

# Curriculum Vita: Andrew G. Duffy

## Professional Preparation

Ph.D., 1995, Queen's University, Canada (Physics).  
M.Sc., 1990, Queen's University, Canada (Physics).  
B.Sc. (Honors), 1987, Mt. Allison University, Canada (Physics).

## Appointments

2009-present	Master Lecturer, Department of Physics, Boston University.
1999-2009	Assistant Professor, Department of Physics, Boston University.
1996-1999	Lecturer, Department of Physics, Boston University.
1995-2002	Director of Physics Lecture Demonstration Facility, Boston University

## Publications

Duffy, A.G., *Essential Physics Workbook*, volume 2, CreateSpace, 2017.

Duffy, A.G., *Essential Physics Workbook*, volume 1, CreateSpace, 2016.

B. B. Goldberg, A. G. Duffy, and M. D. Greenman (2016), "Project Accelerate – Blended Partnerships for STEM Success," in *Proceedings of the 7<sup>th</sup> 2016 LINC Conference 2016, Digital Inclusion: Transforming Education Through Technology*, pp. 103 – 110, Cambridge, USA.

Garik, P., Garbayo, L., Benetreau-Dupin, Y., Winrich, C., Duffy, A., Gross, N., and Jariwala, M., 2015, "Teaching the Conceptual History of Physics to Physics Teachers," *Science and Education*. 24 (4), 387 – 404.

Duffy, A., Garik P., Goldberg, B., Greenman, M, and Jariwala, M., "Three Years of PhysTEC at Boston University," APS Forum on Education Newsletter, Spring 2014.

Duffy, A.G., *Essential Physics*, volume 2, CreateSpace, 2012.

Duffy, A.G., *Essential Physics*, volume 1, CreateSpace, 2012.

Duffy, A., "The Boston University PhysTEC Program" APS Forum on Education Newsletter, Spring 2012.

Duffy, A.G., *Essential Physics Workbook*, Wiley Custom Services, 2007.

Duffy, A.G., Clapham, L., Whitton, J.L., and Ridgway, M.C., 1995, "High dose implantation of Pt ions into Ni using the sacrificial layer technique: A comparison of Al and Al<sub>2</sub>O<sub>3</sub> sacrificial layers." *Nucl. Instrum. Methods Phys. Res.*, **B106**, 504-510.

McKee, B.T.A., Duffy, A.G., Feller, W.B., and Stewart, A.T., 1991, "Thick microchannel plate detectors for 511 keV gamma rays." *Nucl. Instrum. Methods Phys. Res.*, **A310**, 255-260.

Duffy, A.G., Hawkes, R.L., and Jones, J., 1988, "Television observations of the Orionid meteor shower." *Mon. Not. R. astr. Soc.*, **234**, 643-54.

Duffy, A.G., Hawkes, R.L., and Jones, J., 1987, "The determination of shower meteor parameters from single station observations." *Mon. Not. R. astr. Soc.*, **228**, 55-75.

### **Recent Invited and Contributed Talks, Posters, and Workshops**

"Going On Four Cohorts: What We Learned and Are Changing. Project BoNUSS: Boston University Noyce Urban Science Scholarship", poster by P. Garik, D. DeRosa, D. Dill, A. Duffy, B. Goldberg, M. Greenman, & T. Wooley-Brown at the 2016 Noyce Summit, Washington, D.C., July 20-22, 2016.

"Teaching AP Physics 1 to the World, A Second Time," a talk presented at the American Association of Physics Teachers annual summer meeting in Sacramento, CA, July 20, 2016.

"Teaching AP Physics 1 to the World...and to Local Underserved Students," an invited talk presented at the New England section meeting of the American Association of Physics Teachers, Thayer Academy, May 21, 2016.

"Using an Online Course to Supplement an On-Campus Course," a talk presented at the American Association of Physics Teachers annual winter meeting in New Orleans, LA, Jan. 12, 2016.

