FSNA 103. Energy and Society. 4 Units.
This four-credit-hour course provides an introduction to collegiate writing and to various dimensions of academic life, but will focus on the critical appreciation of the world of energy. Currently, most of the world runs on non-renewable resources; this course is designed to help students develop viewpoints about these issues, and to express themselves in a clear, coherent way. The class will involve both literacy and numeracy, and students will learn to become comfortable handling some of the quantitative measures of energy use. The class will be characterized by intense yet open-ended intellectual inquiry, guided by reading, lectures and discussion, and will include practice in written and oral communication individually and in small groups.

FSNA 104. Archaeoastronomy: Monuments and Ideas. 4 Units.
The unifying theme of this course is how astronomical practice and knowledge is central to ancient civilizations and how that emphasis continues today as manifested through scientific endeavor and also as strongly through the power of unifying myths.

FSNA 109. Science and Race. 4 Units.
This four-credit seminar examines the development and impact of the concept of race. We will first focus on the causes of biological variability in species, leading to an evaluation of whether race is a useful device for understanding biological variability in humans. Second, we will examine how the understanding of race has changed over time within the biological sciences. Third, we will examine how scientific conceptualizations about race have influenced, and been influenced by, cultural beliefs. Through readings and open-ended discussion, we will critically examine the scientific process as it has been (and still is) being applied to the study of human races so that each student will ultimately be equipped to develop a scientifically sound conceptualization of race. Topics which will be covered include Social Darwinism, the eugenics movement, legislation to restrict immigration into the U.S., race-based medicine, and race and intelligence. Students are expected to enhance their skills at critical reading, thoughtful analysis, constructing logical arguments, and improving written and oral communication.

FSNA 111. Chemical Aspects of the Aging Mind. 4 Units.
This seminar will focus on three age-related neurological disorders: Alzheimer's, Parkinson's and Huntington disease. These diseases pose enormous social and economic impact, and current drug-based therapeutic approaches are limited and may not be suited to deal with the imminent problems. The seminar will examine lifestyle changes (i.e., diet, exercise, vitamins, and other habits such as reading) that are implicated in preventing or slowing down these disorders. The focus on a medical topic with important socioeconomic ramifications will provide a novel approach to enhancing critical thinking and communication skills.

FSNA 113. Facts and Values in Environmental Decisions. 4 Units.
This four-credit seminar will guide students to critically evaluate the evidence, uncertainties, and value judgments pertinent to some of the world's pressing environmental issues. We will begin by studying climate change. Students will decide the topics of exploration to follow. Through reading, field trips, discussions and writing we will investigate natural environmental processes and how they have changed with the growth in human population and technology. Students will learn about the scientific process and will consider the role of science and technology and their limits in making decisions about shared resources.

FSNA 116. Cities (Under Construction). 4 Units.
Based on the premise that cities are never "finished," and constantly being remade, we will look at the technological and cultural history of cities from the ancient world to the present day. Students will explore the history of building materials—wood, brick, steel, concrete, and glass—used in the construction of cities. We will also trace the development of city infrastructure such as water and sewage systems; streets, bridges, and subways; electricity, telephone and the internet. Specific technological innovations, such as the elevator and the automobile, will receive special consideration. We will move both geographically and temporally to visit the world’s great cities, Athens, Mexico City, Tokyo, and New York City. As we do, we will study the examples of significant building projects, such as the Brooklyn Bridge, the Chicago World's Fair, Washington DC’s Metro, and Cleveland’s first skyscraper, the Rockefeller Building. The course will cover the history of the professions—engineering, architecture, and urban planning—that have contributed to the construction of cities, and will review the works of these practitioners, as well as that of artists, reformers, and utopians that have imagined new directions for the city. We will also explore first person narratives of the city, the impact of the city on personal and collective memory, and the possibilities and pitfalls of the "virtual" city. Through lecture, discussion, textual analysis, computer simulations, and writing assignments, Cities (Under Construction) will help students gain a deeper understanding of their role in remaking and sustaining the built environment.

