Application for Bingham Award Renewal

Jamie Day

2017

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Reflections on Professional Evolution

Jamie Day

"Before enlightenment, chop wood, carry water.
After enlightenment, chop wood, carry water." –traditional Buddhist saying

When I received the Bingham Award roughly fifteen years ago, I was untenured, had no children and my wife was in graduate school in another state. In other words, I had all the time in the world to devote to my profession. I certainly *should* have been excellent! A significant portion of my career has transpired in the interim, and things have grown increasingly more complex in both my personal and professional lives. Nevertheless, new demands such as parenthood and university service as Division Chair did not fundamentally alter my approach to teaching. Although I have earned tenure and two promotions since receiving the Bingham Award, I learned early in my career that I, personally, could not work specifically toward such career markers, as this created anxiety and stifled creativity. Instead, I learned simply to do good work, to answer to my own curiosity and to share this curiosity with our students and my peers. I strive to respect each student as an individual on their own terms, which requires that I do my best to bring authenticity, humility and humanity to my teaching. Further, I consistently try to demonstrate a willingness to take risks and to make mistakes. Coupled with this, I try to model the hope and persistence necessary to learn complex material despite setbacks. Honestly, I find teaching to be difficult intellectually and emotionally…every bit as messy and frustrating as learning was in the first place. Fortunately, I also find teaching very rewarding.

I was pleased that the instructions for the renewal application use the term evolution. A key to understanding Darwinian evolution is to accept the vastness of geologic time in relation to the heartbeat of a mammal. Geologic change and genetic change are always underway, but typically too slow for anyone to notice. Similarly, evolution within my teaching is usually too slow for me to notice at the time. My career has been free from epiphanic events that abruptly altered my course, but following my philosophy outlined above has allowed me to develop slowly but significantly as a teacher.

Scholarship and Teaching

I have the wonderful honor of caring for one of the finest collections of beautiful and bizarre scientific artifacts in America. Curating this collection greatly influences me as a scholar—I began serving as curator of our collection just before receiving the Bingham Award, and have since almost entirely shifted my research focus to the history of science—but it also influences my teaching. The bulk of the collection consists of didactic instruments for teaching Natural Philosophy, so researching these artifacts is effectively researching the history of science teaching. This work has taken me to libraries and museums around the US, Europe, and nearly to China (but enrollment for the travel course fell short). It has led to new courses (discussed below), a new publication (Transylvania Treasures) and introduced me to a global community of scholars interested in the way we illustrate and demonstrate science.

Many of the instruments were constructed simply to illustrate physical phenomena, because the underlying theory was not yet established. They were purchased by the college's earliest scientists to illustrate the beauty and mystery of our world. Unfortunately, many college-level physics courses have become so content driven that we forget to revel in the phenomena that drew us into science in the first place. A few instruments are durable enough to use today. Sometimes instead I build inelegant but functional replicas, and sometimes I must resort to simply discussing what the instruments *could* demonstrate if it were safe and legal to use them today, but the spirit of wonder and excitement these instruments represent is free, and I try to infuse it into my classes.

No Scholar is an Island

I consistently stress to my students that learning is not a solitary pursuit, and this holds true for me as I continue to learn and grow as a teacher. Learning from colleagues is the single most effective means I have found for improvement. Fortunately, working at Transylvania has afforded me many such opportunities. Some of these experiences are quite rejuvenating, such as the three Alternative Winter Break service-learning classes I accompanied to Guatemala. As I told our interim dean at the time, these classes are terribly inefficient ways of building houses, but incredibly efficient ways of changing the hearts and minds of our students (and faculty). Other experiences, particularly mentoring untenured faculty, are primarily a developmental, for me as well as for the untenured professors. In my experience, however, interdisciplinary team teaching is a perfect combination of development and renewal. For the duration of this reflection I will delve into the roles of mentoring and team teaching.

Learning through Mentoring

During my five-year term as division chair, I conducted a total of twenty-five teaching evaluations of ten different instructors. Transylvania's evaluation process is standardized. A meeting is held before hand to discuss a course, the students in the class, the teaching environment, and any specific concerns the instructor wants to share. This is followed by visits to two consecutive classes, after which a formal letter is drafted. A final meeting is held to discuss the letter and any observations or suggestions not discussed in the letter. (NOTE: Especially during an instructor's first three years at Transylvania, I focused primarily on the positive aspects of their teaching in the letter, and discussed any non-egregious negatives in person. This allowed the new hires the opportunity to find their grounding, and gave them the freedom to take risks without fear of mistakes reaching their permanent file.)

Ostensibly, the purpose of mentoring is to help new faculty discover their voice and develop into valued colleagues who sail through the tenure process. In my personal experience, however, the act of mentoring was incredibly valuable to me as well. I find the act of mentoring quite demanding, but very productive in terms of improving my own teaching. This was the case whether the new hire was experienced or green. Interacting with struggling novice faculty members was quite instructive. I was expected not only to observe what was effective or ineffective, but also to find appropriate language to accurately and humanely describe a colleague's teaching and any shortcomings. The act of writing these letters required me to contemplate teaching—including my own—in a very profound manner. In the case of experienced or gifted teachers, the process of mentoring provided many fresh ideas to try in my own classrooms. Additionally, the task of offering useful suggestions to someone who was already quite proficient required extensive effort; yet this was exactly the sort of suggestions I needed to improve my own teaching.

Team Teaching

I discovered team teaching quite early in my career, and feel incredibly fortunate for the many opportunities Transylvania offers for these unique and stimulating experiences. I team taught twice with division members in Biology and Mathematics before receiving the Bingham Award. After attending several Project Kaleidoscope workshops, I began focusing on interdisciplinary teaching with faculty outside the division. Since receiving the Bingham Award, I team-taught interdisciplinary courses six times with four different professors and a fifth faculty member and I taught parallel sections of our first year research course. Furthermore, I team-taught *First Engagements* with students (who I treated as true collaborators) twice in August Term. Each of these experiences was invaluable in terms of personal and professional growth. Below I highlight a few concrete lessons from each of the full-credit team-taught courses.

Faith and Physics: The interplay between received and empirical knowledge.
More than anything, team-teaching this course with a religion (Buddhism) scholar taught me how to direct and manage classroom conversations about exceedingly personal and potentially explosive topics. In it we created a safe environment for our students to grapple with the complex religious and scientific natures of our society. Students were very responsive to this offering and several were turned away due to the large demand. They arrived with a wide variety of scientific and religious backgrounds, and (with my colleague's help) were surprisingly open, respectful and participatory. The world truly needs more classes like this, and I am grateful for the opportunity to have had this learning experience myself.

Health Studies Seminar
It is easy for an undergraduate student to equate "pre-med" with Organic Chemistry and Anatomy. This course, which I team-taught twice with a psychology professor, was designed to counter this misconception, to broaden our students' understanding of health, and to rekindle their curiosity and passion for caring and healing. Originally introduced to the curriculum by a two biologists, my colleague and inherited the course with free reign to modify it to suit our strengths and interests. This May Term course taught me how to direct a seminar, a teaching style which I have since permanently integrated into the physics curriculum in Modern Physics, which I now run entirely as a seminar. It was also the first course for which I organized a series of visitors and field trips, in this case to expose students to an array of health care professionals including an epidemiologist, a surgeon, a naturopathic physician and an herbalist.

A Miracle of Rare Device
Many long and interesting conversations about the fruitful symbiosis between art and science during the enlightenment led to the development of this class. I summarize the final instantiation of our dream as a month-long celebration of wonder. We—students and faculty—entertained ourselves with the beauty and power of words and the beauty and power of the physical world. We invited exploration by leaving several enlightenment-era instruments (electrical machines, vacuum chambers, mirrors and lenses) in the classroom for experimentation. We regularly stayed late in the sculpture studio so students could use power tools to build 3D models of ideas contained within their poems. Through this experience, I learned the very valuable lesson that sometimes it is best simply to let go in a classroom. How do we create life-long learners if we never give them the opportunity to explore their own thoughts and follow their curiosity? I now apply this free-form model of curiosity-driven learning to one of my University Physics labs and several of my upper-level labs in Optics and Modern Physics.

Corporeal Commodity: The Body in Art, Science and Religion
Curating anatomical specimens in Transylvania's collection of historic medical artifacts led me to study anatomy as both a cultural and scientific enterprise. In this class, I teamed with a visual artist who studied anatomy in order to accurately portray the human body. We designed a May-Term course that

examined the many different ways we value and devalue our physical selves; the social injustices heaped upon unfamiliar and unappreciated body types; and the pain and shame we self-inflict. We also explored healthier ways to relate to our bodies. This course was highly project-driven, with a broader array of projects than any course I have ever taught including projects in the visual arts, quantitative homework problems, social experiments, music and dance, and theater projects. Undoubtedly, our assignments were difficult because they required students to grapple with complex, emotionally-charged subjects. We always offered alternative assignments for any students who were uncomfortable, but both times we taught this class I was personally touched by the bravery and creativity of the students. They pushed themselves further than we ever expected, and even inspired me to push myself in new ways. Two students (apparently independently) described having a "religious experience" of self-acceptance while completing one assignment. I cannot imagine anything more satisfying as a teacher.

Conclusion:
I trust that the committee will recognize my commitment to teaching, my habit of regularly challenging myself with new experiences, and my efforts to not only improve my own teaching but that of my colleagues as well. I enjoy this work, and I enjoy it more because of the true liberal arts environment in which I work, which has allowed me so much freedom to explore and grow.

Thank you for your work to help sustain and enhance this environment and this community.

JAMES CARL DAY
Professor of Physics
Transylvania University
Lexington, KY 40508

EDUCATION:

Ph.D., Experimental Atomic Physics, 1995, University of Kentucky, Lexington, KY

B.A., Physics with Honors and Math, 1988, Carson-Newman College, Jefferson City, TN

PROFESSIONAL HISTORY:

Transylvania University, Lexington, Kentucky:

Full Professor: Promoted September, 2008.

Associate Professor: Tenured & Promoted September, 2002

Curator, Moosnick Science & Medical Museum, 2000-Present

Assistant Professor 1997-2002

Visiting Assistant Professor, 1996-1997

The Bakken Museum, Minneapolis, MN:

Visiting Research Fellow, Summer 2010

Smithsonian Institution, Washington, DC:

Dibner Library Resident Scholar, Spring 2003

University of Aarhus, Aarhus, Denmark:

Guest Researcher, Summer 1999

Postdoctoral Researcher, 1995 - 1996

Visiting Researcher, Spring & Summer 1993

Kansas State University, Manhattan, Kansas:

Visiting Researcher, Summers of 1997, 1998

University of Kentucky, Lexington, KY:

Research Assistant, 1990 - 1995

Teaching Assistant, 1989 – 1990

Hanscom Air Force Base, Concord, MA:

Private Scientific Contractor, Summer 1990

Oak Ridge National Laboratories, Oak Ridge, TN:

Summer Student Researcher, 1987

HONORS and GRANTS:

Moosnick Fellow, 2014 - present, Transylvania University

Bingham Award for Excellence in Teaching, 2001 - present, Transylvania University

Bingham Program for Excellence Start-Up Grant, 1997, Transylvania University

Areas of National Need (ANN) Full Fellowship, 1991 - 1995, University of Kentucky

EXTERNAL GRANTS:

The Bakken Museum Visiting Research Fellow: ($2500) 2010.

Kentucky Space Grant Consortium Campus Objective Grant: ($3000) 2007, 2006, 2005; ($1500) 2002.

Smithsonian Institution Libraries Dibner Library Resident Scholar: 2003 ($2500).

National Science Foundation, "Improvement of the Natural Sciences Curriculum Through Use of Multinuclear NMR Spectroscopy." Carl E. Heltzel (Principal Investigator), Eva Csuhai, James C. Day, Peggy S. Palombi: 2000-2002 ($100,000).

