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2006 Annual Report: Appendix
Center for Biofilm Engineering
Reporting Period: June 1, 2005–May 31, 2006

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RESEARCH : PUBLICATIONS

2005 Publications

- Balaban, N., P. Stoodley, C.A. Fux, S. Wilson, J.W. Costerton and G. Dell'Acqua, "Prevention of Staphylococcal Biofilm-Associated Infections by the Quorum Sensing Inhibitor RIP," Clin. Orthop. Relat. R., 437:48-54 (2005). Abstract 05-034
- Beyenal, H. and Z. Lewandowski, "Modeling Mass Transport and Microbial Activity in Stratified Biofilms," Chem. Eng. Sci., 60(15):4337-4348 (2005). Abstract 05-016
- Borch, T., W.P. Inskeep, J.A. Harwood and R. Gerlach, "Impact of Ferrihydrite and Anthraquinone-2,6-Disulfonate on the Reductive Transformation of 2,4,6-Trinitrotoluene by a Gram-Positive Fermenting Bacterium," Environ. Sci. Technol., 39(18):7126-7133 (2005). Abstract 05-029
- Braxton, E.E., G.D. Ehrlich, L. Hall-Stoodley, P. Stoodley, R. Veeh, C.A. Fux, F.Z. Hu, M. Quigley and J.C. Post, "Role of Biofilms in Neurosurgical Device-Related Infections," Neurosurg. Rev., 28(4):249-255 (2005). Abstract 05-035
- Codd, S.L., J.D. Seymour, E.L. Gjersing, J.P. Gage and J.R. Brown, "Magnetic Resonance Microscopy of Biofilm and Bioreactor Transport," Nuclear Magnetic Resonance Imaging in Chemical Engineering, S. Stapf and S. Han (eds.), Wiley-VCH, Weinheim, Germany (2005). Abstract 05-051
- Dohar, J.E., P.A. Hebda, R. Veeh, M. Awad, J.W. Costerton, J. Hayes and G.D. Ehrlich, "Mucosal Biofilm Formation on Middle-Ear Mucosa in a Nonhuman Primate Model of Chronic Suppurative Otitis Media," Laryngoscope, 115(8):1469-1472 (2005). Abstract 05-036
- Douthit, S.A., M. Dlakic, D.E. Ohman and M.J. Franklin, "Epimerase Active Domain of *Pseudomonas aeruginosa* AlgG, a Protein That Contains a Right-Handed β -Helix," J. Bacteriol., 187(13):4573-4583 (2005). Abstract 05-033
- Dutta, L., H.E. Nuttall, A. Cunningham, G. James, and R. Hiebert, "In Situ Biofilm Barriers: Case Study of a Nitrate Groundwater Plume, Albuquerque, New Mexico," Remediation J., 15(4):101-111 (2005). Abstract 05-047
- Ehrlich, G.D., P. Stoodley, S. Kathju, Y. Zhao, B. McLeod, N. Balaban, F.Z. Hu, N.G. Sotereanos, J.W. Costerton, P.S. Stewart, J.C. Post and Q. Lin, "Engineering Approaches for the Detection and Control of Orthopaedic Biofilm Infections," Clin. Orthop. Relat. Res., 437:59-66 (2005). Abstract 05-030
- Gage, J.P., T.M. Roberts and J.E. Duffy, "Susceptibility of *Pseudomonas aeruginosa* Biofilm to UV-A Illumination Over Photocatalytic and Non-Photocatalytic Surfaces," Biofilms, 2(3):155-163 (2005). Abstract 05-048
- Haag, A.P., G.G. Geesey and M.W. Mittelman, "Bacterially Derived Wood Adhesive," Int. J. Adhesion Adhesives, 26(3):177-183 (2005). Abstract 05-028
- Hunt, S.M., M.A. Hamilton, and P.S. Stewart, "A 3D Model of Antimicrobial Action on Biofilms," Water Sci. Technol., 52(7):143-148 (2005). Abstract 05-042
- Kjellerup, B.V., R.H. Veeh, P. Sumithratne, T.R. Thomsen, K. Buckingham-Meyer, B. Frolund, and P. Sturman, "Monitoring of Microbial Souring in Chemically Treated, Produced-Water Biofilm Systems Using Molecular Techniques," J. Ind. Microbiol. Biotechnol., 32(4):163-170 (2005). Abstract 05-020
- Kowles, J.L. and O.R. Stein, "Polar Organic Solvent Removal in Microcosm Constructed Wetlands," Water Res., 39(16):4040-4050 (2005). Abstract 05-026
- Lewandowski, Z., "Editorial: Advances and Challenges in Biofilm Research," Water Sci. Technol., 52(7):v-xiii (2005). Abstract 05-039
- Lewandowski, Z. and H. Beyenal, "Biofilms: Their Structure, Activity, and Effect on Membrane Filtration," Water Sci. Technol., 51(6-7):181-192 (2005). Abstract 05-017
- Marion, K., M. Pasmore, J. Freney, E. Delawari, F. Renaud, J.W. Costerton, and J. Traeger, "A New Procedure Allowing the Complete Removal and Prevention of Hemodialysis Biofilms," Blood Purif., 23(5):339-348 (2005). Abstract 05-022

RESEARCH : PUBLICATIONS

- Marion-Ferey, K., J. Leid, G. Bouvier, M. Pasmore, G. Husson, and R. Vilagines, "Endotoxin Level Measurement in Hemodialysis Biofilm Using the Whole Blood Assay," Artif. Organs, 29(6):475-481 (2005). Abstract 05-018
- Marsili, E., H. Beyenal, L. Di Palma, C. Merli, A. Dohnalkova, J.E. Amonette, and Z. Lewandowski, "Uranium Removal by Sulfate Reducing Biofilms in the Presence of Carbonates," Water Sci. Technol., 52(7):49-55 (2005). Abstract 05-041
- Norris, P., M. Noble, I. Francolini, A.M. Vinogradov, P.S. Stewart, B.D. Ratner, J.W. Costerton and P. Stoodley, "Ultrasonically Controlled Release of Ciprofloxacin from Self-Assembled Coatings on Poly(2-Hydroxyethyl Methacrylate) Hydrogels for *Pseudomonas aeruginosa* Biofilm Prevention," Antimicrob. Agents Chemother., 49(10):4272-4279 (2005). Abstract 05-038
- Nucci, C., M. Artini, M. Pasmore, F. Missiroli, J.W. Costerton, and L. Selan, "A Microbiological and Confocal Microscopy Study Documenting a Slime-Producing *Staphylococcus epidermidis* Isolated from a Nylon Corneal Suture of a Patient with Antibiotic-Resistant Endophthalmitis," Graefe's Arch. Clin. Exp. Ophthalmol., 243(9):951-954 (2005). Abstract 05-049
- O'Toole, G.A. and P.S. Stewart, "Biofilms Strike Back," Nat. Biotechnol., 23(11):1378-1379 (2005). Abstract 05-044
- Patrauchan, M.A., S. Sarkisova, K. Sauer and M.J. Franklin, "Calcium Influences Cellular and Extracellular Product Formation During Biofilm-Associated Growth of a Marine *Pseudoalteromonas* sp." Microbiology, 151(9):2885-2897 (2005). Abstract 05-032
- Pitt, W.G., "Removal of Oral Biofilm by Sonic Phenomena," Am. J. Dent., 18(5):345-352 (2005). Abstract 05-050
- Ren, D., R. Zuo, A.F. González Barrios, L.A. Bedzyk, G.R. Eldridge, M.E. Pasmore, and T.K. Wood, "Differential Gene Expression for Investigation of *Escherichia coli* Biofilm Inhibition by Plant Extract Ursolic Acid," Appl. Environ. Microbiol., 71(7):4022-4034 (2005). Abstract 05-025
- Rhoads, A., H. Beyenal, and Z. Lewandowski, "Microbial Fuel Cell Using Anaerobic Respiration as an Anodic Reaction and Biomineralized Manganese as a Cathodic Reactant," Environ. Sci. Technol., 39(12):4666-4671 (2005). Abstract 05-023
- Sarkisova, S., M.A. Patrauchan, D. Berglund, D.E. Nivens, and M.J. Franklin, "Calcium-Induced Virulence Factors Associated with the Extracellular Matrix of Mucooid *Pseudomonas aeruginosa* Biofilms," J. Bacteriol., 187(13):4327-4337. Abstract 05-031
- Shantaram, A., H. Beyenal, R.R. Angathevar Veluchamy, and Z. Lewandowski, "Wireless Sensors Powered by Microbial Fuel Cells," Environ. Sci. Technol., 39(13):5037-5042 (2005). Abstract 05-024
- Sharp, R.R., P. Stoodley, M. Adgie, R. Gerlach, A. Cunningham, "Visualization and Characterization of Dynamic Patterns of Flow, Growth, and Activity of Biofilms Growing in Porous Media," Water Sci. Technol., 52(7):85-90 (2005). Abstract 05-040
- Shirliff, M.E., A. Bargmeyer and A.K. Camper, "Assessment of the Ability of the Bioelectric Effect to Eliminate Mixed-Species Biofilms," Appl. Environ. Microbiol., 71(10):6379-6382 (2005). Abstract 05-037
- Stein, O.R., J.A. Biederman, P.B. Hook and W.C. Allen, "Plant Species and Temperature Effects on the k-C* First Order Model for Chemical Oxygen Demand Removal in Batch Loaded SSF Wetlands," Ecol. Eng., 26(2):100-112. (2005). **Abstract 05-027**
- Stewart, P.S., "Diffusion Coefficient of Fluoride in Dental Plaque," J. Dent. Res., 84(12):1087-1088 (2005). Abstract 05-045
- Stoodley, P., B. Purevdorj-Gage, and J.W. Costerton, "Clinical Significance of Seeding Dispersal in Biofilms: A Response," Microbiology, 151(11):3453 (2005). Abstract 05-046
- Szomolay, B, I. Klapper, J. Dockery and P.S. Stewart, "Adaptive Responses to Antimicrobial Agents in Biofilms," Environ. Microbiol., 7(8):1186-1191 (2005). Abstract 05-019
- Wesenberg-Ward, K.E., B.J. Tyler, and J.T. Sears, "Adhesion and Biofilm Formation of *Candida albicans* on Native and Pluronic-Treated Polystyrene," Biofilms, 2(1):63-71 (2005). Abstract 05-021

RESEARCH : PUBLICATIONS

Xavier, J.B., C. Picioreanu, S. Abdul Rani, M.C.M. van Loosdrecht, and P.S. Stewart, "Biofilm-Control Strategies Based on Enzymic Disruption of the Extracellular Polymeric Substance Matrix - a Modeling Study," Microbiology, 151(12):3817-3832 (2005). Abstract 05-043

2006 Publications

Borriello, G., L. Richards, G.D. Ehrlich, and P.S. Stewart, "Arginine or Nitrate Enhances Antibiotic Susceptibility of *Pseudomonas aeruginosa* in Biofilms," Antimicrob. Agents Chemother., 50(1):382-384 (2006). Abstract 06-002

Burr, M.D., S.J. Clark, C.R. Spear, and A.K. Camper, "Denaturing Gradient Gel Electrophoresis (DGGE) Can Rapidly Display the Bacterial Diversity Contained in 16S rDNA Clone Libraries," Microb. Ecol., in press (2006). Abstract 06-006

Chambless, J.D., S.M. Hunt and P.S. Stewart, "A Three-Dimensional Computer Model of Four Hypothetical Mechanisms Protecting Biofilms from Antimicrobials," Appl. Environ. Microbiol., 72(3):2005-2013 (2006). Abstract 06-009

Cunningham, A.B., R.S. Sharp, F. Caccavo Jr., and R. Gerlach, "Effects of Starvation on Bacterial Transport Through Porous Media," Adv. Water Resour., in press (2006). Abstract 06-007

Fux, C.A., M. Quigley, A.M. Worel, C. Post, S. Zimmerli, G. Ehrlich, and R.H. Veeh, "Biofilm-Related Infections of Cerebrospinal Fluid Shunts," Clin. Microbiol. Infect., 12(4):331-337 (2006). Abstract 06-001

