AC 2007-243: THE UNTAPPED STUDENT GOLDMINE

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The Untapped Student Goldmine

Abstract

Many university programs in the liberal arts, humanities, and sciences depend on general education credits to maintain viability. As a consequence, instructors in these programs have often designed general education courses to attract students from outside their discipline. Such courses serve the dual purpose of introducing students to a subject they might otherwise never learn about, as well as generating credit hours for the department. Along these lines, a set of general education courses based on the book *How Things Work*, by physics professor Louis Bloomfield, have proven to be extremely popular nationwide. Although Bloomfield's book uses popular devices such as refrigerators, automobile engines, flashlights, and microwave ovens to teach the concepts of *physics*, Oakland University has successfully experimented with using the book as a primary vehicle to teach basic concepts involving *engineering*. Either approach, of course, results in an increase in the technological literacy of the liberal arts and humanities students who take the course.

In this study, thirty randomly selected U.S. schools with accredited engineering programs were examined. Thirty-seven general education physics courses designed primarily for non-science majors were found to have enrollments totaling 5,711 students, in contrast with only four commonly taught engineering outreach courses, with enrollments totaling only 435 students. (Most of these students were enrolled in two popular courses taught at Boise State University.) Ultimately, it appears engineering schools could greatly expand their general education outreach by co-opting some of the techniques used by physics departments, as has been done at Boise State and the authors' own university. An increase in engineering outreach courses nationwide could strengthen engineering programs by cost-effectively increasing the number of credit hours taught; provide positive public relations for the discipline of engineering; serve as a much-needed recruiting conduit for engineering schools; and make a dramatic difference in the technological literacy of humanities and liberal arts students in the United States.

Introduction

Historically, engineering students on college campuses have been viewed as boring, dull, and uncreative.[1-9] This negative perception of engineers and engineering, in fact, is thought to play a role in the difficulty many schools experience in their attempts to build enrollment.[10-13] In part in response to such criticisms, as well as similar criticisms about engineers from the workplace, ABET, the accrediting agency for schools of engineering and technology in the United States, has attempted to broaden the training engineering students receive.[14, 15] Consequently, accrediting criteria now specify that engineering studies must have training involving a number of areas, including professional and ethical responsibility; an ability to communicate effectively; an understanding of the impact of engineering solutions in a global, economic, environmental, and societal context; a recognition of the need for, and an ability to engage in life-long learning; and a knowledge of contemporary issues.[16]

But accreditation attempts to broaden engineering training, while admirable, only address half the story of how the discipline of engineering is perceived by those outside the profession. In fact, many professors and students, particularly those with backgrounds in the liberal arts and humanities, suffer a woeful technological illiteracy.[17] As a result, they have little experience with or appreciation for what engineers do, or what the discipline of engineering encompasses. Those outside engineering thus base long-entrenched external prejudices about engineering students in part on lack of familiarity with the discipline of engineering.

Moreover, the laudable emphasis at most campuses nationwide on ensuring that engineering students obtain a broad liberal arts background has resulted in an odd dichotomy. Engineering students, it seems, often must study far more about a broad variety of subjects outside their discipline than non-engineering students study about *any* facet of engineering. In fact, perhaps in part because of the sheer weight of liberal arts and humanities faculties as opposed to engineering faculties on many college campuses today, non-engineering students are not required, encouraged, or even given the ready opportunity to study engineering, even in its lightest forms. As a result, many university students today graduate without even the faintest notion—or even interest in—simple concepts such as how their refrigerator works, their car runs, or their microwave operates. From an engineering perspective then, these non-engineering students could be thought of as boring, dull, and uncreative!

National efforts to increase technological literacy in humanities and liberal arts students have run into a variety of roadblocks.[17, 18] As this paper shows, the problem is worsened by the fact that many schools of engineering do not actively support outreach efforts to non-engineering students. However, if engineering administrators were to realize that engineering outreach is not a burden, but rather a highly effective opportunity to gain student "market share," this may contribute to a substantial increase in engineering course offerings in this area in the future.