INTERNAL GRANTS:

David and Betty Jones Faculty Development Grants:

2015, 2013, 2011-2007, 2004, 2002 and 2000: To research Transylvania's historic scientific instruments and medical artifacts ($2100-$3500).

1999: To conduct atomic physics research at the Institute for Physics and Astronomy in Aarhus, Denmark ($2700).

1998, 1997: To conduct atomic physics research at the McDonald Lab at Kansas State University, Manhattan, Kansas ($1120, $850).

Keenan Faculty Development Grant: 2010, 2003: Sabbatical Grants to research Transylvania's historic scientific instruments and medical artifacts ($3000, $8650).

CAMPUS SERVICE:

Standing Committees:

Personnel: 2003 - 2005, 2016 - present **Chair:** 2004-2005, 2016-2017

Personnel Subcommittee on Tenure and Promotion: 2010 - 2012

Writing Assessment: 2005 - 2007

Curriculum and Programs Committee (CPC): 1998 - 2000

Board of Trustees Committees:

Liaison to Finance (Budget) 2003- 2005.

Academic Affairs Committee: 1999 - 2001

Other:

Physics Program Director: 1999 – 2002, 2004 – 2007, 2016-present. (Program Reviews: 2000, 2006)

Transylvania Treasures Editorial Committee: 2008 - present

Pre-Health Committee: 2000, 2007-2009, 2013-present, **Chair:** 2007-2009

Chair, Division of Natural Sciences and Math: 2011- 2016

Search Committees: Art (2010), Biology (2007, 2013), Chemistry (2012, 2014), Computer Science (2014), Dean (2013), Exercise Science (2004, 2013, 2015), Math (2015), Physics (2015), Religion (2006, 2007, 2008), Women's Studies (2006).

Faculty Classroom Visitations: (External Visitor): Cox, Fortner, Maupin, Ojeda, Orleans, Poynter; (Division Chair): Bowman, Bray, Brown (J), Duffin, England, Fox, Hanaki, Kaufman, Schnitzenbaumer, Stuffelbeam.

Transylvania Scholars Premier Scholarship Selection Committee: 1999, 2009

Society of Physics Students Local Chapter Director: 1998 – present.

Teagle Student Life Committee: 1998 - 2000

Math Club Faculty Advisor: 1998 – 2000

Boyarsky Award for Excellence in Research, Selection Committee: 1997 - 1999

COURSES TAUGHT:

General Education Courses

Conceptual Physics	PHYS 1014	
First Engagements	FEN 1014	(w/ Kali Mattingly & Elaine Bailey)
Foundations of the Liberal Arts II	FLA 1102	(parallel w/ Richard Taylor)
Measuring the Universe (New)	PHYS 1024	
Sight & Sound (New Course)	NS 1104	(with Peggy Palombi)

Special Topics

The Body in Art, Religion & Science	NS 2294	(with Kurt Gohde)
Faith and Physics	NS/Rel 2294	(with Trina Jones)
Health Studies Seminar	NS 2294	(with Mark Jackson)
Introduction to Theoretical Physics	PHYS 2444	
A Miracle of Rare Device	IDS/ENG 2294	(with Maurice Manning)
Service Learning in Guatemala	IDS 1111	(with Mike LeVan)

Major Courses

University Physics I & II	PHYS 2115, 2125
Modern Physics I & II	PHYS 2154, 2164
Optics	PHYS 2404
Classical Mechanics	PHYS 3014
Thermodynamics	PHYS 3024
Electricity & Magnetism	PHYS 3054
Research in Physics	PHYS 3101
Quantum Mechanics	PHYS 4064
Senior Research in Physics	PHYS 4102

PROFESSIONAL SERVICE:

Henry Clay Memorial Foundation: Advisory Board Member, 2009 – present; Collections Committee, 2009 – present; Educational Programming: 2016 – present.

Kentucky EPSCoR: Kentucky Space Grant Consortium: 2001 – 2011

Kentucky Science and Engineering Foundation Grant Reviewer: 2005-2009

Associate Editor, **Rittenhouse:** Journal of the American Scientific Enterprise. 2004 – 2007

American Association of Physics Teachers, History and Philosophy of Science Committee: 2002 – 2004

MUSEUM LOANS

Ashland: The Henry Clay Estate, "To Educate the Masses: The Kentucky University and Agricultural and Mechanical College at Ashland", Temporary Exhibit, March17 through Dec. 31, 2015, Lexington, KY. Transylvania Artifacts: Korean Suit of Armor, Hair Ball, Taxidermied Birds, Clay-family Carved Coconut, Native American Spoon, plus items from Special Collections.

Indiana State Museum, "Science on the Edge" Temporary Exhibit, March 24 – Oct. 28, 2012, Indianapolis, IN. Transylvania Artifacts: *T.F. Randolph & Bro* Surveying Compass, *E. M. Clarke* Goniometer, *Zeiss* Microscope, Chemical Blowpipe and Lamp, Magnifying Lens.

Hite Museum (University of Louisville,) *"The Arthur Byrd Cabinet of Curiosities from Transylvania University"* Temporary Exhibit Curated by Kurt Gohde, Spring 2010, Louisville, KY. Transylvania Artifacts: Hair Ball, Casts of Brains, Skull Caps, Bucket of Bones.

Chemical Heritage Foundation, "Making Modernity" 2008-2012, Philadelphia, PA. Transylvania Artifact: Joseph Henry's Chemical Scale of Equivalents.

The Benjamin Franklin Tercentenary: "Benjamin Franklin: In Search of a Better World," Traveling Exhibit: 2005-2008, Philadelphia, St. Louis, Houston, Denver, Atlanta & Paris. Transylvania Artifact: Kinnersley Thermometer, one of six instruments featured in "A Gentleman's Laboratory".

American Printing House for the Blind / Kentucky School for the Blind, "In Touch with Knowledge: The Educational History of Blind People," Traveling Exhibit: 2003-2008, 13 locations (including U.S. Capital Rotunda) in 10 states. Transylvania Artifact: Auzoux model of the eye.

Ashland: The Henry Clay Estate, "John Bowman's Natural History Museum," Temporary Exhibit, Lexington, KY, Spring 2007. Transylvania Artifacts: Korean Suit of Armor, Taxidermied Birds, Hair Ball, Carved Coconut, Native American Spoon.

Salato Wildlife Education Center, Frankfurt, KY: "Lewis & Clark Bicentennial Exhibit", Temporary Exhibit, Frankfort, KY, Spring & Summer 2004. Transylvania Artifacts: Traveling Apothecary, Compass, Medical Texts.

ideaFestival, "Time, Chimes & Equine", a component of the ideaFestival 2002 "A Matter of Time", Temporary Exhibit, Lexington, KY, Fall 2002. Transylvania Artifact: W. & S. Jones Orrery.

PUBLICATIONS

Transylvania Treasures:

Volume 8, (2016): No. 2, "A Most Beautiful Species of Illumination" in publication

Volume 6, (2013): No. 1, "A Brief Discourse on the Happy Effects of the Tobacco-Smoke Glyster"

Volume 5, (2012): No. 1, "Barlow's Amazing Planetarium"

Volume 3, (2010): No. 2, "Charles Wilkins Short's Herbarium Cabinet"

Volume 2, (2009): No. 1, "Dr. Charles Wilkins Short's Herbarium"
No. 2, "The Magic of Selenite Slides"
No. 3, "The Anatomical and Surgical Works of John & Charles Bell"

Volume 1, (2008): No. 1, "Robert Peter's Daguerreotype Camera"
No. 2, "A Treasure Trove of Natural History"
No. 3, "Transylvania's Medical Venus"

"Robert Peter's Daguerreotype Camera", James C. Day, *Image: The Magazine of George Eastman House*, **48**, p. 19, (Fall 2010-Winter 2011).

"The Barlow Planetarium: A History and Mechanical Analysis", Jamie Day, *Rittenhouse: Journal of the American Scientific Instrument Enterprise*, **16**, p. 1 (2002).

"Dynamics of a single Rydberg shell in time dependent external fields", M. Føffe, D. Fregenal, J.C. Day, T. Ehrenreich, B. Henningsen, E. Horsdal-Pedersen, L Nyvang, O.E. Povlsen, K. Taulbjerg, and I Vogelius, *Journal of Physics B: Atomic, Molecular and Optical Physics,* **35**, p. 401, (2002).

"Dynamics of Rydberg states in crossed E and B fields", P. Sorensen, J. C. Day, B. D. DePaola, T. Ehrenreich, E. Horsdal-Pedersen and L. Kristensen, *Journal of Physics B: Atomic, Molecular and Optical Physics*, **32**, p.1207, (1999)

"Electron Capture From Rydberg Atoms by a Direction-of-Approach Method", K. B. MacAdam, J. C. Day, D. A. Homan, *Comments on Atomic and Molecular Physics D: Modern Phys*. **1**, p. 57 (1999).

"Electron Capture from Coherent Elliptic Rydberg States", J. C. Day, B. DePaola, T. Ehrenreich, S. B. Hansen, E. Horsdal-Pedersen, Y. Leontiev, K. S. Mogensen, *Phyical Review A*. **53**, 4700 (1997).

"Application of Coherent Rydberg States for Collision Studies", E. Horsdal-Pedersen, J. C. Day, B. DePaola, T. Ehrenreich, S. B. Hansen, Y. Leontiev, K. B. MacAdam and K. S. Mogensen, in XIX International Conference on the Physics of Electronic and Atomic Collisions, Invited Papers, *AIP Conf. Proc.* **360** (1995) p. 609.

"Transient Molecular-Ion Formation in Rydberg-Electron Capture", K. B. MacAdam, J. C. Day, J. C. Aguilar, D. A. Homan, A. D. MacKellar and M. J. Cavagnero, *Physical Review Letters.* **75**, 1723 (1995).

"Coherent Elliptic States in Lithium", K. S. Mogensen, J. C. Day, T. Ehrenreich, E. Horsdal-Pedersen and K. Taulbjerg, *Phys. Rev. A* **51**, 4038 (1995).

"Electron Capture from Oriented Elliptic Rydberg Atoms", T. Ehrenreich, J. C. Day, S. B. Hansen, E. Horsdal-Pedersen, K. B. MacAdam and K. S. Mogensen, *J. Phys. B: At. Mol. Phys.* **27**, L383 (1994).

"Formation of Oriented Elliptic Rydberg Atoms", J. C. Day, T. Ehrenreich, S. B. Hansen, E. Horsdal-Pedersen, K. S. Mogensen and K. Taulbjerg, *Phys. Rev. Lett.* **72**, 1612 (1994).

CONTRIBUTED PAPERS & PRESENTATIONS

“The Barlow Planetarium,” J. C. Day, Kentucky Historical Society’s Boone Day Keynote Speaker, Clark Center for Kentucky History, Frankfort, (June 4, 2016).

“Natural Philosophy during Transylvania’s Golden Age,” J. C. Day, Centre College Physics Colloquium Series (October 7, 2010).

“The Scientific and Medical Collections of Transylvania University,” J. C. Day, The Bakken Museum Colloquium Series (June 17, 2010).

"Legends, Lore, and Outright Lies from Transy's Golden Age,” J. C. Day, Transylvania University’s Spotlight Speaker Series (February 5, 2009).

“Scientific and Medical collections of Transylvania University,” J. C. Day, Smithsonian Museum of American History (Behring Center), Tuesday Colloquium Series (July 8, 2008).

“Material History of Transylvania University’s Medical Department,” J. C. Day, Transylvania University Symposium on the Medical History of Transylvania, Lexington, and the Ohio River Valley, (2007).

“Barlow’s Planetarium,” J. C. Day: After-Dinner Lecture, Second International Conference on Scientific Instrument Collections in Universities (SICU II), Ole Miss, (2007).