Hu, J.-F., E. Garo, M.G. Goering, M. Pasmore, H.-D. Yoo, T. Esser, J. Sestrich, P.A. Cremin, G.W. Hough, P. Perrone, Y.S. Lee, N.T. Le, M. O'Neil-Johnson, J.W. Costerton and G.R. Eldridge, "Bacterial Biofilm Inhibitors from *Diospyros dendo*," J. Nat. Prod., 69(1):118-120 (2006). Abstract 06-010

Komlos, J., A.B. Cunningham, A.K. Camper, and R.R. Sharp, "Effect of Substrate Concentration on Dual-Species Biofilm Population Densities of *Klebsiella oxytoca* and *Burkholderia cepacia* in Porous Media," Biotechnol. Bioeng., 93(3):434-442 (2006). Abstract 06-003

Menicucci, J., H. Beyenal, E. Marsili, R. Angathevar Veluchamy, G. Demir and Z. Lewandowski, "Procedure for Determining Maximum Sustainable Power Generated by Microbial Fuel Cells," Environ. Sci. Technol., 40(3):1062-1068 (2006). Abstract 06-011

Nocker, A. and A.K. Camper, "Selective Removal of DNA from Dead Cells of Mixed Bacterial Communities by Use of Ethidium Monoazide," Appl. Environ. Microbiol., 72(3):1997-2004 (2006). Abstract 06-005

Priscu, J.C., B.C. Christner, C.M. Foreman and G. Royston-Bishop, "Biological Materials in Ice Cores," Encyclopedia of Quaternary Science, Elias, S.A. (ed), Elsevier, UK, in press (2006). Abstract 06-004

Seymour, J.D., J.P. Gage, S.L. Codd, and R. Gerlach, "Magnetic Resonance Microscopy of Biofouling Induced Scale Dependent Transport in Porous Media," Adv. Water Resour., in press (2006). Abstract 06-008

Undergraduate Authors, 2005-06

Borch, T., W.P. Inskeep, *J.A. Harwood* and R. Gerlach, "Impact of Ferrihydrite and Anthraquinone-2,6-Disulfonate on the Reductive Transformation of 2,4,6-Trinitrotoluene by a Gram-Positive Fermenting Bacterium," Environ. Sci. Technol., 39(18):7126-7133 (2005). Abstract 05-029

Burr, M.D., S.J. Clark, *C.R. Spear*, and A.K. Camper, "Denaturing Gradient Gel Electrophoresis (DGGE) Can Rapidly Display the Bacterial Diversity Contained in 16S rDNA Clone Libraries," Microb. Ecol., in press (2006). Abstract 06-006

RESEARCH : CURRENT RESEARCH PROJECTS

Research Area	Title	Principal Investigator	Funding Agency
Biofilm Control / Antimicrobials	Control of Biofilms by Natural Products	Costerton James	NIH via SBIR with Sequoia Sciences
Biofilm Control / Antimicrobials	Modeling Antibiotic Resistance of Biofilm Bacteria	Stewart	NIH
Biofilm Control / Antimicrobials	Kodak Antimicrobial Surface Patent Development	Camper/Stewart Sturman	Kodak
Biofilm Control / Antimicrobials	Ultrasonic Release of Antibiotics from Hydrogels for Biofilm Control	Stewart	NSF
Biofilm Control / Antimicrobials	Eradicating Biofilms with Atmospheric Glow Plasma	James	NIH via SBIR with Atmospheric Glow Technologies
Biofilm Control / Antimicrobials	Testing Anti-Biofilm Enzymes	Stewart James	NSF via SBIR with Diversa
Biofilm Control / Antimicrobials	Controlling Oral Biofilms	Stewart	Colgate-Palmolive
Bioelectrochemistry	Microbial Fuel Cells to Power Submersed Electronic Devices	Lewandowski	ONR
Bioremediation	Subsurface Biofilm Barriers for Enhanced Geologic Sequestration of Supercritical CO ₂	Cunningham	DOE/ZERT
Bioremediation	Resolving the Impact of Biological Processes on Water Transport in Unsaturated Porous Media Through Nuclear Magnetic Resonance Micro-Imaging ^{*2}	Seymour Codd	DOE
Bioremediation	Biofilm Remediation of Contaminated Army Sites	Gerlach	DOD through Center for Innovation
Bioremediation	Long-term Stewardship of Mixed Wastes: Passive Reactive Barriers for Simultaneous <i>In Situ</i> Remediation of Chlorinated Solvent, Heavy Metal, and Radionuclide Contaminants	Gerlach	DOE
Bioremediation	Mobility of Source Zone Heavy Metals and Radionuclides: The Mixed Roles of Fermentative Activity on Fate and Transport of U and Cr	Gerlach Peyton	DOE
Bioremediation	Seasonal, Operational, and Plant Effects on Oxygen Potential and Microbial Responses Influencing Constructed Wetland Performance	Stein	USDA
Bioremediation	Biocomplexity: Biogeochemical Cycling of Heavy Metals ^{*2}	Peyton	NSF
Bioremediation	INRA Subsurface Biotechnology and Bioremediation Research Initiative	Cunningham	INRA
Bioremediation	Environmental and Biofilm Mass Spectrometry Facility	Gerlach	DOD/ARO
Bioterrorism	Health Implications of Biofilms in Drinking Water Systems	Camper, Cunningham	DOD/ARO

RESEARCH : CURRENT RESEARCH PROJECTS

Research Area	Title	Principal Investigator	Funding Agency
Industrial and Drinking Water Treatment	Towards Sustainable Materials for Drinking Water Infrastructure	Camper	NSF
Industrial and Drinking Water	Synthesis Document on the State of Science of Molecular Techniques for Application to the Drinking Water Industry	Camper Burr Nocker	AwwaRF
Industrial and Drinking Water	Biodegradation of HAAs in Distribution Systems	Camper	AwwaRF via University of Minnesota
Industrial and Drinking Water	Investigation of the Mode of Action of Stannous Chloride as an Inhibitor of Lead Corrosion	Camper	AwwaRF via University of Minnesota
Industrial and Drinking Water	Electrolytic Control of Biofilm in Dental Units and Water Lines	Camper Sturman	NIH via STTR with Papadopoulos & Associates
Medical Biofilms	The Role of Biofilms in the Pathogenesis of Otorrhea	Costerton Veeh	NIH via Allegheny-Singer
Medical Biofilms	Pneumococcal Biofilms in Otitis Media	Stewart/Costerton Veeh	NIH via Allegheny-Singer
Medical Biofilms	Molecular Analysis of Pathogens in Otitis Media by PCR	Stewart/Costerton Veeh	NIH via Allegheny-Singer
Medical Biofilms	<i>Staphylococcus aureus</i> and Production of Toxic Shock Syndrome Toxin	Lewandowski	Procter & Gamble
Medical Biofilms	Transcutaneous Devices Permitting Skin Cell Attachment	Stewart James	NIH via University of Washington
Medical Biofilms	Mobilization of <i>Candida albicans</i> Biofilms	Suci	NIH
Medical Biofilms	Analysis of Wound Biofilms	James	Southwest Regional Wound Care Center
Microbial Ecology	Microbial Ecology of Swimming Pool Biofilms	Sturman Veeh	Arch Chemicals, Inc.
Microbial Ecology	Analysis of Flexhose-Associated Biofilms ^{*1}	Pyle Veeh	NASA
Natural Organic Matter	Collaborative Proposal: Biogeochemistry of Dissolved Organic Matter in Pony Lake, Ross Island ³	Foreman	NSF
Natural Organic Matter	Paleorecords of Biotic and Abiotic Particles in Polar Ice Cores ³	Foreman	NSF
Souring	Control of Iron Sulfide and Microbial Souring in Oil/Gas-Bearing Formations Using Nitrite, Nitrate and Molybdate	Sturman Peyton	Saudi Aramco
Standardized Biofilm Methods	Development of Routine Bias Checks at the Removal and Disaggregation Steps When Testing the Efficacy of an Antimicrobial Against Surface-Associated Bacteria	Hamilton Goeres	EPA
Standardized Biofilm Methods	Research Support for the Manufacturing and Marketing of the Drip-Flow Biofilm Reactor	Goeres	MTBRC

RESEARCH : CURRENT RESEARCH PROJECTS

Research Area	Title	Principal Investigator	Funding Agency
Structure-Function	Microbial Biofilm Development	Stewart	Keck
Structure-Function	Confocal Scanning Laser Probe	Costerton Dickensheets	NSF
Structure-Function	Gene Expression in <i>Pseudomonas aeruginosa</i> During Biofilm Development ^{*1}	Franklin	NIH
Structure-Function	ADVANCE Fellows Award - NMR Microscopy of Structure-Function Relationships and Microfluidics in Biofilms and Cellular Suspensions ^{*2}	Codd	NSF

*Denotes a project running through a different MSU department, but involving collaboration with CBE researchers and/or use of CBE facilities.

¹MSU Department of Microbiology

²MSU Department of Chemical and Biological Engineering

³MSU Department of Land Resources & Environmental Sciences

List of Acronyms

API – American Petroleum Institute

ARO – Army Research Office

AwwaRF – American Water Works Association Research Foundation

DOD – Department of Defense

DOE – U.S. Department of Energy

EPA – U.S. Environmental Protection Agency

INRA – Inland Northwest Research Alliance

Keck – W. M. Keck Foundation

MTBRC – Montana Board of Research and Commercialization

NASA – National Aeronautics and Space Administration

NIH – National Institutes of Health

NSF – National Science Foundation

ONR – Office of Naval Research

SBIR – Small Business Innovation Research

USDA – United States Department of Agriculture

ZERT – Zero Emissions Research and Technology

RESEARCH : FACULTY LISTING

Name	Department	Specialty
Haluk Beyenal	Chemical & Biological Engineering	Biochemical engineering
Anne Camper	Civil Engineering	Biofilms in environmental systems
Ross Carlson	Chemical & Biological Engineering	Metabolic engineering, metabolic networks
Sarah Codd	Mechanical Engineering	Magnetic resonance imaging
Bill Costerton	Microbiology	Biofilms in microbial pathogenicity
Al Cunningham	Civil Engineering	Subsurface biotechnology and bioremediation
David Dickensheets	Electrical & Computer Engineering	MEMs, confocal microscopy
Jack Dockery	Mathematical Science	Mathematical models of biofilms
Tim Ford	Microbiology	Drinking water, public health microbiology
Christine Foreman	Land Resources & Environmental Sciences	Microbial ecology in cold temperature environments
Michael Franklin	Microbiology	Molecular genetics, gene expression, alginate
Gill Geesey	Microbiology	Molecular and cellular interactions at interfaces
Robin Gerlach	CBE/Civil Engineering	Environmental biotechnology & bioremediation
Marty Hamilton	Statistics	Applied biostatistical thinking
Warren Jones	Civil Engineering	Water distribution systems
Taimur Khan	Center for Biofilm Engineering	Environmental engineering
Isaac Klapper	Mathematical Science	Mathematical modeling
Zbigniew Lewandowski	Civil Engineering	Microsensors, chemical gradients, biofilm structure, hydrodynamics
Tom Livinghouse	Chemistry & Biochemistry	Organic synthesis, signaling analogues
Timothy McDermott	Land Resources & Environmental Sciences	Biofilms in extreme environments
Bruce McLeod	Electrical & Computer Engineering	Bioelectric effect
Andreas Nocker-Einsiedler	Center for Biofilm Engineering	Molecular microbiology
Brent Peyton	Chemical & Biological Engineering	Environmental biotechnology & bioremediation
Barry Pyle	Microbiology	Environmental, water and food microbiology
Rocky Ross	Computer Science	Web-based, active learning education
Joseph Seymour	Chemical & Biological Engineering	Magnetic resonance imaging
Otto Stein	Civil Engineering	Engineered waste remediation
Phil Stewart	Chemical & Biological Engineering	Biofilm control strategies
Paul Sturman	Civil Engineering	Biofilms in waste remediation and industrial systems
Peter Suci	Microbiology	Fungal biofilms
Brett Towler	Civil Engineering	Biofilm mechanics
Rick Veeh	Center for Biofilm Engineering	Bacterial identification using oligonucleotide probes

