.com/download/common/coj_v1_1.pdf
11. Smith M, Innocenti M, and **Greenfield E**, 2004, Unlocking the signaling mechanisms behind aseptic loosening, *Case Orthop J*, 1:51-55.
http://ortho.uhhs.com/download/common/coj_v1_1.pdf
12. Chen X & **Greenfield E**, 2005, Protein kinase inhibitor and the anabolic effect of PTH, *Case Orthop J*, 2:79-84.
13. Islam A, Beidelschies M, & **Greenfield E**, 2005, Endotoxin adherent to titanium wear particles activate Toll-like receptors independent of lipid rafts, *Case Orthop J*, 2:33-36.
14. **Greenfield E**, Bi Y, Ragab A, Goldberg V, Nalepka J, & Seabold J, 2005, Does endotoxin contribute to aseptic loosening?, *J Biomed Mater Res Appl Biomater*, 72B:179-185.

15. Rubin J & **Greenfield E**, 2005, Osteoclast origin and differentiation, In: Bone Resorption, Volume 2 in Topics in Bone Biology Series. Eds: F. Bronner, M. C. Farach-Carson, and J. Rubin, Springer-Verlag, London, pp. 1-23.
16. Beidelschies M, Islam A, Smith M, & **Greenfield E**, 2006, Adherent endotoxin on orthopaedic wear particles acts independently of lipopolysaccharide binding protein, Case Orthop J, 3:27-8.
17. **Greenfield E**, 2006, Particulate Matter and Host Reactions, In: Encyclopedia of Biomaterials and Biomedical Engineering. Eds: Wnek & Bowlin, Taylor Francis, New York, pp. 1-8. DOI: 10.1081/E-EBBE-120041619
18. Messerschmitt P, Getty P, & **Greenfield E**, 2007, Targeting Tyrosine Kinase Signaling in the Treatment of Osteosarcoma, Case Orthop J, 4:93-5.
19. **Greenfield E** & Chen X, 2008, Use of siRNA and antisense knockdown to study regulation of PKA by PKI, In: Handbook of Cell Signaling. Eds: Bradshaw & Dennis, Elsevier, San Diego, in press
19. Messerschmitt P, Garcia R, Abdul-Karim F, Wiersma S, **Greenfield E**, & Getty P, 2008, Osteosarcoma, submitted
20. **Greenfield E** & Bechtold J, 2008, What other biological and mechanical factors might contribute to osteolysis, J Amer Acad Ortho Surgeons, Supplement on Implant Wear, in press

14. TEACHING EXPERIENCE:

Administration:

- | | |
|---------|--|
| 1993-94 | Course Coordinator, Orthopaedic Resident Research Course |
| 1995-98 | Section Leader, Musculoskeletal and Integument Committee |
| 2007 | Course Director, Skeletal Biology, PHOL512 |

Lectures:

- | | |
|-----------|--|
| 1991-2005 | Musculoskeletal and Integument Committee |
| 1992 | Clinical Musculoskeletal Pathology Elective |
| 1992 | Orthopaedic Pathology Tumor Conference |
| 1992 | Orthopaedic Residents Basic Science Rotation |
| 1993-94 | Orthopaedic Residents Research Course |

1993-94	Clinical Issues in Rheumatology, RHEU5003
1995	MetroHealth Medical Center Basic Science Lecture Series
1996	Summer Undergraduate Research Program, Dept. of Physiology & Biophysics
1996-1999	Cell Biology II, CBIO454
1996-2004	Cell Signalling, PHOL466
1996-97	Horizons on Biomedical Science Health Career Enhancement for Minorities Program, Dept. of Physiology & Biophysics
1997	Clinical Pathology Conference
1997-2007	Orthopaedic Grand Rounds
1997-99	Molecular Organization of the Cell, PHOL532
2000	Northeast Ohio Infectious Diseases Roundtable Conference
2000-2004	Cell Structure and Function, PHOL432
2000-2001	Cell Signalling, C3MB mini-course
2002	CWRU/UHRI/CCF Musculoskeletal Research Seminar Series
2003	Update on siRNA, MSTP Retreat
2007	Skeletal Biology, PHOL512

Small Group Discussions:

1992-93, 95-00	Biological Basis of Disease Committee
1994-1999	Cell Biology II, CBIO454
1995	Homeostasis Committee
1996-2008	Cell Signaling, PHOL466
1997-99	Molecular Organization of the Cell, PHOL532
2000	Endocrinology Committee

2000-2001	Cell Signaling, C3MB mini-course
2003-2007	Cell Structure and Function, PHOL432
2006	Endocrinology Block
2007	Skeletal Biology, PHOL512
2007	Musculoskeletal Block

Journal Club Presentations:

1992-2002	Cell Biology Program Colloquia
1993-2001	Orthopaedics/Rheumatology Research Journal Club
1994-2008	PHOL498 Cell Biology and Signaling Journal Club

Reading Courses:

1993	Apoptosis, Patricia Hoffman, St. Louis University, GCMB698
1994	Regulation of Bone Resorption, Michelle Blaha, Michigan State University, PSL480

Graduate Students:

1996-2001	Yanming Bi, BSTP (Pathology) Ph.D. Program. Currently: Staff Scientist, Molecular Biology of Bones and Teeth Unit, NIH
2000-2001	Joscelyn Seabold, Dept. of Physiology M.S. Program. Currently: Research Consultant, CWRU
2002-present	Michelle Innocenti, Dept. of Physiology Ph.D. Program. Currently: Graduate Student, CWRU
2002-2005	Jen Nalepka, Dept. of Physiology M.S. Program. Currently: Research Assistant, Athersys, Cleveland, OH
2004-2005	Erica Keenan, BSTP (Pathology) Ph.D. Program. Currently: Graduate Student, CWRU
2006-2007	Aaron Brister, Dept. of Physiology M.S. Program. Currently: Graduate Student, CWRU

- 2007-present Lindsay Bonsignore, BSTP (Pathology) Ph.D. Program. Currently: Graduate Student, CWRU
- 2007-present Ashley Rettew, BSTP (Pathology) Ph.D. Program. Currently: Graduate Student, CWRU

Graduate Student Thesis Committees:

- 1993 Ph.D. Secondary Proposal Committee, Patricia Hoffman, St. Louis University, Cell and Molecular Biology Program
- 1995 Ph.D. Secondary Proposal Committee, Todd Ridky, Biochemistry
- 1996 M.S. Thesis Committee, Richard Rupp, Biology
- 1996-98 Ph.D. Committee, Ben Humphreys, MSTP (Physiology)
- 1996-2001 Ph.D. Committee, Yanming Bi, BSTP (Pathology)
- 1997 M.S. Thesis Committee, Charles Kunos, Anatomy
- 1998 Ph.D. External Examiner, Nabiha Yusuf, Aligarh Muslim University (Aligarh, India), Dept. of Biochemistry
- 1998-2004 Ph.D. Committee, Doug Pennington, Anatomy
- 2000-2001 M.S. Committee, Joscelyn Seabold, Physiology
- 2001 Ph.D. Preliminary Exam Committee, Danielle MacKay, Biology
- 2001 Ph.D. Preliminary Exam Committee, Myeong Seon Lee, Biochemistry
- 2001-2002 M.S. Committee, John Longsworth, Biomedical Engineering
- 2002- 2006 Ph.D. Committee, Minrong Ai, BSTP (Genetics)
- 2003-present Ph.D. Committee, Michelle Innocenti, Physiology
- 2003-present Ph.D. Committee, Corttrell Kinney, Physiology
- 2003-2004 Ph.D. Committee, John Longsworth, Biomedical Engineering
- 2003-2005 M.S. Committee, Jen Nalepka, Physiology
- 2004-2008 Ph.D. Committee, David Chang, MSTP (Biomedical Engineering)

2005	Ph.D. Committee, Erica Keenan, BSTP (Pathology)
2005-2006	M.S. Committee, Nomith Ramdev, Dental School
2006-present	Ph.D. Committee, Andrew Blum, MSTP (Physiology)
2006-2007	M.S. Committee, Aaron Brister, Physiology
2007-present	Ph.D. Committee, Vance Holt, Biology
2008-present	Ph.D. Committee, Lindsay Bonsignore, BSTP (Pathology)
2008-present	Ph.D. Committee, Ashley Rettew, BSTP (Pathology)

Graduate, Medical, and Undergraduate Laboratory Rotations:

1991-92	Steven Shaw, Medical student. Currently: Fellow, Dept. of Medicine, Univ. of Washington
1992	Weldon Phillips, BSTP student. Currently: Law Student, Univ. of California
1993	Michelle Blaha, Summer undergraduate student. Currently: Local Representative, Roche Pharmaceuticals
1993	Michelle Merrill, BSTP student. Currently: Research Associate, CWRU
1995-96	Kristina Siddall, Biomedical Engineering Senior Project. Currently: Medical Student, CWRU
1996	Yanming Bi, BSTP student. Currently: Staff Scientist, NIH
1996	Emmanuel Konstantakos, Medical Student Basic Science Research Elective. Currently: Medical Student, CWRU
1996-97	Komal Bajaj, Undergraduate student, BIOL388. Currently: Undergraduate Student, CWRU
1998-2000	Scott Kaar, Summer undergraduate student/Medical Student Basic Science Research Elective. Currently: Resident, Dept. of Orthopaedics, Univ. of Michigan
1999	Kurt Hotmire, Dept. of Pathology Ph.D. student. Currently: Ph.D. student, CWRU

1999-2000 Moustafa Banna, Dept. of Physiology SURP student. Currently: Medical Student, Univ. of Cincinnati