The political economy of university collections," D. Pantalony, Chair, J. C. Day, R. Liebowitz, R. McElheny, A. Morrison-Low: Round-Table session, International Conference on Scientific Instrument Collections in Universities (SICU), Dartmouth College, (2004).

"Images of Natural Philosophy in Transylvania University's Medical Library," James C. Day, American Association of Physics Teachers (AAPT) 129th National Meeting in Sacramento, CA (2004).

"Time in Technology: A Rare Look Back," James C. Day, ideaFestival: "A Matter of Time" Lexington, KY (2002).

"Sight and Sound: A Cross-Disciplinary Approach to Non-Majors Science Teaching," Peggy Shadduck Palombi and James C. Day, Association of College and University Biology Educators (ACUBE), Terre Haute, Indiana, (2000).

"Curriculum Strategies of Transylvania University's Undergraduate Physics Program," J. C. Day, Project Kaleidoscope Conference: "Undergraduate Physics Curricula: What Works and What Needs To Be Done" Lincoln, Nebraska, (1997).

"Electron Capture from the Top Stark Level of Na(n=24) Rydberg Atoms Near the Matching Velocity," D. M. Homan, O. P. Makarov, K. B. MacAdam, J. C. Day, E. Horsdal-Pedersen, and T. Ehrenreich, *Bull. Am. Phys. Soc.* **41**, 1071 (Paper WP41) (1996).

"Variation of Electron Capture from a Na Stark State as a Function of Alignment Angle," O. P. Makarov, D. M. Homan, O. P. Sorokina, J. C. Day and K. B. MacAdam, *Bull. Am. Phys. Soc.* **41**, 1071 (Paper WP40) (1996).

"Three-Swap Electron Capture for Ion Collisions with Oriented Circular- State Rydberg Atoms," D. M. Homan, J. C. Day, M. J. Cavagnero, K. B. MacAdam and D. A. Harmin, XIX International Conference on the Physics of Electronic and Atomic Collisions, Abstracts of Contributed Papers (1995) p. 113.

"Electron Capture from Oriented Elliptic Rydberg Atoms," T. Ehrenreich, J. C. Day, B. DePaola, S. B. Hansen, E. Horsdal-Pedersen and K. S. Mogensen, XIX International Conference on the Physics of Electronic and Atomic Collisions, Abstracts of Contributed Papers (1995) p. 851.

"Electron Capture from Aligned d-State Rydberg Atoms Near the Matching Velocity," J. C. Day, J. C. Aguilar, D. M. Homan and K. B. MacAdam, *Bull. Am. Phys. Soc.* **40**, 1337 (Paper FP33) (1995).

"Rapid Production of Circular Rydberg States by the Adiabatic Crossed- Field Method Using Pulsed Fields," J. C. Day, D. M. Homan, J. C. Aguilar and K. B. MacAdam, *Bull. Am. Phys. Soc.* **40**, 1337 (Paper FP34) (1995).

"Three-Swap Electron Capture for Ion Collisions with Circular Rydberg Atoms Near the Matching Velocity," D. M. Homan, J. C. Day, K. B. MacAdam and M. J. Cavagnero, *Bull. Am. Phys. Soc.* **40**, 1311 (1995).

"Electron Capture from Oriented Elliptic Rydberg Atoms," T. Ehrenreich, J. C. Day, S. B. Hansen, E. Horsdal-Pedersen, K. S. Mogensen and E. Wolfrum, XVIII International Conference on the Physics of Electronic and Atomic Collisions, Abstracts of Contributed Papers (1993) p. 725.

"Topology of Coplanar 3-Body (Ion-Rydberg) Collisions," J. C. Day, *Bull. Am. Phys. Soc.* **37**, 1097 (1992).

"Effects of Target Alignment on Rydberg-to-Rydberg Total Charge Transfer Cross Sections at Low Velocity," J. C. Day, S. B. Hansen, L. G. Gray and K. B. MacAdam, *Bull. Am. Phys. Soc.* **36**, 1257 (1991).

Syllabi

In reverse chronological order, I present five recent and representative syllabi:

(I removed standard material about Title XI, the Americans with Disabilities Act, Academic Integrity, etc. which are nearly identical in all Transylvania syllabi. Additionally, gathering these into one document significantly altered the formatting, so I apologize for any random errors that I was unable to fix.)

Modern Macabre Aesthetics

First Year Research Seminar
FYS 1104 Section 05

Our intricate, impermanent, physical bodies inspire a host of contemporary artists working within a variety of media. Our shared familiarity with the human corpus couples with our shared mortality to imbue our hearts, lungs, bones and brains with archetypal symbolism. Thus, our bodies provide artists with an arsenal of powerful visual metaphors. This course will examine the wide-spread incorporation of these elements into art forms as diverse as street art, sculpture, song lyrics, wall paper, haute couture, painting, tattoos, poetry, and photography, and will begin to address how artists turn the frightening and the repulsive into captivating and engaging creations.

(Dress detail, by Rachel Wright)

I certainly don't see the humour in my work as something that detracts from its seriousness. It's just a way of making difficult messages more palatable. –Patricia Piccinini

The difference between art about death and actual death is that one's a celebration and the other's a dull fact. –Damien Hirst

I like making images that from a distance seem kind of seductive, colorful, luscious and engaging, and then you realize what you're looking at is something totally opposite. It seems boring to me to pursue the typical idea of beauty, because that is the easiest and the most obvious way to see the world. It's more challenging to look at the other side. –Cindy Sherman

People who hate what I make hate me, too. They must think I am a demon or some kind of evil sorcerer. Those who understand what I do appreciate the determination, love, and courage it takes to find wonder and beauty in people who are considered by society to be damaged, unclean, dysfunctional, or wretched. –Joel Peter Witkin

Professor: Dr. Jamie Day BSC 105 233-8229 jday@transy.edu

Class Meetings: Shearer Art Building room 101, MWF 10:30-11:20

Office Hours: (others by appointment)

M	T	W	Th	F
9-10	10-11:30	9-10	10-11:30	9-10
3:30-5	4-5	3:30-5	4-5	

Student Learning Objectives:

- Demonstrate control/mastery of research-based academic writing;
- Conduct ethical and responsible independent research that draws from a variety of kinds of primary and secondary sources;
- Produce revisions that elevate the quality of work and thought;
- Create clear, purposeful writing appropriate for and engaging to intended audience;
- Use details in support of ideas;
- Demonstrate in written work and class discussion evidence of critical and creative reflection over assigned texts and course theme;
- Respect, acknowledge, assimilate, and reconfigure views of others, both in written work and class discussion.

Grading:

I grade on a 10-point scale so if your final grade is an 80, for example, you will receive at least a B-. However, I also compare the distribution of grades and look for clusters. This sometimes results in a more lenient grading scale. Your cumulative grade will be determined based on the following weights:

Participation (in class and on blog): 20%
Informal/short writing assignments: 20%
Topic Analysis: 10%
Annotated Bibliography: 10%
Proposal: 10%
Presentation: 10%
Final Draft: 20%

(Juan Gatti)

Your work in this course will continue to consist of critical reading, discussion, and writing -- all designed to enhance creative and critical reflection. During the term, you will again employ skills enabling you to develop, present, and support your own ideas and opinions while maintaining respect for those of others. You will also learn how to read more critically, to write about and discuss the assigned readings, and to reflect upon the issues raised. In addition, your work in this term will focus on learning effective research methods and on writing a well-researched, fully documented argumentative essay.

Class Participation

Class time will be spent discussing class readings and issues associated with those readings, learning how to write effectively, learning effective research skills, and participating in conference style presentations. Because the writing assignments and development of a research topic require a thorough understanding of the reading materials, discussions are aimed at clarifying issues and increasing students' critical comprehension. Productive discussions depend upon thorough reading of the material; attentive, respectful engagement with that material and with the positions and ideas of others; and a commitment to improvement of your writing. Your ability to succeed in this course, therefore, will be significantly influenced by your class participation.

Conferences with Professor and with Writing Center Consultants

Because one-on-one and small group discussions benefit thinking and writing, you are urged to take full advantage of opportunities to consult with other thinkers and writers as you progress through the term. You are also encouraged to schedule periodic conferences with your professor and to participate in Writing Center offerings as you progress through the stages of the research project and as you encounter the interesting and challenging texts presented in the course.

The Portfolio

You will do a great deal of writing in this class. You will assemble all informal writing (reflections, in-class writing, etc.) along with the topic analysis, annotated bibliography, strategic-plan/proposal, draft of the final essay, and final essay (including any drafts, peer reviews, and instructor's comments) into a portfolio.

The FYRS instructor will inform students as to submission procedures for individual assignments and for the final portfolio. Many instructors will request on-line submission of materials. Others will require paper submissions, including a portfolio of all informal and formal writing (including drafts) submitted at the end of the term.

- **Formal Writing**

Your formal writings in the class will all focus on the research project. Each of the assignments will represent a stage in the development of that project, which culminates in a 15-20 page research-based argumentative essay. Each assignment will be graded separately. *The final paper will be graded only after you turn in a completed draft to the professor, and revise with his or her suggestions in mind.*

- **Informal Writing**

Throughout the term, you will be writing in-class and out-of-class reflections of different sorts. Informal writing may involve brainstorming, freewriting, generating ideas, exploring and commenting on readings and discussions, etc.

(Joel Peter Witkin, Cupid and Centaur)

Writing Center:

All students are encouraged to take advantage of the Writing Center located in the basement of Haupt (rooms 12 and 15). Specially trained student consultants are available to assist you with any writing assignment at any stage of the writing process. Walk-ins are welcome, but it is best to schedule an appointment at https://sites.google.com/a/transy.edu/writing-center/home?pli=1

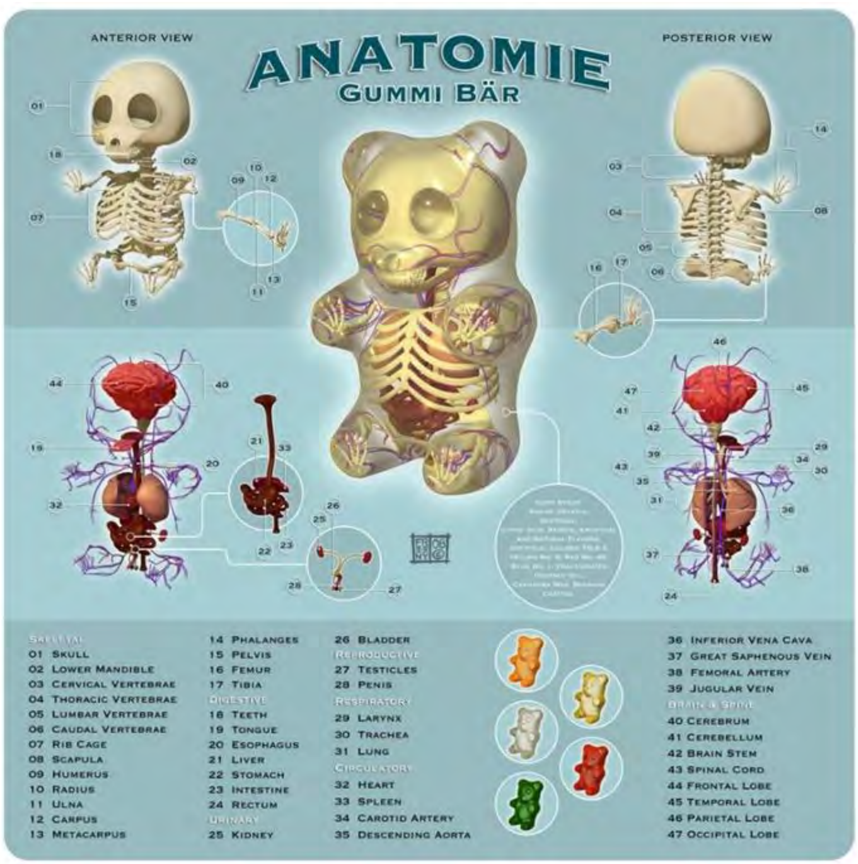
Tentative Course Schedule

Jan 9	Introductions, development of class policies
Jan 11	Purdue Owl // A Healthy Mania for the Macabre
Jan 13	Visual Metaphors of Edward Gorey // WC Liaison, Jordan Long
Jan 16	Martin Luther King Day
Jan 18	Library Day 1
Jan 20	Jan Švankmajer // Brothers Quay