EDUCATION : STUDENT STATISTICS

2005–2006 Undergraduate Students*

Discipline	Male	Female	Total
Biomedical Science		3	3
Business	1	1	2
Biotechnology	1		1
Cell Biology & Neuroscience		2	2
Chemical & Biological Engineering	9	6	15
Chemistry	2	1	3
Civil Engineering	3	1	4
Computer Engineering	1		1
Ecology		1	1
Mechanical Engineering	1		1
Microbiology		3	3
Nursing		2	2
Total	18	20	38

*The CBE employs 6 additional undergrads in the areas of administrative and technical support

2005–2006 Graduate Students

Discipline	MS/PhD	Male	Female	Total
Chemical & Biological Engineering				11
	MS	1	2	3
	PhD	6	2	8
Chemistry				1
	PhD	1		1
Civil & Environmental Engineering				9
	MS	5	1	6
	PhD	3		3
Computer Science				1
	PhD	1		1
Electrical Engineering				1
	PhD	1		1
Land Resources & Environmental Sciences				2
	MS		1	1
	PhD	1		1
Mathematics				2
	PhD	1	1	2
Microbiology				5
	MS		1	1
	PhD	1	3	4
Totals		21	11	32

EDUCATION : FALL 2005 SEMINAR SERIES

Date	Speaker	Title
08 Sep 05	Howard Shapiro Consulting and R&D Services in Flow Cytometry	Cytometry 2005: It Ain't Necessarily Flow
15 Sep 05	Brett Towler, Ph.D. Department of Civil Engineering, Montana State University and Mike Sutton, Undergrad in Mechanical Engineering, Montana State University	Manipulating the Shear Strain Response of Biofilms Through Cation Cross-Linking of the EPS
22 Sep 05	Alessandra Agostinho, D.D.S., Ph.D. University of São Paulo, Brazil	Dental Biofilms: A Tooth Story
29 Sep 05	Phil Stewart, CBE Director	Strategic Planning
06 Oct 05	Phil Stewart, CBE Director	Strategic Planning
13 Oct 05	Taimur Khan CBE Assistant Research Professor	Effect of Biofouling on Powdered Activated Carbon – Microfiltration (PAC-MF) Membrane System
27 Oct 05	Scott Wallace, P.E. Senior Vice President, North American Wetland Engineering, L.L.C., White Bear Lake, MN	Influence of Microbial Communities in Constructed Wetlands
31 Oct 05	Chris Tanner Waste Treatment Consultant, NIWA Research, New Zealand	Constructed Wetland Research in New Zealand
10 Nov 05	Frances Lefcort, Ph.D. Dept. of Cell Biology & Neuroscience Montana State University	Live Time-Lapse Imaging of Neural Crest Cell Migration
17 Nov 05	Ailyn Perez, Graduate Student Microbiology, Montana State University	Genomics of <i>Pseudomonas</i> Virulence
01 Dec 05	Betsey Pitts, M.S. CBE Research Associate	State of the Art: How We Use the CBE Imaging Facility
08 Dec 05	Robin Patel, M.D. Associate Professor, Microbiology and Medicine, Mayo Clinic College of Medicine, Rochester, MN	Novel Approaches to Prosthetic Joint Infection Diagnosis

EDUCATION : SPRING 2006 SEMINAR SERIES

Date	Speaker	Title
19 Jan 2006	Thom Hughes, Ph.D. Associate Professor Cell Biology & Neuroscience Montana State University	Genetically Encoded Reporters for Studying Living Cells
26 Jan 2006	Phil Stewart & Executive Committee	In Preparation for TAC
01 Feb 2006	Douglas B. McIlwaine, Ph.D. ChemTreat Inc., Ashland, VA	Biocides: Modes of Action and Implications
09 Feb 2006	Jeyong Yoon, Ph.D. Associate Professor, School of Chemical & Biological Engineering Seoul National University, Korea	Disinfection and Biofilm Control
16 Feb 2006	Jan Sunner, Ph.D. Associate Professor, Chemistry/Biochemistry Department Montana State University	Molecular Characterization of Biofilms with Modern Mass Spectrometric Techniques – Results and Potentials
02 Mar 2006	David Hill, Ph.D. Biological Physicist University of North Carolina	Defending the Lung: From Mucus Flow to Why Bugs Grow
09 Mar 2006	Jack Dockery, Ph.D. Professor Mathematics Department Montana State University	Biofilm Modeling
23 Mar 2006	Tim McDermott, Ph.D. Associate Professor Land Resources & Environmental Sciences Montana State University	Studies on Biogeochemical Cycling in a Model Yellowstone Biofilm Community
30 Mar 2006	Shulin Chen, Ph.D. Professor Biological Systems Engineering Washington State University	Aquaculture Engineering
06 Apr 2006	Ron Sims, Ph.D. Professor Utah Water Research Laboratory Utah State University	Biological & Irrigation Engineering
13 Apr 2006	Katherine Sossa-Fernández CBE Visiting Researcher Universidad de Concepción, Chile	Plant Biofilms & H ₂ O ₂
20 Apr 2006	Luke Hanley, Ph.D. Professor Chemistry Department University of Illinois	Vacuum Ultraviolet Postionization for Mass Spectrometry of Biomaterials & Bacterial Biofilms

TECHNOLOGY TRANSFER : TAC AGENDA SUMMER 2005

CENTER FOR
BIOFILM
ENGINEERING

Agenda CBE Technical Advisory Conference July 6–8, 2005 Montana State University, Bozeman

Tuesday July 5

6:00–7:30 p.m.
**Pre-registration and
Welcome Reception**
GranTree Inn
North 7th Ave, Bozeman

Wednesday July 6

7:30–8:30 a.m.
**Registration and
Continental Breakfast**
Strand Union Building (SUB)
Ballroom B & C

8:30–8:45
Introductory Remarks
SUB Ballroom D
Paul Sturman, CBE Industrial
Coordinator
Mel Czechowski, Church & Dwight,
TAC Chair

Keynote Presentation
8:45–9:40
**Gallium, a potential new anti-biofilm
therapeutic**
Pradeep Singh, Assistant Professor,
Department of Internal Medicine,
University of Iowa

SESSION 1: **Medical Biofilms**

9:40–10:00
**Overview of research in the Medical
Biofilm Laboratory**
Garth James, CBE Medical Biofilm
Laboratory Manager

10:00–10:20
**The results of a one stage joint
revision for infected joints using
radical debridement and antibiotic
cement**
Gary Maale, Orthopedic surgeon,
Dallas-Ft. Worth Sarcoma Group

10:20–10:40 Break

10:40–11:00
**Evaluation of biofilms in chronic
wounds**
Ellen Swogger, CBE Undergraduate,
Chemical & Biological Engineering

11:00–11:20
Biofilm-based wound care
Randy Wolcott, Director, Southwest
Regional Wound Care Center,
Lubbock, Texas

Special Presentation

11:20–12:10
**State of the CBE and vision for the
future**
Phil Stewart, CBE Interim Director

12:10–1:00
Lunch, Catered
SUB Ballroom B & C

Industry Presentation
1:00–1:30
**Biofilms in the hospitality, food and
healthcare industries**
Scott L. Burnett, Microbiologist,
Ecolab, Mendota Heights, MN

SESSION 2: **Biofilm Structure and Function**

1:30–1:40
Session Introduction
Zbigniew Lewandowski, CBE
Professor, Civil Engineering

1:40–2:00
**Three-dimensional biofilm structure
and activity**
Raaja Raajan Angathevar
Veluchamy, CBE MS Candidate,
Environmental Engineering

2:00–2:20
**Hollow fiber membrane biofilm
reactor for dye wastewater
treatment**
Kyung-Min Yeon, Visiting
Researcher, Institute of
Environmental Protection and
Safety, School of Chemical
Engineering, Seoul National
University, Korea

2:20–2:40
Particle capture in biofilms
Anne Camper, CBE
Professor, Civil Engineering

2:40–3:00 Break

Special Presentation
3:00–3:30
**Bacteria can do amazing things:
Tertiary structure in biofilms**
Bill Costerton, Director, Dental
Biofilm Center, University of
Southern California

Special Presentation
3:30–4:00
**The *Pseudomonas aeruginosa*
dispersion autoinducer**
David Davies, Assistant Professor,
Biology, University of Binghamton,
New York

4:00–5:30
Poster Session

Focus Group Session
5:30–
**Medical biofilm methods
consortium**
Coordinated by Marty Hamilton
The inaugural meeting of CBE
members interested in the
development of validated, FDA-
accepted laboratory methods

TECHNOLOGY TRANSFER : TAC AGENDA SUMMER 2005

Thursday July 7

7:30–8:30 a.m.

**Registration and
Continental Breakfast**
Strand Union Building (SUB)
Ballroom B & C

Invited Presentation

8:30–9:20

**A short range signaling system for
coordinated dispersal in biofilms**

Paul Stoodley, Associate Professor,
Center for Genomic Sciences
Allegheny-Singer Research
Institute, Pittsburgh, Pennsylvania
Laura Purevdorj-Gage, recent CBE
PhD graduate, Microbiology

SESSION 3: **Biofilm Methods**

9:20–9:30

Session Introduction
Darla Goeres, CBE Research
Engineer

9:30–10:00

**Drip flow biofilm reactor: Design
and Repeatability**
Nic Beck & Jackie Whitaker, CBE
Biofilm Systems Training Laboratory
(BSTL) interns

10:00–10:20

**Parallel testing to determine the
influence of biofilm growth
conditions on antimicrobial log
reduction: The rest of the story**
Kelli Buckingham-Meyer, CBE
Laboratory Specialist

10:20–10:40 Break

10:40–11:00

High throughput biofilm screening
Elinor Pulcini, CBE Research
Associate

11:00–11:30

**An integrated platform to optimize
therapeutic agents for biofilm
activity**
Tim Morris, Senior Scientist,
Cumbre, Dallas, Texas

11:30–11:50

**Distinction between viable and dead
bacteria using EMA-PCR**
Andreas Nocker, CBE Assistant
Research Professor

11:50–12:10

**Analysis of biofilm communities
using DGGE**
Mark Burr, CBE Research Associate
Sabrina Behnke, Visiting
Researcher, University of
Duisberg-Essen, Germany

12:10–1:10

Lunch, Catered
SUB Ballroom B & C

SESSION 4: **Biofilm-Metals Interaction**

1:10–1:40

Heavy metal reduction and toxicity
Brent Peyton, Associate Professor,
Chemical and Biological
Engineering, Washington State
University

1:40–2:00

**Mixed waste remediation: Influence
of biofilms, minerals, and organic
matter on the fate of explosives,
chlorinated solvents, and heavy
metals**
Robin Gerlach, CBE Assistant
Research Professor, Civil
Engineering

3:00–5:00

TAC Business Meeting
Springhill Pavillion

6:00–8:00

Dinner
Springhill Pavillion

Friday July 8

7:30–8:30 a.m.