"Creating Interactive Web Simulations with HTML5 and Javascript," workshop presented at the American Association of Physics Teachers annual summer meeting in College Park, MD (July 2015) and the annual winter meeting in New Orleans, LA (Jan. 2016). I was the sole leader.

"Teaching AP Physics 1 to the World," an invited talk presented at the American Association of Physics Teachers annual summer meeting in College Park, MD, July 29, 2015.

"HTML5 Simulations for Introductory Physics," a talk presented at the American Association of Physics Teachers annual summer meeting in College Park, MD, July 28, 2015.

"Preparing a MOOC for AP Physics 1," a talk presented at the American Association of Physics Teachers annual winter meeting in San Diego, CA, Jan. 6, 2015.

"Creating Interactive Web Simulations with HTML5 and Javascript," workshop presented at the American Association of Physics Teachers annual winter meeting in San Diego, CA, Jan. 3, 2015. I was co-leader, and Dan Schroeder of Weber State University was the leader.

"Studio Seating Arrangements and the Gender Gap in Introductory Physics," a talk presented at the American Association of Physics Teachers annual summer meeting in Minneapolis, MN, July 30, 2014. (Co-authors Bennett Goldberg and Pankaj Mehta)

“Creating Interactive Web Simulations with HTML5 and Javascript,” a workshop presented at the American Association of Physics Teachers annual summer meeting in Minneapolis, MN, July 27, 2014. I was co-leader, and Dan Schroeder of Weber State University was the leader.

“Using Learning Assistants to Transform Your Class,” a workshop presented at the Northeast Regional Learning Assistant workshop, Boston University, Mar. 20-21, 2014.

“Studio Physics for Life-Science Majors at Boston University,” a talk presented at the American Association of Physics Teachers annual winter meeting in Orlando, FL, Jan. 6, 2014.

“The Learning Assistant Program at Boston University,” a talk presented at the joint meeting of the New Jersey, New York, and New England sections of the American Association of Physics Teachers, Poughkeepsie, NY, Sept. 28, 2013.

“Using Piazza in an Introductory Physics Class,” a talk presented at the American Association of Physics Teachers annual summer meeting in Portland, OR, July 17, 2013. (With Meredith Knight of the School of Education)

“Linking In-Service and Pre-Service Teachers at Boston University,” a talk presented at the spring meeting of the New England sections of the American Association of Physics Teachers, Milton, MA, Apr. 13, 2013.

“Adapting the Colorado Learning Assistant model,” a workshop presented at the national PhysTEC conference along with Laurie Langdon (Colorado), Laird Kramer (FIU), Amy Robertson (Seattle Pacific), and Ed Price (San Marcos). Baltimore, MD, Mar. 16, 2013.

“Boston University’s Differentiated Learning Assistant Programs Feed the Teacher Pipeline,” a poster presented at the national PhysTEC conference (with Manher Jariwala, Meredith Knight, Peter Garik, Bennett Goldberg, and Mark Greenman). Baltimore, MD, Mar. 16, 2013.

“Implementing Studio Physics at Boston University,” a talk presented at the American Association of Physics Teachers annual winter meeting in New Orleans, LA, Jan. 8, 2013.

“iPhone and iPad app development”, a 4-hour workshop presented at the American Association of Physics Teachers annual winter meeting in New Orleans, LA, Jan. 6, 2013.

“iPhone and iPad app development”, a 3-hour workshop presented at the Fall joint meeting of the New England sections of the American Physical Society and American Association of Physics Teachers in Williamstown, MA, Nov. 10, 2012.

“Engaging Students in the Learning Process”, an invited talk presented under the auspices of Boston University's Center for Excellence and Innovation in Teaching, Oct. 22, 2012.

“An iPad app textbook for Introductory Physics,” a talk presented at the American Association of Physics Teachers annual summer meeting in Philadelphia, PA, July 30, 2012.

## **Awards and Special Recognition**

Co-winner of the very first Gerald and Deanne Gitner Family Innovation in Teaching with Technology Award, in 2014, awarded for the transformation of the introductory physics sequences at Boston University. Shared with Bennett Goldberg, Manher Jariwala, and Pankaj Mehta, of the Department of Physics.

