**AP® Physics: Challenging Concepts from Physics 1 & Physics 2**

We, the co-editors, are pleased that you are using the Davidson Next AP®Physics 1 and Physics 2 program. We have designed the program to help AP®students and teachers learn the most challenging concepts in introductory physics. Fourteen challenging concepts have been chosen, seven from each of the two AP® courses. The importance and challenge of these concepts have been affirmed by data relating to past AP®test performance provided by the College Board.

For each concept, there are questions to assess whether you are ready for the new material, short video lectures to introduce the concepts, activities to build your understanding of the material, and assessment questions. We have chosen presenters from high school faculty nationwide who have generally been involved with AP®Physics for many years. They combine the disciplinary knowledge to clearly explain the material with the experience of working with high school AP®students in these challenging areas.

We are persuaded that if students properly engage the content of a unit and work carefully through the activities and the assessment questions then they will have a strong initial mastery of the challenge concept. Such knowledge will serve them well in further coursework in their high school classes, in taking the AP®Physics 1 and AP®Physics 2 exams, and in taking subsequent courses in physics.

We are very excited about this novel project. To that end, we hope that you will provide us any feedback or suggestions to improve this work.

Your co-editors,

Peggy Bertrand, University of Tennessee (Knoxville, TN), Bob Morse, St. Albans School - retired (Washington, D.C.) and Larry Cain, Davidson College (North Carolina)

# Prerequisites

Prior knowledge:  In presenting these challenge concepts we assume that you have knowledge of basic physics concepts. Each unit contains a section describing skills and prior knowledge that you should bring to the unit. The section “Let’s See What You Already Know” will test you briefly on some of this prior knowledge.

# Course Overview and Recommended Usage

**Flexibility in Units**

These 14 units (concepts) were designed with the intent of flexibility. They can be used in any order, to suit your class sequence, but we have a recommended order if you would like to use all of them. This is the typical order for many introductory courses.

**For Students and Teachers**

The units can be used in a variety of ways:

• by individual students to enhance their understanding of AP® Physics

• by teachers to help plan and/or use them in a class as a teaching tool

• as videos and activities for students to watch/use at home as part of a blended-learning or flipped classroom environment

• as review tutorials before the AP® exam

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| **Unit #** | **Name** | **Unit Author** |
|  | AP Physics 1 Topics |  |
| 1 | Acceleration | Dolores Gende |
| 2 | Force Diagrams | Peggy Bertrand |
| 3 | Momentum | Terri McMurray |
| 4 | Rotational Motion | Connie Wells |
| 5 | Angular Momentum | Paul Lulai |
| 6 | Standing Waves | Jeff Funkhouser |
| 7 | Conservation of Charge and Energy in Circuits | Angela Jensvold |
|  | AP Physics 2 Topics | Robert Morse |
| 8 | Electrostatic Fields | Robert Morse |
| 9 | Gravitational and Electric Potentials | Marc Reif |
| 10 | Electromagnetic Induction | Deborah Roudebush |
| 11 | Thermodynamics | James Lincoln |
| 12 | Pressure, Force, and Flow in Fluids | Gardner Friedlander |
| 13 | Diffraction and Interference | Rebecca Howell, Brad Davis |
| 14 | Atomic Transitions | Deborah Ormond |

# Unit Design and Grading

Each unit has 4 major components.

1. **Introduction** You will be introduced to the concept and the instructor(s). All instructors have significant experience with the AP®Physics program.
2. **Let’s See What You Already Know (5%)** Pre-assessment questions test concepts you should know in order to continue with the unit. These questions were not meant for teaching purposes and as such have no explanation with the answer.
3. **Learning cycles (70%)** Each learning cycle contains a short video explanation of the concept, one or more activities that allow you to practice the concept, and formative assessment questions that include feedback. You can self-assess and teachers can also receive feedback about your understanding.
   1. **Module Introduction:** You will be introduced to the concept and instructor, learning objectives, and a list of important vocabulary.
   2. **Video Content:** An experienced AP Physics instructor explains the concept(s) in the learning cycle.
   3. **Activity:**The activities aim to merge innovative teaching technology with AP®focused content. In many cases, we are pushing the boundaries of assessment within the edX platform. Because of the novelty of many of our assessment techniques, these are not always strictly graded; however, we do expect you to take the activities seriously.
   4. **Formative Assessment Questions:** Formative assessment questions include feedback for you. You can self-assess and teachers can also receive feedback about your understanding.
4. **Let’s See What You’ve Learned (15%)** Post-assessment questions cover the information from the unit. These questions also contain feedback for you to help you better understand the concepts. This feedback includes where to look in the unit for the information tested in each question.

There is no final exam for this course.