**Registration and
Continental Breakfast**
Strand Union Building (SUB)
Ballroom B & C

Invited Presentation

8:30–9:10

**Disinfecting biofilm-associated
Legionella pneumophila: The
importance of free-living protozoa**
Rodney Donlan, Centers for Disease
Control and Prevention

SESSION 5: **Alternative Control Strategies**

9:10–9:20

Session Introduction
Phil Stewart

9:20–9:40

Anti-biofilm surface coatings
Ross Carlson, CBE Assistant
Research Professor, Chemical
and Biological Engineering

9:40–10:00

**Cohesive strength measurement as
a tool for evaluating biofilm removal
strategies**
Ray Hozalski, Visiting Researcher,
Associate Professor, Civil
Engineering, University of
Minnesota

10:00–10:20 Break

10:20–10:40

**A 3-D model of four hypothetical
protective mechanisms of biofilms**
Jason Chambless, CBE PhD
Candidate, Chemical and
Biological Engineering

10:40–11:10

**Arginine enhances antibiotic action
against *Pseudomonas aeruginosa*
biofilms**
Phil Stewart

11:10–11:30

**Controlled ultrasonic release of
antibiotics from hydrogel surfaces**
Patrick Norris, recent CBE MS
graduate, Mechanical Engineering

11:30–11:40

**Session/Meeting Wrap-up and
Industry Comment**



February 1–3, 2006

Technical Advisory Conference Agenda

Center for Biofilm Engineering

Wednesday February 1

6:00–8:00 p.m.
Pre-registration and
welcome reception
GranTree Inn
North 7th Ave, Bozeman

Thursday February 2

8:00–8:45 a.m.
Registration and
continental breakfast
Strand Union Building (SUB)
Ballrooms B and C

8:45–9:00
Introductory remarks
SUB Ballroom D
Paul Sturman, CBE Industrial
Coordinator
Mel Czechowski, Church &
Dwight, TAC Chair
Robert Marley, Dean, MSU
College of Engineering
Phil Stewart, CBE Director

SESSION 1: Biofilm Control

9:00–9:10
Session introduction
Phil Stewart

9:10–10:00 KEYNOTE PRESENTATION

Using iron to manipulate
Pseudomonas aeruginosa
biofilms
Peter Greenberg, Chair and
Professor of Microbiology,
University of Washington

10:00–10:30
Enhancing antibiotic
susceptibility of *Pseudomonas*
aeruginosa biofilms by
quorum sensing inhibition
Caol Huff, CBE PhD Candidate,
Chemistry

10:30–10:50 Break

10:50–11:10
Dormant cells in *Pseudomonas*
aeruginosa biofilms
Lee Richards, CBE PhD
Candidate, Chemical &
Biological Engineering

SESSION 2: Biofilm Structure

11:10–11:20
Session introduction
Zbigniew Lewandowski,
CBE Professor, Civil
Engineering

11:20–11:45
Structure and activity of
Pseudomonas aeruginosa
PAO1 biofilms
Raaja Raajan Angathevar
Veluchamy, CBE MS
Candidate, Environmental
Engineering

11:45–12:00
Characterization of
Campylobacter jejuni
biofilm formation
Vildan Caner, Visiting Scientist,
Assistant Professor in the
Molecular Microbiology Lab,
School of Medicine with
Pamukkale University,
Denizli, Turkey

12:10–1:00
Lunch, catered
SUB Ballrooms B and C

SESSION 3: Phage Interactions with Biofilm

1:00–1:40
Viruses/phage: Biofilm
players...but what else?
Rick Veeh, CBE Senior Research
Associate

1:40–2:10
Cage-based MRI contrast
agents for diagnosis of biofilm
infections
Peter Suci, CBE Assistant
Research Professor,
Microbiology

2:10–2:40
Display phage technology:
Development of peptide
aptamers for the detection
and neutralization of toxins
Joe Fralick, Professor,
Microbiology, Texas Tech

2:40–3:00 Break

SESSION 4: Medical Biofilms

3:00–3:30
Plant derived biofilm
inhibitors
Garth James, CBE Medical
Projects Manager and
High throughput 96-well
screening
Amy Martin, CBE
Undergraduate Researcher

3:30–4:00
A laboratory model of wound
biofilms
Ellen Swogger, CBE Laboratory
Technician, and
Community analysis of chronic
wounds using molecular
techniques
Pat Secor, CBE Undergraduate
Researcher

TECHNOLOGY TRANSFER : TAC AGENDA WINTER 2006

SPECIAL PRESENTATION

4:00–4:30

The two-photon “capture” microscope: A slime guy’s fervent dream

Bill Costerton, Director, Center for Biofilms, School of Dentistry, University of Southern California

FDA PRESENTATION

4:30–5:00

FDA regulatory outlook: How to get a submission approved by the U.S. FDA

Victoria Hitchens, Scientist Director, Division of Biologics, Office of Science and Engineering Laboratories, Center for Devices and Radiological Health, FDA

Poster Session

5:00–6:00

Poster session

Ballrooms B and C

6:00

Dinner

Catered, Ballroom B and C

7:00

Business meeting

Ballroom A

(for Industrial Associate designated representatives only)

Friday February 3

8:00–8:45 a.m.

Registration and continental breakfast

Strand Union Building (SUB)
Ballrooms B and C

SESSION 5:

The Biofilm Matrix

8:45–9:30

The biofilm extracellular matrix

Phil Stewart

9:30–10:10

Dyed and buried...how to use stains and dyes to uncover information in biofilms - an informal discussion of VERY recent CBE experience with microscope stains

Betsy Pitts, CBE Research Associate/Facilities Manager, Microscopy

10:10–10:50

The role of staphylococcal extracellular polymers in biofilm formation and immune evasion

Michael Otto, Principal Investigator, Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases, The National Institutes of Health

10:50–11:10 Break

11:10–11:30

Exotoxin expression during biofilm growth of *Pseudomonas aeruginosa*

Ailyn Lenz, PhD Candidate, Microbiology

11:30–11:50

Manipulating the shear strain response through cation cross-linkage of the EPS

Mike Sutton, CBE Undergraduate Researcher, Mechanical Engineering

11:50 – 12:00

Session/Meeting wrap-up and industry comment

TECHNOLOGY TRANSFER : INDUSTRIAL ASSOCIATE MEMBERSHIP

Industrial Associate Memberships
(June 1, 2005 - May 31, 2006)

ORGANIZATION	TYPE OF INDUSTRY	NUMBER OF YEARS OF SUPPORT
American Air Liquide, Inc.	Healthcare/Food Safety	05,06
Aramco Services Company	Petroleum	87,88,89,90,91,92,93,94,95,96,97,98,99,00,01,02,03,04,05,06
Church & Dwight Co., Inc.	Household Products	02,03,04,05,06
Colgate-Palmolive	Household Products	00,01,02,03,04,05,06
C.R. Bard, Inc.	Healthcare	04,05,06
Cumbre, Inc.	Healthcare	04,05,06
Dow Chemical Company	Specialty Chemicals	90,91,92,93,94,95,98,99,00,01,02,03,04,05,06
DuPont	Specialty Chemicals	95,96,97,98,00,03,04,05,06
Eastman Kodak Company	Other	91,92,97,98,99,00,01,02,03,04,05,06
Ecolab, Inc.	Specialty Chemicals	05,06
Edstrom Industries, Inc.	Water Treatment	03,04,05,06
Electric Power Research Institute (EPRI)	Other	88,89,90,04,05
Genencor International, Inc.	Healthcare	02,03,04,05
GlaxoSmithKline	Pharmaceutical	04,05,06
Idaho National Laboratory (INL)	Government Lab	87,88,89,90,91,92,93,94,95,96,97,98,99,00,01,02,03,04,05,06
Masco	Household Products	05,06
NASA	Government Lab	05,06
NovaCal Pharmaceuticals, Inc.	Pharmaceutical	05,06
Novozymes North America, Inc.	Healthcare	05,06

TECHNOLOGY TRANSFER : INDUSTRIAL ASSOCIATE MEMBERSHIP

ORGANIZATION	TYPE OF INDUSTRY	NUMBER OF YEARS OF SUPPORT
Tyco Healthcare (formerly Kendall Healthcare Products Company)	Healthcare	98,99,00,01,02,03,04,05,06
Unilever	Household Products	06
U. S. Bureau of Reclamation	Drinking Water	98,99,00,01,02,03,04,05,06
W. L. Gore & Associates	Healthcare	97,98,99,00,01,02,03,04,05,06

TECHNOLOGY TRANSFER : COLLABORATIONS OVER HISTORY OF CBE

Industrial and Government Collaborators over the History of the CBE
Updated May 31, 2006

ORGANIZATION	SIZE OF ORGANIZATION:			FOREIGN	INDUSTRIAL ASSOCIATE ?	IF INDUSTRIAL ASSOCIATE (LIST YEARS)
	SMALL <500	MEDIUM 500-1000	LARGE >1000			
3M Corporation			X	NO	NO	
ADA Technologies, Inc.	X			NO	NO	
Affinity, Inc.	X			NO	NO	
Albemarle Corporation			X	NO	YES	98,99,00
Allied Tube & Conduit		X		NO	NO	
American Air Liquide, Inc.			X	NO	YES	05,06
American Petroleum Institute	X			NO	NO	
American Water Works Association Research Foundation (AwwaRF)	X			NO	YES	91,92,93,94,95,96,97,98
American Water Works Service Company	X			NO	NO	
Aramco Services Company			X	YES	YES	87,88,89,90,91,92,93,94,95,96,97,98,99,00,01,02,03,04,05,06
Arbor Surgical Technologies	X			NO	NO	
Arch Chemicals (formerly Olin Chemicals)			X	NO	YES	93,94,95,96,97,98,99,00,01,02
Arco Exploration & Production Technology			X	NO	YES	86,87,88,89,90,91,92,93,94,95,97,98
*Army Research Office (ARO)			X	NO	NO	
Atmospheric Glow Technologies	X			NO	NO	
Atrium Medical Corporation			X	NO	NO	
Australian Water Technologies	X			YES	NO	
Bayer Chemical Company			X	NO	NO	
Becton Dickinson Technologies			X	NO	YES	98,99,00,01
Betz Dearborn, Inc.		X		NO	YES	99,00,01,02
Betz PaperChem			X	NO	YES	91,92,93,94,95,96
BHP Copper (formerly Magma Copper)		X		NO	YES	96,97,98
Biolab		X		NO	YES	99,00,01
Bioquatic Supply	X			NO	NO	
Biomedical Development	X			NO	NO	
BioSurface Technologies Corporation	X			NO	NO	

TECHNOLOGY TRANSFER : COLLABORATIONS OVER HISTORY OF CBE

ORGANIZATION	SIZE OF ORGANIZATION:			FOREIGN	INDUSTRIAL ASSOCIATE ?	IF INDUSTRIAL ASSOCIATE (LIST YEARS)
	SMALL <500	MEDIUM 500-1000	LARGE >1000			
Bitterroot Restoration, Inc.	X			NO	NO	
Black & Veatch			X	NO	NO	
BP - Amoco Corporation (formerly Amoco Corporation)			X	NO	YES	87,88,89,90,91,92,93,94,95,96,97,98,99,00,01
Brentwood Industries	X			NO	NO	
British Petroleum Research			X	NO	YES	91,92,93
Calgon Corporation		X		NO	YES	92,93,94,95,96,97,98
Canon Communications, Inc.		X		NO	NO	
Centers for Disease Control (CDC)			X	NO	NO	
Center for Innovation (CFI)	X			NO	NO	
Chevron Petroleum Technology Company			X	NO	YES	88,89,90,91,92,93,94,95,96,97,98,99,00
Church & Dwight Co., Inc.			X	NO	YES	02,03,04,05,06
Ciba Vision			X	NO	YES	99
Cincinnati Water Works	X			NO	NO	
City of Laval		X		YES	NO	
Clearwater Systems	X			NO	NO	
Clorox Company			X	NO	YES	94,95,96,97,98,99
Colgate-Palmolive Company			X	NO	YES	01,02,03,04,05,06
Compagnie Générale des Eaux (CGE)		X		YES	NO	
Conductive Medical Devices			X	NO	NO	
Conoco, Inc.			X	NO	YES	87,88,89,90,91,92,93,94,95,96,97,98
C.R. Bard, Inc.			X	NO	YES	04,05,06
Cumbre, Inc.	X			NO	YES	04,05,06
Cytergy, LLC	X			NO	NO	
*Defense Advanced Research Projects Agency (DARPA)			X	NO	NO	
Demeter, Inc.	X			NO	NO	
DePuy, Inc.			X	NO	YES	02,03,04
Diversa Corporation	X			NO	YES	04,05,06
Dow Chemical U.S.A.			X	NO	YES	90,91,92,93,94,95,98,99,00,01,02,03,04,05,06
DuPont			X	NO	YES	95,96,97,98,00,03,04,05,06

