Master of Arts in Physics Education (MAPE) Degree Program with Distance Learning

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NSTA Regional Conference
Richmond, VA
Dec 2 - 4, 2004
Outline

RL 10 min

What is MAPE
Targeted High School Teachers
BA in Physics for High School Teachers
Why Distance Learning
Teaching Philosophy behind MAPE

ST 10 min

Teaching Methodology
Teaching Tools
List of Courses taken by MAPE Students
Courses that Require Calculus
Outline

RL 15 min Slides
- Suggested Plan of Study - 2 1/2 years
- Scheduling of Current Distance Learning Courses
- Example of a Distance Learning Course PHYS 605
- Example of a Residential Course PHYS 632

ST 15 min
- Example of Distance Learning Course PHYS 633 Modern Physics
- Example of Distance Learning Course PHYS 641 Physics Pedagogy
- Number of Students Graduated
- Future Plans

Questions
Masters Degree Program

- Master of Arts in Physics Education (30 cr.) (MAPE).

- Department of Physics. Graduate degree in the College of Arts & Science

- Need
Targeted Teachers

- Do not have an undergraduate degree in physics
- Want to increase content and teaching skills in physics.
- Crossover from teaching Chemistry or Biology to teaching Physics.
- Need certification/endorsement credits in Physics.
- Want to be better prepared to teach the material required by the SOLs
Percent of High School Teachers with Physics Degrees

- Major in Physics: 22%
- Minor in Physics: 8%
- Major in Physics Education: 11%
- Minor in Physics Education: 4%

Why Distance Learning

• Because it provides an educational delivery system for in-service science teachers to take science courses from home.

• Because it allows teachers to advance themselves without giving up their teaching positions and are not handicapped because they live and teach in rural areas.

• How do we maintain the integrity of our learning system in this environment.
Teaching Philosophy (MAPE)

- Lecture courses are calculus-based introductory physics
- Laboratory Courses - summer residence
- Cooperative problem solving - study groups
- Peer instruction (Utilize best H.S. teachers)
Teaching Methodology

- Distance Learning - View edited lectures of UVa physics courses on CDs on your computer at home.
- Course website - central source for all information.
- WebAssign (Internet service) is used as a homework and examination delivery system.
- Blackboard and Yahoo are used as discussion board/listserv/virtual class room
- Sometimes give problem solutions and mini-lectures
Teaching

- A Discussion Group for the class is set up through Blackboard or Yahoo.
  - Listserve/Discussion Boards
  - Chat room/Virtual Class room
  - Digital Drop Box
  - Email Photo album

- Email for other communication.

- (Audio/video conferencing) - In the future
Teaching

- Exams may be proctored - Principals, Department Heads, Supervisors, etc.

- Registration is online or by phone through UVa School of Continuing and Professional Studies

- Reduced tuition rates for teachers. $200/credit hour in state; $300 out-of-state. Fees ~$35-40.
Courses that require Calculus

- Phys 631 Mechanics, Motion, and Heat (4 cr.)
- Phys 632 E/M, Waves, Optics (4 cr.)
- Phys 633 Modern Physics (4 cr.)
- Phys 635 Curriculum Enhancement I / Lab (3 cr.)
- Phys 636 Curriculum Enhancement II / Lab (3 cr.)
Distance Learning Courses for MAPE

- PHYS 605 How Things Work I (3 cr.)
- PHYS 606 How Things Work II (3 cr.)
- PHYS 609 Galileo and Einstein (3 cr.)
- PHYS 633 Clas. and Mod. Physics III (Quantum Physics) (4 cr.)
- PHYS 641 Physics Pedagogy (3 cr.)
Summer Residence Courses for MAPE, 3-4 weeks

First Summer:
- PHYS 631 Clas. and Mod. Physics I (Motion, Fluids, Heat) (4 cr.)
- PHYS 635 Curriculum Enhancement I /Lab (3 cr.)