FSNA 120. The Impact of Materials on Societal Development. 4 Units.
This four-credit-hour SAGES seminar provides an introduction to various dimensions of academic life through open-ended intellectual inquiry and guided by reading from primary and secondary sources. The course will require practice in written and oral communications in small groups. A primary focus of the seminar will be to examine the impact of engineering materials on societal development through human history using a few specific materials of interest as examples: concrete, steel, and semiconductors. At the conclusion of the course, students will be encouraged to explore the impact of other materials on the development of specific technologies as a group project.

FSNA 123. The Automobile: Its Origins, Development, and Impact on American Society. 4 Units.
The automobile is without doubt one of the defining influences on American life and society. In 1900, most people lived in rural communities, and the main forms of personal transportation were walking and the horse and buggy. Half a century later, most Americans lived in cities or suburbs, there were millions of cars in garages, and roads and highways criss-crossed the nation. The car has transformed where we live and work, how we play, and the very nature of our cities. This course will examine the American automobile from several perspectives: its origins, evolution and effect on industry; its impact on American life and leisure; and the automobile as an art form and American icon. We will also discuss how we preserve examples of our automotive heritage. These topics will be explored in the context of the usual writing and discussion components of a first SAGES course.
FSNA 124. The Challenge of Sustainability. 4 Units.
This four-credit-hour course provides an introduction to collegiate writing and to various dimensions of academic life, but will focus on the critical appreciation of the challenges we face in transitioning— or failing to transition—to a sustainable society. Climate change, along with increased development and population, are altering the natural environment we live in and rely on. This course will review some of the current and future impacts of these changes, and explore alternate paths forward and how they might be forged. The class will involve both literacy and numeracy, and students will learn to become comfortable handling some of the quantitative measures relevant to sustainability issues. The class will be characterized by intense yet open-ended intellectual inquiry, guided by reading, lectures and discussion, and will include practice in written and oral communication.

FSNA 125. The Right Stuff. 4 Units.
This course will examine the Space Race. A key text for the course will be Tom Wolfe’s The Right Stuff. By taking a historical approach to the study of the achievements and failures of NASA scientists and astronauts, it is possible to examine: 1) how individuals dedicated to achieving a particular scientific end draw on the scientific method, 2) the consequences of scientific inquiry, and 3) how science develops in specific historic contexts.

FSNA 126. Urban Ecology. 4 Units.
This course will explore the natural world in an urban context. Urban spaces are defined by the interaction between human creation (the built environment) and the natural world. We will explore how those definitions can be complicated by human innovation meant to re-create nature, such as engineered wetlands. We’ll read some classical ecology to understand how ecological issues differ in cities. Some topics we’ll cover include: wildlife management; human/organism conflict and interdependence; urban heat islands; watershed, stormwater, and sewer management; and how trees grow in urban conditions. We’ll also explore ethical issues such as environmental justice and sustainable development. Our field trips are meant to illuminate how urban planners, park managers, and others deal with such issues to create positive and healthy environments for their communities. Students will apply arguments and concepts learned in the course readings to the sites we visit.

FSNA 128. Naturally Spicy: Spices, History, Culture, Health and Cuisine. 4 Units.
This course will delve into the world of spices. Each commercially important spice will be discussed with the goal of understanding the influence spices and the spice trade had on the history, culture, and cuisines of different parts of the world. The chemistry of some of the natural compounds present in the spices and their effect on various diseases will be explored by reading and discussing scientific literature. Finally, the class will cook with some of these spices and sample other distinctly spiced foods to learn more about various cuisines and cultures.

FSNA 129. Engineering Design for the World’s Poorest. 4 Units.
Almost half (47%) of the people in Africa have incomes less than $1.25 per day. Most of these people live as subsistence farmers in small villages with no electricity, running water or automobiles (but with cell phones). Through readings, group discussions, writing assignments, and open-ended experiential learning activities, the course will address ways that engineering solutions can improve peoples’ lives within these severe economic constraints. A hands-on component of the course will involve designing and building affordable devices to meet specific needs. We have developed interactions with villages in Senegal, Malawi, and Botswana, and the engineering solutions will be explored within the context of these villages.

FSNA 133. Engineering Innovation and Design. 4 Units.
Innovation and design are cornerstones of the engineering profession and are responsible for many of the improvements in the quality of life that have taken place over the last century. Innovation is also viewed as the essential skill that will drive economies and solve many of the challenges facing societies around the globe. This seminar-based course will provide a disciplined approach to engineering innovation and design. The course requires students to engage in written and oral communications as well as working in small teams to complete open-ended design/build-related assignments. The course will culminate in the design, fabrication and validation of a prototype product to meet an identified need. The design, fabrication and validation of these products will be carried out in thinkbox 1.0 (Prentke-Romich Collaboratory), and the Reinberger Design Studio.

