

2009 Smith College Summer Science and Engineering Program Research Courses

Miniature Worlds: Visualizing Life's Hidden Structures Led by Richard Briggs, Ph.D., Professor, and Judith Wopereis, M.Sc., Laboratory Instructor and Microscopy Facility Manager, Department of Biological Sciences, Smith College. Microscopes have been used for over 300 years, allowing scientists to explore miniature worlds that the unaided eye cannot see, revealing life's hidden treasures. In this course, students will explore microscopic worlds using sophisticated tools and technologies including bright field, fluorescent, scanning electron, and transmission electron microscopy. We'll explore the structures and processes used by different cells and organisms to—for example—eat, breathe, move, and defend themselves, and we'll conduct an in-depth exploration of our own blood cells to better understand our own bodies. Students in this course will be challenged to think about the real appearances and functions of structures after combining information collected by various techniques at different levels of organization (molecules, organelles, cells, tissues, and organs). We'll learn how to document what we observe in the microscopes through photo- and videomicroscopy, and will use the information we gather to construct 3-D models of life's structures.

Two-week course offered June 29–July 10

- **Who should take this course?** *Miniature Worlds: Visualizing Life's Hidden Structures is open to all students interested in exploring biological features at a microscopic level. Students in this course will spend lots of time observing and documenting the structures and activities of different kinds of cells and tissues using some of the most sophisticated light and electron microscopes in biological research today.*

- **What do students who have taken this course have to say?**

This course taught me about the different kinds of microscopes and the amazing structures of your own body.

I loved looking at my blood cells under the scanning electron microscope.

I learned about optics, how different microscopes work, various staining techniques, how to prepare specimens for different microscopes, how to make 3-D models from microscopic images.

I learned about anatomy, for example, the small intestine, skeletal muscle, and kidneys.

Getting to study the small intestine with several types of microscopes was really cool.

Both of my professors were really great and really nice. They have a lot to say about microscopes. They put so much effort into our class!

By Girls, For Girls Led by Leslie Jaffe, M.D., Director of Health Services, Smith College. Adolescent girls face an array of health-related challenges in their daily lives, and this course empowers young women to address these challenges while investigating health issues. Through individual and group activities, this course provides opportunities to learn about health issues relevant to young women. Course activities include research, discussion, field trips, and presentations. Participants contribute to the program website, www.bygirlsfor girls.org, and develop peer theater skits while investigating topics such as the menstrual cycle, healthy eating, media literacy, violence, alcohol and other drugs, reproductive health, contraception and sexually transmitted diseases, and emotional health. These topics are considered within the contexts of current research in biology and medicine, and today's multi-cultural society. Supported by the Howard Hughes Medical Institute, a medical research organization, **By Girls, For Girls** is an intense and rewarding course that builds individual and group knowledge and awareness.

- **Two-week course offered June 29–July 10**

- **Who should take this course?** *By Girls, For Girls is open to all students motivated to learn. Students in this course become members of a close-knit working group, sharing their own stories and learning from others while conducting research and participating in course activities. Students interested in health-related careers and medicine may find this course useful.*

- **What do students who have taken this course have to say?**

I really enjoyed the acting experience, and being able to take trips to hospitals was really a privilege. I learned from this course that people around us need to be aware of issues that surround girls' and women's health.

I really liked all the doctors and other speakers who came to tell us about their careers. I've learned a lot about different fields in medicine and women's health.

I liked how informal the class was, how open discussion could be, how honest and thoughtful the information was.

I really liked learning about issues that directly affect me.

The professor was great! He was attentive to individual opinions of all involved.

I recommend this course to anyone interested in women's health who wants to be a doctor.

Designing Intelligent Robots Led by Doreen Weinberger, Ph.D., Associate Professor, Physics Department, Smith College. This course is a hands-on introduction to robot design and introductory programming. Student teams will receive a kit containing a microprocessor controller, a set of motors and sensors, and various Lego building parts and tools. They will learn how to connect the components and program the controller to make a robot that can move autonomously and intelligently in its environment. For instance, with appropriate programming the robot can avoid obstacles, seek out light, make decisions for changing its behavior based on sensory input, or respond to messages communicated by other robots. Students will perform a wide range of activities: building simple robots to accomplish specific tasks, programming in a PC lab, creating their own final robot project, and testing and re-designing to optimize their robot performance. They will also learn HTML and use it to create their own web pages, which will serve as a record of their progress in the course.