Second Summer:
- PHYS 632 Clas. and Mod. Physics II (E/M, Waves, Optics) (4 cr.)
- PHYS 636 Curriculum Enhancement II /Lab (3 cr.)
Other Courses for MAPE

• PHYS 613 Instructional Materials Development (3 cr.) (4 week summer session at Jefferson Laboratory)

• PHYS 640 Independent Study (3-6 cr)
Suggested Plan of Study

• Summer 2005
  PHYS 631 Classical & Modern Physics I (4 cr.)
  Topics include mechanics, motion, fluids, and heat
  PHYS 635 (3 cr.) Taken in parallel with PHYS 631.
  Uses probes and sensors with computers in the Lab.
  Lesson plans and in-service presentations due in the Fall

• Fall 2005
  PHYS 605 How Things Work I (3 cr.)
Suggested Plan of Study

• Spring 2006
  PHYS 606 How Things Work II (3 cr.)

• Summer 2006
  PHYS 636 Classical & Modern Physics II (4 cr.)
  Topics include electricity, magnetism, and optics.
  PHYS 636 (3 cr.) Taken in parallel with PHYS 632.
  Uses probes and sensors with computers in the Lab. Lesson plans and in-service presentations due in the Fall

• Fall 2006
  PHYS 609 Galileo & Einstein (3 cr.)
Suggested Plan of Study

• Spring 2007 (Third Year)
  PHYS 641 Physics Pedagogy (3 cr.)

• Summer 2007
  PHYS 633 Classical & Modern Physics III (4 cr.)
  Topics include quantum physics, relativity

• December graduation
  Completed entire program in 2 1/2 years
Scheduling (Distance Learning)

- Spring 2005  PHYS 641 Phys. Pedagogy (3 cr.)
- Spring 2005  PHYS 606 How Things Work II (3 cr.)
- Fall 2005    PHYS 605 How Things Work I (3 cr.)
- Fall 2005    PHYS 609 Galileo and Einstein (3 cr.)
- Spring 2006  PHYS 606 How Things Work II (3 cr.)
- Spring 2006  PHYS 641 Phys. Pedagogy (3 cr.)
- Every Summer PHYS 633 Modern Physics (4 cr.)
  Classical & Modern Physics III
Example
Phys 605: How Things Work I

- Emphasizes motion, mechanics, fluids, gases, heat, and sound

- Examples: skating, seasaws, baseballs, Newton’s Laws, forces, motion, acceleration, frisbees, water, buoyancy, pressure, vacuum cleaners, rockets, clocks, etc.
Start with the Home Page

- Phys 605 Course website or home page
- Schedule of Classes
- Course Information
- WebAssign.
- Blackboard
- Email
- Exams are proctored
- Online registration..
PHYS 605: How Things Work I

January - May 2004

Instructor: Richard A. Lindgren, Research Professor of Physics
Lecturer and Demonstrator: Lou Bloomfield, Professor of Physics

This course is a practical introduction to physics and science in everyday life. This course considers objects from our daily environment (baseballs, frisbees, roller coasters, vacuum cleaners, rockets, clocks and much more!) and focuses on their principles of operation, histories, and relationships to one another. This course emphasizes motion, mechanics, liquids, heat, gases, and sound.
Home Page Website

- Introduction
- General Course Information
- Problem Sets, Exams, Proctors, and Honor Code
- Acceptance, Registration, and Tuition Information
- Schedule of Classes and Syllabus
- WebAssign
- Blackboard
- Individual Lecture Slides - original Powerpoint and Word files
- Individual Lecture Slides - Acrobat (PDF) files
- Link to lecture slides from another edition of the course.
- Physics Applets
- Physics Flashlets
- Click for Instructions on Obtaining Your UVa Email
- Click for Instructions on Obtaining Transcripts
- Click for Frequently Asked Questions
HOW THINGS WORK

howthingswork.virginia.edu

Book Information

Louis A. Bloomfield, Professor of Physics, The University of Virginia

The 2nd edition of my textbook for the course "How Things Work" is now available from John Wiley & Sons. This book examines 61 objects in our everyday world and serves both as a comprehensive introduction to physics and as a guide to how many of the objects around us work. It is intended as a text for liberal arts students in a one or two semester survey course. What makes this essentially non-mathematical text unusual is that it begins with the objects and looks within them for the concepts of physics. It is first and foremost a book about those objects.