Purpose of This Study

If non-engineering students are to increase their technological literacy, the engineering community is ideally situated to assist in the effort. As this paper shows, such outreach efforts can simultaneously assist engineering schools in growing their own programs—a win-win situation. This paper was written to assist in these processes by:

- Establishing a baseline of what types of outreach courses are *typically* available to humanities and liberal arts students from engineering schools, along with typical enrollments.
- Comparing the enrollment and number of engineering school outreach courses to similar outreach courses from physics departments. (Physics courses were

selected because the content is often fundamentally similar to that of engineering.)

- Presenting a proven idea for an engineering outreach course that capitalizes on the best of physics outreach efforts, and summarizing other engineering outreach courses that have been successfully taught at other universities.

Methodology

ABET, Inc. (formerly the Accreditation Board for Engineering and Technology) is the accrediting agency for schools of engineering and technology in the United States. There are 363 institutions of higher learning within the United States, as well as a few institutions overseas, that had accredited engineering programs as of October 1st, 2006.[19] These 363 institutions were tabulated and used to form the base listing for this study. Next, since the study involves only general education-related engineering outreach courses to liberal arts and humanities students in four-year institutions, other types of institutions were deleted from the tabulated listing. (This step eliminated community colleges, specialized polytechnic institutes and technical universities, as well as those institutions that had only computer science, forestry, or technology type programs.) In this fashion, 319 institutions were left for consideration. To obtain a random sample of this group, every tenth institution was then selected for study from the first 300 of the 319 institutions left in the alphabetized listing. Ultimately, 30 institutions were obtained for the detailed analysis of this paper.

On-line catalogs and course materials were then studied for each institution. The description of physics and engineering courses that were specifically targeted for non-science, non-engineering students were annotated in Table 1 (Appendix A). Administrators and instructors at each institution were then contacted to gain an idea of how often each of the annotated courses was taught, along with enrollment statistics. This information was also entered into Table 1.

Limitations of this study: Some of the universities had very large numbers of course offerings in a number of different departments, which means that the authors may have inadvertently missed relevant courses. It should be noted that web-development and computer-science type courses were not included in the listing of engineering outreach courses, since they relate to computer rather than to technological literacy.[20] (Along related lines, physics departments also conduct outreach by teaching courses such as introductory astronomy and meteorology, which were also not included in this survey, since these courses are quite different from those offered from engineering.) Enrollment figures were obtained from various sources—instructors, registrars, and administration officials—and are thus approximate. Finally, the reader should keep in mind that some of the physics outreach courses may have been required for some professional schools such as nursing or K-12 education. As such, they may not fall into the category of outreach to humanities and liberal arts students. Courses specifically designated for teachers in the course description were not included in the table. Additionally, laboratory courses were not included in the table, since these courses were almost always affiliated with another class and including them would have artificially boosted the enrollment numbers.

Discussion

After analyzing the thirty universities, thirty-seven general education *physics* courses designed primarily for non-science majors were found to have enrollments totaling 5,711 students. This contrasted with only four commonly taught *engineering* outreach courses, with enrollments totaling only 435 students. These results are particularly noteworthy given that departments of physics are generally far smaller than schools of engineering nationwide. Only Boise State University had popular engineering outreach courses: “Energy for Society” and “Engineering for Humanity.” These Boise engineering courses were very popular indeed, with annual enrollments totaling 370. The University of Texas, Austin was the only other university with a viable engineering outreach course: “World Health and Biotechnology,” with an annual enrollment of 55.

