

PASCO Academy: Physics (PA-1100)

Welcome to PASCO Academy: Physics 1! This interactive, instructional tool is accessible to educators from September 1, 2020 to January 31, 2021, and includes 15 full weeks of instructional resources, plus an interactive coaching and mentoring forum. PASCO Academy: Physics 2 begins January 1, 2021 and continues through the end of June 2021.



PASCO's expert physics Instructors provide a full semester (15 weeks) of phenomena-based, distance learning topics complete with instructional support, faculty coaching, lab demonstrations and data collection videos, sample data files for student analysis and follow-up explanations. Dan Burns and JJ Plank will use the *Essential Physics* book to supplement your institution's existing curriculum, while supporting students and faculty with the instructional resources, lab demonstrations, and professional development. Complete biographies for each of our Instructors can be found on the [Academy website](#).

Each Week of PASCO Academy Includes:

- Digital student and educator resources for the weekly lab investigation, including an editable student lab handout, editable teacher key, and links to additional instructional resources within the *Essential Physics* e-Book
- An educator-directed video segment in which PASCO Instructors explain the weekly phenomena-based lab topic, discuss relevant instructional and laboratory resources, and share strategies for content delivery and distance learning
- A student-directed video segment in which PASCO Instructors conduct the weekly pre-lab demonstration(s), explain the equipment set up, collect data using PASCO sensors, hardware, and software, and pose questions for students to consider during their analysis
- Sample data file(s) for students that contain all the data collected during the weekly laboratory investigation
- A second student-directed video segment that presents deep analysis of the data from the investigation, while providing additional insights and assistance with answering difficult questions from the student materials.
- Educator-access to an online forum curated by PASCO Instructors and content specialists where educators can interact with the Instructors, ask questions and utilize Academy resources for coaching and mentoring.

Support Resources:

- All files and other digital resources are provided in formats that easily integrate into learning management systems.
- Faculty and students receive the recorded activities, data sets for analysis, and follow-up videos with the Instructor's analysis of the data.
- Faculty and students receive complete access to the *Essential Physics* 3rd Edition curriculum and e-Book, which include electronic student and teacher versions, interactive animations and simulations, student worksheets with answer keys, teacher lesson plans, PowerPoint presentations, teaching tips, and tools for formative and summative assessment.
- Faculty receive complete access to the *Essential Physics* 3rd Edition Test Bank.
- Faculty and students receive a site license for PASCO's award-winning SPARKvue data-collection and analysis software, which permits students and faculty to install the software on computers and devices at home.

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Online Platform & Academy Portal:

The PASCO Academy resources are made available to faculty through the [PASCO Academy website](#). Once purchased, the website and resources become available to all faculty within the school. PASCO **does not** track educators' usage or charge for individual educator accounts. Educator accounts are created in the first login. After creating an account and logging

in, the forum and student/faculty resources will become accessible through the Academy Portal. The Academy is provided as either: (1) a license to the school and all users within that school - regardless of the number of faculty or (2) a license to a single educator and their course of fewer than 100 enrollees. Resources within the Academy Portal may be shared freely by the educator; Students will not have direct access to the Academy Portal. The PASCO Academy **does not** monitor student usage of the Academy resources. Student data is not collected nor are student accounts created within the Academy. As such, there are no reports to generate and no student data to protect.

The Academy Forum:

Educators who participate in the Academy have access to discussions within the [Academy Forum](#). Here, faculty are provided with weekly insights about the lessons and activities to be covered, as well as links to important resources and suggestions for achieving success in the classroom. Educators may ask PASCO Faculty time-relevant questions and will receive important coaching and mentoring on techniques used for distance, hybrid and in-class learning. Each week, there will be new discussions about the weekly content and resources. Our Academy Faculty have many successful years of instructional experience to share with educators in the Academy Forum.