TECHNOLOGY TRANSFER : COLLABORATIONS OVER HISTORY OF CBE

ORGANIZATION	SIZE OF ORGANIZATION:			FOREIGN	INDUSTRIAL ASSOCIATE ?	IF INDUSTRIAL ASSOCIATE (LIST YEARS)
	SMALL <500	MEDIUM 500-1000	LARGE >1000			
Eastman Kodak Company			X	NO	YES	91,92,97,98,99,00,01,02,03,04,05,06
Ecolab, Inc.			X	NO	YES	05,06
Ecole Polytechnique de Montréal		X		YES	NO	
Economic & Engineering Service, Inc.		X		NO	NO	
Edstrom Industries, Inc.	X			NO	YES	03,04,05,06
Electric Power Research Institute (EPRI)	X		X	NO	YES	88,89,90,04,05
Engineering & Economical Development				NO	NO	
*Environmental Protection Agency (EPA)			X	NO	NO	
*EPA/Kansas State University		X		NO	NO	
Ethicon Endo-Surgery, Inc.		X		NO	NO	
Exponent, Inc.		X		NO	NO	
Exxon Production Research			X	NO	YES	89,90,91,92,93,94,95,96,97,98
Fine Particle Society		X		NO	NO	
FMC Corporation	X			NO	NO	
Fraser Dental			X	NO	NO	
Gambro Corporate Research			X	YES	YES	02,03,04,05
Genencor International, Inc.			X	NO	YES	02,03,04,05
Genome Therapeutics Corp.		X		NO	YES	02,03
GlaxoSmithKline			X	NO	YES	04,05,06
GlycoMimetics, Inc.	X			NO	NO	
ICU Medical		X		NO	NO	
*Idaho National Laboratory (INL) (formerly INEEL, INEL and EG&G)			X	NO	YES	87,88,89,90,91,92,93,94,95,96,97,98,99,00,01,02,03,04,05,06
Inland Northwest Research Alliance, Inc. (INRA)	X			NO	NO	
Intelligent Optical Systems (IOS)		X		NO	NO	
International Copper Association			X	NO	YES	89,90,91
Kurita Water Industries Ltd.			X	YES	YES	01,02,03
Lanxess Energizing Chemistry (formerly Bayer)			X	NO	NO	
Little Bear Labs	X			NO	NO	
*Los Alamos National Laboratory			X	NO	NO	
Lovelace Medical Foundation			X	NO	NO	
Lynntech	X			NO	NO	

TECHNOLOGY TRANSFER : COLLABORATIONS OVER HISTORY OF CBE

ORGANIZATION	SIZE OF ORGANIZATION:			FOREIGN	INDUSTRIAL ASSOCIATE ?	IF INDUSTRIAL ASSOCIATE (LIST YEARS)
	SMALL <500	MEDIUM 500-1000	LARGE >1000			
Masco			X	NO	YES	05,06
Matney-Frantz Engineering, P.C.			X	NO	NO	
MBI		X		NO	NO	
Medtronic			X	NO	NO	
Mentor Urology, Inc.		X		NO	NO	
Metropolitan Water District of Southern California		X		NO	NO	
Microban			X	NO	NO	
Microbia, Inc.			X	NO	YES	01,02,03
MIOX Corporation	X			NO	NO	
Montana Biotech	X			NO	NO	
Montana Power Company		X		NO	YES	89,90,91,92,93,94,95
Montana Tech	X			NO	NO	
MSE, Inc.		X		NO	YES	96,97,98,99
Nano Vibronix	X			NO	NO	
*NASA			X	NO	YES	05,06
*National Institutes of Health (NIH)			X	NO	NO	
*National Science Foundation (NSF)			X	NO	NO	
National Water Research Institute (NWRI)	X			NO	NO	
Neopoxy	X			NO	NO	
NovaCal Pharmaceuticals, Inc.	X			NO	YES	05,06
Novozymes North America, Inc.	X			NO	YES	05,06
*Office of Naval Research			X	NO	NO	
Ondeo Nalco Chemical Corporation (formerly Nalco Chemical Corporation)			X	NO	YES	90,91,92,93,94,95,96,97,98,99,00,01,02
Orange County Water District		X		NO	YES	91,92,93,94,95
Osel		X		NO	NO	
*Pacific Northwest National Labs (PNNL) (formerly Battelle)			X	NO	YES	92,93,94,95,96,97,98
Papadopoulos and Associates	X			NO	NO	
Philips Oral Healthcare, Inc.			X	NO	YES	02,03,04
Procter & Gamble Company			X	NO	YES	91,92,93,94,95,96,97,98,99,00
Reckitt Benckiser, Inc.			X	NO	YES	01,02,03
Rohm & Haas Company			X	NO	YES	96,97,98

TECHNOLOGY TRANSFER : COLLABORATIONS OVER HISTORY OF CBE

ORGANIZATION	SIZE OF ORGANIZATION:			FOREIGN	INDUSTRIAL ASSOCIATE ?	IF INDUSTRIAL ASSOCIATE (LIST YEARS)
	SMALL <500	MEDIUM 500-1000	LARGE >1000			
S.C. Johnson & Son (formerly S.C. Johnson Wax)			X	NO	YES	93,94,95,96,97,98,99,00,01,02,03,04
Sequoia Sciences	X			NO	NO	
Shell Development Company			X	NO	NO	
Smith & Nephew, Inc.			X	NO	YES	03,04,05
SmithKline Beecham			X	NO	NO	
South Central Connecticut Regional Water Authority	X			NO	NO	
Southern Company Services, Inc.		X		NO	YES	86,87,88,89,90,91,92
Southwest Regional Wound Care Center	X			NO	NO	
Space Hardware Optimization Technology (SHOT)		X		NO	NO	
S.S. Papadopoulos & Associates, Inc.	X			NO	NO	
St. Jude			X	NO	NO	
Sulzer Carbomedics, Inc.			X	NO	YES	98,99,00
Surmodics	X			NO	NO	
Swiss Federal Institute for Water Resources & Water Pollution Control		X		NO	NO	
Texaco			X	NO	YES	98,00,01,02
Tyco Healthcare (formerly Kendall Healthcare Products Company)			X	NO	YES	98,99,00,01,02,03,04,05,06
Unilever Home & Personal Care			X	NO	YES	06
Unilever Research			X	YES	YES	92,93,94,95,98,99,00
Union Carbide Corporation			X	NO	YES	87,88,89,90,91,92,94,95,96,97,98,99,00,01,02,03,04
*U.S. Army Research Office			X	NO	NO	
*U.S. Bureau of Reclamation			X	NO	YES	98,99,00,01,02,03,04,05,06
*U.S. Department of Agriculture			X	NO	NO	
*U.S. Department of Defense			X	NO	NO	
*U.S. Department of Energy			X	NO	NO	
*U.S. Department of the Interior			X	NO	NO	
*U.S. Department of the Navy			X	NO	NO	
U.S. Filter/Everpure, Inc.			X	NO	YES	00
*U.S. Geological Survey		X		NO	NO	
*U.S. National Park Service			X	NO	NO	
University of New Mexico	X			NO	NO	

TECHNOLOGY TRANSFER : COLLABORATIONS OVER HISTORY OF CBE

ORGANIZATION	SIZE OF ORGANIZATION:			FOREIGN	INDUSTRIAL ASSOCIATE ?	IF INDUSTRIAL ASSOCIATE (LIST YEARS)
	SMALL <500	MEDIUM 500-1000	LARGE >1000			
Unocal Corporation			X	NO	NO	
Vapotherm	X			NO	NO	
Vivendi Water			X	YES	YES	02,03
Warner-Lambert Company			X	NO	YES	99,00
*Westinghouse Savannah River Company			X	NO	YES	95,96,97,98,99,00,01,02
Westvaco			X	NO	YES	88,89,90,91,92,93,94,95
Weyerhaeuser			X	NO	YES	89,90
Wilson-Cook Medical GI Endoscopy			X	NO	NO	
W. L. Gore & Associates			X	NO	YES	97,98,99,00,01,02,03,04,05,06
Yellowstone Environmental Science, Inc.	X			NO	NO	

*Indicates a Government Organization

TECHNOLOGY TRANSFER : FACULTY AND STAFF VISITS TO INDUSTRY

Faculty and Staff Visits to Industry (June 1, 2005–May 15, 2006)

Date(s)	CBE Faculty/Staff	Visit to Corporation (Location)	Purpose of Visit
9/14/05	Darla Goeres, CBE Research Engineer and Marty Hamilton, CBE Professor Emeritus, Statistics	US Environmental Protection Agency (EPA) (Arlington, VA)	Darla presented "Anti-bacterial Efficacy Against Surface Bacteria Depends on the Method Used to Establish Bacteria on the Surface." Marty presented "Surrogate Spore Study: Statistical Results." These presentations were made to the Antimicrobials Division (AD) of the US-EPA. They also met with AD science teams and the AD contract officer to discuss progress, planning and reporting for CBE projects funded by the AD, US-EPA.
9/15/05	Marty Hamilton, CBE Professor Emeritus, Statistics	US Environmental Protection Agency (EPA) (Ft. Meade, MD)	Marty also presented "Surrogate Spore Study: Statistical Results" to the EPA Office of Pesticide Programs Microbiology Lab in Ft. Meade, MD. This was a joint meeting of EPA scientists and their collaborators from the US Army's Edgewood Chemical Biological Center where the surrogate spore laboratory experiments were conducted.
9/27/05	Phil Stewart, CBE Director	DuPont (Wilmington, DE)	Phil met with DuPont researchers and presented "Diffusion, Dormancy, and Detachment in Biofilms."
9/29/05	Paul Sturman, Coordinator of Industrial Development	US Food & Drug Administration (FDA) (Washington, DC)	Paul visited with research personnel and presented "In Vitro Reactor Systems for the Validation of Anti-Biofilm Claims in Medical Devices."
10/19/05	Darla Goeres, CBE Research Engineer	Ecolab (St. Paul, MN)	Darla visited with research personnel and presented "Standardized Biofilm Methods Development."
12/8/05	Phil Stewart, CBE Director	Novozymes North America, Inc. (Franklinton, NC)	Phil met with Novozymes researchers and presented "Biofilms: What they are, where they occur, some examples of industries and applications where they cause problems, possible control strategies."
4/19/06	Phil Stewart, CBE Director	Unilever (Rolling Meadows, IL)	Phil was an invited speaker at this CBE Industrial Associate company and presented "Controlling Biofilms" to Unilever Home & Personal Care researchers.
4/24-4/25/06	Phil Stewart, CBE Director and Garth James, Medical Projects Manager	Medtronic (Fridley, MN)	Phil and Garth were invited to this potential CBE Industrial Associate company to discuss collaborations. Phil presented "Biofilms and Their Control."
5/11-5/12/06	Phil Stewart, CBE Director	Kimberly-Clark (Roswell, GA)	Phil was an invited speaker at this potential CBE Industrial Associate company and presented "Biofilm Infections and Antimicrobial Tolerance."