Recipient of the 2012 Metcalf Cup and Prize for Excellence in Teaching, Boston University's highest teaching award.

Appointed to Master Lecturer in Physics, summer 2009. As of early 2013, I was one of only six Master Lecturers in the College of Arts and Sciences at Boston University.

Recipient of a 2005 Outstanding Teaching Award from the College of Arts and Sciences Honors Program at Boston University.

Recipient of the 2004 Boston University Neu Family Award for Excellence in Teaching.

## **Professional Service**

Chair of the Committee on Educational Technologies, for the American Association of Physics Teachers, Jan. 2014 – Jan. 2015.

Vice-Chair of the Committee on Educational Technologies, for the American Association of Physics Teachers, Jan. 2013 – Jan. 2014.

Co-chair of the Joint Spring Meeting of the New England Sections of the American Physical Society and American Association of Physics Teachers. (Boston University 3-31 and 4-1, 2006.)

## **Memberships in Professional Groups**

Member of the AAPT (American Association of Physics Teachers)

Member of the APS (American Physical Society)

## **Service on Committees**

Member, AAPT Committee on Educational Technologies

Member, Department of Physics Undergraduate Curriculum Committee and the PY105/PY106 sub-committee

Member, Premedical and Predental Advisory Board, Boston University

Past: Member, College of Arts and Sciences Lecturer Promotion Committee

Past: Member, Metcalf Award Committee

## Recent Grant-Funded Projects

***Teaching Physics in Urban Schools*** (Aug. 2014 – July 2017). \$270,000 from Boston University sources (shared equally between the Office of the Provost, the School of Education, and the Department of Physics).

This internal grant is aimed at sustaining our PhysTEC efforts (see next item), by continuing to support a physics teacher-in-residence, strengthening the culture of physics teacher training, and sustaining a local physics teacher network. I am the PI on this grant, with the co-PI being Peter Garik (Boston University School of Education).

***Transforming Physics Education at Boston University with a Teacher in Residence*** (Aug. 2011 – July 2014). \$300,000 from the Physics Teacher Education Coalition (PhysTEC).

The main purpose of this grant is to increase the number of undergraduate students who graduate as trained physics teachers. This addresses a national need for high school physics teachers. Our project activities include building a relationship with local physics teachers; promoting teaching opportunities for undergraduate students, such as through the new Learning Assistant program; and raising the profile of physics teaching as a profession among Boston University physics faculty members. The program at Boston University is the first PhysTEC project in New England, and another goal of our project is to raise awareness about PhysTEC in the region. I am the PI on this grant, with the co-PI being Peter Garik (Boston University School of Education).

***Improving the Teaching of Physics II*** (Jan. 2008 – Dec. 2010). \$360,000 from the Massachusetts Board of Higher Education.

A partnership between the Boston University Physics Department and School of Education, and the University of Massachusetts Boston. The focus of the program is a sequence of 10 two-credit physics courses high school physics teachers. Currently (spring 2015), the program continues with one cohort of teachers. I have been the lead instructor of the physics content for all the courses, and a member of the core team of developers for the program. In addition, from September, 2008, to June, 2011, the program was expanded to western Massachusetts. I taught once a week in Chicopee, MA. I was co-PI on this grant, with the principal investigators being Peter Garik (Boston University School of Education) and Arthur Eisenkraft (UMass Boston).

***Improving the Quality of Teachers of Physics I*** (Jan. 2005 – Dec. 2007). \$450,000 from the Massachusetts Board of Higher Education.

The initial grant for the program described above. In the first grant cycle, two complete cohorts, of about 10 teachers each, completed the program. I was the lead instructor of the physics content for all the courses, and a member of the core team of developers for the program. I was co-PI on this grant, with the principal investigators being Peter Garik (Boston University School of Education) and Arthur Eisenkraft (University of Massachusetts Boston).