FSNA 134. Fuel Cells. 4 Units.
Fuel Cells convert hydrogen and other fuels directly to electricity and are viewed as a key technology for non-polluting, oil-independent energy in the future. In this course, we will study and critically analyze the prospects, technical and economic barriers, and impact of broad implementation of fuel cells, focusing on the transportation sector and portable power. Major topics of the course include: (i) World and US energy outlook; (ii) Potential role and impact of fuel-cells; their advantages, principles of operation, design and materials issues, limitations and prospects for improvements; (iii) Special focus on details of a polymer type fuel cells (PEMFCs) for transportation and portable power; (iv) Modeling fuel cell performance and evaluation of controlling mechanisms that limit performance. The course is designed for students from all disciplines. Students will be expected to read assigned texts and articles and critically analyze statements and points of view presented. Quantitative analysis will be encouraged and developed. Student teams will develop a hypothesis to improve fuel cell performance by modifying the design of a component of the fuel cell. The new component design with then be fabricated and tested in an operating prototype fuel cell. Data analysis, hypothesis conclusion, and reporting of results are expected.
BioDesign basics explores the art of finding patient needs. No prior clinical or medical education is required, as we focus on acquiring and refining the underpinning critical thinking skills needed to identify and articulate unmet clinical patient needs in contemporary healthcare settings. Many—if not a majority of—ideas leading to healthcare innovation are derived from issues that arise during the daily activities of caring for patients. Whether it is frustration with the use of a specific surgical instrument, processes that interfere with health care delivery, better waiting rooms for the family, designing more comfortable hospital gowns, or materials inadequate for intended outcomes, patient needs cover a broad range of physical and emotional states. Many students find the idea of identifying a "patient need" quite ambiguous at first, but the BioDesign process for defining patient need is a widely use national model developed at Stanford University that the student will find contains easy-to-follow steps that are simple and appealing. As an interactive and "hands-on" course, students will be engaged in discussions, events and activities to promote a first-hand understanding of "needs finding" to support individual mastery of writing and oral presentation skills. The Fourth Hour will be centered on "walking tours" of local medical institutions around University Circle as well as actual use of medical devices (wheelchairs and crutches) on campus as ways to help your efforts identify a patient need based on those observations. In short, you will create your own experiences leading to stories that make writing fun. The course requires students to engage in written and oral communications as well as working in small teams to complete open-ended assignments.

FSNA 136. Saving the World from Poverty, Disease, Injustice and Environmental Exploitation. 4 Units.
Half of the world's population lives in poverty. The causes of poverty and injustice are complex and the ramifications are numerous and serious and include grave risk to human health and to the environment. Through reading, analysis, writing, and rigorous discussion the class will investigate issues surrounding poverty and disparities in health and opportunity. We will also explore how innovation and engineering design can help address causes of poverty and disparity and meet needs of people at risk. Design teams will work throughout the semester to identify an unmet need to engineer a solution to benefit an under-served or under-resourced population. Fourth-hour activities will include interviewing knowledgeable stakeholders (locally and abroad via teleconference), learning about and volunteering with service organizations, and visiting local institutions and/or companies addressing these issues.

FSNA 137. Volts, Amps, Bits, Bytes. 4 Units.
The electrical grid, the computer, biomedical devices, electric vehicles, interactive art, and smart homes are a few examples of the pervasiveness of electronics and computer technology. This seminar will introduce the engineering design process, and present the basics of electricity, electronic circuits, measurement, sensors, and microcomputers (the Arduino), and how to use them to design and build useful devices. Students will reverse-engineer products, learn electrical and mechanical prototyping and fabrication, and apply them in a variety of hands-on labs. The course will conclude with students proposing, designing, and prototyping innovative design projects. The course will make extensive use of the Sears Design Lab and Think[box] and is writing intensive.

