



US DEPT. OF EDUCATION  
BLUE RIBBON SCHOOL



PRESIDENTIAL AWARDS FOR EXCELLENCE  
IN MATHEMATICS AND SCIENCE TEACHING



CALIFORNIA DISTINGUISHED  
SCHOOL

# RIO AMERICANO LABORATORY PHYSICS

## THE PROGRAM

All high school students planning a baccalaureate education should take one year of biology, one year of chemistry, and one year of physics. Students electing physics are introduced to the subject matter at many levels through a variety of activities. Nearly all of the curriculum materials used in the physics and AP Physics courses have been developed by the teacher specifically for students at Rio. Students investigate topics through hands-on laboratory activities (many involving the use of computers and various sensors), directed discussions, demonstrations, video presentations, readings, and homework assignments.

## PHYSICS AND AP PHYSICS

Physics is intended to provide any college-bound student with an introduction to physics. Math used in the course is maintained at the Algebra 1 level. Topics include force and motion, circular motion and gravity, conservation of momentum and energy, electricity and magnetism, waves, and light. The content in Physics is being aligned to the newly-adopted Next Generation Science Standards.

AP Physics B (offered at Rio from 1986 through 2013) no longer exists. It was replaced by AP Physics 1 and AP Physics 2 in 2014.

AP Physics 1 is the equivalent of a first-semester college course in algebra-based physics. The exam covers Newtonian mechanics (including rotational dynamics and angular momentum); work, energy, and power; mechanical waves, sound, and electric circuits. We will also learn about electrostatics, magnetism, light and optics.

AP Physics 2 is the equivalent of a second-semester college course in algebra-based physics. The exam covers fluid mechanics; thermodynamics; electricity and magnetism; optics; atomic and nuclear physics.

Rio students have always done well on the AP Physics exam. For the past thirty+ years, Rio's AP Physics pass rate has been well over 90%.

Rio's AP Physics students have earned national honors several times in the American Association of Physics Teachers' Physics Bowl competition exam. Our students have earned medals in the Science Olympiad Physics Lab event at the state and national levels.

Rio physics students have gone on to greatness. Five are now teachers at Rio, two teach physics at other schools. One double-majored in science at Cornell and graduated at the top of her class, another became National Teacher of the Year. One serves as a justice on California's Supreme Court.

## PREREQUISITES

Physics and AP Physics 1 are first-year physics courses. AP Physics 2 is a second-year course.

### PHYSICS

Any student who has successfully completed Algebra 1/IM1 can enroll in Physics. The mathematics involved in the course is generally limited to simple algebra and geometry.

### AP PHYSICS 1

Successful completion of Algebra 2/IM3+.

### AP PHYSICS 2

Successful completion of Physics or AP Physics 1.  
Successful completion of Algebra 2/IM3+.

## ABOUT THE TEACHER

I have taught physics and AP Physics at Rio since 1986. I hold a Bachelor of Science degree (physics major, math minor) from the School of Education at the University of Michigan and a Master of Science degree in Instructional Leadership from National University. I have presented papers and demonstrations at meetings of the American Association of Physics Teachers (AAPT). I've had articles published in AAPT's academic journal, *The Physics Teacher*. I served as a mentor in a National Science Foundation-funded physics education program.

I recently served as an appointed member of the AAPT's Committee on Physics in High Schools, and was a recipient of the AAPT Distinguished Service Citation in 2008. I was elected and served as an officer in the Northern California and Nevada Section of the AAPT, and was a recipient of its Distinguished Service Award in 2001. I was an appointed member of the State Board of Education's Assessment Review Panel, where I served as a content advisor to the California Department of Education (CDE). I am a contributor to the high school edition of *Conceptual Physics*, and author of lab manuals for high school and college editions of *Conceptual Physical Science* and *Conceptual Integrated Science*, as well as for the college edition of *Conceptual Physics*. I have designed lab products and authored curriculum products sold by Arbor Scientific.

In 2012, I was selected by the CDE, the National Science Foundation, and the White House Office for Science and Technology Policy as California's Science recipient of the Presidential Award for Excellence in Mathematics and Science Teaching. In 2014, I was made a fellow of the American Association of Physics Teachers.

## WHAT PARENTS CAN DO TO ENCOURAGE STUDENT SUCCESS

1. Make sure your student is completing all homework assignments on a daily basis. Please see to it that your son or daughter is completing all assignments daily. This is the single most important thing a parent can do. You do not need to check for correctness (correct answers are posted for students to check or can be obtained in class). Having correct answers is nice, but students learn physics in the process that occurs in getting to those answers. Sometimes students will load up on correct answers via friends or tutors. If a student doesn't know how to get to those answers, the answers themselves are fairly useless.

2. Ask your son/daughter about what he or she is learning in physics. They should be able to describe strange and wonderful things.