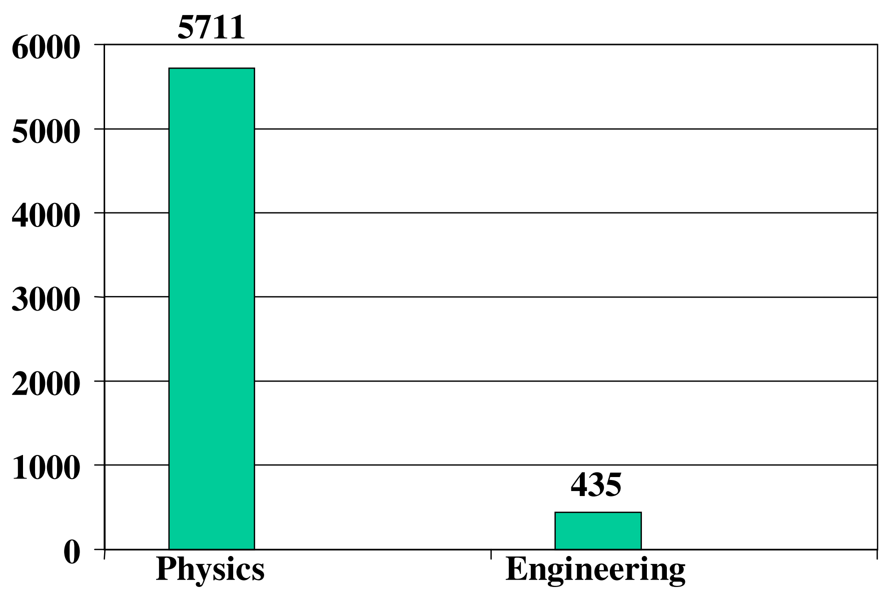

Figure 1: Enrollments in general education outreach courses to humanities and liberal arts students from physics versus engineering programs.

It might be said that the results found here simply relate to the fact that general education courses lend themselves more easily to the subject of physics than to engineering. However, a key point of this paper is that this type of justification is misleading, as the Boise State University courses show. In fact, an examination of the popular outreach physics courses often show content with surprising similarity to engineering, particularly those courses which use the textbook *How Things Work*, by physics professor Louis Bloomfield of the University of Virginia.

How Things Work, in fact, teaches physics by showing how "things" work, including, for example, refrigerators, cars, microwaves, and flashlights. In point of fact, this physics outreach course has cleverly stolen a march from engineering by using engineered items to explain the fundamental concepts of physics. Perhaps the best part about this "stolen" use of materials is the fact that it is successful—courses that use the *How Things Work* textbook appear to be immensely popular. This can be seen not only from universities listed in the table that use the *How Things Work* textbook, but also from the fact that *How Things Work* is used in over 200 schools nationwide, making it the most widely used text on the technological literacy market.[17]

At Oakland University, we decided to reverse engineer the usual "How Things Work" course and use the *How Things Work* textbook to teach the fundamental concepts of *engineering*, rather than physics. After all, engineering involves using fundamental concepts of physics to produce designed and manufactured items that are of use to humankind. We supplement the *How Things Work* textbook and accompanying classroom demonstrations by having the students read one of Henry Petroski's books, either *To Engineer is Human: The Role of Failure in Successful Design* or *Success through Failure: The Paradox of Design*.[21, 22] Additionally, we frequently show snippets of videos that illustrate the many considerations involved in designing and manufacturing various objects, such as cars, insulation, bridges, and even lowly duct tape. (Many such videos are available from www.coolstuffbeingmade.com by the National Association of Manufacturers.) We also take students through some of the engineering laboratories. This allows them to get their hands on refrigeration systems, to take a look at the insides of car engines, and to see how electrical equipment is used.

We have learned quite a bit over the past three semesters related to engineering outreach with the engineering-based "How Things Work" course. Initially, the course was called "Everyday Engineering." This was very nearly the kiss of death, as initial enrollments were small (seven and fourteen students for the first two semesters it was taught). For the third semester, the course name was changed to "How Things Work." It is thought that positive word of mouth from the previous semesters, along with the name change, caused the most recent growth in enrollment (to 29 students in Winter, 2007). Further enrollment increases are anticipated.

As far as building enrollment, advertising the course appears to be helpful. We have a banner put up in the student center during registration week, and we also post fliers in buildings around campus, particularly near the registration area. In an age where websites such as www.ratemyprofessors.com make it easy for students to check a professors' teaching expertise, it is also important that a popular professor teach any engineering outreach courses.

Reactions of students who have taken the engineering-based "How Things Work" course are excellent. A fairly typical comment on the anonymous course evaluation system was: "Fantastic course... I would strongly recommend everyone in college to take this course. I think one thing this society lacks is a general knowledge of how things in the world actually work, which I believe is vital."