***Enhanced Learning for Students in Intermediate and Advanced Physics*** (July 2003 – June 2006). \$70,993 from the NSF.

As the principal investigator, I led the effort to improve our intermediate and advanced lab experiments through the introduction of new equipment, new technology, and a focus on guided inquiry. Major accomplishments include three laboratory experiments with completely new equipment and lab write-ups. These include experiments on Millikan's Oil Drop, the Photoelectric Effect, and Atomic Spectra. Co-PI's Robert Carey and Bennett Goldberg.

## Projects and Activities

**1. PhysTEC grant.** As outlined above, I am leading the Boston University effort to train more physics teachers. This addresses a national shortage of such teachers. Boston University is becoming a regional center for training physics teachers. In 2015, six such teachers graduated from Boston University, more than we have ever graduated in one year.

**2. Teaching physics to physics teachers.** In addition to teaching introductory physics in the Department of Physics, I have also taught physics to in-service Boston-area and Chicopee-area high school physics teachers, through Project ITOP (Improving the Teaching of Physics). The courses for the teachers include courses covering standard introductory-level physics content, as well as courses that go beyond that level and cover topics such as Quantum Physics, Special Relativity, and Computer Modeling in Physics. The courses are taught in a hands-on format and also integrate readings from the history and philosophy of physics, and from the Physics Education Research literature, with the physics content.

**3. Pedagogical reform in the Department of Physics.** The Boston University Department of Physics initiated pedagogical reforms in the introductory physics classes, supported by a RULE grant from the Office of the Provost, and I am playing a key role in these reforms. Among other activities, I developed pre-class quizzes, introductory movies that are posted on YouTube, as well as doing curriculum development for teaching physics in a studio setting. We have an 81-student studio space that came on-line in Fall 2013, and I am a key player in the development of the curriculum for use in the studio in PY105 and PY106 (algebra-based physics).

**4. Developing and teaching online courses on edX.** In Spring 2015, I led the development and teaching of an online course on edX, supported by Boston University's Digital Learning Initiative. The course, AP Physics 1, is aimed at high school students who are taking the algebra-based AP Physics 1 exam, but it also attracted many students (it had 11,000 registrants) from all over the world who were interested in learning introductory physics. The course is being offered a second time, Sept. 2015 – May 2016. In addition, Peter Garik (SED) and I developed and taught a Force and Motion course for physics teachers in Fall 2015.

**5. Teaching science to elementary and middle school teachers.** In the summer of 2007, I helped to develop and teach a two-week workshop in the summer, covering geometrical optics, for 15 elementary school teachers. The workshop comprised a two-credit course, SED SC531. In the summer of 2008, the summer experience was expanded to include five three-hour sessions as well as the two-week workshop, (now a four-credit course, SED SC532), which I taught for 13 kindergarten and elementary school teachers. I also helped to develop and teach a new course, SED SC533: Immersion in Green Energy, which was taught for 26 elementary and middle school teachers in the summer of 2008 and a similar number of teachers in 2009 and 2010, and for 12 teachers in the summer of 2011. These courses are supported by two different projects, the Immersion in Science project, funded by the Stephen Bechtel Foundation, and the Inquiring Minds project, funded by the state of Massachusetts. The aim is to expose elementary and middle school teachers to a hands-on method of doing science, so that the teachers are more comfortable doing science using inquiry-based methods in their own classrooms.

**6. Essential Physics.** This is a textbook I wrote for the introductory algebra-based physics course. The goal of the book is to focus on the basics, and to write a book that is a few hundred pages shorter than many of the books currently on the market. About 400 students per year use the textbook in the PY105 and PY106 courses at Boston University. The book is currently available in electronic form through WebAssign, an on-line homework system, and an iPad version of the book is available through the App Store. New for 2016-17, volumes I and II of the *Essential Physics Workbook*, which the PY105/6 students use in class.

**7. Physics simulations and training.** I have scripted over 300 Physlet simulations and animations for introductory physics courses, as well as a number of simulations using the Easy Java Simulations (Ejs) program. More recently, I have been developing HTML5 simulations (currently, there are more than 90 HTML5 simulations). These are on-line at:  
<http://physics.bu.edu/~duffy/classroom.html>.