3. Ask your son/daughter when the next unit test is scheduled to take place and ask what he or she is doing to ensure success. Students are allowed to use homework turned in throughout the unit during each test. There is also a practice test for each unit of Physics 1 online at [phyz.org](http://phyz.org). All students should take the practice test before the actual test.

4. Ask your son/daughter about his/her current grade. Progress grades are updated monthly and graded material is returned to students on a regular basis, so each student knows his/her current standing. If your student is having difficulty, encourage him/her to see the instructor at lunch or after school for additional assistance. You can check grades in progress yourself by visiting my website ([phyz.org](http://phyz.org)). Grades are posted in PDF format and are updated at the official marking intervals. Grades are listed by period, then by each student's ID number.

## POLICIES AND EXPECTATIONS

Your son or daughter has a copy of each. He or she should have asked you to sign the bottom of the Rules/Policies form.

## COMMUNICATIONS OPTIONS

1. E-Mail. I can be reached through electronic mail at [dbaird@sanjuan.edu](mailto:dbaird@sanjuan.edu). This is the most effective method of communication for me. You don't have to track me down and I don't have to track you down; we each communicate when our schedules allow. E-mail is definitely the "best value" in terms of response time and reliability.

2. WWW. I have a site on the World Wide Web. It includes useful information for students and parents: grades in progress, unit schedules, curriculum materials, etc. Point your browser to <http://phyz.org>.

## WHAT ABOUT Q?

Detailed grade reports are posted at [phyz.org](http://phyz.org). After selecting the course (Physics PHY, AP Physics 1 AP1, or AP Physics 2 AP2), click the link labeled "Grade Summaries". Less detailed "marks" are posted to Q/Zangle. Both reports are updated at the monthly, official marking intervals. The first Q report will be available soon via ParentConnection. I do not use Q's Gradebook feature, so incremental (hourly/daily/weekly) updates are not always made between official posting dates. Please ask your son or daughter about their inter-marking period progress. On the course page (PHY, AP1, or AP2), you can find links to more detailed "Test Scores" and "Lab Scores". These are updated after each four-week interim.

## NEXT GENERATION SCIENCE STANDARDS

We are in the process of switching over from the old content standards to the new California NGSS standards. Students are now assessed on the new science standards via the California Science Test (CAST), which became operational in 2019.

In the next few years, we plan to phase out "Physics" and replace it with the NGSS-aligned "Physics of the Universe" which will be accessible to freshmen.

## SAT II PHYSICS EXAM

A number of students have asked me about their preparedness for the SAT II examination in physics. Upon reviewing the examination outline, I can say that only students who have completed both Physics (or AP Physics 1) and AP Physics 2 are fully prepared for the SAT II in physics.

## WHAT STUDENTS NEED FOR PHYSICS

1. A binder just for physics. We collect and organize a fair amount of paper documents in physics, so a dedicated physics binder sees quite a bit of use.
2. Pencil. In some classes, students may very well need to write in ink. In physics, we prefer pencil so that we can easily and efficiently erase mistakes.
3. Scientific calculator. (\$10 TI-30, for example). A simple scientific calculator is all the calculator we need in physics. I allow students to borrow a calculator from me during tests, but they must surrender an item for collateral until they return my calculator. Some will leave a \$500+ iPhone in trade for use of a \$10 TI-30. Some deposit a shoe.
4. Ruler + Protractor. Separate rulers and protractors are okay, but for ease and convenience, the combined ruler-protractor is recommended.
5. Internet. To access the resources at [www.phyz.org](http://www.phyz.org), PhET simulations, and online video content (YouTube, etc.) students need Internet access on a web-capable computer (up-to-date browser, updated Flash and Java). Course homework and classroom activities are printed and distributed in class, but reading material is online only. PhET sims are at [phet.colorado.edu](http://phet.colorado.edu). They are developed by a team headed by a Physics Nobel Laureate, distributed for free, and used around the world.

## ENGAGE!

Some students struggle in physics (and/or AP Physics). Some do not. I think physics is a difficult subject to learn, but that it's so fascinating, the effort is truly worth it.

But how can a student learn this demanding subject?

Memorization—a skill so useful in so many academic endeavors—is virtually useless in physics. (Students accustomed to academic success sometimes have their first serious setbacks in physics.) Instead, we strive to answer questions by applying and extending general principles.

Students are given opportunities to learn this way via their homework. Whether it's a set of problems and questions or a single-themed PhysJob, homework is where student have the opportunity to struggle with and resolve questions and problems involving the physics at hand.

There is essential value in engaging in classroom presentations of physics concepts and hands-on activities.

But students do not take ownership of the content until they can find their way from physics questions to physics answers. Completing daily physics homework on a daily basis is how students learn physics.

Doing homework is not always fun. Students have more appealing options for spending their time away from school.