We have discovered several additional positives about Oakland University's "How Things Work" course. Roughly one sixth of the students in the first two classes have indicated that they will be switching to an engineering major. Thus, the "How Things Work" course looks as if it may be an unexpected source of recruitment for the engineering school (further studies in this area are planned). Moreover, approximately 80% of the students who have elected to take the course are men. In this sense, then, the course appears to have strong appeal to the problematic disengaged male students who are most at risk in the widening gender imbalance that is occurring on college campuses throughout the country.[23] Related types of engineering outreach courses could also easily be envisioned: Table 3 provides titles for a range of "technological literacy" courses that have been taught nationally—many of which are based out of schools of engineering.

Table 3: Examples of courses that provide outreach to non-engineering/science students[17, 24]

Course title	Location
Designing People	Bucknell University
Converging Technologies	Union College
How Things Work	University of Virginia
Technology and Human Values	Lehigh University
Science at Work: Technology in the Modern World	Mission College
Fuel Cell Systems	University of St. Thomas
The Hidden World of Engineering	University of Illinois at Urbana-Champaign
Science and Technology of Everyday Life	Hope College
The Digital Information Age	Yale University
The Engines of Our Ingenuity	University of Houston
Engineering in the Modern World	Princeton University
Electrical Machines and Information Technology Systems	United States Naval Academy
Technological Literacy: How Things Work	North Carolina State University
Technology 21	University of Denver
Electrical Signals and Systems	University of Denver
Innovation, Invention, and Technology	California State University, Northridge
Introduction to Computer-Aided Graphics Tools	California State University, Northridge
Technology and the Human Built World	University of Massachusetts-Lowell
Engineering for Non-Engineers	Wichita State University

Conclusions

This study has shown that, unlike departments of physics, which share much of the same subject material, engineering schools nationwide typically have few viable outreach courses for non-engineering students. Yet some of the most popular physics outreach courses use a textbook that teaches fundamental concepts related to engineering! One institution, Boise State University, teaches two highly popular courses that demonstrate the enormous potential for outreach that is possible with a well-designed engineering outreach course. The authors' efforts at their own university are similarly encouraging. Engineering schools might significantly expand their general education outreach to non-engineering students by co-opting some of the techniques used by physics departments and teaching general education engineering courses. An increase in such courses in the United States could strengthen engineering programs by cost-effectively increasing the number of credit hours taught; serve as a much-needed recruiting conduit for engineering schools; provide positive public relations for the discipline of engineering; and improve the technological literacy of humanities and liberal arts students.

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Appendix A

Table 1: Summary list of courses focusing on outreach courses to humanities and liberal arts students from physics departments and schools of engineering from 30 randomly selected institutions of higher education with ABET approved engineering programs. Enrollment data have been obtained from departmental and/or registrar's office staff. Course descriptions are abbreviated from catalogs and syllabi available online.

PHYSICS	ENGINEERING
1. The University of Akron	
Courses were not found.	Courses were not found.
2. Alfred University	
PHYS 111 Introductory General Physics I A lecture and laboratory course which includes mechanics, wave motion and sound, fluids and heat. Calculus is not used but some knowledge of algebra and trigonometry is assumed. **Annual Enroll: 20** PHYS 112 Introductory General Physics II A lecture and laboratory course including electricity and magnetism, optics, and some modern physics. Calculus is not used but some knowledge of algebra and trigonometry is assumed. **Annual Enroll: 10**	Courses were not found.
3. Boise State University	
PHYS 100 Foundations of Physics Selected concepts of matter and energy that are widely applicable toward understanding our physical environment. A one-semester course for non-science majors. **Annual Enroll: 136** PHYS 101 Introduction to Physics A broad survey of basic physics concepts and principles including motion, energy, electricity, magnetism, light, relativity, atoms, fission and fusion. Some examples will be related to social applications. A one-semester core course that uses some basic algebra. **Annual Enroll: Course rarely taught—enrollment n/a.**	ENGR 100 Energy for society A general interest course having no prerequisite. A basic understanding of energy and how it has been put to use is developed to promote a better understanding of our present technological society with its energy, environmental, social, and political problems. Alternative as well as conventional energy solutions are considered. **Annual Enroll: 280** ENGR 101 Engineering for humanity How engineered works are designed, and the social obligations that exist between engineers and non-engineers. Includes the application of engineering science and engineering ethics. Discusses the aesthetics of engineered works, the collaborative nature of engineering, the psychology of engineering decisions, and the professionalization of engineers. **Annual Enroll: 90**
4. California State University, Fullerton	
PHYS 101 Survey of Physics: Basic concepts of physics for the non-science major. Physical concepts in real-world contexts such as global warming. How our ideas about motion, energy, heat and temperature, light and color, electricity, and atoms form a framework for understanding the natural world. **Annual Enroll: 280.**	Courses were not found.