In addition I have run several training sessions in the scripting of Physlets and in the writing of Ejs simulations. I have also developed several physics-related apps that are available on Apple's App Store, for the iPhone, the iPod Touch, and the iPad, and presented workshops on programming apps, and writing HTML5 simulations, at regional and national AAPT meetings.

#### **A summary of Boston University courses taught**

Summer 1996 – PY106, Elementary Physics II

Fall 1996 – PY105, Elementary Physics I

Spring 1997 – PY106, Elementary Physics II

Summer 1997 – PY105, Elementary Physics I

Fall 1997 – PY105, Elementary Physics I

Spring 1998 – PY106, Elementary Physics II

Summer 1998 – PY106, Elementary Physics II

Fall 1998 – PY105, Elementary Physics I

Spring 1999 – PY106, Elementary Physics II

Summer 1999 – PY106, Elementary Physics II

Fall 1999 – PY105, Elementary Physics I

Spring 2000 – PY106, Elementary Physics II

Fall 2000 – PY212, General Physics II

Spring 2001 – PY211, General Physics I

Summer 2001 – PY211, General Physics I

Fall 2001 – PY212, General Physics II

Spring 2002 – PY106, Elementary Physics II and PY212, General Physics II

Fall 2002 – PY212, General Physics II

Spring 2003 – PY211, General Physics I

Summer 2003 – PY211, General Physics I

Fall 2003 – PY105, Elementary Physics I (and the honors discussion section)

Spring 2004 – PY106, Elementary Physics II  
Summer 2004 – SED SC525, Force and Motion  
Fall 2004 – PY105, Elementary Physics I (and the honors discussion section)  
Fall 2004 – SED SC526, Electricity & Magnetism and SED SC527, Rotation & Thermodynamics

Spring 2005 – PY106, Elementary Physics II (and the honors discussion section)  
Spring 2005 – SED SC528, Waves and Optics and SED SC529, Electromagnetism  
Summer 2005 – SED SC530, Quantum Physics  
Fall 2005 – PY105, Elementary Physics I (and the honors discussion section)  
Fall 2005 – SED SC525, Force and Motion and SED SC547, Special Relativity

Spring 2006 – PY106, Elementary Physics II (and the honors discussion section)  
Spring 2006 – SED SC548, Computer Modeling and SED SC549, Everyday Applications  
Summer 2006 – SED SC550, Quantum Mechanics  
Fall 2006 – PY105, Elementary Physics I (and the honors discussion section)  
Fall 2006 – SED SC545, Electromagnetism and SED SC546, Quantum Physics

Spring 2007 – PY106, Elementary Physics II (and the honors discussion section)  
Spring 2007 – NS541, Gravitation and Rotation and NS547, Special Relativity  
Summer 2007 – NS548, Computer Modeling of Physical Phenomena  
Summer 2007 – SED SC531, Immersion in Geometrical Optics (2 credits)  
Fall 2007 – PY105, Elementary Physics I (and the honors discussion section)  
Fall 2007 – NS540, Force and Motion and NS549, Everyday Applications of Physics

Spring 2008 – PY106, Elementary Physics II (and the honors discussion section)  
Spring 2008 – NS542, Fluids and Thermodynamics and NS543, Electricity and Magnetism  
Summer 2008 – NS544, Harmonic Motion, Waves, and Geometrical Optics  
Summer 2008 – SED SC532, Immersion in Geometrical Optics (4 credits)  
Fall 2008 – PY105, Elementary Physics I (and the honors discussion section)  
\*Fall 2008 – NS540, Force and Motion and NS541, Gravitation and Rotation