But if learning physics is the objective, completing daily assignments is the path to meeting that goal.

Getting from questions to answers can be frustrating. Very few people are born with an intuitive and complete sense of physics. Navigating from questions to answers is a struggle for nearly everyone. A wise colleague expresses this reality with the words

## CONFUSION IS THE SWEAT OF LEARNING.

I provide answers for most of the questions and problems I ask students to solve. Students should check these only after they've come up with an answer of their own. Some will short-circuit their learning by writing these answers for the questions without engaging on their own. Some will copy answers from other students. Some will have tutors who will give them answers.

Any avoidance of the discomfort of the struggle inherent in getting from questions to answers circumvents the learning process. It provides a comforting illusion of understanding but leaves students incapable of using physics principles to guide their thinking from questions to answers. Confusion is the sweat of learning.

Being in possession of coordinated questions and answers seems useful. And there may well be courses in which such couplings have value. But a course in physics is not one of them. Flash cards are useless in physics.

## ANALOGY

We can think of physics learners like budding weightlifters. In class, they learn all about weightlifting technique. The instructor even lifts weights to show them how it can be done.

For homework, students are given weights to lift. (Some of the weights are light, some are heavy). The weights also have a safety feature: rapidly-inflating helium balloons that render the weights "weightless".

Students who lift the weights despite the struggle learn the lesson. Students who inflate the balloons get an artificial sense of accomplishment by lifting weightless objects. Students who allow others to lift their weights while they spectate remain similarly unmuscled.

When an in-class assessment demands students lift balloon-free weights on their own, the approach they took to homework is revealed

## TUTORS

I'm not a huge fan of tutoring in physics. Too often, a tutor will be eager to do a student's homework for them with the assumption that obtaining a correct answer was the purpose of the homework question. Also, I don't know any tutors; the counselors might.

# HOW GRADES ARE MADE IN PHYSICS AND AP PHYSICS

## 1. Basics (Getting Academic Credit)

Students' grades in Rio lab physics are composed of scores in three performance areas.

Unit Tests

Labs/Clicker Quizzes

Final Exam

Unit Tests are given at the end of each unit of study; we have about five units in each semester. Unit tests are scored on a 100-point scale. They are composed chiefly of questions on the most current unit of study, but will also reach back to topics covered in previous units.

Labs are collaborative activities usually completed by student groups in class. Some labs may be turned in; most labs are followed by an open-lab quiz. Most labs are scored on a 50-point scale. Longer labs are scored as "doubles" (two 50-point scores). One score out of every four lab scores is dropped. In other words, the best three of every four lab scores are counted. Because labs are collaborative group activities, we generally don't have make-up activities for missed labs. Instead, missed labs become the dropped scores. Clicker quizzes are similarly collected into sets of four from which one score is dropped.

The Final Exam is administered at the end of the semester and covers material from throughout the semester. The first semester exam covers first semester topics; the second semester final exam covers second semester topics. The exam is scored on a 250-point scale.

## 2. Modifiers (Bonus Points and Recovering Academic Credit)

**CTF: Credit Toward Final** - Our version of extra credit is awarded for a variety of things throughout the semester. The points are applied to the score of the final exam. We've already had a few CTF opportunities relating to course paperwork and an online quiz on [phys.org](http://phys.org). Credit Toward Final can be gained by various activities; it can also be lost through activities. CTF-losing activities are posted in class.

**CTL and CTT: Credit Toward Labs and Credit Toward Tests** - Similar to Credit Toward Final, but applied to Lab and Test points.

**TCJ (PHY only): Test Correction Journal.** Several days after each unit test, students review the questions and their answers in a group setting. They record journal entries for each missed item in accordance with in-class instructions. Students who complete their TCJs before the posted deadline are eligible to take the TCJ Quiz.

The TCJ Quiz consists of ten questions from the corresponding unit test. Students are given back 10% of half the points they missed on the unit test for each quiz item they answer correctly. A student who answers all ten questions correctly gets back half the points they missed on the original test. The TCJ Quiz is usually administered several days after the corresponding TCJ day.

Why is homework not granted academic credit?

No academic credit is granted for homework completion for the same reason no points are given to sports teams when they show up to the game/match/meet/event. Members of the team may have practiced for several hours over the course of a week before the event. Yet when they arrive at the competition, the scoreboard shows them with a score of zero. If the team works so hard at practice, why is this work not acknowledged on the scoreboard? And if there is no scoreboard acknowledgement of practice, why do teams practice before competitions? Homework is practice; tests are the "competitive event".

| <b>A</b>        | <b>B</b>       | <b>C</b>       | <b>D</b>       | <b>F</b>      |
|-----------------|----------------|----------------|----------------|---------------|
| <b>90%–100%</b> | <b>80%–89%</b> | <b>70%–79%</b> | <b>60%–69%</b> | <b>0%–59%</b> |