- **Two-week course offered June 29–July 10**

- **Who should take this course?** *Designing Intelligent Robots* is open to all students. Unlike many courses in robotics where the task is to build a robot that performs a specific function (for example pushing ping pong balls or battling with another robot), in this course students use their own creativity to design robots that do whatever they want. There is lots of trial and error problem-solving in both computer programming and building the robots. Students also learn how to create their own web pages where they document their design process.

- **What do students who have taken this course have to say?**

It was very hands-on, I love learning that way—building something, then learning from its flaws. Teamwork!

I loved building my web site. I also loved the feeling I got after I had completed my first robot—it was a feeling of pride, astonishment, accomplishment, joyfulness, and sheer self-confidence all mixed into one.

My professor was the greatest—very experienced and always helpful.

I would definitely recommend this course. It was a great learning experience from the designing to programming to your finished product. It's a great hands-on course that provides excitement and hard work.

You constantly challenge yourself and redesign without pressure and get to play with Legos and make things move.

I knew nothing about robots or web page design (HTML), now I've learned so much.

Making Connections: An Investigation of the Nervous System Led by Adam Hall, Ph.D., Associate Professor, Neuroscience Program, Department of Biological Sciences, Smith College. Through studies of the nervous system, neuroscientists explore how we sense, feel, think, and move. Students in this course will learn about how neurons (cells of the nervous system) communicate through a fascinating array of mechanisms and networks to generate complex human behaviors. Using some sophisticated microscopes, we will examine the cells of the nervous system and the neuroanatomy of the brain. Through experiments in the laboratory we will explore how neurons function at multiple levels: molecular, cellular, and in living organisms such as ourselves. With some simple (and painless) techniques, we will even measure nerve conduction in our own bodies and brains. This course is supported by the Howard Hughes Medical Institute, a medical research organization.

- **Two-week course offered June 29–July 10**

- **Who should take this course?** *Making Connections: An Investigation of the Nervous System* is open to students who have completed one year of high school biology. This course is suited to science students who want to get an idea of neuroscience and of what it's like to work in a laboratory. Students will make observations of brain cells and anatomy, relate it to function, and then measure and analyze neuronal conduction in their own peripheral and central nervous systems.

- **What do students who have taken this course have to say?**

- *Making Connections: An Investigation of the Nervous System* is a new course for the summer of 2009, so there are not yet any student evaluations.

Telescopes and Astronomical Imaging Led by Meg Lysaght Thacher, Laboratory Instructor, Department of Astronomy, Smith College. In this class we will explore the tools employed in modern astronomy and see how they are used to make scientific discoveries. We will learn how telescopes work and become proficient in using them to observe celestial objects such as nebulae, clusters, galaxies, and solar system bodies. We will also study how astronomers record and analyze digital images of celestial objects, how to learn about those objects just by analyzing the light coming from them, and how to make beautiful color pictures.

- **Two-week course offered June 29–July 10**

- **Who should take this course?** *Telescopes and Astronomical Imaging* is open to all students. Class sessions are routinely held in the evenings for observations. If you are an avid amateur astronomer, or if you are simply interested in learning more about the sky, this course provides an opportunity to explore a field which is rarely offered in high school.

- **What do students who have taken this course have to say?**

I liked the fact we got to work with our own telescopes and learned a lot about how to use one.

I learned about the science behind the digital imaging used in astronomy.

I liked the night courses the best because they were very fun and helped us apply everything we learned.

Meg Thacher is a great teacher and very helpful. She is kind and likes to have great conversations with the class.

This class furthered my knowledge of the sky from constellations to the way astronomers locate objects in the sky. I liked the “hands-on” approach to the telescopes.

The night classes were awesome!!! You learned how to operate, set up, and take care of your telescope. You had so much fun you forgot you were in school!!!

If you’re an astronomy lover, you can learn details on what you want to know about in depth.

I would definitely recommend this course to someone else; simply put, this class provided me with a hands-on approach and information I could not have gotten elsewhere.

Experiment and Exploration: A Laboratory for Writers Led by Robert E. Hosmer Jr., Ph.D., Senior Lecturer, Department of English Language and Literature, Smith College. Writing is more than self-expression, more than communication, perhaps even more than art—it is a way of making meaning and discovering knowledge. This course will focus on strategies for generating substantive, graceful writing from observation. In the beginning, the world of Nature will be our laboratory for a variety of exercises emphasizing description and narration. Later, we’ll shift our attention to the world of the arts—poetry, painting, and sculpture—and build upon those earlier experiments and explorations. Because writing and reading are complementary activities, we’ll read some essays, some poetry, perhaps some fiction, to enlarge our experience and develop our insights. This course will provide students with opportunities to experiment without pressure, to work independently as well as in small groups, and to meet individually with the instructor.