In keeping with the changing world of information, one-third of this book is located on the web rather than on paper. Of the book’s 61 sections, 21 are available to anyone, whether or not they own the printed portion of the book. To access those web sections, just click on their links below. Look for the sections that appear underlined in blue in the following Table of Contents! — Lou Bloomfield

Louis A. Bloomfield
## Phys 605 Schedule of Classes

(Click on course home page)

<table>
<thead>
<tr>
<th>Date</th>
<th>CDS</th>
<th>Lecture</th>
<th>Subject</th>
<th>Reading Section</th>
<th>Chapter</th>
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<td>Monday January 26</td>
<td>1</td>
<td>1</td>
<td>Introduction and Skating</td>
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<td>Wednesday January 28</td>
<td>1</td>
<td>2</td>
<td>Skating</td>
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<td>1</td>
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<td>Friday January 30</td>
<td>1</td>
<td>3</td>
<td>Skating, Falling Balls &amp; Ramps</td>
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<td>Monday February 2</td>
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<td>Falling Balls &amp; Ramps</td>
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<tr>
<td>Wednesday February 4</td>
<td>1</td>
<td>5</td>
<td>Ramps &amp; Seesaws</td>
<td>1.3</td>
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<tr>
<td>Friday February 6</td>
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<td>6</td>
<td>Seesaws</td>
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<td>Monday February 9</td>
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<td>Wheels</td>
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<td>Wednesday February 11</td>
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<td>Bumper Cars</td>
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<td>10</td>
<td>Bouncing Balls, Carousels &amp; Roller Coasters</td>
<td>3.2,3.3</td>
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<td>Bicycles</td>
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<td>Water Distribution I</td>
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• View lectures on CDs on your computer at home.
  – CD-Roms in Real Media format
  – Use Software RealOne Player

• How Things Work I

• Lecture Samples
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<tr>
<th>Assignment Name / Description</th>
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MACKERCHER MARK: Responses

The figure below is a schematic picture of the cross section section of a wing taken from your textbook. In the reference frame of the wing the air is flowing from left to right and the unbroken lines are streamlines.

1. Besides gravity what other two forces are acting on the wing?
Response:
The two forces acting on the wing other than gravity are lift and drag.

Score: [1] out of 1

Comment:
Correct.

Previously graded 1 by jason d powell TA on Tuesday, November, 23 2004 03:55 PM EST.

Key: The two important forces are called lift and drag. Lift is the force resulting from the air flowing faster over the top of the wing than the bottom of the wing producing a higher pressure on the bottom of the wing and a lower pressure on the top of the wing. The net force resulting from this air flow is not directly up, but it has some horizontal component that tends to slow down the plane. This horizontal component is a drag force, which is called induced drag, and increases with the speed of the airflow leaving the top of the wing (See page 167 in the text for more details).

Is Bernoulli’s equation hold for air flowing over the wing? Explain.

Response:
It does hold true. The total energy of the air flowing around the wing stays the same. The equation holds for laminar flow and breaks down turbulence.

Score: [1] out of 1

Comment:
Correct.

Previously graded 1 by jason d powell TA on Tuesday, November, 23 2004 03:55 PM EST.

Key: Bernoulli’s equation holds for laminar flow. When the air becomes turbulent, the details of the speed and pressure can not be predicted by Bernoulli’s equation. Qualitatively, however, the Bernoulli prediction that as the speed of the fluid increases, the pressu
1. In the graph below, the height (vertical position) of a tennis ball is plotted versus its downfield position (horizontal position). The time is given at selected points, and the velocity of the ball is given by the arrows. What is the horizontal velocity of the tennis ball?

- (a) 10 m/s
- (b) 20 m/s
- (c) 30 m/s
- (d) 40 m/s

**Solution or Explanation:**

Ans: 30 m/s. Why? The horizontal velocity is constant since there is no acceleration in the horizontal direction. The velocity is equal to the downfield displacement divided by the time it takes to go that distance. The total distance is 90 m divided by the time of 6 s gives a velocity of 30 m/s.

2. Which of the following is not an example of stored energy?

- (a) chemical energy in a battery
- (b) gravitational potential energy in a apple attached to a tree.
- (c) magnetic energy in a magnetic attraction between two magnets.
- (d) kinetic energy of a child swinging in its lowest position.