Jan 23	Danse Macabre // FYRS conference 3:30-5:15
Jan 25	David Altmejd *Heads* and *Heart is a Werewolf*
Jan 27	Special Collections: Historic Anatomical Atlases
Jan 30	Discuss Annotated Bibliography
Feb 1	Danse Macabre
Feb 3	Moosnick Museum Tour
Feb 6	Topic Analysis Due
Feb 8	Workshoping Theses
Feb 10	Library Day 2
Feb 13	Writing Center Liaison workshop
Feb 15	Resource/Artist Sharing
Feb 17	Library Day 3
Feb 20	Discussion of Proposal
Feb 22	Theories of the Uncanny
Feb 24	Annotated Bibliography Due
Feb 27	Workshop proposals Presentation on Presentations: 12:30-1:30 or 3:30-4:30
Mar 1	Murder Ballads
Mar 3	Final editing of Lexicon of Disquietude
Mar 6	Michelle Davis (visiting medical illustrator and artist)
Mar 8	Proposal Due
Mar 10	Feedback on Proposals; Archetypes and Synecdoches

13-17	SPRING BREAK!!!
Mar 20	Peer Review: Intros and Claims
Mar 22	Two presentations
Mar 24	Two presentations
Mar 27	Peer Review (4-5 pages)
Mar 29	Two presentations
Mar 31	Two presentations
Apr 3	Peer review (9-10)
Apr 5	Two presentations
Apr 7	Two presentations
Apr 10	Peer review (full paper)
Apr 12	Two presentations
Apr 14	Two presentations
Apr 19	Make-up (snow) day if needed

(Jason Freeny)



Phys 2115 University Physics I

Professor: Dr. Jamie Day BSC 109 233-8229 jday@transy.edu

Introduction and Course Objectives:

When you were four, you were asking the right questions. Why do bees buzz? Why is the sky blue? Why is my face upside down when I look at it in a spoon? Four year olds are excellent at asking physics questions, but, unfortunately, most parents are generally pretty lousy at answering them. By the time you reach this class, society has done a fine job of beating a lot of your curiosity about the world out of you. I can't reverse two decades of social conditioning, but I'm sure as hell going to try. It is my sincere hope that you will leave this course with a refreshed sense of curiosity about the natural world and a new confidence of your ability to ask and find answers to significant scientific questions.

Several of you may not even know what physics is, so I'll offer one of my own definitions: Physics is an orchestrated human endeavor to describe the behavior of the physical world as accurately and succinctly as possible. There are two points about this definition that I want to emphasize. 1] First, physics, like all sciences, is a "human endeavor". This means that, despite our best intentions, both personal and cultural prejudices creep into the field. As students of science you need to be aware of this fact, and you also need to actively strive to limit the influences of your own preconceptions as you study. 2] Second, the purpose of physics is to "describe" the physical world. Physics tells us how things work, not why things work. (Metaphysicians and philosophers grapple with the question of why.) Physicists do not unlock secrets of the universe. We are not Dorothy, peeking behind the curtain to see the mighty Oz. We just the observe the physical universe, and then try to describe it with increasing precision and elegance. We'll discuss the behavior of electrons, but we'll never discuss what electrons really are (because we don’t know!) We'll use the idea of energy to solve all manner of problems, but at the end of the day, nobody knows what energy is, just that it helps us to simplify the math.

My primary goal for this course is to help you to become better thinkers. Solving physics problems requires many mathematical skills, but it also involves much critical thinking. You will gradually learn, or re-learn, many methods of quantitative reasoning that are applicable to many situations you will face in life. Solving physics problems requires you to isolate the significant quantities and ignore superfluous information. In many ways asking the right questions is the most important aspect of critical thought. A second and obvious goal is that you learn some physics! It's handy stuff to know and it will impress your friends and family. It will help you solve problems in other fields… there is, after all, a good reason why your major requires this course, so please trust your major professors and believe that, approached with the proper attitude, this class will make you better at whatever it is you're going to be.

Learning physics:

Learning physics is an iterative process where you interact with people, read books and web-sites, watch videos, and experiment over and over until you become able to solve problems, describe situations, predict outcomes, etc. It takes patience, and it takes effort; usually a lot of both, and I don't know any way to short circuit the learning process.

People: Don't be afraid of your species. I'm here to help you learn, and I encourage you to ask me for help, both inside and outside of class. Also, get in the habit of asking your peers for help. You will learn a lot from them and they will learn from you. We also have physics tutors in the library Sun-Thurs. [Note: You will learn best from people when you are honest with them and with yourself. Don't pretend to understand when you don't.]

Books: I know it's hard to read a physics book. Don't expect to understand everything you read, and don't expect one book to suffice. I'd advise against reading every word of the textbook; just peruse it before class. Look for the sticking points where you really bog down and try to write specific questions to ask me.

Web sites and Videos: There are thousands of physics web sites and videos on line, ranging from web pages of formulas to videos of entire MIT courses. When you're stuck on a concept, google it and get another perspective (and if you find something particularly useful, tell me and your classmates about it.)

Problems: You can learn a lot by watching and listening to others but, ultimately, to learn physics you need to solve problems. You should first attempt to work the assigned problems independently. Expect some difficulty, and be patient with yourself. However, when you get stuck please do not waste too much time spinning your wheels before you ask someone for a nudge. Whenever possible, try to not merely copy solutions. Make sure you understand them. Doing the assigned problems is the best way to prepare for the quizzes and tests.

Office Hours: For many students, this is the most significant opportunity for learning. Please take advantage!

Everyday	9:00-10:00
Tuesday through Thursday	3:30 – 5:00

Other times can be arranged by appointment. You can also reserve times during my regular hours if you want some privacy. Otherwise, there may be a crowd. To minimize the spread of panic, *office hours on test days are by appointment only*, and I will see you individually rather than in groups.

Student Learning Objectives: The primary "big idea" of this course is to better understand the physical world through physical principles, and to apply those principles to solving conceptual and quantitative physics problems. In light of this, upon successful completion of this course students will be able to:

- Using Newton's Laws, analyze forces acting on an object to find the object's position, velocity, and acceleration as a function of time (known as "equations of motion").
- Relate potential and kinetic energies to work; apply conservation laws and work-energy theorems to find equations of motion.
- Mathematically describe rotational motion including angular velocity and acceleration, rotational inertia, and torque, and apply conservation laws and Newton's equations to solve problems with rotating objects.
- Analyze systems with linear restoring forces or torques and describe their simple harmonic motion (oscillations).
- Recognize how physics shapes everyday life

Absence Policy: Please do not spread germs! If you are contagious, stay home and I will work with you when you are better. I try to be understanding about reasonable absences, but if an excuse smells fishy, I will ask you to take the matter to the academic dean. If you're called out for texting or surfing the web at any time during a period you will be counted as absent. Three or more unexcused absences may result in a lower grade for the course.

Grading:

Quizzes:	15%
Three Tests:	15% each
Comprehensive Final	20%
Class work and labs:	20%

I grade on a 10-point scale, so if your final grade is 80%, for example, you will receive at least a B-. However, I also compare the distribution of grades and look for clusters. Often this results in a more lenient grading scale.

Quizzes:

Short quizzes will be given about once a week, and at any time during class. These are significant: together, these quizzes are equal to a single test grade. The majority of quizzes will be based on the recent homework problems, but reading assignments, class work, lectures or lab ideas may creep in from time to time. I will drop the lowest quiz grade (maybe even a few of the lowest quiz grades).

Tests and final:

Tests will typically consist of several problems of varying difficulty that are similar to those assigned as homework and the examples worked in class. You will have the full period (until 3:20) to work on the tests. All necessary fundamental formulas and physical constants will be provided during the quizzes, tests and final.

Class work and Labs: One fifth of your final grade is based on exercises and labs conducted in class, usually in cooperation with a partner or two. Much of this work will be graded for effort, but occasionally I may ask you for formal reports, which will be evaluated based on data collection, analysis and interpretation as well as your clarity and grammar. The value of an exercise or lab will depend on the level of difficulty and time required for completion. I may give a few ***"Lab Quizzes"*** to ensure that people pay attention to the process and understand what they are doing. These will be administered pseudo-randomly, but always the period after a lab. These will be incorporated into your lab grade and count up to 20% of the grade for the relevant experiment.

Lab Reports (sometimes "lab results"):

> Note: I define a week as five regular school days (such as a Wednesday to the following Wednesday) unless a holiday intervenes.
>
> 1] Reports are due within one week after each lab, but will be accepted as late during the following week and be penalized one letter grade per day.
>
> 2] Lab reports should be emailed to me and to all members of the lab group who will receive credit. I will reply to all that I have received the report.
>
> 3] I will review each report within one week and reply to all if any action (such as recalculation, etc.) is necessary.
>
> 4] Groups have one week following the return of the report to complete any changes.

Course Schedule: Problems are tentative. Test dates are firm.

Text: Young & Freedman, University Physics, 13^{e}

Date	Reading	Problems to Attempt Before Start of Class
Sept 7		Welcome Aboard
Sept 9	1.1-7	11,12,15,16,17,20,22,26,56,60
Sept 12	1.8-10	31,35,41,43,44,45,47,53,70,73,74,90
Sept 14	2.1-3	5,6,8,10,11,12,15,18
Sept 16	2.4-5	23,29,32,38,40,43,63,68,84 Too many v^2 = V^2 probs
Sept 19	3.1-3	4,7,10,12,13,15,19,48
Sept 21	3.4	25,27,29,30,51,58,63,65
Sept 23	3.5	31,33,34,35,36,38,80,84
Sept 26	4.1-5	2,3,10,13,16,19,21,23
Sept 28	4.6	27,28,31,32,37,43,46,59
Sept 30	Test #1	
Oct 3	5.1-3	2,6,8,15,33,34,39,56,68
Oct 5	5.4-5	42 (bad diagram),44,46,49,51,53,115,117

Oct 7	6.1-2	**Start at 2:00 pm** 1,7,10,12,13,21,24,29,64
Oct 10	6.3-4	34,43,51,52,56,75,79,94
Oct 12	7.1-3	5,6,12,15,20,28,31,35,46
Oct 14	7.4-5	35,55,63,65,68,82,86
Oct 17	Break!	Fall Break!
Oct 19	8.1-3	1,9,13,19,21,26,69,77
Oct 21	8.4-6	34,37,41,47,48,83,85,91
Oct 24	8	51,53,61,63,67,79,98,106,108
Oct 26	9.1-3	3,7,9,11,13,18,19,23,29
Oct 28	9.4	21,24,25,33,35,41,47
Oct 31	Test #2	
Nov 2	10.1-3	1,3,7,13,15,21,25,67,87
Nov 4	10.4-7	31,32,33,37,38,43,45,49,51
Nov 7	12.1-3	2,7,9,11,13,21,25,30,31
Nov 9	12.4-5	37,39,40,41,45,46
Nov 11	Rest	
Nov 14	14.1-2	2,4,7,9,11,14,15,19
Nov 16	14.3-4	25,27,3540,42,72,77
Nov 18	14.5	45,47,50,65,91,95
Nov 21	15.1-3	1,5,7,9,11,12,13
Nov 23		Thanksgiving Break!
Nov 25		Thanksgiving Break!
Nov 28	15.4-6	15,19,23,32,35,56,61
Nov 30	15.7-8	37,38,39,41,44,49,72,80
Dec 2	Test #3	
Dec 5	16.1-3	9,11 (v_{brass} = 3475 m/s) 25,26,29
Dec 7	16.4-6	21,31,33,35,37,38,66
Dec 9	16.7-9	40,41,45,49,51,56,72
Dec 15	Final	Thursday, 9:00 AM

Modern Physics: Introduction to Quantum Mechanics

Phys 2164 Fall 2016

Introduction: This course is an opportunity for you to learn about one of the greatest and strangest theories advanced during the 20th century: Quantum Mechanics. The phrase "paradigm shift" may be overused these days, but it is appropriate (perhaps even a bit of an understatement) when applied to the revolution in scientific and philosophical thought brought about through the development of quantum mechanics. As you will see, the objects in the quantum realm behave very differently than those we encounter in everyday life. Simple concepts such as position and velocity grow vague. Cause and effect sometimes become difficult to distinguish. In general, the bizarreness of the quantum world makes interpretation of experiments and theory difficult.