Spring 2009 – PY106, Elementary Physics II (and the honors discussion section)  
\*Spring 2009 – NS542, Fluids and Thermodynamics and NS543, Electricity and Magnetism  
\*Summer 2009 – NS544, Harmonic Motion, Waves, and Geometrical Optics  
Summer 2009 – SED SC533, Immersion in Green Energy  
Fall 2009 – PY105, Elementary Physics I (and the honors discussion section)  
\*Fall 2009 – NS545, Electromagnetism and NS546, Quantum Physics

Spring 2010 – PY106, Elementary Physics II (and the honors discussion section)  
\*Spring 2010 – NS547, Special Relativity and NS548, Computer Modeling  
\*Summer 2010 – NS549, Everyday Applications of Physics  
Summer 2010 – SED SC533, Immersion in Green Energy  
Fall 2010 – PY105, Elementary Physics I (and the honors discussion section)  
\*Fall 2010 – NS540, Force and Motion and NS541, Gravitation and Rotation

Spring 2011 – PY106, Elementary Physics II (and the honors discussion section)  
\*Spring 2011 – NS542, Fluids and Thermodynamics and NS543, Electricity and Magnetism



\*Summer 2011 – NS544, Harmonic Motion, Waves, and Geometrical Optics  
Summer 2011 – PY105, Elementary Physics I (co-taught with Manher Jariwala)  
Summer 2011 – SED SC533, Immersion in Green Energy  
Fall 2011 – PY105, Elementary Physics I

Spring 2012 - PY106, Elementary Physics II  
Spring 2012 – NS542, Fluids and Thermodynamics I (co-taught with Manher Jariwala)  
Spring 2012 - NS543, Electricity and Magnetism I (co-taught with Manher Jariwala)  
Summer 2012 – NS544, Harmonic Motion, Waves, Optics (co-taught with Manher Jariwala)  
Fall 2012 - NS545, Electromagnetism

Spring 2013 – PY106, Elementary Physics II  
Fall 2013 – PY105, Elementary Physics I, studio section

Spring 2014 – PY106, Elementary Physics II, studio section  
Summer 2014 – PY211, General Physics I  
Fall 2014 - PY105, Elementary Physics I, studio section

Spring 2015 – PY106, Elementary Physics II, studio section  
Spring 2015 – Preparing for the AP Physics 1 Exam, an online course through edX, developed under the auspices of Boston University’s Digital Learning Initiative  
Summer 2015 – PY211, General Physics I (co-taught with Manher Jariwala)  
Fall 2015 – PY105, Elementary Physics I, S1 studio section  
Fall 2015 – PY105, Elementary Physics I, S3 studio section  
Fall 2015 – Force and Motion: Pedagogical Content Knowledge for Teaching Physics, an online course for physics teachers on edX, co-taught with Peter Garik (SED)  
Fall 2015 – Spring 2016, AP Physics 1 (renamed), the second iteration of the online course on edX

Spring 2016 – PY106, Elementary Physics II, S1 studio section  
Spring 2016 – PY106, Elementary Physics II, S3 studio section  
Summer 2016 – PY211, General Physics I  
Fall 2016 – PY105, Elementary Physics I, S1 studio section  
Fall 2016 – PY105, Elementary Physics I, S3 studio section  
Fall 2016 – Spring 2017, Preparing for the AP Physics 1 Exam (renamed again), the third iteration of the online course on edX

Spring 2017 – PY106, Elementary Physics II, S2 studio section

\* These courses were taught in Chicopee at Chicopee Comprehensive High School.  
Notes: The 10-course sequence for high school physics teachers started as the two-credit SED courses SC525, SC526, SC527, SC528, SC529, SC530, SC547, SC548, SC549, SC550. This sequence then was re-designed and re-numbered as the CAS courses NS540 through NS549. The summer courses for elementary and middle school teachers are the courses SED SC531, SC532, and SC533.

**Collaborators (at Boston University unless indicated otherwise)**

Emily Allen

Robert Carey

Don DeRosa

Gay Stewart (University of West Virginia)

Arthur Eisenkraft (UMass Boston)

Peter Garik

Bennett Goldberg (Northwestern)

Mark Greenman

Nicholas Gross

Manher Jariwala