5. University of California, San Diego	
<u>PHYSICS 8 Physics of Everyday Life</u> *Course text: How Things Work.* Examines phenomena and technology encountered in daily life from a physics perspective. Topics include waves, musical instruments, telecommunication, sports, appliances, transportation, computers, and energy sources. Physics concepts will be introduced and discussed as needed employing some algebra. No prior physics knowledge is required. **Annual Enroll: 600** <u>Physics 11 Survey of Physics</u> Survey of physics for non-science majors with strong mathematical background, including calculus. Physics 11 describes the laws of motion, gravity, energy, momentum, and relativity. A laboratory component consists of two experiments with gravity and conservation principles. **Annual Enroll: 200**	Courses were not found.
6. University of Central Florida	
Courses were not found.	<u>EGN 1050C The Digital Universe</u>: PR: High School Algebra or Trigonometry. Science, math, engineering, and technology fundamentals of the information technology. Historical significance of the advances in digital technology. Real world applications. Hands-on laboratories using digital signal processor kits. Occasional. **Annual Enroll: Course rarely taught—enrollment n/a.** <u>EGN 1360 Materials in Today's World</u>: A survey of the properties, manufacture, and uses of metals, ceramics, and polymers in today's world with emphasis on modern developments and new materials. **Annual Enroll: Course rarely taught—enrollment n/a.** <u>EGN 2815C Space Science and Technology: Past, Present, and Future</u>: Introduction to space technology, past, present and future. Applications to modern life. **Annual Enroll: Course rarely taught—enrollment n/a.**
7. University of Colorado at Boulder	
<u>PHYS 1010 (3). Physics of Everyday Life 1</u>**.** Course text: *How Things Work* Intended primarily for nonscientists, this course covers physics encountered in everyday life. Topics include balls, scales, balloons, stoves, insulation, light bulbs, clocks, nuclear weapons, basics of flashlights, and microwave ovens. Prereq., high school algebra or equivalent. **Annual Enroll: 200** <u>PHYS 1020 (4). Physics of Everyday Life 2.</u> Course text: *How Things Work* Intended primarily for nonscientists, this course	Courses were not found.

is a continuation of PHYS 1010. Includes electrical power generation and distribution, electrical motors, radio, television, computers, copiers, lasers, fluorescent lights, cameras, and medical imaging. Prereqs., PHYS 1010 and high school algebra. **Annual Enroll: 51**	
8. University of Dayton	
PHY 105 Physical science Broad introduction to physical science. Emphasis on concepts and scientific thought processes dealing with principles in physics; some applications to chemistry, astronomy, and meteorology. This course includes an integrated laboratory component. For non-science students. **Annual Enroll: 126** PHY 108 Physical science of light an color A treatment of physical science with emphasis on light, color, and the interaction of light with materials. For non-science students. **Annual Enroll: 66** SCI 190. The Physical Universe An introduction to physical science which uses cosmological evolution as a unifying theme. Emphasis will be on concepts and scientific thought processes in dealing with the fundamental principles in physics involved in the Big Bang to planetary evolution. **Annual Enroll: 844**	Courses were not found.
9. Fairfield University	
Courses were not found.	Courses were not found.
10. Gannon University	
Courses were not found.	Courses were not found.
11. University of Hartford	
Courses were not found.	Courses were not found.
12. Idaho State University	
Courses were not found.	Courses were not found.
13. Kansas State University	
PHYS 101 The Physical World I The course is designed to present an overview of the physical sciences for students who have little or no previous physical science. The Physical World I is principally physics and atomic theory. The observations and phenomena are simple and basic. **Annual Enroll: 500** PHYS 102 The Physical World II Continuation of PHYS 101. The Physical World II presents an over- view of astronomy, geology, chemistry, and molecular biology. **Annual Enroll: 80**	Courses were not found.
14. Lipscomb University	
Courses were not found.	Courses were not found.
15. University of Maryland College Park	
PHYS101 Contemporary Physics For non-science students who are interested in the evolution of scientific thought and its present day	Courses were not found.