Paradigm shifts are quite rare and rather messy. Many modern physics courses gloss over the mess and present an unrealistically tidy picture of the development and current understanding of quantum mechanics. This is unfortunate. There is so much to be learned by studying the mess! Furthermore, many courses offer a broad but shallow overview of the field. In my experience such approaches utterly fail to impart any real understanding of quantum mechanics and, more disturbingly, of the practice of science in general. So my approach will be messy and somewhat narrow, but deep.

We will study a few crucial experiments (recent and historical) that forced physicists to confront the inadequacies of classical theory. We will read original essays and articles (sometimes in translation) to see how physicists struggled to adapt prevailing theories to explain unexpected experimental measurements. Naturally, we will also reproduce some of these experiments ourselves. Most importantly, we will reflect on the significance of these experiments on our understanding of matter. What was learned? How certain are we about our measurements and our analysis of them? Is quantum theory the only valid interpretation of the results? Can nature really be so weird?

Course Goals: My primary goal for this course is to help you gain some sort of intuition about quantum phenomena so that you can think and reason about the sub-atomic world.

A secondary goal is to develop your ability to read and express scientific ideas in words, formulas and even in experimental apparatus. Every equation represents an idea, and every physics equation is a statement about our understanding of nature: one which can be parsed, read and interpreted on a variety of levels. The relationships it asserts between various physical entities (electrons, photons, etc.) may or may not represent physical reality. It is our job to tease out all the relationships implied by the equation and to then discern how accurately it describes the observable world. Much like an equation, an experimental apparatus also presents ideas. Furthermore, the ideas that prompted its construction may not be the most significant ideas it presents! An apparatus initiates interactions between physical entities that often do not behave as expected. A mature experimentalist must learn to parse, read and interpret apparatus as well as equations. You'll get plenty of practice at this!

Course Style: You will have at your disposal at least five great ways to learn: class discussions and lectures, lab exercises, reading, quantitative problems and writing. These methods are listed in increasing order of difficulty and significance. Solving physics problems and writing about physics are two of the most humbling tasks that you will ever attempt, but they are also two great ways for you to grow intellectually.

Some differences between this course and University Physics are: greater student independence and responsibility; less lecture and more interactive discussion, including more insightful questions and responses from students; more complex readings and homework assignments; and better lab equipment! There will also be fewer of us in the room, so it will be difficult to hide if you haven't prepared.

Student Learning Outcomes: Upon successful completion of the course students will possess several skills important to a career in science. By practicing traditional homework problems, through participation in class discussion, and by performing experiments and preparing lab reports, students will be learn to

apply fundamental quantum mechanical ideas to *solve* quantitative problems.

interpret and *articulate* complex physical concepts derived from both personal laboratory experiments and published manuscripts.

analyze quantitative data, to *compare* it to physical models, and to *present* it graphically and numerically.

Contact Information:

Dr. Jamie Day, BSC 105 233-8229 jday@transy.edu

Office Hours: (Tentative and subject to change as responsibilities evolve):

Please take advantage!

Everyday	9:00-10:00
Tuesday through Thursday	3:30 – 5:00

Texts: Greenstein and Zajonc The Quantum Challenge (ISBN 076372470X)

Tipler and Llewellyn, Modern Physics, 5e (on line open source at archive.org)

Open source books and various articles and essays will also be distributed throughout the course. At times you may be required to track down original source materials. Furthermore, you are expected to consult the library and the web to enhance your understanding of the readings. Read that previous sentence again, and pay special attention to "expected."

Class Meetings: 10:30 - 11:20 MWF, BSC 102.

Lab Sessions: 9:30 – 12:00 Tuesdays. (Proposed)

Grading: To allow for flexibility of learning and scheduling, we will have a variety of assignments and assessments. The values of each will be announced in advance when possible. (Note that some labs end up being more difficult or taking more time than expected and values will be adjusted accordingly.) The number of opportunities I expect to offer and the typical values are listed below:

Tests:	3 at 100 pts each. Dates listed below
Labs:	~ 6, roughly 25 pts each, but vary with difficulty
Quizzes:	~10 at 10 pts each
Participation:	35 classes, 3 pts per class
Homework, Moodlin' & Essays:	2-15 pts, ~10

Tests: Tests will consist of several problems of varying difficulty that are similar to the problems worked in class or assigned as homework and/or essay questions about the various readings. Fundamental equations will be given to you on the covers of the exams. If you get stuck during a test, it is always better to ask for help than to spin your wheels!

Labs: Modern Physics lab will afford you much independence, and with it great responsibility. There will be two types of lab assignments, physical and computational.

Physical Labs: We will arrange to meet for an hour or so before each physical lab for an introduction. You can then schedule time to complete labs at your own convenience, although I encourage you to use the scheduled time slot. Written reports, including data, analysis and results of your individual lab exercises, plus concise interpretation and discussion of error, are due within one week of the assignment. Grades will be based on your lab skills, the accuracy and precision of your measurements and the clarity and insight of your discussions. To receive an "A" your reports should reveal a thorough understanding of the procedures and analysis, and demonstrate critical thinking, especially when discussing the errors inherent in the procedure.

Usually you will work in teams to conduct physical lab exercises and jointly prepare lab reports. Slackers will receive lower grades than their attentive peers.

We have some excellent modern physics lab equipment (it doesn't get abused the way University Physics labs do) that will challenge you and teach you many skills. Possible physical labs to be performed include:

- Photoelectric Effect
- Planck's Constant
- Franck-Hertz Experiment
- Electron Diffraction
- Spectroscopy of Simple Atoms and Molecules

Computational Labs: There are many phenomena of quantum mechanics that are beyond the scope of undergraduate labs. Fortunately, computer simulations can vividly illustrate these phenomena with ease. Computational labs may involve playing with demos, answering questions about the simulations, or preparing spreadsheets or codes to calculate and graph various phenomena. This work will be graded individually.

Quizzes: Like your worst ninja nightmare, I'll spring quizzes on you at the least expected times. They won't be "hard" unless you haven't kept up. Their primary purpose is to encourage you to stay current with the material. They'll come in two types: **Quantitative Quizzes:** Typically they will be based on a variant of a problem worked in class or assigned for homework. These could also include derivations found in articles. They will always be fair, with no bizarre problems or overly complex problems. **Discussion Quizzes:** Typically they will ask for discussion of the various readings or class discussions. I won't expect regurgitation of arcane minutia.

Participation: Presence, preparation and participation will earn you 3 pts. per class. Physical presence but intellectual absence is worth about half a point. Scores for intermediate participation will be interpolated from these extremes.

Homework Problems: Please, please, please try to start the problems independently. Then work with peers to finish any you can't alone. Start early and ask for help when you need it. I will grade largely for effort (about 75%) and a bit for correctness. In this class the process is as important as the answer, so please show plenty of work.

Moodlin' & Essays: At times I'll ask you in class to respond informally to questions related to previous classes and reading assignments. Your written responses should be about a page long and should often include diagrams. I'd recommend including hand-drawn diagrams, as they are generally much quicker and easier to create than digital ones. At other times you will be asked to use Moodle to submit questions, responses, summaries and the like outside of class to summarize, interpret or clarify the readings or problems.

Reading and Problem Schedule: (Tentative, although test dates are firm.)

Part one: Subatomic particles and Quantization

Date	Author	Assignment to complete BEFORE class
Sep 9	Rutherford & Royds	The Nature of the α particle, complete
Sep 12	Lenard	Nobel Lecture, read to break on page 120
Sep 14	Lenard	Finish
Sep 16	JJ Thomson	Cathode Rays (my abridged version)
Sep 19	Tipler & Llewellyn	3:1-2, problems 1,2,4,6,7,12,14,16,44
Sep 21	Tipler & Llewellyn	3:3-4, problems 24, 26, 27, 30, 42, 45
Sep 23	Millikan	The Elementary Electric Charge (i.e. the oil drop expt)
Sep 26	Millikan	Photoelectric Determination of $\hbar$: Read first two sections, groups present subsections of part 3 as discussed in class
Sep 28	Milllikan	Finish
Sep 30	Test #1	

Part two: Wave-Particle Duality

Oct 3	Greenstein	Cht 1:1-4 Matter Waves
Oct 5	Tipler & Llewellyn	Cht 5:1-2, problems 1,2,4,5,7,11,13
Oct 7	Tipler & Llewellyn	Finish Cht 5, problems 17,18,21,25,28,29,37 +handout
Oct 10	Greenstein	Finish Cht 1
Oct 12	Greenstein	Cht 2:1 Photons
Oct 14	Greenstein	Cht 2:2 Wave-Particle Duality for Single Photons
Oct 17		Fall Break
Oct 19	Lecture	Intrinsic Spin
Oct 21	Greenstein	Cht 3:1 One Photon from Two Lasers
Oct 24	Greenstein	Cht 3:2-5 The Uncertainty Principle
Oct 26	Lecture	Position and Momentum Operators
Oct 28	Greenstein	Cht 3:6 Quantum Non-Demolition Measurements
Oct 31	Test 2	

Part three: Paradoxes, Paradigms & Entanglements

Nov 2	Greenstein	Cht 4:1-2 Complimentarity
Nov 4	Greenstein	Cht 4:3 The Information Paradigm
Nov 7	Greenstein	Cht 4:4 Complimentarity and the Uncertainty Principle
Nov 9	Lecture	Stern-Gerlach Experiment
Nov 11	Greenstein	Cht 5:1-2 The EPR Paradox
Nov 14	Greenstein	Cht 5:3-4 Bell's Theorem and Local Reality
Nov 16	Mermin	Local Reality Machine
Nov 18	Greenstein	Cht 6:1-3 Entanglement

Nov 21	Greenstein	Cht 6:4-6 Non-locality
Nov 23		Thanksgiving!
Nov 25		Thanksgiving!
Nov 28	Greenstein	Cht 7:1-4 Schrodinger's Cat
Nov 30	Greenstein	Cht 7:5-7 Decoherence
Dec 2	Greenstein	Cht 8:1-2 Measurement and Infinite Regress
Dec 5	Greenstein	Cht 8:3 Quantum Zeno Effect
Dec 7	Scully	The Quantum Eraser
Dec 9	Jaynes	Quantum Beating
Dec 13	Final	3-5 pm

PHYS 1024 **May 2016**

Measuring the Universe

Introduction and Course Objectives:

How do we measure something we can't touch? Especially something as vast as the universe? We do it in tiny steps, a little bit at a time, and with many inferences along the way. Humans have speculated about the workings of the heavens for ages, and discerning the size of the cosmos remains a significant challenge for modern science. Measuring the Universe is designed to introduce non-science majors to the analytical and quantitative problem solving methods used by physicists and astronomers to extract meaningful measurements from extremely limited information. You will learn how scientists use specific experiments performed on earth (or in nearby space) to formulate generalized principles that govern the behavior of the matter throughout the universe. Fundamental physics concepts will be applied to the task of building the "cosmic distance ladder" used by cosmologists to measure the size and age of the universe. A review of historical methods will provide you with a deeper appreciation of the power of abstract thinking. Lab exercises and data analysis will improve your mathematical literacy and assist you in understanding the strengths and limitations of the scientific process.