TECHNOLOGY TRANSFER : INDUSTRY AND GOVERNMENT VISITS TO CBE

Industry and Government Visits to the CBE (June 1, 2005–May 31, 2006)

Date(s)	Name of Participant, Institution (Location)	Foreign Institution		Description
		Yes	No	
7/6-7/8/05	Technical Advisory Conference (TAC) had 42 participants, representing 32 different organizations (2 foreign organizations).	X	X	Attended the Summer 2005 Technical Advisory Conference (TAC) at the CBE.
8/8/05	Garth Ehrlich, Executive Director, Center for Genomic Sciences, Allegheny General Hospital (Pittsburgh, PA)		X	Garth met with CBE research project collaborators.
8/8-8/12/05	Microsensors: Manufacture and Applications workshop had 7 participants, representing 6 different organizations (3 foreign organizations)	X	X	This workshop was sponsored by the CBE Structure-Function Research Group (Zbigniew Lewandowski's Group).
8/11-8/12/05	Ruth Cutright and John Squeri, W.L. Gore and Associates, Inc. (Flagstaff, AZ)		X	Ruth and John met with CBE research personnel to discuss biofilm prevention in commercial refrigeration and meat packing—where Gore surfaces include sealants and tapes.
8/12/05	Minna Keinänen, Professor, Environmental Sciences, University of Kuopio (Finland)	X		Minna has been working with the US EPA on drinking water issues. She visited with Anne Camper's research group and gave a seminar to the CBE.
9/26-9/29/05	Mansour Bassiri, Senior Director of Cell Biology and Microbiology, NovaCal Pharmaceuticals (Emeryville, CA)		X	Mansour met with Garth James and the MBL research group to discuss collaborations.
9/27/06	Scott Wallace, PE, Senior Vice President, North American Wetland Engineering (White Bear Lake, MN)		X	Scott visited with CBE research personnel and presented a seminar "Influence of Microbial Communities in Constructed Wetlands."
10/14/05	Jean-Francois Cazaubon, Air Liquide (Cedex, France), James Yuan and Ali Kilic, American Air Liquide (Countryside, IL)	X	X	Air Liquide representatives met with Paul Sturman and CBE research personnel to discuss possible collaborations and the Industrial Associate Program.

TECHNOLOGY TRANSFER : INDUSTRY AND GOVERNMENT VISITS TO CBE

Date(s)	Name of Participant, Institution (Location)	Foreign Institution		Description
		Yes	No	
11/16-11/17/05	David Gascoyne, Chemist, GE Global Research Center Integrated Polymer Systems Lab (Niskayuna, NY)		X	David visited with several CBE researchers to discuss working in the area of biofilms, possible collaboration and the Industrial Associate Program.
11/16/05	Tim Hidell, Quip Labs (Wilmington, DE)		X	Tim was hosted by Garth James and the MBL research group in relation to their Vapotherm project.
11/16/05	Barry Speronello, Engelhard Corporation (Iselin, NJ)		X	Barry was hosted by Garth James and the MBL research group in relation to their Vapotherm project.
11/18/05	H. Toby Markowitz, Distinguished Scientist, Medtronics, Inc. (Minneapolis, MN)		X	Toby visited with Garth James and Phil Stewart to discuss implantable medical devices and biofilms.
12/6/05	Marcia Ryder, Associate for Vascular Access (San Mateo, CA)		X	Marcia met with Garth James and his MBL research group to discuss collaboration.
12/6/05	Rich Sullivan, Dick Wimmeyer, Frank LaRonde from Interface Biologies Inc. (Toronto, Ontario, Canada)		X	Rich, Dick and Frank met with Garth James and his research group to discuss possible collaboration.
12/8/05	Robin Patel, Director, Infectious Disease Research Laboratory, Mayo Foundation for Medical Education and Research (Rochester, MN)		X	Robin visited with Center research personnel and gave a seminar "Novel Approaches to Prosthetic Joint Infection Diagnosis."
1/4/06	Helen Joyce and Frank Cote, MSE Technology Applications (Butte, MT)		X	Helen and Frank met with Randy Hiebert and Garth James to discuss possible collaboration.
1/17-1/18/06	Naama Dror and Tsvia Erlich, NanoVibronix (Nesher, Israel)	X		Naama and Tsvia, microbiologists, came from Nano Vibronix, a private corporation focused on research and development of solutions to prevent catheter acquired infection, other hospital infections and non-catheter biofilm based infections. Garth James and Elinor Pulcini hosted research personnel from Nano Vibronix at the CBE and gave them a 2-day workshop.

TECHNOLOGY TRANSFER : INDUSTRY AND GOVERNMENT VISITS TO CBE

Date(s)	Name of Participant, Institution (Location)	Foreign Institution		Description
		Yes	No	
1/24/06	Matthew Mynnti, Medtronics, Inc. (Jacksonville, FL)		X	Matthew visited with Garth James and the MBL research group to discuss collaborative projects.
3/2/06	Marcia Ryder, Consultant, Healthcare Acquired Infections (San Mateo, CA)		X	Marcia met with Garth James and the MBL research group to discuss collaboration.
3/22-3/23/06	Paul Meers, Director, Biological Research and Development, Transave, Inc. (Monmouth Junction, NJ)		X	Paul met with Garth James and the MBL research group to discuss possible collaboration.
4/11-4/12/06	Jennifer Raeder-Devens, Medtronic Neurological Division (Columbia Heights, MN)		X	Jennifer Raeder-Devens met with Garth James and the MBL group to discuss projects.
4/12/06	Matthew Mynnti, Medtronic Xomed (Jacksonville, FL)		X	Matthew visited with Garth James and the MBL research group to discuss collaborative projects.
5/5/06	Garth Ehrlich, Executive Director, Center for Genomic Sciences, Allegheny-Singer Research Institute (Pittsburgh, PA)		X	Garth met with several CBE researchers to discuss ongoing projects and new collaborations.
5/8/06	Leticia Vega, NASA, Johnson Space Center (Houston, TX)		X	Leticia came to the CBE for a mini-workshop with Paul Sturman and Diane Walker.
5/19/06	Marcia Ryder, Consultant, Healthcare Acquired Infections (San Mateo, CA)		X	Marcia met with Garth James and the MBL research group to discuss collaborative projects.
5/24/06	Matthew Mynnti, Medtronic Xomed (Jacksonville, FL)		X	Matt met with Garth James and the MBL research group to discuss collaborative projects.

TECHNOLOGY TRANSFER : WORKSHOPS

Workshops (June 1, 2005–May 31, 2006)

Date(s)	Name of Participant Corporation (Location)	Description
7/5/05	Biofilm Methods Workshop – CBE (Bozeman, MT)	Both basic and advanced biofilm techniques were covered, taught by instructors actively engaged in biofilm research. This workshop had 7 participants.
7/21-7/22/05	Biofilm Structure Quantification and Image Analysis Workshop - CBE (Bozeman, MT)	This workshop was sponsored by the CBE Structure-Function Research Group (Zbigniew Lewandowski's group). This workshop had 10 participants representing 9 different organizations (3 foreign organizations).
8/8-8/12/05	Microsensors: Manufacture and Applications Workshop - CBE (Bozeman, MT)	This workshop was sponsored by the CBE Structure-Function Research Group (Zbigniew Lewandowski's group). This workshop had 7 participants representing 7 different organizations (3 foreign organizations).
8/24-8/27/05	Bioelectrochemistry: Microbially Influenced Corrosion and Microbial Fuel Cells Workshop – CBE (Bozeman, MT)	This workshop was sponsored by the CBE Structure-Function Research Group (Zbigniew Lewandowski's group).
10/24-10/26/05	Biofilm Conference, University of Southern California, School of Dentistry (Los Angeles, CA)	Darla Goeres, Ben Klayman and Linda Loetterle presented a workshop "Cultivation of Bacterial Biofilms In Vitro" at the Biofilm Conference. There were approximately 25 participants.
12/8/05	CDC Biofilm Reactor Workshop at Novozymes North America, Inc. (Franklinton, NC)	Linda Loetterle conducted this workshop and gave a presentation "Basic Biofilm Techniques - Biofilm Growth Reactors." There were approximately 20 participants.
1/17-1/18/06	NanoVibronix, Inc. Biofilm Workshop - CBE (Bozeman, MT)	NanoVibronix is a private corporation focused on research and development of solutions to prevent catheter acquired infection, other hospital infections and non-catheter biofilm based infections. Garth James, Elinor Pulcini and Betsey Pitts hosted 3 research personnel from NanoVibronix at the CBE and gave a 2-day workshop for them.
2/1/06	Biofilm Methods Workshop – CBE (Bozeman, MT)	Both basic and advanced biofilm techniques were covered, taught by instructors who are actively engaged in biofilm research. This workshop had 16 participants.
2/3/06	Research Imaging Workshop - CBE (Bozeman, MT)	Diane Gray from Molecular Probes™/Invitrogen donated 11 fluorescent stains to use at this innovative TAC workshop. This workshop had 14 participants and was presented by 10 CBE research staff and students.

TECHNOLOGY TRANSFER : WORKSHOPS

Date(s)	Name of Participant Corporation (Location)	Description
12/5 – 12/9/06	Biofilm Methods - Southwest Regional Wound Care Center, Lubbock, TX	Brent Coleman (undergraduate student at Texas Tech., supervisor Joe Fralick) and Dan Rhoads (Clinical Microbiologist, Southwest Regional Wound Care Center) visited the CBE and Garth James' lab to learn biofilm methods.
11/16 – 11/17/05	David Gascoyne, Chemist, GE Global Research Center, at the CBE	Basic Biofilm Methods
12/21/05	Administrative Staff Imaging Workshop CBE	Developed and conducted by Betsey Pitts, this workshop introduced CBE administrative staff to some of the equipment and methods involved in CBE microscopy. Involved hands-on use of the stereo-microscope, epifluorescent scopes, cryosectioning methods.
5/8 – 5/9/06	Leticia Vega, Researcher at NASA	Basic Biofilm Methods
3/22/06	Standard Biofilm Methods Intern Workshop Jackie Whitaker, Nic Beck, Alex Hilyard, Shannon Goeres, Rafaela Pulcini; Jeyong Yoon, Katherine Sossa	Provided a comprehensive microscopy experience to 5 SBM interns and 2 visiting scientists: staining, viewing techniques using their project reactors, colony biofilms and dental unit water lines. Stereomicroscope, epifluorescent scopes and CSLM. Conducted by Betsey Pitts, Kelli Buckingham-Meyer and Diane Walker.

VISITORS : VISITING RESEARCH SCHOLARS

CBE Visiting Research Scholars (June 1, 2005 – May 31, 2006)

Name	Sex	Institution	Country	Dates at CBE	Title	Description
Agostinho, Alessandra	F	University Sao Paulo	Brazil	03/01/05 – 02/28/06	Visiting Student/ PhD Candidate	Alessandra worked with Paul Sturman and Anne Camper researching dental unit water line antimicrobials. She is currently working with the Medical Biofilms Lab on collaborative research as a Post Doctoral Research Assistant.
Behnke, Sabrina	F	University of Duisburg-Essen	Germany	10/15/05-01/15/06	Visiting Student/ MS Candidate, Microbiology	Sabrina worked with Sue King researching microbial populations in hot springs, sediments, and microbial mats. Sabrina is currently pursuing her MS degree in Microbiology at Montana State University while working as a graduate research assistant for Anne Camper.
Caner, Vildan	F	University of Pamukkale	Turkey	06/01/05-05/05/06	Visiting Faculty/ Assistant Professor, Dept. of Medical Biology, School of Medicine	Vildan worked with Zbigniew Lewandowski studying the structure and activity of biofilms using microsenors, molecular probes, and image analysis systems. Her project was "The Determination of Extended Survival and Persistence of <i>Campylobacter jejuni</i> in Bacterial Biofilms Isolated from Different Sources."
Corbin, Audrey	F	National Institute of Applied Sciences (INSA)	France	01/01/06-06/30/06	Visiting Student/ MS Candidate, Microbiology	Audrey worked with Phil Stewart's Biofilm Control Lab studying aspects of <i>E. coli</i> gene expression in biofilms.
Cotter, John	M	University College Dublin	Ireland	03/01/06-04/06/06	Visiting Student/ PhD Candidate, School of Chemical and Bioprocess Engineering	John worked with Phil Stewart studying <i>Staphylococcal</i> biofilms as a result of collaboration with Dr. Eoin Casey.
Eschenhagen, Martin	M	TU Dresden, Institute of Microbiology	Germany	03/01/06-04/01/06	Visiting Scientist/ Post Doctoral Researcher	Martin worked with Anne Camper as a result of collaboration with Dr. Uhl.