We fully recognize that schools and faculty may be teaching different topics at different times, and we have accounted for this by providing open forums each week. This enables an educator seeking assistance with material from Week 1 to have the same synchronous support as an educator starting lessons from Week 3. To allow for faculty autonomy and varied district schedules, we will provide 15 weeks of consecutive lessons with interactive forums until the end of January 2021. PASCO Academy: Physics 2 begins January 1, 2021 and continues through the end of June 2021.

Throughout the 15 weeks, our Instructors will provide some insights on successful strategies and lab activities to support the earth and space sciences. There will be special topics that offer faculty opportunities to present activities in sea floor spreading, supernovae, and other topics as they relate to traditional physics content. By making the Academy Forum open to these special events, we hope to provide some structure to faculty who may be searching for ways to incorporate these new topics in their course sequence. Special topics that support this model are included in the provided syllabus.

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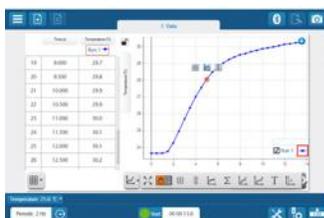
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Special Topics in Physics (1st and 2nd Semester):

Earthquake Waves: Students use their kinematics skills to learn about P and S waves. They develop a model for the motion of each type of wave using data from constant velocity cars. The results lead to discussions about earthquake hazards, how to warn people about an earthquake and how earthquake waves are used to learn about the interior of the Earth.

Supernovae: Students study the motion of 2 Smart Carts that are falling down a track-like material in a collapsing star. Students use the conservation of energy to figure out how the top cart bounces higher than its release point. This is a model for the energy source in an exploding star called a supernova.

Sea Floor Spreading: Students use a Magnetic Field Sensor to map the magnetic field of a model ocean floor spreading center. They use the resulting pattern to infer about the history of the motion of the igneous rocks that form at the spreading center.

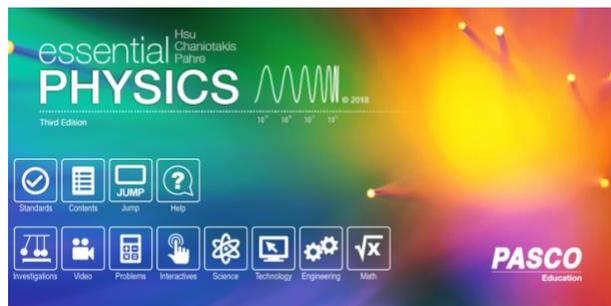


Additional Training:

PASCO offers free webinars and a library of support videos that cover a wide range of applications, from the foundations of software usage to advanced applications, such as coding and computational thinking. Educators may join any of our free webinars to enhance their skills, browse the video library, or share selected video links with students who may need some assistance.

Professional Development Certificates:

Faculty participating in the PASCO Academy have the option of receiving a 16-hour professional certification (in-service) as part of the school or district PD plan. PASCO Powered educators will develop skills and strategies through mentoring, coaching and interactive forums.



Online Access to Essential Physics:

The Essential Physics 3rd Edition curriculum is available to both students and faculty through the Essential Physics Portal. Two user access keys — one student key and one teacher key — are provided to the school or district to be shared freely with faculty and students. The curriculum portal does not collect student data nor information and cannot collect or generate student usage reports. The portal provides resources that may be assigned by the faculty and used freely to support

their instruction. The Essential Physics Portal has a simple URL that can be shared without a need for rostering or roster updates.

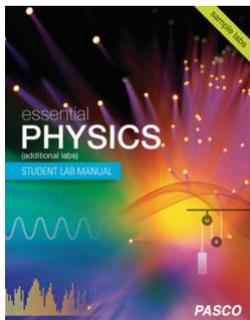
Teacher Access: [Teacher.PASCO.com](https://www.pasco.com/teacher)

Student Access: [Student.PASCO.com](https://www.pasco.com/student)

Student User Codes: A student user code may be provided for advanced evaluation by [contacting your local sales representative](#).

