RET Research Projects for Summer 2010

Title	**1. Nanomilling of Active Pharmaceutical Ingredients and Crosslinked Polymers in a Wet Stirred Media Mill**
RET Teachers	Kristin L. Furlong, Science Park High School
Faculty Mentor	*Prof. Ecevit Bilgili and Prof. R* *Department of Chemical, Biological, and Pharmaceutical Engineering*
Graduate Mentors	*Mohammad A. Azad*
Project Description	The objective of this project is to study the formation of stable nano suspensions of Active Pharmaceutical Ingredients (APIs) and various crosslinked polymers in the presence of a stabilizing polymer/surfactant system. Wet stirred media milling will be used to produce nanosuspensions, and the stability of the suspensions will be evaluated. Several model APIs and crosslinked polymers will be used. This project is part of a larger ongoing program at NJIT in which bioavailability of BCS Class II compounds are improved by size reduction. Our goal is to rationally design structured nanocomposite particles for the bioavailability enhancement of poorly water-soluble compounds via nanomilling of the compounds followed by various spraying processes or film-formation processes.
Title	**2. Drop-on-demand printing of API on polymer films**
RET Teachers	Manisha Midha and Ghania Hamrani, Technology High School
Faculty Mentor	*Prof. Boris Khusid* *Department of Chemical, Biological, and Pharmaceutical Engineering*
Graduate Mentor	*Ezinwa Elele and Yueyang Shen*
Project Description	Project Description: The main objective is to establish the following procedures: 1) creating thin porous polymer films by freeze-drying aqueous solutions of hydroxypropylmethyl cellulose and hydroxypropyl cellulose, 2) creating solutions of Active Pharmaceutical Ingredient (API) in polyethylene glycol (PEG), and optimizing the amount of API they can contain, 3) printing solutions of API in PEG onto porous film and assembling unit doses, 4) conducting dissolution tests of unit doses.
Title	**3. Characterization of Effects of Processing on API Polymorphism by Raman Spectroscopy**
RET Teachers	William C. Romney and Bryan S. Barzaga, East Side High School
Faculty Mentor	*Professor Zafar Iqbal* *Department of Chemistry*
Graduate Mentor	*Anna Zarow*
Project Description	The main objective of this project is to answer the following question: Can milling induce disorder and polymorph formation in acetaminophen (APAP) and if formed what is the mechanism by which milling stabilizes a metastable polymorph? During the milling process required to micronize compounds, the crystalline structure can be altered resulting in a polymorph. Griseofulvin has been found to disorder but not to form a polymorph. APAP is known to have at least 3 polymorphs which can be detected by Raman spectroscopy. This project will determine what happens in APAP as a function of milling. The effects of thermal treatment and annealing will also be studied.

Title	**4. Nanomaterials synthesis and characterization**
RET Teachers	Stephen Nyarko, Dickinson High School
Faculty Mentor	*Professor Xianqin Wang*
Graduate Mentor	*Zhong He*
Project Description	The main objective of this project is to 1) synthesize bimetallic nanoparticles using impregnation method; 2) study the calcination temperature effect on the size distribution; 3) investigate the reduction temperature effect on the size distribution; and 4) learn to determine the particle sizes using chemisorption method.
Title	**5. Optimization of Formulation of Griseofulvin Nanosuspensions for Long-term Stability**
RET Teachers	Thomas E. Power, Dickinson High School
Faculty Mentor	*Department of Chemical, Biological, and Pharmaceutical Engineering*
Graduate Mentor	*Anagha Bhakay*
Project Description	The objective of this project is to study the effect of: 1) polymers (Hydroxypropylcellulose (HPC), Hydroxypropylmethylcellulose (HPMC) and Polyvinylpyrrolidone (PVP), 2) surfactants (Sodium Dodecyl Sulfate (SDS) and Pluronic F-68) and a 3) combination of the polymers and surfactants on the particle size of griseofulvin nanosuspensions produced via wet stirred media milling. The goal of this work would be to optimize the formulation of griseofulvin nanosuspensions by using different types of stabilizers and varying their concentrations to obtain stable suspensions. This is a part of the larger effort to formulate stable nanosuspensions of poorly water soluble drugs for strip film manufacturing and drying of nanosuspensions for solid oral dosage forms.
Title	**6. Formation of API loaded films for Oral Drug Delivery**
RET Teachers	Angela Vitiello, Thomas Jefferson Arts Academy
Faculty Mentor	*Professor Somenath Mitra,* *Chemistry Department*
Graduate Mentor	*Susana Addo Ntim*
Project Description	The anti-solvent synthesis of micron-scale particles, their stabilization in the suspension, and subsequent self-assembly as homogeneous polymer films will be studied. Films will be made by encapsulating the particles in polymers such as hydroxypropyl methyl cellulose (HPMC) and polyvinylpyrrolidone (PVP). These films will contain as much as 50% by weight of the drug Griseofulvin (GF) or other APIs. An important part of the study will be the resuspension of the APIs from the films.
Title	**7. Surface Modification of Pharmaceutical Materials**
RET Teachers	Daphne P. Sison and Joshua F. Rosenblum, Cranford High School
Faculty	*Prof. Rajesh Dave*

Mentor	*Chemical, Biological, and Pharmaceutical Engineering*
Postdoc. Mentor	*Dr. Chinmay Ghoroi (postdoctoral research associate)*
Project Description	This research is focused on developing techniques and novel applications of functionalization and coating by and of nano-particles for enhancement of pharmaceutical materials. RETs will be using dry coating techniques involving nano-particles and additives for various pharmaceutical excipients and actives to alter properties such as flow, electrostaticity, hydrophilicity, compressibility, packing, glidant, lubricative, and other. You will work with our group to examine how best to use and develop the surface modification methods where nano sized particles are coated on drug particles to improve flow and handling of those particles. You will also provide materials to project 8.
Title	**8. FB coating of API Suspensions on Surface Modified Excipient Particles**
RET Teachers	Nancy Farlow, Thomas Jefferson Arts Academy
Faculty Mentor	*Prof. Rajesh Dave* *Chemical, Biological, and Pharmaceutical Engineering*
Postdoc. Mentor	*Dr. Chinmay Ghoroi (postdoctoral research associate)*
Project Description	This research is focused on taking the results from project 7 of surface modified excipients and carrier particles and examine the fluidization and subsequent film coating of those excipients (or actives) through based functionalization will be examined, along with use of the state of the art processing and characterization. You will work with our group to examine how well the particles from project 7 can be fluidized. You will also interact with Prof. Ecevit Bilgili group to get their drug/API suspensions and coat them on to the carrier particles.
Title	**9. Mixing of Nano-powders in Dense Carbon Dioxide**
RET Teachers	Abbey Tharian and Vincent R. Chiles, Leonia High School and St. Peter's College
Faculty Mentor	*Prof. Rajesh Dave* *Chemical, Biological, and Pharmaceutical Engineering*
Postdoc. Mentor	*Dr. Chinmay Ghoroi (postdoctoral research associate)*
Project Description	The research work is focused on mixing of nano-powders using high pressure CO2. Binary suspension of nano-powders will be mixed in supercritical, liquid or gaseous CO2. The homogeneity of the mixed nano-powders will be analyzed by the scale of segregation, which statistically correlates mixing quality using the data from energy-dispersive spectroscopy (EDS). The teachers will work with our group to study the effect of pressure, mixing time, and stirring speed on mixing quality.