VISITORS : VISITING RESEARCH SCHOLARS

Name	Sex	Institution	Country	Dates at CBE	Title	Description
Groth, Christopher	M	Manhattan College, NY	United States	06/01/05-08/15/05	Visiting Student/ Undergraduate	Christopher worked with Al Cunningham and Robin Gerlach on the Zero Emissions Research and Technology (ZERT) project "Biofilm Barriers for CO ₂ Sequestration." Christopher is a student of Rob Sharp, a CBE PhD alumnus in Civil and Environmental Engineering.
Hozalski, Ray	M	University of Minnesota	United States	11/08/04-07/15/05	Visiting Faculty, Environmental Engineering	Ray was on sabbatical from the University of Minnesota and worked with Anne Camper's group. His research involved biofilms in water distribution systems and rheological properties of biofilms.
Jennings, Laura	F	Cornell University, Ithaca, NY	United States	09/01/05-08/31/08	Visiting Student/ PhD Candidate, Civil Engineering	Laura is working with Al Cunningham and Robin Gerlach on the project "Investigations of <i>Polaromonas sp.</i> strain JS666 as a Potential Bioaugmentation Agent at cDCE-Contaminated Sites" to investigate the culturing conditions that facilitate growth on cDCE. Laura is a previous CBE undergraduate research assistant and is fully funded by Cornell and will complete her PhD at Cornell under the direction of Jim Gossett.
Kim, Jae-eun	F	Seoul National University	Korea	01/01/05-02/28/06	Visiting Student/ PhD Candidate, School of Chemical & Biological Engineering	Jae-eun was working with her advisor, Jeyong Yoon, in conjunction with Anne Camper to study biofilms in distribution systems with various disinfectants and would like to learn new methods and concepts from biofilm fields.
Korenblum, Elisa	F	Federal University of Rio de Janeiro	Brazil	04/01/06-09/15/06	Visiting Student/ PhD Candidate, Microbiology	Elisa is working with Brent Peyton in his Environmental Biotechnology research group investigating antimicrobial substances and their actions against biofilms in order to understand spatial organization of biofilms and the surfaces supporting their development.

VISITORS : VISITING RESEARCH SCHOLARS

Name	Sex	Institution	Country	Dates at CBE	Title	Description
Levinson, Jessica	F	Manhattan College, NY	United States	06/01/05-08/15/05	Visiting Student/ MS Candidate	Jessica worked with Al Cunningham and Robin Gerlach on the Zero Emissions Research and Technology (ZERT) project "Biofilm Barriers for CO ₂ Sequestration." Christopher is a student of Rob Sharp, a previous CBE graduate student who earned a PhD in Civil and Environmental Engineering.
Morris, Cindy	F	Recherche Agronomique (INRA)	France	04/03/06-05/31/06	Visiting Faculty, Plant Science & Plant Pathology	Cindy worked with Anne Camper, Dave Sands and Katherine Sossa-Fernández on aerial dissemination of bacterial biofilms from plant surfaces.
Richard, Jessica	F	University of Duisburg-Essen	Germany	04/05/05-07/31/05	Visiting Student, Undergraduate in Microbiology	Jessica worked with Anne Camper on "Biofilms in Drinking Water" as directed by Dr. Hans-Curt Flemming at the University of Duisburg-Essen.
Sharma, Deepak	M	University of Ottawa	Canada	01/27/05-11/30/05	Visiting Scientist, Chemical Engineering	Deepak worked with Zbigniew Lewandowski on using the CSLM in order to understand the structure of biofilm formation in rock apparatus.
Sossa-Fernández, Katherine	F	Universidad de Concepción	Chile	06/01/05-11/15/06	Visiting Scientist/ Post Doctoral Researcher, Microbiology	Katherine is working with Anne Camper on the project "Phytopathogen Microbial Biofilm Control by Secondary Metabolites Produced by Chilean Native Plants." This project is part of an on going collaboration with Dr. Homero Urrutia Briones.
Takenaka, Shoji	M	Niigata University	Japan	10/01/05-09/30/06	Visiting Faculty/ Operative Dentistry & Endodontics	Shoji is working with Phil Stewart's Biofilm Control Lab where he is using a consortium of oral bacteria to study diffusion and antimicrobial efficacy.
Yeon, Kyung-Min	M	Seoul National University	Korea	03/01/05-10/01/05	Visiting Scientist, Chemical Engineering	Kyung-Min worked with Zbigniew Lewandowski's research group.
Yoon, Jeyong	M	Seoul National University	Korea	08/01/05-07/15/06	Visiting Faculty/ Chemical & Biological Engineering	Jeyong is working with Anne Camper studying biofilms in distribution systems with various disinfectants and would like to learn new methods and concepts from biofilm fields.

VISITORS : SHORT-TERM ACADEMIC VISITORS

Short-term Academic Visitors to the CBE
(June 1, 2005–May 31, 2006)

Date (s)	Name of Participant, Institution (Location)	Foreign Institution		Description
		Yes	No	
7/13/05	Chung-Hak Lee, Director and Professor, Institute of Environmental Protection and Safety, School of Chemical and Biological Engineering, Seoul National University (Seoul, Korea)	X		Chung-Hak visited with CBE researchers and gave a seminar titled "Let's Open the Microbiological Black Box in MBR for Water Environment."
7/21-7/22/05	Virginia (Ginny) Anderson, Professor, Dept. of Biological Sciences, Towson University (Towson, MD)		X	Ginny contributed her expertise to the evaluation assessment of the NSF/CCLI project "Biofilms: The Hypertextbook." She discussed assessment, evaluations and grading with the Hypertextbook Team.
7/21-8/12/05	Marshall Sheldon, Lecturer, Cape Peninsula University of Technology, Dept. of Chemical Engineering (Cape Town, South Africa)	X		Marshall came to the CBE to attend the Biofilm Image Analysis workshop with Z. Lewandowski's group. She stayed at the CBE after the workshop to learn more about biofilms.
8/11/05	Eoin Casey, Professor, Department of Chemical and Biochemical Engineering, University College (Dublin, Ireland)	X		Eoin met with CBE researchers and gave a presentation concerning reactor technologies in wastewater treatment. Specifically, he discussed recent developments with the membrane-aerated biofilm design.
9/9/05	Anozie Ebigbo and Andreas Bielski, Institute of Hydraulic Engineering, University of Stuttgart (Germany)	X		Anozie and Andreas visited with CBE researchers as part of the ZERT seminar series. Andreas gave a seminar titled "Numerical Simulation of CO ₂ Sequestration in Geological Formations."
11/29/05	Aaron Maxim John Law, Post-Doc Research Associate, University of North Carolina at Chapel Hill (Chapel Hill, NC)		X	Aaron met with several CBE researchers to discuss research at the Center.
3/23/06	Michael A. Celia, Professor, Department of Civil and Environmental Engineering, Princeton University (Princeton, NJ)		X	Michael visited the CBE and was a ZERT seminar speaker. He gave a seminar "Geological Storage of CO ₂ : Analysis and Modeling of Leakage Potential."

VISITORS : SHORT-TERM ACADEMIC VISITORS

Date (s)	Name of Participant, Institution (Location)	Foreign Institution		Description
		Yes	No	
4/13-4/14/06	Homero Urrutia, Professor, Biofilm and Environmental Microbiology Lab, University of Concepcion (Concepcion, Chile)	X		Homero visited with CBE researchers to discuss on ongoing collaborative project.
4/17-4/18/06	Matthew Fields, Assistant Professor, Department of Microbiology, Miami University (Oxford, OH)		X	Matthew was brought to the CBE as a candidate for the biofilm microbiologist faculty position. He presented a seminar "Characterization of Bacterial Biofilms in the Sulfate-Reducer, <i>Desulfovibrio vulgaris</i> , and the Metal-Reducer, <i>Shewanella oneidensis</i> ."
4/19/06	Luke Hanley, Chemistry Professor, University of Illinois (Chicago, IL)		X	Luke is collaborating with Ross Carlson on a grant, and is using mass spectrometry and synchrotron x-ray to analyze biofilms. He also presented a seminar "Vacuum Ultraviolet Positionization for Mass Spectrometry of Biomaterials & Bacterial Biofilms."
4/24-4/25/06	Karin Sauer, Assistant Professor, Department of Biological Sciences, Binghamton University (Binghamton, NY)		X	Karin was brought to the CBE to visit as a candidate for the biofilm microbiologist faculty position. She presented a seminar "Regulatory Aspects of the Biofilm Developmental Life Cycle."
5/1-5/2/06	Paul Stoodley, Associate Professor of Microbiology and Immunology, Allegheny-Singer Research Institute (Pittsburgh, PA)		X	Paul was brought to the CBE to visit as a candidate for the biofilm microbiologist faculty position. He presented a seminar "Bacterial Biofilms in Laboratory, Natural Environments and Medical/Dental Specimens."
5/23-5/25/06	Rainer Helmig, University of Stuttgart (Germany)		X	Rainer met with Al Cunningham to discuss ongoing collaborations.

OUTREACH : PRESENTATIONS

PRESENTATIONS:

May 22–December 31, 2005

Anne Camper presented “Bacterial Pathogens in Drinking Water,” U.S. Army Research Office, Cashiers, NC, May 22–25, 2005.

Robin Gerlach presented “Biofilm-Based Technologies for Mixed-Waste Remediation – Influence of Biofilms, Minerals, and Organic Matter on the Fate of TNT, TCE, and Cr(VI),” U.S. Army Research Office, Cashiers, NC, May 22–25, 2005.

Phil Stewart, as an invited speaker, presented “Biofilm Infections and Antibiotic Tolerance,” American Society for Artificial Organs (ASAO) 51st Annual Conference in Washington, DC, June 9, 2005.

Robin Gerlach presented “Fermenters and Reductive Contaminant Transformation Processes in the Subsurface,” The Joint International Symposia for Subsurface Microbiology (ISSM 2005) and Environmental Biogeochemistry (ISEB XVII). Jackson Hole, WY. August 14–19, 2005. Co-authors: T. Borch, N.R. Ballor, A.B. Cunningham, B.M. Peyton, W.A. Apel.

Robin Gerlach presented “Bacterial Transport and Biofilm Formation in Porous Media,” The Joint International Symposia for Subsurface Microbiology (ISSM 2005) and Environmental Biogeochemistry (ISEB XVII). Jackson Hole, WY. August 14–19, 2005. Co-authors: J.P. Gage, M. Adgie, J.D. Seymour, S.L. Codd, R.S. Sharp, A.B. Cunningham.

Brent Peyton presented “Uranium Immobilization by *Cellulomonas sp.*,” The Joint International Symposia for Subsurface Microbiology (ISSM 2005) and Environmental Biogeochemistry (ISEB XVII). Jackson Hole, WY. August 14–19, 2005. Co-authors: V. Sivaswamy, S. Viamajala, R. Gerlach, W.A. Apel, R. Sani, A. Dohnalkova.

Justin P. Gage presented a poster titled “MR Measurement of the Impact of Column Walls on the Dispersion Time Dependence of Flow in a Cylindrical Bead Pack,” 8th International Conference on Magnetic Resonance Microscopy, Utsunomiya, Japan, August 22–26, 2005. Co-authors: J.D. Seymour, R.S. Maier, S.L. Codd, H.T. Davis.

Sarah L. Codd presented a poster titled “Magnetic Resonance Microscopy Analysis of Advective Transport in a Biofilm Reactor,” 8th International Conference on Magnetic Resonance Microscopy, Utsunomiya, Japan, August 22–26, 2005.

Joseph D. Seymour presented “Magnetic Resonance Microscopy of Scale Dependent Transport Phenomena: Bioactivity in Porous Media,” 8th International Conference on Magnetic Resonance Microscopy, Utsunomiya, Japan, August 22–26, 2005.

Philip Stewart presented “Dormancy and Antibiotic Tolerance in *P. aeruginosa* Biofilms,” UWEB 2005 Summer Symposium, Bugs and Biomaterials: Bacteria and the Biointerface, co-sponsored by CBE, University of Washington Campus, Seattle, Washington, USA, August 24–26, 2005.