Intangible Outcome: My ultimate goal for this course is for each of you to be changed by the experience of thinking long and hard about complex and beautiful ideas.

Learning Outcomes: At the conclusion of this course, students should be able to (i) name historical figures who advanced cosmology and explain their measurements; (ii) name and explain the primary methods of determining astronomical distances including parallax, standard candles (RR Lyrae and Cepheid variables, type 1a super novae), main-sequence fitting; and redshifts; (iii) perform the fundamental geometric and algebraic calculations associated with the methods above; (iv) calculate image positions and magnifications for thin lenses; (v) explain image formation in simple telescopes; and (vi) apply inverse-square laws to optical and gravitational systems.

Professor: Dr. Jamie Day BSC 109 233-8229
jday@mail.transy.edu

Texts: For the first time ever, I'm trying this course without any book. I've never found one that fits the subject, level and May-term pacing of the course. We will have texts, however, in the form of scientific papers that will be distributed throughout the course. Some are to be perused and others are to be carefully and thoroughly read. I will provide clear instructions as to which is which.

Class Meetings: 9:00 - 11:00 pm, M-F, BSC 114

Office Hours: Typically 12:30-4:30 pm

Be Cool: Be nice and respectful of everyone. Pull your share of the load in lab and in class discussion. Be on time and pay attention. Don't text or surf the web during class or lab. Keep your germs to yourself. Habitual failure to be cool will result in a lower final grade, typically a third of a letter grade per egregious offense.

Grading: A bit less than half of your grade is based on what you do in and around class, and a bit more is based on how well you absorb and synthesize what you do. Although everyone has different abilities, a motivated student can readily pass this class because you have total control over a large fraction of the grade.

40% Labs, Measurements, Calculations, Homework, etc: A large portion of your final grade is based on exercises and labs, usually conducted in cooperation with a partner or two. Much of this work will be graded for effort, but occasionally may be evaluated based on data collection, analysis and accuracy. Some labs are weather dependent, and some exercises are more difficult than others. The value of an exercise or lab will depend on the level of difficulty and time required for completion. Note that because of the experimental nature of the topic and of the class, sometimes we won't know how difficult a task is until we try it!

15% each: Quiz average, Two Tests, and Comprehensive Final

Tentative Schedule

Part 1	The Ancients	
Date	Topic	Lab/Exercise
Wed, 4/27	Introductions	Angular Size
Thur, 4/28	Triangulation	Surveying through Paralax
Fri, 4/29	Eratosthenes	Angular size of sun
Mon, 5/2	Aristarchus	Distance to Sun via Lunar Eclipse
Tues, 5/3	Hipparchus	
Wed, 5/4	Test 1	
Part 2	The Revolutioinaries	
Thur, 5/5	Tycho Brahe & Kepler	Kepler's 3rd law
Fri, 5/6	Galileo	Optics: Lenses and Telescopes
Mon, 5/9	Transit of Mercury…Live!	Distance to inferior planets
Tue, 5/10	Transit of Venus	Distance to superior planets
Wed, 5/11	Newton	Stellar distance from planetary brightness
Thur, 5/12	Optics	
Fri, 5/13	Test 2	
Part 3	The Moderns	
Mon, 5/16	Bradley, Etc.	
Tues, 5/17	Moving clusters	Distance to Hyades
Wed, 5/18	Standard Candles	Inverse Square Laws
Thurs, 5/19	Cepheid Variables	
Fri, 5/20	Hertzsprung-Russel diagrams	Main Sequence Fitting
Mon, 5/23	Doppler shift and Hubble Constant	
Tues, 5/24	Comprehensive Final	

A Miracle of Rare Device

May Term 2013

Maurice Manning
Creative House
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Jamie Day
BSC 109
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This is an experimental course designed to explore the creative interaction between natural philosophy and poetry. We will examine literary and physical phenomena from multiple perspectives, and observe historical cross-fertilization between the disciplines. Learning science generally requires learning new languages: usually intricate, abstract, symbolic ones; but for centuries poets have attempted to convey the ideas of science—whether beautiful, boring or horrifying—in creative and emotionally expressive language. Beautiful words grappling with wordless ideas…that's the basic idea behind this course. This course is also about thinking, and learning, and seeing and feeling. It's about physical reality and about emotional reality. Above all it's about curiosity, and the bravery required to be curious. **Dive in.**

Class Meetings:

12:00 - 2:00 pm, Student Art Gallery, Shearer Art Building

Demonstrations:

11:30 am, BSC 114 (As Needed, Announced in Advance)

Texts: Various poems, articles, essays will be distributed

Moving Images: We will occasionally screen films or videos outside of class time. Most will be available online for those who are unable to attend screenings.

Grading: Q: How will you grade a completely experimental course?
A: Fairly, and roughly along these lines:

Discussion, Participation, and Manifestations of Personal Bravery: 35%
Projects 65%

Attendance:

This class is wonderful! You won't want to miss it.

Projects:

We will have a variety of projects in this class, ranging from simple, observational laboratories to major, week-long projects. Some will receive full credit for satisfactory completion, others will be graded using traditional scales; some will be in writing, others will require more physical materials and constructions. Generally the value of each product will correspond roughly to the amount of time necessary to complete the work.

Reading List:

Most of these poems appear in The Norton Anthology of Poetry (Shorter Fifth Edition) if you like printed materials, but they are readily available on line. The poets/poems listed are in reverse order because the scientific complexity of the poems seems to increase as we go backward in time. (Perhaps that's because the complexity of science increases as we go forward in time, increasing the chasm between the sciences and the humanities, which results in fewer and fewer poets who bother to try to engage scientific ideas.) The dates listed are approximate, but perhaps parallel particular trends or discoveries made in the sciences.

Wallace Stevens (1923): Thirteen Ways of Looking at a Blackbird; The Snow Man

Edward Thomas (1916): As the team's head brass

Robert Frost (1914): Going for Water; After Apple-Picking

Edwin Arlington Robinson (1920): Mr. Flood's Party

William Butler Yeats (1919): The Second Coming

Gerard Manely Hopkins (1877-1885): No Worst, There is None; Felix Randal; As Kingfishers Catch Fire; Pied Beauty; The Windhover; God's Grandeur; Inversnaid

Thomas Hardy (1914): Channel Firing

Christina Rossetti (1856): In an Artist's Studio

Emily Dickinson (1860-1888): A Route of Evanescence, Tell all the Truth, Split the Lark, On a Columnar Self, There's a Certain Slant of Light, Some Things That Fly There Be

Matthew Arnold (1867): Dover Beach

Walt Whitman (1865, 1868): When I Heard the Learn'd Astronomer; A Noiseless Patient Spider

Edgar Allen Poe (1829): Sonnet—To Science

Oliver Wendell Holmes (1858): The Chambered Nautilus

John Keats (1821): Bright Star; Ode on a Grecian Urn; Ode to a Nightingale

Samuel Taylor Coleridge (1798-1800): Dejection an Ode; Rime of the Ancient Mariner; Frost at Midnight; Kubla Khan

William Wordsworth (1798): Ode Intimations of Immortality; The Prelude; Tintern Abbey

George Herbert (1633): The Pulley; Artillery

Robert Herrick (1655): To Find God; Delight in Disorder

John Donne (1633): I Am a Little World Made Cunningly; Good Friday, 1613; A Valediction Forbidding Mourning; The Sun Rising

Class Schedule:

Day 1: Resonance in Physical Systems. e.e. cummings *O sweet spontaneous*.
Day 2: Resonance in Poetry, Art and Musical Instruments. Companionable Forms Machine. Erik Demaine Lecture.
Day 3: Robert Penn Warren's *Boy Wondering in Simm's Valley*. Demaine discussion. 7 x 7 matrix assigned.
Day 4: Thomas' *As the team's head brass*. 7 x 7 assignment discussed. Surveying, Parallax and Triangulation.
Day 5: Frost's *Going for Water*. Class Flag Project Assigned. Triangulation and Angular Size.
Day 6: Pandaemonium screening
Day 7: Pandaemonium discussion. Electrical Mites and Indoor Lightning. Intro to Lenses, Cameras Obscura, Telescopes. Frost's *After Apple-Picking*.
Day 8: Class Flag Day. Sonnets, physical and literary
Day 9: Museum Tour
Day 10: Rafinesque's *The World;* Intro to Sculpture Workshop; Starting Fire with Light and Water.
Day 11: STC's letters read aloud; Gary Soto's *Oranges*.
Day 12: Cummings' *Space being (Don't forget to remember) curved*; Frost's *Mending Walls*; Raf's tomb.
Day 13: As you like it (acting); Pythagoreans.
Day 14: Physical (3D) Sonnets presented
Day 15: Jeremy Paden's Class (Translation, Katerina); Erik Demaine Exhibit, UK Art Gallery.
Day 16: 20 Figures of Speech presented
Day 17: Mary Austin Holley; Center of Mass of Campus
Day 18: Folded Poems discussed
Day 19: Special Collections Library Tour
Day 20: Rime of the Ancient Mariner final assignment due.

Pedagogical Materials

My day-to-day work, whether in a classroom or in my office, consist almost entirely of solving problems on a whiteboard and helping students do the same. Therefore, I have few materials that seem appropriate for this application. I submit the following, which I hope will provide some additional insight into my teaching. [Note: Figures and empty spaces were edited to reduce size]


Image by Colleen Pinksi

Measuring the Universe Final May, 2016

Show Sufficient Work on all Mathematical Problems. Explain any Simplifying Assumptions (e.g. "This is a small angle, so …")

1 inch = 2.54 cm $A = \pi r^2$ $A_{sphere} = 4\pi r^2$ $\theta_{radian} = l/r$ ang. size of sun = 32' ~ 1/2°

$\sin\theta$ = opp/hyp $\cos\theta$ = adj/hyp $\tan\theta$ = opp/adj $hyp^2 = opp^2 + adj^2$

AC = AB $\sin(\beta)/\sin(\alpha+\beta)$ where angles α, β & γ are at corners A, B and C $1/f = 1/o + 1/i$ $|m| = h_i/h_o = i/o$

Kaitlin's version: Desired side = Baseline x sin(opposite angle) / sin(sum of baseline angles)

T^2/R^3 = const e = (separation of foci)/(major axis) $1/S = 1/P_{fast} - 1/P_{slow}$ $I_1/I_2 = (r_2/r_1)^2$ $d = vt$

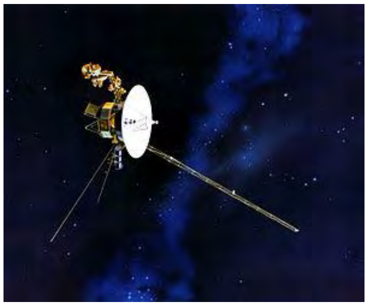
$c = 3 \times 10^8$ m/s $d = 1/\pi''$ 1pc = 2.06×10^5AU 1AU = 1.5×10^{11}m

$$\lambda_{observer} = \lambda_{source}\sqrt{\frac{1+v/c}{1-v/c}}$$ $\lambda_{max} = (2.898 \times 10^6 \text{ nm K})/T$

$m_1 - m_2 = -2.5 \, Log_{10}(I_1/I_2)$ $m - M = 5 \log_{10}(d_{pc}/10)$ $v = H_o \, r$

Object	Mean Distance from Sun (m)	Mean Radius (m)
Sun	---	6.96×10^8
Venus	1.08×10^{11}	6.06×10^6
Earth	1.50×10^{11}	6.37×10^6
Mars	2.28×10^{11}	3.37×10^6

1] 10 pts: Wiki says: “Voyager 1 is a space probe launched by NASA on September 5, 1977. Having operated for 38 years ...the spacecraft is at a distance of 134 AU as of April 2016...the farthest spacecraft from Earth and the only one in interstellar space.” What is the angular size of the sun viewed from Voyager 1?