- **Two-week course offered June 29–July 10 *and* July 13-24**

- **Who should take this course?** *Experiment and Exploration: A Laboratory for Writers* is open to all students.

The ability to express one’s ideas clearly and effectively is critical to achievement in science and engineering. The goals of this course are to develop and enhance the quality of each student’s writing. Inspired by the beautiful Smith campus and its extraordinary libraries, along with venues throughout the Pioneer Valley such as Emily Dickinson’s homestead, students in this course create a portfolio of original essays and poetry.

- **What do students who have taken this course have to say?**

Wow—I learned how to be a great writer. I loved everything about it.

Mr. Hosmer is an inspiring professor. He taught me many things about writing that have helped me greatly.

It is hard work but you get so much out of it. You learn about not only writing, but also life and yourself.

I definitely recommend this course because I feel like I grew as a writer and produced some of my best writing ever.

This class is good for college preparation.

I liked all the field trips and I enjoyed being able to write so freely.

I would recommend this course to someone who is serious about writing, or just wants to improve her writing. It goes deeply to the heart of writing essays and analyzing your own work and style to improve it.

Women and Exercise: A Biochemical Investigation Led by Stylianos P. Scordilis, Ph.D., Professor, Department of Biological Sciences, Smith College. The tissues that make up our bodies are very plastic and respond to environmental changes and stresses in ways we don't even notice. No tissue is more plastic than muscle; it atrophies (decreases in volume) from disuse, hypertrophies (increases in volume) from weightlifting, and is constantly changing in response to daily exercise. In this course we will explore the effects of exercise on ourselves and on animals. With the aid of bright field and fluorescence microscopy, we will examine different mammalian cell types. We will do biochemical analyses of metabolites such as glucose and lactate, and enzymes such as creatine kinase and lactate dehydrogenase, to elucidate changes due to exercise. We will also use a series of biochemical techniques to explore structural molecular alterations that help our bodies to compensate for new exercise patterns. This course is supported by the Howard Hughes Medical Institute, a medical research organization.

- **Two-week course offered July 13-24**

- **Who should take this course?** *Women and Exercise: A Biochemical Investigation* is open to students who have completed one year of high school biology. This course is well-suited to the advanced science student who wants to get a good sense of what it is like to work in a research laboratory. There is an emphasis on doing biochemical experiments, and the subjects of these experiments are the students themselves. Students who volunteer to participate in the experiments will collect their own blood samples (with a simple finger poke) for a variety of analyses.

- **What do students who have taken this course have to say?**

I loved that we learned based on experiments done on our own bodies. It helped me better internalize what was being taught, as well as learn more about my body.

I learned about exercise myths, muscles, muscle damage from exercise, different kinds of microscopes, and how much really goes on in the body during exercise.

This course was very challenging and prepped me for chemistry.

Dr. Scordilis made the course for me. He is an incredible professor and knows how to explain concepts so that high school girls can understand them.

This course was very good for tying together biology, chemistry, physiology and anatomy (especially with regard to muscle), exercise, etc. The course gave me the opportunity to use equipment and conduct experiments that I could never do at high school.

Truth in Advertising: A Chemical Analysis of the Products We Buy Led by Rebecca Thomas, Ph.D., Laboratory Instructor, Department of Chemistry, Smith College. In this course, we will use chemical methods to uncover the truth about what we as consumers are told about products that we purchase every day. We will investigate consumer labels on products from orange juice to margarine, calculate the amounts of key ingredients, determine the accuracy of the labels, and develop an understanding of the theory behind the marketing of household products. We also will look at the effectiveness of household products such as laundry detergent and soap, and will explore the chemistry behind the production of various foods, from ice cream to beer.

- **Two-week course offered July 13-24**

- **Who should take this course?** *Truth in Advertising: A Chemical Analysis of the Products We Buy* is for students who have not yet taken chemistry in high school. The goal will be for students to explore how chemists think about problems while learning some fundamental techniques used in the chemistry laboratory. This course will be a great preparation for students who are anticipating (or dreading) taking chemistry in high school.

- **What do students who have taken this course have to say?**

I really liked the labs and field trips, and I thought that we all learned a lot about what is really in products.

It was fun, yet educational, and it helped me prepare for chemistry next year, plus the teacher was awesome.

