

Biomanufacturing for Middle School Teachers



NCSU Biomanufacturing Training and Education Center

“Biotechnology and Biomanufacturing with Middle Grades in Mind” is a four-day workshop designed for participants that teach middle grades Exploring Biotechnology or middle grades Science. Participants in this workshop will learn budget-friendly laboratory exercises to teach Biotechnology skills and effective ways to teach basic concepts. Teachers will be given detailed lesson plans that were developed by two Kenan Fellows, in conjunction with the North Carolina State University Biomanufacturing Training and Education Center and Biogen Idec. The lessons will include an interactive method to teach students the impact of biotechnology on the North Carolina economy. In addition, a series of experiments that mimic the day to day operations found in the Biomanufacturing industry will be shared.

Workshop Dates: July 26-30, 2010

Introductory Biotechnology for Middle School Teachers



Carteret Community College

Participants will come away from this workshop with new tools for teaching science in middle schools. Teachers will learn basic techniques in biotechnology, with an emphasis on microbiology. They will learn easy, inexpensive, fool-proof methods to integrate biotechnology into the middle school Biology curriculum.

Participants will be exposed to an array of topics related to the NC Standard Course of Study for middle grades 6-8, including the following:

- DNA structure and replication
- Introduction to gene expression and regulation
- Introduction to sterile technique and estimating culture density
- Transformation of *Escherichia coli*
- Restriction enzymes and their role in recombinant DNA technology
- Restriction analysis of DNA
- Mechanisms of antibiotic resistance
- Commercial applications and career opportunities in biotechnology

Biotechnology Basics



North Carolina School of Science and Mathematics

“Biotechnology Basics” workshops are three-day versions of our standard five-day Introductory Biotechnology workshops for high school teachers. The agenda is somewhat different, but generally based on the standard “Introductory Biotechnology” workshop content.

Lead Instructor: Dr. Noreen Naiman

Workshop Description:

Participants will learn basic scientific concepts and techniques in biotechnology, as well as how to teach these effectively. They will also learn how to integrate biotechnology into the high school Biology curriculum according to the NC Standard Course of Study.

Participants will be exposed to an array of topics related to both fundamental science and application of DNA-related aspects of biotechnology, including the following:

- DNA structure and replication
- Introduction to gene expression and regulation
- Protein structure and its relation to function
- Restriction enzymes and their role in recombinant DNA technology
- Mechanisms of antibiotic resistance
- Transformation of *Escherichia coli*
- Restriction analysis of DNA
- Molecular biology of gene cloning
- Commercial applications and career opportunities in biotechnology
- Gene cloning vs. organismal cloning
- PCR theory and practice

Additionally, teachers will have hands-on training in the following practical applications:

- Growing, storing, and disposing of *Escherichia coli* in the lab
- Laboratory biosafety issues
- Sterile technique
- Preparing, handling, staining, and analyzing agarose gels
- Classroom preparation for wet labs
- Using a thermal cycler

The Introductory workshop is based on the text *Molecular Biology and Biotechnology*, Third Edition, Helen Kreuzer and Adrienne Massey (2008), provided to participants.

Biotech Bag of Tricks for Middle School Teachers - NCSU-BTEC

“Biotech Bag of Tricks for Middle School Teachers” is a four day workshop designed for participants that teach middle grades Exploring Biotechnology or middle grades Science. Participants in this workshop will learn budget-friendly laboratory exercises to teach Biotechnology skills and effective ways to teach basic concepts.



Teachers will be given detailed lesson plans that were developed by two Kenan Fellows, in conjunction with the North Carolina State University Biomanufacturing Training and Education Center and Biogen Idec. The lessons will include an interactive method to teach students the impact of biotechnology on the North Carolina economy. In addition, a series of experiments that mimic the day to day operations found in the Biomanufacturing industry will be shared. BTEC staff will also play a vital role in the workshop schedule, by leading tours of the facility, giving lectures on topics such as aseptic technique and conducting demonstrations and activities in the lab.

Introductory Biotechnology for High School Teachers - UNC-Wilmington

Participants will learn basic scientific concepts and techniques in biotechnology, as well as how to teach these effectively. They will also learn how to integrate biotechnology into the high school curriculum according to the NC Standard Course of Study.

Participants will be exposed to an array of topics related to both fundamental science and application of DNA-related aspects of biotechnology, including the following topics:

- DNA structure and replication
- Introduction to gene expression and regulation
 - Protein structure and its relation to function
 - Restriction enzymes and their role in recombinant DNA technology
 - Mechanisms of antibiotic resistance
 - Transformation of *Escherichia coli*
 - Restriction analysis of DNA
 - Molecular biology of gene cloning
 - Current commercial applications of biotechnology
 - Organismal cloning
 - PCR theory and practice



Additionally, teachers will have hands-on training in the following practical applications:

- Growing, storing, and disposing of *Escherichia coli* in the lab
- Laboratory biosafety issues
- Making and sterilizing solutions and media needed for classroom experiments
- Sterile technique
- Preparing, handling, and staining agarose gels
- Classroom preparation for wet labs
- Using a thermal cycler

The Introductory workshop is based on the text *Molecular Biology and Biotechnology*, Third Edition, Helen Kreuzer and Adrienne Massey (2008), provided to participants.