**Solution or Explanation:**

Ans: (d). Kinetic energy is not stored energy; it is a form of energy that an object possesses while it is in motion. Magnetic and chemical energy can be stored and released, whereas gravitational potential energy is a form of energy related to the position of objects with respect to each other.
• Calculus - based

• 19 - 2 hour physics lecture/demonstrations (Over 100).
• Use pedagogy that teachers can take into classroom.
• Numerous illustrations, overheads, notes, cartoons
• Include JiTT with Webassign and PhysLets.

• 16 - 1 1/2 hour recitation using best high school teachers. Live in dorms and tutor.
• Problems sets continue through October using Webassign.
• Four weekly quizzes in summer. Final exam proctored in Fall
• Make connections to other areas in science & real life
# PHYS 632

**Classical & Modern Physics II: Electricity, Magnetism, Waves, Sound, and Optics**

**Schedule for Summer 2002**

| DATE                  | 8:15 - 9:45 AM                          | 10:00 AM - 12:00 Noon |  
|-----------------------|----------------------------------------|-----------------------|--------
| Monday, July 8        | Orientation                            | Electric Charge       | Ch 22  |
| Tuesday, July 9       | Recitation                             | Electric Field        | Ch 23  |
| Wednesday, July 10    | Recitation                             | Gauss’ Law            | Ch 24  |
| Thursday, July 11     | Recitation                             | Electric Potential    | Ch 25  |
| Friday, July 12       | Recitation                             | Capacitance           | Ch 26  |
| Monday, July 15       | TEST #1                                | Current & Resistance  | Ch 27  |
| Tuesday, July 16      | Recitation                             | Circuits              | Ch 28  |
| Wednesday, July 17    | Recitation                             | Magnetic Fields       | Ch 29  |
| Thursday, July 18     | Recitation                             | Magnetic Fields & Current | Ch 30 |
| Friday, July 19       | Recitation                             | Induction             | Ch 31  |
| Monday, July 22       | Recitation                             | Lenz’s Law/Faraday’s Law | (cont.) |
| Tuesday, July 23      | TEST #2                                | Waves/Sound           | Ch 17  |
| Wednesday, July 24    | Recitation                             | Waves/Sound           | Ch 18  |
| Thursday, July 25     | Recitation                             | Electromagnetic Waves | Ch 34  |
| Friday, July 26       | Recitation                             | Images                | Ch 35  |
| Monday, July 29       | Recitation                             | Images                | (cont) |
| Tuesday, July 30      | Test #3                                | Interference          | Ch 36  |
| Wednesday, July 31    | Recitation                             | Diffraction           | Ch 37  |
| Thursday, August 1    | Recitation                             | Diffraction           | (cont.)|
| Friday, August 2      | Test #4                                | Interference & Diffraction | (cont) |

19 classes, Over 100 demos, Over 100 problems, 4 exams, Proctored final exam given in October
Third Summer: PHYS 633
Last of 3 calculus-based courses.
Distance learning from home.

Look at mini-lecture, problem solutions.
• View lectures on CDs on your computer at home.
  – CD-Roms in Real Media format
  – Use Software RealOne Player

• How Things Work I

• Lecture Samples
Near to last course: PHYS 641
Course on teaching physics and its pedagogy.

Overview of programs, curricula, techniques. Covers everything including demos and labs.

Look at syllabus and assignments. Lots of written work uploaded into course website. Students read and critique each other’s work.
Master of Arts in Physics Education

**Current Status:** 33 teachers

We are admitting more than 10 teachers per year.

Can take two of our courses before applying to be in MAPE program.
MAPE Graduates

- 2000: 5 graduates
- 2001: 8 graduates
- 2002: 1 graduate
- 2003: 5 graduates
- 2004: 4 graduates
- 2005: 9 graduates
Future Plans

• Reduce time for administrating the proctoring of exams and answering duplicative questions by email.

• Make better use of chat room. Include audio/video.

• PHYS 601-2, two new courses for K-8 teachers.

• Incorporate experiments done at home.

• Eventually replace CDs with DVDs.

• Appeal to a broader group of teachers.
For More Information

- Website: www.k12.phys.virginia.edu
- Email: PhysicsEducation@Virginia.edu