1999 Chi Zheng, BSTP student. Currently: Post-doc, Baylor Univ.

2000 Joscelyn Seabold, Dept. of Physiology M.S. Student. Currently: Instructor, Lakeland Community College

2000-2001 Andrew Islam, Medical Student. Currently: Resident, CWRU Dept. of Orthopaedics

2001 Jackie Rohrer, Dept. of Physiology SURP Student. Currently: Resident, Dept. of Family Medicine, Lancaster General Hospital in Lancaster, Pennsylvania

2001 Duprane Young, BSTP student. Currently: BSTP Student, CWRU

2001-02 Michelle Innocenti, Dept. of Physiology Ph.D. Student. Currently: Ph.D. student, CWRU

2002 Kate Webber, BSTP student. Currently: BSTP Student, CWRU

2003 Anne Huml, Medical student. Currently: Internal Medicine Resident, CWRU

2003 Erica Keenan, BSTP student. Currently: BSTP Student, CWRU

2003 Fatima McKindra, Medical Student Basic Science Research Elective. Currently: Medical student, CWRU

2004 Christopher Utz, Medical student. Currently: Orthopaedics Resident, Cleveland Clinic

2005 Jonathan Keary, Medical student. Currently: Medical student, CWRU

2005 Ravi Patel, MSTP student. Currently: MSTP student, CWRU

2005 Bishr Aldabagh, MSTP student. Currently: MSTP student, CWRU

2006-07 Robert Brookover, Undergraduate & MS student. Currently: MS student, CWRU

2006 Bryan Doriean, Dept. of Physiology Ph.D. Student. Currently: Ph.D. student, CWRU

2006 Lindsay Bonsignore, BSTP student. Currently: BSTP Student, CWRU

2006	Ashley Rettew, BSTP student. Currently: BSTP Student, CWRU
2007-08	Avanti Jakatdar, Undergraduate student. Currently: BS student, CWRU
2007	Mitali Rakhit, High school student. Currently: Student, Laurel School
2007	Dave Shukla, Medical Student. Currently: Medical student, University of Dublin
2007	Karen Gibbons, Medical Student. Currently: Medical student, CWRU
2008	Sean Arlauckas, Undergraduate Student. Currently: Undergraduate student, CWRU
2008	Nick Schroeder, Medical Student. Currently: Medical student, CWRU

Resident and Fellow Laboratory Research Training:

1991-92	Miguel Khoury, M.D. Currently: Assistant Professor, Dept. of Orthopaedics, Buenos Aries University, Argentina
1992-93	James Ninomiya, M.D. Currently: Associate Professor, Dept. of Orthopaedics, Medical College of Wisconsin
1993-94	Michael Banks, M.D. Currently: Orthopaedics private practice
1994-95, 96-97	Ashraf Ragab, M.D. Currently: Associate Professor, Department of Orthopedics, University of Mississippi
1997-98	Bekir Alper Kilic, M.D. Currently: Assistant Professor, Dept. of Orthopaedics, Pamukkale University, Turkey
1998-2000	Najmul Islam, Ph.D. Currently: Associate Professor, Dept. of Biocemistry, Aligarh Muslim University (Aligarh, India)
1999-2000	Bob Lowe, M.D. Currently: Orthopaedic Surgeon, Nashville, TN
1999-2005	Jia-Chun Dai, M.D. Currently: Dental Student, CWRU
2000-present	Xin Chen, M.D., Ph.D. Currently: Research Associate, CWRU
2000-2005	Ping He, M.D, Ph.D. Currently: Research Associate, Cleveland Clinic

2000-2001	Ralph Stanford, M.D. Currently: Senior Lecturer, Dept. of Orthopaedics, University of New South Wales, Sydney, Australia
2000-2003	Naoya Taki, M.D. Currently: Associate Professor, Dept. of Orthopaedics, Yokohama City University Medical Center, Japan
2001-2002	Michael Lee, M.D. Currently: Assistant Professor, Dept. of Orthopaedics, University of Washington
2003-2004	Matt Smith, M.D. Currently: Resident, Dept. of Orthopaedics, University Hospitals of Cleveland
2004-2005	Andrew Islam, M.D. Currently: Resident, Dept. of Orthopaedics, University Hospitals of Cleveland
2006-2007	Patrick Messerschmitt, M.D. Currently: Resident, Dept. of Orthopaedics, University Hospitals of Cleveland
2007-2008	Aasis Unnanuntana, M.D. Currently: Senior Fellow, Dept. of Orthopaedics, University Hospitals of Cleveland

Training Programs:

1991-present	BSTP Program in Cell Biology
1992-present	BSTP Program in Molecular and Cellular Basis of Disease
1993-present	Training Program in Musculoskeletal Research; Steering Committee Member: 1999-present, Co-director: 2005-07, Director: 2007-present
1995-present	Dept. of Physiology Training Program in Cell Physiology
1997-present	Medical Scientist Training Program
1999-present	Biomedical Engineering Training Program
2000-2004	Dept. of Physiology Training Program in Exercise Physiology
2006-present	Pediatric Rheumatology Fellowship Program