significance. Historical, philosophic, experimental and theoretical aspects of physics are presented. Topics in mechanics, relativity, electricity and magnetism, and nuclear physics are covered. **Annual Enroll: 33** PHYS102 Physics of Music A study of the physical basis of sound, acoustical properties of sound, the human ear and voice, reproduction of sound, electronic music, acoustical properties of auditoriums, and other selected topics. **Annual Enroll: 137** Physics 104 How Things Work This course is based on the course for non-science majors, which has been taught at the University of Virginia by Lou Bloomfield. Although this is a primarily a non-mathematical physics course, I expect you to have math understanding at the high school level. Explanations will be mainly with words and pictures; only simple mathematical relations will be used to aid in the description of the basics of mechanical, electrical, and optical devices. The lectures will concentrate on covering the major topics and providing insight into the material. **Annual Enroll: 471** PHYS111 Physics in the Modern World A survey course in general physics emphasizing the role that physics plays in science, technology, and society today. The course is concept oriented and minimal use of mathematics is made. Intended for the general student; does not satisfy the requirements of the professional schools. **Annual Enroll: 58**	
16. Miami University	
PHY 101 Physics and Society Introduction of fundamental principles of physics and discussion of the interaction of science and society, both today and in the past. Provides skills in thinking critically about societal problems which have a scientific or technological component. **Annual Enroll: 336** PHY 121 Energy and Environment Application of physics principles and models to societal uses of energy. Includes mechanics, electricity and magnetism, thermodynamics, and atomic and nuclear physics. Energy topics include resources, environmental problems, global atmospheric challenges, nuclear power, solar energy, alternative energy systems, and energy conservation. Algebraic skills are required but no previous course in physics is needed. **Annual Enroll: 112** PHY 141 Physics in Sports Various aspects of a dozen or more sports are treated using the laws of physics. Provides the	Courses were not found.

non-science student with insight into principles governing motion, dynamics, and other elements of physics in sports. **Annual Enroll: 47** MPF 131 Physics for Music Introduction to the basic physics of sound within the context of music. Production, transmission, and reception of sound waves; traditional and electronic musical instruments; physics of sound reproduction. **Annual Enroll: 75**	
17. University of Mississippi	
PHYS 107 Physical Science I The obstacle of advanced mathematics are avoided in this course by presenting the ideas of physics conceptually with equations used as guides to thinking about the relationships in nature rather than as recipes for algebraic computations. **Annual Enroll: 222** PHYS 108 Physical Science II Continuation of PHYS 107. **Annual Enroll: 198**	Courses were not found.
18. University of Nevada - Las Vegas	
Courses were not found.	Courses were not found.
19. State University of New York at New Paltz	
PHY100 Physics for the Inquiring Mind A course in basic physics for non-science majors that stresses conceptual understanding of familiar (and not so familiar) phenomena. Mathematical formalism is held to a minimum, although some elementary algebra is helpful. **Annual Enroll: 20**	Courses were not found.
20. Northeastern University	
PHY 121 Provides non-science majors interdisciplinary introduction to the basic ideas of the natural sciences. This course is an introduction to science, and how it is used to understand the world around us, as well as the universe beyond our planet, and the microscopic world of atoms and molecules that we cannot see directly. The emphasis in the course will be on the ideas and experimental facts which underlie scientific knowledge, but we will also deal with fairly simple quantitative (numerical) problems. **Annual Enroll: 114**	Courses were not found.
21. Oklahoma Christian University	
Courses were not found.	Courses were not found.
22. Pennsylvania State University, Harrisburg, The Capital College	
Physics 001 The Science of Physics Historical development and significance of major concepts, with emphasis on the nature of physics and its role in modern life. (For students in non-mathematical fields.) **Annual Enroll: 79**	Courses were not found.
23. University of Puerto Rico, Mayaguez Campus	
Courses were not found.	Courses were not found.