FSNA 138. Light. 4 Units.
This course explores Light, otherwise known as visible electromagnetic radiation. We will examine what light is in its various forms; how it is created and detected; how we perceive it; and how it has influenced our evolutionary development, our technological, artistic, and religious cultures, and our conceptions of space and time. Students will discuss topics suggested by the course readings and by exposure to the many scientific activities, historical artifacts, and artistic works on the CWRU campus and at other local institutions that involve light in a significant way.

FSNA 142. Designed by Man, Built by Nature. 4 Units.
If you look at the structure of a human tendon, and at the reinforcement system in an automobile tire, they share many design elements in common. The eye of an octopus and a high performance surveillance lens can be similar as well. The structure of sea shell and of vehicular armor - again, these share common features. In this class we will examine how nature designs things for performance, and how mankind copies these to produce useful objects. Two general introductions to technology will be supplemented with specific readings from the technical literature to provide a broad introductory background. This writing-intensive seminar is tailored for incoming CWRU students with an interest in science, engineering and technology. Among other class activities this seminar will require the student to research, design and build prototype bio-inspired systems according to assignments made in class, with a competition held during the last week of the semester.

FSNA 143. Materials and Energy. 4 Units.
Manufacturing and using the materials of modern life—metals, polymers, ceramics, paper products, and others—play major roles in the world's consumption of energy and natural resources. This course will objectively and (when applicable) quantitatively explore the technological and social forces that drive current levels of materials usage. Through readings, group discussions, writing assignments, and open-ended experiential learning activities, the course will address the following questions: What are the scale and geographical distribution of materials usage? How do the magnitude and impact of materials usage compare to those of other demands on energy and resources (such as agriculture, transportation, residential heating, and clean water)? What are the impacts—positive and negative—of materials consumption on society and the natural environment? How did the world get to its current situation, and what should, and can, be done in the future? Students successfully completing this course will be able to think critically and objectively about the role of materials in society's use of energy and natural resources, and to articulate realistic, persuasive arguments based on quantifiable facts about these topics.

FSNA 144. Is Mind What the Brain Does?. 4 Units.
Together we will explore the nature of the human mind by asking the question, "Is the mind what the brain does?" Through an exploration of neurological and psychological case studies, empirical research studies, direct experimentation, and readings and films about brain structure and function, we will form hypotheses about the relationship between the mind and the brain and gather evidence to test our hypotheses. Writing assignments will explore ideas about your own mind and brain, examples of other individuals with unusual or atypical brains and minds, and a research topic of your choice.
FSNA 145. Hostile Water. 4 Units.
Water is an essential, valuable resource that is protected by a wide variety of social, legal, and technical institutions. However, not all water is desirable. Hostile water is unwanted water from which we seek to protect ourselves. Hostile waters challenge our understanding of the natural world and the social doctrine upon which our understanding is based. This course will examine how historical "hostile water" events have altered our social perceptions and legal institutions, led to structural flood control, "damn" engineering, the National Flood Insurance Program, Landsat satellites, "Wild Rivers," FEMA, wetlands preservation, detention basins, etc., and to homeowner stormwater management options such as rain barrels and rain gardens. The course will begin with a review of the original documentation and modern interpretation of the Johnstown Flood. Students will then conduct research on historical events and prepare written briefing documents and oral presentations focusing on the physical impacts and social consequences of dramatic hostile water events. The course will end with a critical review of the Hurricane Katrina event. Class discussions will examine how hostile water events have impacted U.S. policies and institutions, and appears to be leading to stormwater management obligations for individual homeowners.

FSNA 148. Science or Pseudoscience? Exploring Extraordinary Claims. 4 Units.
In the contemporary world, extraordinary claims about ghosts, aliens, and the nature of the universe appear on popular television shows, on the Internet, and in the press. Many of these claims are framed as science. In this seminar, we critically examine the nature of these understandings of the world around us. We will ask if these claims are scientific and, if not, whether they constitute a form of pseudoscience. We will explore the role of demarcation, evidence, scientific progress, and fallacies of reasoning in pseudoscience. We will also consider the historical and sociocultural currents that give rise to these pseudoscientific claims as well as their social and political implications. Drawing on anthropological, philosophical, and historical case studies, we will consider topics such as cryptozoology, astrology, ancient aliens, parapsychology, the Nemesis theory of dinosaur extinctions, theories of intelligence, and other extraordinary claims.