Microbial Magic for Middle School Teachers – UNC-Charlotte



Participants will learn basic scientific concepts and techniques in biotechnology, as well as how to teach these effectively, integrating them with genetics and microbiology topics relevant to the middle school classroom and the North Carolina Standard Course of Study. The activities in this workshop are designed to have minimal preparation for the teacher, to be inexpensive, and to grab the attention of your students!

Participants will be exposed to an array of topics related to both fundamental science and application of DNA-related aspects of biotechnology, including the following topics:

- DNA structure and replication
- Introduction to gene expression and regulation
- Protein structure and its relation to function
- Mutations
- Mechanisms of resistance to antibiotics and antibacterial agents
- Food microbiology
- Genetically modified organisms

Additionally, teachers will have hands-on training in the following practical applications:

- Growing, storing, and disposing of bacterial cultures in the lab
- Laboratory biosafety issues
- Making media needed for classroom experiments
- Sterile technique
- Classroom preparation for wet labs

Examples of some of the activities planned for this workshop include:

- Classroom epidemics

Workshop Dates: July 25-28, 2011

- Testing the effectiveness of antibacterial products
- DNA extractions in 15 minutes or less
- Testing food microbiology myths
- The role of enzymes in cheese production
- The genetics of tooth decay susceptibility

Stem Cells: Their Sources, Therapeutic Uses, and Fates UNC-Asheville

The tremendous potential that stem cells have in medicine, together with the ethical and legal controversies surrounding their use, make stem cells a hot topic right now, and one that teachers will want to be prepared to discuss with their students.

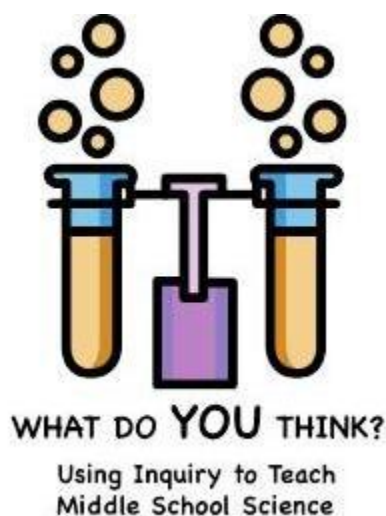
Building on what you learned in the Center's standard Introduction to Biotechnology workshop for high school teachers, you will use some of the basic techniques of biotechnology to study stem cells in the lab. Both wet and dry labs will be connected to practical human health applications.



A major focus of this workshop will be on the relationship of gene expression to stem cells because the pattern of which genes are turned "on" or "off" can determine how a cell becomes differentiated. Gene expression is of great importance in understanding not only stem cells but cancer biology, a particular research interest of Workshop Co-Director Dr. Ted Meigs.

Note: Completion of an NCBC Introductory Workshop for high school teachers or the equivalent is a prerequisite for this workshop.

What Do **YOU** Think? Using Inquiry to Teach Middle School Science - Campbell University



*"What Do **YOU** Think? Using Inquiry to Teach Middle School Science"* is designed to cover the basics of inquiry-based methods to teach middle school science. It will be done with regard to the North Carolina Department of Public Instruction (NCDPI) science goals for 6th-8th grade teachers in a professional development setting. The workshop will have a general focus of helping teachers use inquiry in their daily teaching. The biotechnology focus of the workshop will be using activities that relate to the basic biotechnology concept: using a living organism to produce something that is useful or beneficial for human beings. As our college's expertise lies in pharmaceutical sciences, the activities will have a pharmaceutical sciences slant to them.

The College of Pharmacy & Health Sciences at Campbell University will host this four-day workshop.

Workshop content includes:

- Learning how to convert labs and lesson plans to inquiry
- Time to convert labs and lesson plans that you bring with you
- The four levels of inquiry and the difference in this and active learning
- How to assess inquiry in your classroom

This workshop is most suitable for all teachers who teach science at the middle school level.

Graduate credit is not available for this workshop.

Workshop Dates: July 27-31, 2009

Biotechnology for High School Agricultural Education
NC State University
Lead Instructor: Dr. Beth Wilson



If you are teaching high school agricultural education and want to add more biotechnology to your program, this workshop is for you. Faculty from plant biology, animal science and agricultural education departments at NCSU will teach the current applications of biotechnology in the agriculture industry as well as new technologies currently under development. Instructors will focus on the applications of biotechnology in plant and animal science and will demonstrate related classroom activities. **Teachers who have not successfully completed an NCBC Introductory Biotechnology Workshop are encouraged (but not required) to attend an additional two-day workshop offered by the instructors at NCSU June 30-July 1.**

Workshop director Dr. Beth Wilson will contact each registrant with regard to this two-day supplemental workshop, which will focus on the fundamentals of biotechnology and will help teachers get reacquainted with the science laboratory. If you have preliminary questions about the supplemental workshop, please contact Dr. Wilson at bwilson@ncsu.edu.