24. Rutgers, The State University of New Jersey - -New Brunswick	
<u>106 Concepts of physics for humanities and social science students</u> *Not for credit towards physics major or minor.* Concepts of physics and astronomy in their scientific, social, historical, and current technological context, with no mathematical problem-solving. How the physical universe works, from mechanics and the solar system to relativity, quantum behavior, and the Big Bang. Contributions of scientists from Aristotle, Galileo, and Newton through Einstein, Bohr and up to the present time. **Annual Enroll: 180**	Courses were not found.
25. Seattle University	
Courses were not found (lower level physics courses, for example, were for premed and similar students).	Courses were not found.
26. Southern Methodist University	
<u>1301 The Ideas of Modern Physics</u> Will attempt to present cosmology, relativity, quantum mechanics, and particle physics in an essentially descriptive, nonmathematical framework accessible to all SMU students. Fulfills a requirement for Laboratory Science. Prerequisite: None. **Annual Enroll: 45** <u>PHYS 3333 The Scientific Method – Critical and Creative Thinking (Debunking Pseudo Science)</u> This course will provide you with an understanding of the scientific method sufficient to detect pseudoscience in its many guises: paranormal phenomena; free-energy devices; alternative medicine; intelligent-design creationism; and many others. You will learn to think critically and to question outlandish claims, hype, and outright BS. Expect to do a lot of reading, writing, and, most of all, thinking. **Annual Enroll: 55** <u>PHYS 1313 Fundamentals of Physics</u> On-line course description was not found. Based upon verbal communication with the instructor, the course is appropriate for non-science majors. **Annual Enroll: 30**	Courses were not found.
27. Syracuse University	
<u>Phy 101 Major Concepts of Physics</u> An introductory course in physics. The course is a survey of introductory physics and its application to other sciences, organized around the theme of energy. **Annual Enroll: 270**	Courses were not found.
28. University of Texas, Austin	
<u>309K Elementary Physics for Nontechnical Students.</u> Designed for students who do not intend to do further work in natural sciences, engineering, mathematics, or medicine. Mechanics, heat, and	<u>301 World Health and Biotechnology</u> Overview of contemporary technological advances to improve human health. Introduction to major human health problems, the engineering method as applied to medical technologies, and

sound. Approx **Annual Enroll: 45** 309L (TCCN: PHYS 1307). Elementary Physics for nontechnical Students. Designed for students who do not intend to do further work in natural sciences, engineering, mathematics, or medicine. Electricity and magnetism, light, atomic and nuclear physics. **Annual Enroll: 45**	legal and ethical issues involved with the development of new medical technologies. **Annual Enroll: 55**
29. Tri-State University	
PH 104 Physical Science A development of basic concepts and theories in the physical sciences and physics. Conceptual view of mechanics, thermodynamics, sound waves, electricity, magnetism, and sound waves. **Annual Enroll: 27** PH 114 Introduction to Physics (Algebra and Trig. Prereq.) An introduction to the concept and application of Newton's Law, linear motion, rotation motion, laws of conservation of both energy and momentum, etc, etc.). **Annual Enroll: 14**	ENT 323 Engineering Concepts for Non Engineering Majors Fundamental engineering concepts are introduced, with an emphasis on developing foundations for lifelong learning on technological issues. Broad-based technologies and the importance of technical communication are emphasized. Current and future technologies are discussed by visiting practitioners. Not open to students enrolling in engineering and technology programs. **Annual Enroll: 10**
30. Vanderbilt University	
Phy 105 Conceptual Physics Introduction to fundamental concepts that provide an integrated view at all length scales. Selected topics from classical physics and major advances in 20th century. **Annual Enroll: 80**	Courses were not found.