2] 2 pts: Name a female astronomer who was historically significant in the development of the cosmic distance ladder.

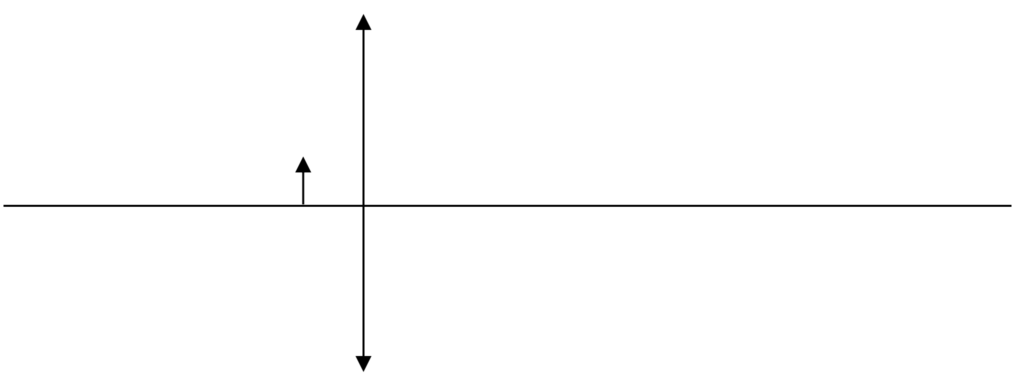
3] 2 pts: Name a type of diagram in which apparent magnitude is plotted as a function of color or temperature for a cluster of stars.

4] 2 pts: The ____________________ effect causes the spectra of stars to be shifted toward the red or blue end of the spectrum due to relative motions of the stars and the observer.

5] 3 pts a) How hot is the surface of a star whose peak emitted wavelength is λ = 420 nm?
2 pt: b) The _________effect causes the spectra of stars to be shifted toward the red or blue end of the spectrum due to the relative motion of the stars and the observer.
4 pts: How fast would the star in part a have to be moving relative to an observer in order for the wavelength to appear 750 nm?

6] 10 pts: The absolute magnitude of a Type Ia supernova is −19.3, whereas the apparent magnitude of the sun is -26.7. (a) Determine the absolute magnitude of the sun. (b) Determine the ratio of the brightness of a Type Ia supernova to the brightness of the sun.

7] 5 pts: Mark two focal points 2 cm away from the lens and trace three rays to determine the position of the image formed by the converging lens. Describe the image as Real or Virtual, Magnified or Reduced and Upright or Inverted.



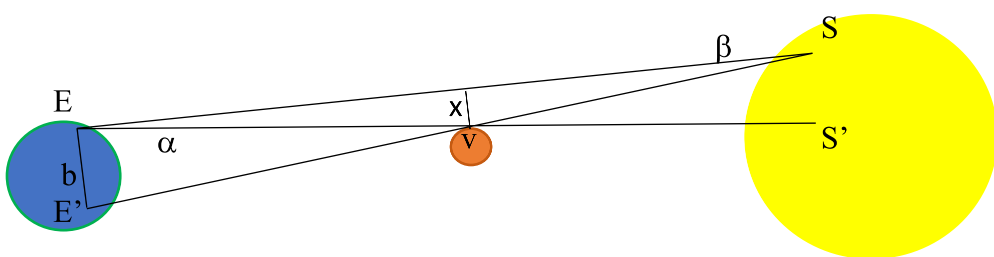
Do Only FOUR of the 15-point problems. Clearly put an X over the space for the problem you omit.

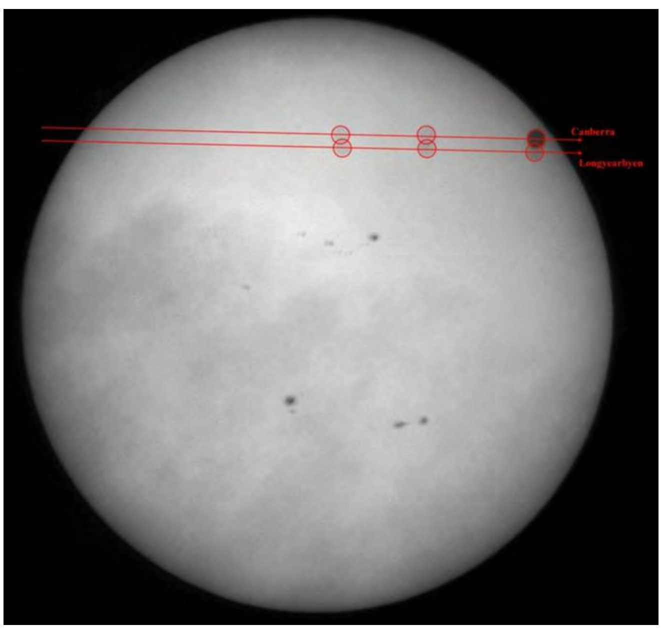
8] 15 pts: The average radial velocity of a moving cluster is 7330 AU/yr. The average proper motion of the cluster is 0.015" per year, and the center of the cluster lies at 58° from the convergent point. How far away is the cluster? (Explain your work.)

9] 15 pts: After aliens mistakenly destroy Venus, a planetary fragment orbits the sun with a maximum elongation (viewed from Earth) of 72°. What is the synodic period of fragment/Earth system?

10] 15 pts: Suppose that the moon exactly filled our view of the sun during a solar eclipse and exactly filled 2/3 of the shadow of the earth during a lunar eclipse. Sketch an instructive drawing of these events and determine the diameter of the moon in terms of the earth's diameter. Show plenty of work.

11] 15 pts: The paths for two observations of the 2012 transit of Venus are shown in the image below. Given that the maximum elongation of Venus is 46.3° and 1 AU = 1.5e8 km, determine the base-line, b, which is the separation of the two observation points. Explain your work.





12] 15 pts: I took the two superimposed pictures of the moon above, which is why the exposures are so different. I aligned the images so that Venus overlaps itself. Thus, the composite shows the motion of the moon relative to Venus during the evening. Since Venus moves much slower than the moon, pretend it is stationary among the stars. (a) Measure the angular distance the moon traveled during the time interval, (b) determine the angular speed of the moon, and (c) estimate the orbital period of the moon in days. Image 1: 8:47:14 PM Image 2: 10:44:00, PM

Magnetic Induction

1] We are using cheap compasses that are not uniformly painted, so you will need to determine which end of your compass points north. Carry your compass outside (or at least into the lobby far from anything metal) and determine which end of the needle points north. This is the "north seeking pole" of your compass. Now use your compass to locate a region of relatively uniform magnetic field in the lab.

2] Connect the primary coil (smaller diameter) to the power supply and adjust the current to about 0.5 A. Use your compass to investigate the magnetic field of the coil. Describe what you observe. Do your observations agree with the right hand rule?

3] Use your compass to double check the labels on your bar magnet. Very often the poles have switched from being stored near stronger magnets. If so, remagnetize it using our handy magnetizer.

4] Connect the galvanometer to the terminals of the secondary coil (which has more coils of finer wire and a larger diameter than the primary.) Move the magnet in, out, and around the secondary coil and record the magnitude and direction of the galvanometer deflection relative to (a) the speed at which the magnet is moved; and (b) the magnet's polarity. (c) Make at least one carefully-labeled sketch that illustrates the helicity of the coil in relation to the magnet and indicate the direction of the induced current for a given direction of the magnet's motion.

5] Measure the length of the primary coil (ignore the iron core that extends beyond the coil.) _____ cm

6] Insert the primary coil into the secondary coil. Perform a series of measurements of the galvanometer's deflection as the power supply is switched on and off as a function of the current setting on the power supply. Determine the average deflections for at least six different current settings and make a graph of average deflection as a function of current using excel. Discuss apparent trends or lack thereof. Propose a theoretical basis for your observations.

7] Using a current setting that results in a nearly full-scale deflection in part 6, perform a series of at least six measurements of average galvanometer deflection as a function of the length of overlap between the primary and secondary coils. Make a graph of average deflection as a function of coil overlap (measured in cm) using excel. Discuss apparent trends or lack thereof. Propose a theoretical basis for your observations.

In our next class, we will discuss Rutherford and Royds "The Nature of the Alpha Particle from Radioactive Substances" Phil Mag ser 6, xvii p. 281-6 1909. I've prepared the following assignment to help you prepare for the discussion.

Review this brief note about seminar behavior: [http://sciencenetlinks.com/student-teacher-sheets/how-prepare-seminar/ .](http://sciencenetlinks.com/student-teacher-sheets/how-prepare-seminar/) You can and should find lots of other advice online. As you read the article, consider the following questions and tips. (These are useful for practically any experimental paper you will discuss in any seminar.)

What is the principle aim of the experiment?

What were the shortcomings of previous experiments in this area?

Visualize the experimental apparatus. Imagine assembling it, and imagine conducting the experiment yourself. What happens? Make notes of any parts you don't understand, or any experimental steps that are confusing. (I've attached larger schematics of the apparatus below to help you interpret the experiment.)

Note the authors' attempts to anticipate errors and their methods to prevent them, and try to think of any that they didn't consider.

How would you summarize the results for the general public? For a college student? For a physics major?

This is an old paper with some antiquated terms, and you may be unfamiliar with some of the contemporary terms as well. Look these up immediately, but keep a list of other terms and references you don't know and research them as time permits. Supplemental reading and research is what sets apart outstanding students from good ones.

Also, keep a list of questions concerning portions you don't understand, and also ideas to discuss in class.

*Before coming to class, post at least two questions on moodle, and try for at least one open-ended question for discussion in class. Others can be practical questions about clarification.

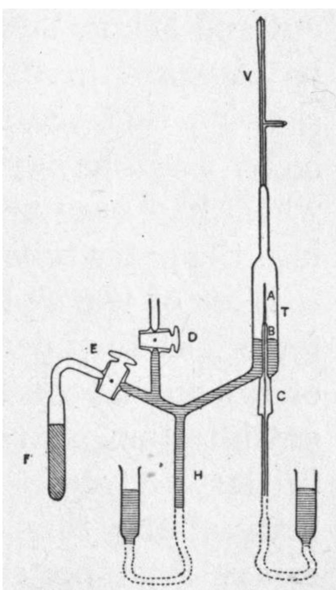
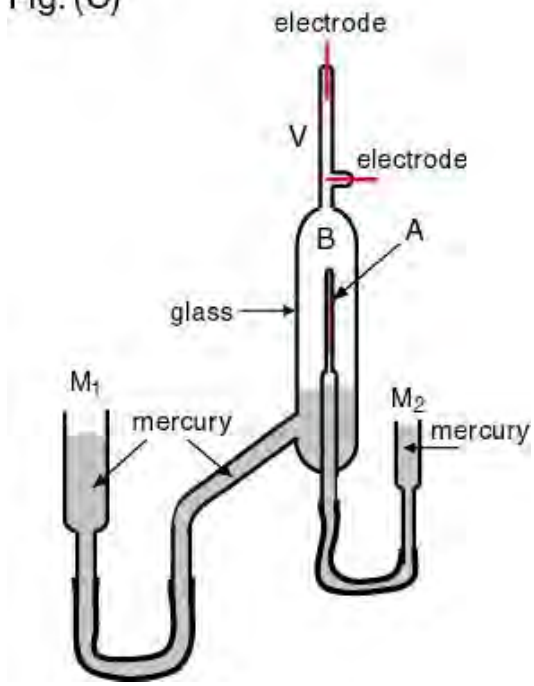


FIG. 7.—APPARATUS USED IN EXPERIMENT BY RUTHERFORD AND ROYDS.