I liked everything. All the field trips were fun, as were all the labs. I learned everything I would ever want to know about food and then some. I learned how ice cream was made and how much vitamin C there was in orange juice and so much more. I really liked the class.

I learned all about chemistry and what products actually contain.

We took a field trip to Bart's ice cream. We did lots of practical experiments to discover the "TRUTH" in advertising of Coke, potato chips, and orange juice.

It was very useful and interesting and it allowed me to be a smarter consumer.

The professor was so nice and funny, and really treated us like equals. Becci was an amazing teacher. She taught us

so much and was the nicest person.

It's a fantastic class!!!!!!

Celebrating Biodiversity: Special Emphasis on Rare and Endangered Species and Their Habitats Led by Visiting SSEP Faculty Laurie Sanders, M.S., and Fred Morrison, M.Ed., Independent Field Biologists. Everyone has heard of endangered species like the giant panda, California condor, and right whale. But not all rare species are found in far-off, exotic places. During this course, we'll find rare and endangered species—from insects to eagles—that live right here in New England. We will do almost all our work in the field, exploring habitats where these species live, meeting scientists who study them, and learning why these species are worthy of protection.

- **Two-week course offered July 13-24**

- **Who should take this course?** *Celebrating Biodiversity: Special Emphasis on Rare and Endangered Species and Their Habitats is open to all students. Students in this course spend much of their time in the field, exploring habitats and meeting scientists who study rare and endangered species. Clothing and shoes that you don't mind getting wet and dirty are a must!*

- **What do students who have taken this course have to say?**

A lot of species need our help. I know so much more about diverse habitats, including vernal pools, which I have right near my home!

I learned about sturgeon fish, box turtles, bogs, vernal pools, birds of prey, sand plains, floodplains, habitats, tiger beetles, water life, environmental conservation, invasive species, to love nature.

I learned that Nature is very valuable and each of its species plays a critical role in it.

I liked the field trips and how everything was hands-on; it helped me to remember and understand the environment a lot better. Fred and Laurie Rock!!! Some of the best teachers I have ever had.

The field trips were a little dirty and muddy, but they gave me a better understanding and appreciation for animals and their habitats.

It's very motivating and educational. You may get your hands dirty, but you'll be smiling ear to ear!!

I would recommend this course for anyone interested in animals and having different adventures.

I learned about habitats, bugs, plants, amphibians, fish, and other animals.

I enjoyed taking many field trips and meeting scientists in the field who are studying different species.

Your Genes, Your Chromosomes: A Laboratory in Human Genetics Led by Robert Merritt, Ph.D., Professor, and Lou Ann Bierwert, M.A., Research Associate, Biological Sciences Department, Smith College. Human genetics has fascinated us for centuries—beginning with the basic question of why we look like our ancestors and continuing to recent advances in medical and courtroom analyses. In this course, students will gain experience with a variety of classical and modern techniques used in human genetic analysis. The course will include explorations in basic genetics, probability, pedigree analysis, molecular genetics, and population genetics. Participants will determine their own blood types and calculate the frequencies of blood type alleles in their class, photograph their own chromosomes, sort them into a karyotype, and construct part of their own DNA fingerprints using the polymerase chain reaction (PCR).

- **Two-week course offered July 13-24**

- **Who should take this course?** *Your Genes, Your Chromosomes: A Laboratory in Human Genetics is open to all interested students; however, it is best suited to students who have completed a year of high school biology. Students in this course spend the majority of their time in the research laboratory. The subjects of the experiments are the students themselves—students will collect their own blood samples (with a simple finger poke) for a variety of analyses. Time between experiments is spent working on genetic problem sets. Visiting speakers include a genetic counselor and a DNA crime scene analyst.*

- **What do students who have taken this course have to say?**

This class had a lot of hands-on activities, visitors, we did a lot of good blood work, which was new to me since I have never done any blood typing or even looked at my cells.

I enjoyed the presentations made by the genetic counselor and the DNA crime scene analyst.

Our experiments helped me actually see my 46 chromosomes and what DNA bands are supposed to look like! The genetic problem sets were difficult and challenging but it was fun to solve them by myself and with others.

Practical, real-world applications of genetics, whether in medicine or forensic science; discussions of ethical implications of this field; covering a third to half of my high school biology course and also going far beyond it.

Studying with Professor Merritt was one of the great experiences of my life! He was really smart and enthusiastic about genetics—he knew so much about it.

I recommend this course because it was very informative and the experiments were cool, I liked finding out my blood type and photographing my chromosomes.