FSNA 150. Hobbies - Engineering fun. 4 Units.
This seminar introduces students to the idea that engineering can be found in all sorts of unexpected places, even in our hobbies. To test our hypothesis, we will examine the hobbies enjoyed by the course instructors: baseball and building synthetic coral reef aquariums. Students will then work under the instructors' guidance to analyze how principles of engineering can be used to understand the successes and failures they have encountered in their own hobbies, with the ultimate goal of developing a proposal for improving their experience of these hobbies.

FSNA 154. The Green Energy Transformation in Germany. 4 Units.
This seminar introduces students to the development and successes of green technologies in Germany. We will examine the proactive development of renewable energy and energy conservation technologies, commonly referred to as Energiewende, that was started by the German Green movement and promoted by Germany's innovative renewable energy policies. We will consider such questions as: What are the implications of this German success story, both for the US and the rest of the world? What lessons can be applied to other situations? What factors might limit the utility of those lessons? In the process of our investigation, we will examine such important issues as globalization, resource finiteness, and sustainability challenges, including economic crises, climate change, energy insecurity, and global competition.

FSNA 157. Plastics Recycling: Re-use of Plastic Waste. 4 Units.
About 300 million tons of plastics are produced globally each year, but only about 10 percent of these products are recycled, despite the fact that recycling uses significantly less energy and produces fewer greenhouse gas emissions than does manufacture of the virgin materials. This course will address the scientific, economic, environmental, and political issues involved in plastics recycling. Following an introduction to the chemical structures and properties of commodity plastics, we will discuss the actual recycling of plastics in municipal waste including the problems faced in collection and sorting of plastic waste and recycling economics. Then we will address the commercial applications and properties of recycled plastics and why they generally have inferior properties to virgin materials, which significantly reduces their market value. Finally we will look at biodegradable alternatives to oil-based materials as well as some options to plastics recycling, including land filling, burning for power generation, and monomer reclamation.

FSNA 158. What is Making and Manufacturing Today and Why is Innovation Part of the Story?. 4 Units.
The rise of the creative class into the world of "making" has resulted in new economic models, new definitions of manufacturing, and new ways of working. "Making" is inclusive of a wide variety of activities, from the arts and crafts, to woodworking, to high technology integrating with traditional craftsmanship, to products with embedded sensors in traditional materials, to the use of 3D printing of everything from polymers to metals to chocolate. Within all of these approaches, "innovation" is often the buzzword, the common denominator. What does innovation mean in this context? Are innovators and makers today any different from the innovators and manufacturers of the past? What role does science and math have in making and manufacturing? Through both a hands-on and historical approach, we will explore the commonalities between today's makers and yesterday's manufacturers, and arrive at an understanding of innovation and apply this understanding to a project that could continue throughout your time at CWRU.

FSNA 159. Nanotechnology in Medicine: The Fantastic Voyage. 4 Units.
This course is a freshman seminar designed to introduce students to Nanoscience and Nanotechnology, their application in the world of biomedicine, and the fundamental science and engineering principles that guide the current state-of-art and future approaches. The course will begin with an introduction to the history, science and terminology of 'Nano scale', 'Nanotechnology' and 'Nanomedicine'. It will then focus on the historical advancements in the field and describe why and how the field became an exciting component of medical technologies. The course will draw on a variety of texts including book sections, newspaper articles, editorials, scientific journal articles and internet-sourced information to understand the realm of nanoscience and nanotechnology in various STEM areas and their specific application in biomedicine. The course will also correlate science fiction with reality, pertaining to the Nanomedicine area, via two classic movies: Fantastic Voyage (1966) and Inner Space (1987). The students will be asked to interpret components/sections of the movies in terms of 'conceptual correctness', 'scientific correctness' and 'challenges in nanomedicine'.

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FSNA 160. Technological Development and Popular Perception. 4 Units.
The central theme of this seminar is the basic functioning of engineered
devices and systems. The devices/systems covered will be 1) automobiles, 2) airplanes, and 3) production of electric power. Material for
the seminar will come from a wide range of sources, including a reference
book "How Things Work", historical references, popular pseudo-technical
periodicals, and technical journal articles. We will discuss topics ranging
from a) how to characterize the basic physical principles at work in the
devices/systems to z) how popular opinion can affect the adoption or
abandonment of sound technology.