Garth James presented “Bacterial Colonization of Central Venous Catheters,” UWEB 2005 Summer Symposium, Bugs and Biomaterials: Bacteria and the Biointerface, co-sponsored by CBE, University of Washington Campus, Seattle, Washington, USA, August 24–26, 2005.

Patrick Norris presented “Ultrasonically Controlled Release of Ciprofloxacin from Self-Assembled Coatings on pHEMA Hydrogels for *Pseudomonas aeruginosa* Biofilm Prevention,” UWEB 2005 Summer Symposium, Bugs and Biomaterials: Bacteria and the Biointerface, co-sponsored by CBE, University of Washington Campus, Seattle, Washington, USA, August 24–26, 2005.

Ross Carlson presented “Anti-Biofilm Surface Coatings,” UWEB 2005 Summer Symposium, Bugs and Biomaterials: Bacteria and the Biointerface, co-sponsored by CBE, University of Washington, Seattle, Washington, USA, August 24–26, 2005.

Darla Goeres presented “Anti-Bacterial Efficacy Against Surface Bacteria Depends on the Method Used to Establish Bacteria on the Surface” and **Marty Hamilton** presented “Surrogate Spore Study: Statistical Results” to the Antimicrobials Division (AD), US-EPA, Arlington, VA, September 14, 2005. Darla and Marty met with AD science teams and with the AD contract officer to discuss progress, planning, and reporting for CBE projects funded by the AD, US-EPA.

OUTREACH : PRESENTATIONS

Marty Hamilton also presented “Surrogate Spore Study: Statistical Results” to the EPA Office of Pesticide Programs Microbiology Lab, in Ft. Meade, MD, September 15, 2005, at a joint meeting of EPA scientists and their collaborators from the US Army's Edgewood Chemical Biological Center where the surrogate spore laboratory experiments were conducted.

Phil Stewart, as an invited speaker, presented “Controlling Microbial Biofilms,” in the Seminar Series at Center for Genomic Sciences, Allegheny General Hospital, Pittsburgh, PA, September 19, 2005.

Robin Gerlach presented “Bacterial Transport and Biofilm Formation in Porous Media,” Platform Presentation, INRA Environmental and Subsurface Science Symposium, Big Sky, MT, September 19–21, 2005. Co-authors: J.P. Gage, M. Adgie, J.D. Seymour, S.L. Codd, R.S. Sharp, A.B. Cunningham.

Erin Field presented a poster, “Influence of Carbon Source, Iron Minerals, and Electron Shuttling Compounds on the Bacterial Reduction of Chromate,” INRA Environmental and Subsurface Science Symposium, Big Sky, MT, September 19–21, 2005. Co-authors: L.K. Jennings, A.B. Cunningham, B.M. Peyton, R. Gerlach and W.A. Apel.

Abbie Richards presented a poster, “Characterization of a Siderophore Produced by the Halo-Alkaliphile *Halomonas campisalis*,” INRA Environmental and Subsurface Science Symposium, Big Sky, MT, September 19–21, 2005. Co-authors: B.M. Peyton (MSU), W.A. Apel (INL), A.K. Camper (MSU) and J.N. Petersen (WSU).

Brent Peyton presented “Multiple Mechanisms of Uranium Immobilization by *Cellulomonas*,” INRA Environmental and Subsurface Science Symposium, Big Sky, MT, September 19–21, 2005. Co-authors: V. Sivaswamy, S. Viamajala, R. Gerlach, W. Apel, R. Sani, and A. Dohnalkova.

Phil Stewart, as an invited speaker, presented “Diffusion, Dormancy, and Detachment in Biofilms,” to DuPont in Wilmington, DE, September 27, 2005.

Paul Sturman presented “In Vitro Reactor Systems for the Validation of Anti-Biofilm Claims in Medical Devices,” to the FDA, Washington, DC, September 29, 2005.

Michael Franklin, the newly named Ferguson Professor of Microbiology at Montana State University, gave his inaugural lecture, “Teaching and Research on DNA to Biofilms,” Montana State University, Bozeman, MT, October 28, 2005.

Darla Goeres and **Garth James** were invited to a special retreat at Santa Catalina Island following the Biofilm Conference, USC School of Dentistry, Los Angeles, CA, October 27–28, 2005. They were invited to the retreat as potential contributors to a book on Biofilm Methods for a Springer Publications series of books on biofilms. Bill Costerton and Paul Stoodley have been commissioned to design and edit the book.

Phil Stewart presented “Heterogeneity of Biofilm Populations as Seen In Situ and By Cell Sorting,” Biofilm Conference, USC School of Dentistry, Los Angeles, CA, October 24–26, 2005.

Linda Loetterle presented two posters: “Biofilm Growth Reactors” and “Analysis of Laboratory Biofilm from Three Growth Reactors: Effects of Shear,” Biofilm Conference, USC School of Dentistry, Los Angeles, CA, October 24–26, 2005.

Darla Goeres, Linda Loetterle and **Benjamin Klayman** presented a workshop “Cultivation of Bacterial Biofilms In Vitro,” Biofilm Conference, USC School of Dentistry, Los Angeles, CA, October 24–26, 2005.

Darla Goeres presented “Standardized Biofilm Methods Development” at Ecolab in St. Paul, MN on October 19, 2005.

Darla Goeres attended the ASTM E35.15 subcommittee meeting in Dallas, TX on October 17–18, 2005. The subcommittee will vote on the biofilm method titled “Standard Test Method for the Quantification of a *Pseudomonas aeruginosa* Biofilm Grown with High Shear and Continuous Flow Using a CDC Biofilm Reactor” on the December ballot.

Zbigniew Lewandowski presented “Utility of Microbial Fuel Cells,” Meeting of the American Chemical Society. Washington DC, August 28–September 1, 2005.

OUTREACH : PRESENTATIONS

Phil Stewart was invited to speak at Pacificchem 2005, Honolulu, HI December 15–20, 2005. This conference is co-sponsored by the American Chemical Society, the Chemical Society of Japan, the Canadian Society for Chemistry, the Korean Chemical Society, the New Zealand Institute of Chemistry, and the Royal Australian Chemical Institute. Phil presented “Alternative Strategies for Biofilm Control.”

Anne Camper presented “Pathogen Integration into Biofilms,” American Water Works Association Water Quality Technology Conference, Quebec City, Quebec Canada, November 6–8, 2005.

Anne Camper presented “Public Health and Small Water Systems: Report of an International Colloquium,” American Water Works Association Water Quality Technology Conference, Quebec City, Quebec Canada, November 6–8, 2005.

Anne Camper gave a workshop presentation “Monitoring Methods for Bacteria in Chloraminated Water,” American Water Works Association Water Quality Technology Conference, Quebec City, Quebec Canada, November 6–8, 2005.

Joseph Menicucci presented “Sustainable Power Measurement for a Microbial Fuel Cell,” AIChE Annual Meeting, Cincinnati, OH, October 30 – November 4, 2005.

PRESENTATIONS: January 1 – May 31, 2006

Phil Stewart, as an invited speaker, presented “Biofilms: What they are, where they occur, some examples of industries and applications where they cause problems, possible control strategies,” at Novozymes North America, Inc., Franklinton, NC, December 8, 2005.

Linda Loetterle conducted a CDC Biofilm Reactor workshop and gave a presentation titled “Basic Biofilm Techniques—Biofilm Growth Reactors” at Novozymes, Franklinton, NC, December 8, 2005.

Anne Camper, as an invited speaker, presented “Biofilms in Drinking Water Systems: Engineering Applications,” University of Michigan seminar series, Environmental and Water Resources Engineering Department, Ann Arbor, MI, January 12, 2006.

Anne Camper, as an invited speaker, presented “Health Implications of Biofilms in Drinking Water Systems,” University of Michigan, Environmental Health Sciences Department, Ann Arbor, MI, January 13, 2006.

Anne Camper, as an invited speaker, presented “Chloramines, Chlorine, Distribution System Materials and Regrowth,” Inorganic Contaminants Annual Workshop, American Water Works Association, Austin, TX, January 31, 2006.

Jason Chambless presented “A 3D Computer Model Analysis of Four Hypothetical Biofilm Detachment Mechanisms,” Biofilms II Attachment and Detachment Conference, Leipzig, Germany, March 23–24, 2006.

Phil Stewart, as an invited speaker, presented “Biofilm and Hemodialysis,” Hemodialysis: The Environmental Challenges, San Francisco, CA, February 25–26, 2006. This conference was jointly sponsored by the International Society for Hemodialysis, Northwest Kidney Centers (Seattle, WA), Kidney Dialysis Foundation (Singapore), and Medical Education Institute, Inc. (Madison, WI).

Al Cunningham presented “Microbially Enhanced Geologic Sequestration of Supercritical CO₂,” University of Stuttgart, Germany, February 17–24, 2006.

Haluk Beyenal presented “Biofilm Structure Quantification” at the Seminar in Environmental Toxicology, UC Santa Cruz, March 14, 2006.

Christine Foreman, as an invited speaker, presented “Biogeochemistry of Dissolved Organic Matter in Pony Lake, Antarctica,” at the International Conference on Alpine and Polar Microbiology, Innsbruck, Austria, March 27–30, 2006.

Christine Foreman, as an invited speaker, presented “Life in Ice: Terrestrial Analogues in the Search for Life,” at the University of Innsbruck (Innsbruck, Austria), March 28, 2006.

Caol Huff, as an invited speaker, presented “Enhancing Antibiotic Susceptibility of *Pseudomonas aeruginosa* Biofilms by Quorum Sensing Inhibition,” at the Montana Section of the American Chemical Society Meeting-in-Miniature at Carroll College in Helena, MT, April 1, 2006.

OUTREACH : PRESENTATIONS

David Stepler presented a poster on Capitol Hill: “Motility of Source Zone Heavy Metals and Radionuclides: The Mixed Roles of Fermentative Activity on Fate and Transport of U and Cr,” at the 2006 Environmental Remediation Science Division Annual Principal Investigator Meeting, Airlie Conference Center, Virginia, April 3–5, 2006.

Zbigniew Lewandowski, as an invited speaker, presented “Structure and Activity of Bacterial Biofilms,” at the Northeast Algal Symposium, School of Science, Marist College, Poughkeepsie, NY, April 22, 2006.

Phil Stewart, as an invited speaker, presented “Biofilms and Their Control,” at Medtronic, Inc., Fridley, MN, April 24–25, 2006.

Al Cunningham presented “Microbially Enhanced Geologic Sequestration of CO₂,” at the Conference on Carbon Sequestration, Washington, DC, May 8–10, 2006.

OUTREACH : COMMUNITY OUTREACH

Community Outreach
(June 1, 2005–May 31, 2006)

Date(s)	Organization/Event	Description
10/26/05	Leadership Bozeman, a program of the Bozeman Area Chamber of Commerce, Bozeman, MT	Leadership Bozeman (local business owners and entrepreneurs) came to the MSU campus to learn more about the university's research programs, the nature of the student body and the economic impacts on Bozeman. Approximately 35 community leaders were toured by Phil Stewart, John Neuman and Tricia Cook through the CBE's laboratories who described the CBE's research impact.
10/28/05	Inaugural Lecture of the Ferguson Professor of Microbiology, Montana State University, Bozeman, MT	Michael Franklin, the newly named Ferguson Professor of Microbiology at Montana State University, gave his inaugural lecture "Teaching and Research on DNA to Biofilms."
4/1/06	Montana Section of the American Chemical Society Meeting-in-Miniature, Carroll College, Helena, MT	Caol Huff presented "Enhancing Antibiotic Susceptibility of <i>Pseudomonas aeruginosa</i> Biofilms by Quorum Sensing Inhibition."
4/15/06	"Expanding Your Horizons in Science and Mathematics," Montana State University, Bozeman, MT	CBE educators conducted a workshop "Hot Tubs: Much More than a Relaxing Soak" at this hand-on career exploration for young girls in grades 6, 7, and 8, encouraging them to participate in science and mathematics during their school education. The one-day event attracted about 150 students and was an exciting interaction between professional women and young girls just beginning to think about their futures in the work place.