The following topics will be covered in lectures, demonstrations and/or hands-on activities:

- Careers in Agricultural Biotechnology
- Teacher suggestions and best practices for equipment needed to teach biotechnology in agricultural education
- Current biotechnology research, regulations and trends in food crops
- Current biotechnology research, regulations and trends in animal production
- Ethical, legal, and social implications of using biotechnology in the agriculture industry
- Sustainability and agricultural biotechnology

Activities will include:

- Growing and caring for *Arabidopsis*
- Plant tissue culture
- Aseptic technique
- Genetic engineering of plants using *agrobacterium*
- Preparing, staining and disposal of agarose gels
- Preparation of semen and oocytes for *in-vitro* fertilization
- Marker assisted selection of animals
- Field trip to Monsanto

Workshop Dates: July 10-14, 2006

Kills Bugs Dead: The Biology and Chemistry of Antibiotics Campbell University

Antibiotics provide an opportunity to mingle biology and chemistry in a practical way that is relevant to everyone. Participants at this 5-day workshop will learn the basics of how antibiotics are discovered, developed, produced and used. An emphasis will be placed on tying these areas to the NC high school curriculum for chemistry and biology. Hands-on paper and wet lab activities will be used to illustrate how antibiotics can be used in the classroom to demonstrate concepts in biology and chemistry.

Workshop content includes:

- Microbial diversity in your backyard
- Testing local soil samples for antibiotic-producing microbes
- Evaluating natural products for antibiotic activity
- Chemical synthesis of an antibiotic in the high school classroom
- Improvement of antibiotics through applied chemistry
- Industrial use of microbes to make antibiotics
- The development of antibiotic resistance



This workshop is most suitable for high school science teachers who have either taken a Center-sponsored Introductory Biotechnology Workshop, or have the equivalent experience in the judgment of the Workshop Coordinator.

Graduate credit is not available for this workshop.

Biotechnology for Plants, Animals and the Environment North Carolina State University

This workshop will focus on the applications of biotechnology in agriculture and in environmental protection, using the popular curriculum *Biotechnology for Plants, Animals and the Environment*, provided to participants. Participants will learn to implement activities that illustrate biotechnology applications in three different areas:

Current Techniques in Animal Husbandry

- Gamete isolation and evaluation
- DNA extraction from oocytes
- Paternity testing

Applications of Plant Science

- Isolation of DNA from fruit
- Genetic alteration of plants through *Agrobacterium*-mediated transformation
- *In vitro* plant micropropagation (tissue culture)

Environmental Protection

- Use of bacteria to break down toxins such as oil released into the environment
- Diagnostic kits that detect the presence of agricultural chemicals in water

The workshop will be taught by university faculty, several of whom helped develop the curriculum, and it will include special guest lectures and a field trip. Significant time will be devoted to discussion of the societal/ethical issues raised by applications of biotechnology, including genetically modified foods.

This workshop is suitable for Agricultural Education, Biology, Earth and Environmental Science, and pre-service teachers (nearing the end of their training). The workshop is also appropriate for *Exploring Biotechnology* middle school teachers, but the curriculum used is most suitable for high school students.



Graduate credit may be awarded by completing extra study and assignments and paying university tuition. Check with the workshop coordinator for more details.

Biotechnology, the Flu and You: Using Bioinformatics to Learn About Disease – Campbell University

Bioinformatics has been described by Fredj Tekaiia at the Institut Pasteur as “the mathematical, statistical and computing methods that aim to solve biological problems using DNA and amino acid sequences and related information.” During this 4-day workshop participants will learn to use the tools of Bioinformatics to characterize biological molecules in the context of understanding disease. No previous knowledge of Bioinformatics is necessary. Hands-on paper and wet lab activities, along with web-based



tools will be used to illustrate Bioinformatics approaches. The workshop will conclude with participants presenting lesson plans to their peers, developed using content presented during the workshop, including:

- DNA Isolation from Strawberries
- Using Web-Based Tools To:
 - Perform DNA Sequence Alignments (BLAST)
 - Understand the Genetic Basis of Specific Diseases (OMIM)
 - Find Genes in a Stretch of DNA Sequence
 - Identify Genes
 - Understand Gene Annotation (GenBank)
- Genetic Variation
 - Its Relevance to Flu Outbreaks
 - Analysis Using Participants' mtDNA sequence as a model
 - Single Nucleotide Polymorphisms (SNPs)
 - Ethical/Privacy Issues Associated with Genetic Information
- Protein Structure and Function
 - Visualize 3-D Protein Structure using Cn3D Viewer
 - Compare Structures of Related Proteins
 - Examine Relationship of Structure/Function in Proteins