Fig. (C)



Daily assignment from Corporeal Commodity (2012). I have found that students sometimes pay more attention when instructions or assignments are given in non-traditional formats, especially when the task is otherwise unexceptional. In this case, scanning the code reveals the following text: "Submit your ideas for the 'Daily Body-Related Question' as printed QR codes made at deliver.com (which was linked). Use the 4x scale. Finally, end your question like this: '—question submitted by (your name here).'"

Aristarchus' Eclipse Geometry Lab

Attached are copies of pictures I took of the March 30, 2007 lunar eclipse, plus a composite image I found on the web. Your task is to determine the diameter of the Earth's shadow (at the location of the moon) in terms of the moon's diameter, $D_{Earth's\ Shadow}/D_{Moon}$ and use this to determine the distance to the moon in Earth radii. You will use three methods.

Method 1: Work together but trade roles in this process on the first three images (under-exposed, inverted and overexposed) of the moon.

a) Carefully measure the diameter of the image of the moon. This is the largest distance you can measure across the moon. Let each member of your group do this independently. Do not share your results until each person has completed this task. Then average your results. Feel free to repeat any measurements that are drastically different from the rest of the group's if there is reason to believe somebody misread or misplaced the ruler.

b) Let the team member with the steadiest hands trace the edge of the shadow as smoothly and carefully as possible. Now carefully cut out the bright crescent of the moon. Again, keep the inside (concave) edge smooth and accurate. Use the crescent you just cut as a template to sketch a circle representing the circular shadow of the Earth. Use a light hand and an iterative approach. Adjust and modify the sketch until it is a smooth circle. Measure the diameter of this circle in several directions and obtain an average.

c) Finally determine the ratio $D_{Earth's\ Shadow}/D_{Moon}$ and use this to estimate the distance to the moon, $R_{E\text{-}M}$, in terms of the Earth's diameter, D_E, using Aristarchus' geometric technique as discussed in class.

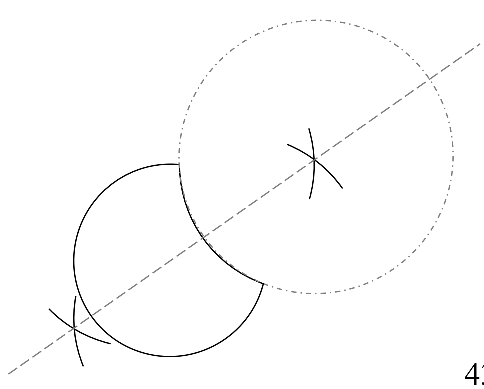
Method 2: Use the figures in the corners of the pages.

a) Bisect the figure using this classic geometric technique (Note: a rough diagram of the method is shown below): Set a compass to a radius of about 1.5x the diameter of the moon. (The exact length isn't important.) Position the sharp end of the compass at one tip of the bright crescent and create two arcs to each side of the moon. Repeat from the opposite end of the crescent. The intersections of the arcs create two points where the arcs intersect, and a line drawn through these points will bisect the crescent.

b) Begin by adjusting your compass to the approximate radius of the earth's shadow. Through trial and error adjust spread of the compass and the location of the center until it traces the edge of the shadow. At this point the compass is set to the radius of the shadow.

d) Sketch a complete circle. Mark the center clearly (as there will be several holes poked in the paper by this point). Draw a diameter that passes through this center and measure it to find $D_{Earth's\ Shadow.}$

d) Finally determine the ratio $D_{Earth's\ Shadow}/D_{Moon}$ and use this to estimate the distance to the moon in terms of the Earth's radius.



Method 3: Composite image.

The composite image (found on Space.com) was created during the April 4, 2015 eclipse using a tracking telescope that moved with the sun rather than the moon, so we see the moon in various positions relative to the Earth's shadow during the eclipse. Directly measure the diameters $D_{Earth's\ Shadow}$ and D_{Moon} and determine the distance to the moon.

Analysis and Questions: (Write answers and calculations on the back of this sheet.)

1] (a) Which of the methods do you expect to be most accurate and why? (b) Which of the amateur images did you find easiest to use? Explain.

2] Compare each of you results with the value of $R_{E\text{-}M} = 30\ D_E$ used by Newton when testing his theory of Universal Gravitation. Find the percent difference between this value and your determinations that lie (a) closest to, and (b) furthest from the accepted value.

3] Is your average result better or worse than Aristarchus'? What do you think accounts for the difference?

(NOTE: Images were compressed and shifted for the purpose of saving space in the Bingham Application.)

December 7, 2016

Professor Michael J. Bell
Bingham Trust
Transylvania University
300 N. Broadway
Lexington, KY 40508

Dear Professor Bell,

It is my pleasure to send you my enthusiastic support for Professor Jamie Day, who is applying for an extension of his Bingham Teaching Award. I know of no other colleague at Transylvania who is more deserving of this important recognition.

In my time at Transylvania it has been easy to observe Professor Day's devotion to this institution, to its broad health and stability, to our fellow professors and administrators, and above all to our students. In the last few years, Jamie Day has provided exceptional service as the Division Chair for Natural Sciences and he has served on all manner of committees dedicated to enhancing our curriculum, meeting accreditation requirements, and nurturing the welfare of Transylvania, in general, to ensure that it remains an esteemed and vital institution of higher learning. He has also continued his research and scholarly activities with a degree of accomplishment that is simply daunting, given his service and administrative commitments. My view is Jamie Day is not merely an accomplished professional in his field; he exemplifies a passion to support and enrich our entire community, based on his affection for the special community we have, for the unique character and in-laid spirit of our university.

But I also have firsthand experience with Professor Day's manner in the classroom, and that is the best evidence of my support for an extension of his Bingham Teaching Award. A few years ago Professor Day and I co-taught a May Term course we called A Miracle of Rare Device. The title of the course comes from Samuel Taylor Coleridge's poem, "Kubla Khan." Our aim in this course—derived from long years of conversation and shared interests—was to bring together selected poems from the English Romantic era and the fields of physics and natural science. I had the notion that poets such as Coleridge and Wordsworth, were not only aware of the science of their day (late 18th and early 19th century), they were fascinated by it, and wove their grasp of scientific discoveries and physics into their poetic expression. Jamie had the idea that he could bring scientific demonstrations to our classroom, transforming it at times into a laboratory, to prove that the poetry and the science had met in our readings on common ground. We would read passages from poems and then Jamie would demonstrate the principal of sympathetic motion in objects. We'd read sections from *The Rime of the Ancient Mariner*, and Jamie would demonstrate principals that have to do with astronomy and the practical science behind navigation. When we read passages in which Coleridge notes that the sun is directly above the mast of the ship when it is stalled at the equator, Jamie provided the scientific explanation to justify the poetic image.

These are but a few examples of how this wonderful course worked. Our shared vision for the course was to demonstrate in hands-on terms for our students the plain fact that the arts are not at all separated from the sciences—and that there is practical reason to make sure the natural bond they share is reiterated and extended. This, in a discrete example, is the value of a liberal arts education. The separation and segregation of our academic fields that has seemed to increase over the last couple of generations is a mistake, in my opinion. I'm reading about this very topic at the moment in Wendell Berry's most recent book, *A Small Porch*. It is a collection of poems that includes a long essay at the end reckoning with the fact that the arts and the sciences, as human endeavors, must remain joined if we are to survive the challenges that await us in this century. That is a moral and intellectual principal Professor Jamie Day has demonstrated to me, through the example of his curiosity and talents, and through the real outcomes of his service to Transylvania and his excitement to engage our students and give them meaning and purpose to take with them into the world.

Professor Jamie Day is a bright light on our campus. It is an honor to be his colleague and humbling to follow his lead. I trust you and those who make decisions regarding the Bingham Teaching Award will recognize the contributions of this exceptional colleague to the community we share and love.

Yours truly,

Maurice Manning
Professor of English and Writer-in-Residence

January 14, 2017

Dear Bingham Renewal Committee,

It is my pleasure to submit this recommendation for Dr. Jamie Day for renewal of his Bingham Excellence in Teaching Award. I have known and worked with Jamie since I was hired as a biology faculty member in 2004. During the last 13 years he has been an important mentor, support system, and colleague to me. His official role occurred during his time as our Division Chair in Natural Science and Mathematics, but he has always been someone I seek for wisdom, thoughtfulness, and deep conversations. We have observed each other teach more than once and have given guest lectures in each other's classes.

Despite a thriving physics major at Transylvania, in terms of numbers, Jamie teaches more physics to non-majors than majors. This is because University Physics is a pre-requisite for so many medical graduate programs. University Physics is often considered the most dreaded and difficult hurdle that pre-medical students face. Because of this Jamie must teach a number of students that would not have enrolled in the course by choice. And these students are often stressed out, convinced that the difference between a C+ and a B- will keep them from getting into medical school. This population of students and the fact that so many students do struggle with the quantitative, sometimes abstract, nature of physics means that our two physics professors never have a free minute during their office hours and sometimes have to provide emotional support for struggling students. I have often heard students talk with gratitude about Jamie's help outside of the class, both with physics and otherwise.

So how does Jamie handle this part of his teaching responsibilities? In my opinion, exceptionally well. Much of my opinion comes from conversations with students who praise Dr. Day for being such a great teacher. They talk about his use of creative examples to explain difficult concepts, his patience in the classroom and during office hours, and his quirky, caring personality that creates a learning community. A couple of years ago one of my senior seminar students included an acknowledgements slide for his final project: "Thanks to Dr. Day for making physics not suck." Perhaps this does not seem like a glowing endorsement, but it is high praise from students that truly fear and struggle with physics.

I have also witnessed Jamie's continued efforts to improve student learning through innovation. Several years back he went to scheduling University Physics as a two-hour block Mondays, Wednesdays, and Fridays instead holding separate meetings times for lecture and lab. The idea was that to infuse the teaching of foundational physics with the hands on lab exercises. Jamie was instrumental in designing the classroom/lab space for this purpose. All signs suggest this was an excellent idea and is one that the biologists have experimented with following. One year Jamie and his former colleague, after much research, used an online textbook for the course. Although the textbook was highly regarded by many professors, including Jamie, the students complained there weren't enough practice problems and generally gave it negative reviews. Regardless, I was impressed with the risk in using a nontraditional textbook and, although they have gone back to the $300 plus mammoth hard copy book for now, I know Jamie and his new colleague are looking into other, more innovative options.

Jamie's passion, creativity, and excellence in teaching are well recognized across campus. His greatest contribution as our division chair was his mentoring of junior faculty. He took his job of observing classes, meeting with the faculty, and writing evaluations more seriously and thoughtfully than the four other division chairs I have worked under. Unlike many others, he does not try to impose his teaching style or philosophy, but rather recognizes the importance of individualism in teaching. I think it takes a more than average level of empathy to be a great teacher. It seems that to grow and evolve as a teacher one must attempt to put themselves in the shoes of the students and appreciate and respond to diversity in learning strengths and weaknesses. Jamie epitomizes this approach to teaching, but also in his approach to mentoring colleagues. I'm always impressed with his intense, thoughtful analysis of our job as educators combined with common sense often forgotten or ignored by others.

This recommendation only begins to recognize and describe Jamie's excellence in teaching. I have focused on his teaching as it applies to our division in an effort to bring some depth to it.   However, there is so much more to be said about Jamie. His team teaching accomplishments in terms of number, diversity, creativity, and success are unparalleled at Transylvania. He has not just participated in our ever-changing first year curriculum, but done so with thoughtful contributions and special attention to the goals and challenges specific to incoming students. Finally, his research on Transylvania's museum collection is flat-out fascinating, enlightening, and impressive. His research has been the inspiration for many of his special topic and first year courses. He also brings amazing stories and artifacts to his major courses, providing young scientists with a unique and fascinating look at not just the history of science, but also the history of our college. I'm confident that Jamie's application materials and letter from Maurice Manning will provide ample evidence for much of what I haven't done justice. I can't think of anyone more deserving of an award for excellence in teaching.

Sincerely,
Belinda Sly
Associate Professor of Biology