Standards Alignment: *Essential Physics* is aligned to your state standards. [Contact your local sales representative](#) for access to your e-book and standards alignment information.

PASCO Academy - Physics & Chemistry



Essential Physics Curriculum

Overview: The *Essential Physics* 3rd Edition e-Book features all of the content in the print textbook, as well as interactive features, such as simulations and equation solvers that help bring difficult concepts to life. To support science literacy, glossary words are defined in context, and the definitions can be read aloud in English and Spanish. Each page is focused on a single topic and is presented in an outline format that helps improve reading comprehension. Solved problems guide students through mathematical content and “Test-Your-Knowledge” questions provide opportunities for formative assessment with immediate feedback. “More” paragraphs and end-of-chapter readings include additional content that appeal to students’ interests to help them see a direct line from the content

to real-life STEM applications. The “Take-A-Quiz” feature at the end of each section allows students to review a question or concept until they achieve mastery.

Infusing rigor, PBL and technology: The Essential Physics curriculum focuses on practical applications that connect students to physics concepts that are relevant to life, earth, and the physical sciences, while incorporating mathematics, technology, and engineering practices. It includes labs that are coordinated with the textbook and e-Book. Many of these investigations use PASCO’s Wireless Sensors and SPARKvue software, which are provided as part of the Academy package. Using this equipment to conduct hands-on labs, students can quickly develop concepts without long data collection times and spend more time making important connections between macroscopic phenomena and microscopic particles. Sensor-based lab investigations allow students to use technologies similar to those used by scientists in the field, while PASCO software helps them develop data visualization and analysis skills. Engineering design projects motivate students to engage in the engineering design process, while cross-cutting concepts to reinforce content woven through multiple disciplinary core ideas.

Progress monitoring and resources: The *Essential Physics* 3rd Edition digital teacher edition includes lesson plans, PowerPoint slide presentations, student work, and answer keys. Each lesson follows a 5-E learning cycle design and includes opportunities for differentiation. To assist with progress monitoring, all lesson presentations include pre-lesson and post-lesson assessment questions to help faculty and students gauge student learning and readiness for summative assessment. The “Take-A-Quiz” feature at the end of each section allows students to review a question or concept until they achieve mastery. An infinite test bank is also included with the program.

Essential Physics Resources:

Full access to *Essential Physics* provides instructors with additional resources for physics instruction including:

- Full e-book with innovative and interactive media
- Flexible assessment options
- Interactive simulations
- 89 investigations
- 8 design challenges for project-based learning
- Faculty access to the Teacher Resources
- Distance learning videos and data sets
- In-text vocabulary definitions with phonetic aids
- Translated vocabulary in Spanish (*Note: The e-book is written in HTML5 and is fully compatible with Google translation applications. The book may be fully translated into any language selected within the Google translation suite.*)

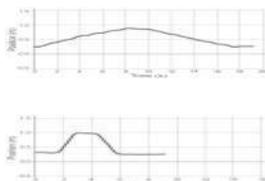


PASCO Academy: Physics Sample Agenda

Week 3: Newton's Second Law, Lab 5A - Newton's Second Law, Introduction to Forces

1. (Faculty only) Faculty are provided with the weekly PASCO PD to clarify questions from Week 2 and to gain insights on the lesson for Week 3. Distance learning resources will be showcased with links to important online investigations, animations, and simulations. PASCO Instructors will also share best practice strategies for online science instruction to support distance learning.

2. (For Students) PASCO Academy provides a laboratory investigation on a key, standardized physics phenomenon. An Instructor conducts the investigation using demonstration and questioning techniques that provide students with opportunities to develop a deeper understanding of the content. Each activity is designed to engage students without simply providing them the answers to important questions. Students may be directed to key content within the Essential text to assist them in performing their analysis of the investigation. They receive a copy of the collected data along with access to PASCO software to facilitate deeper investigations and analyses of the phenomena. To assist participating faculty, PASCO Academy Instructors will model techniques for science inquiry and quality distance learning processes, which may be reproduced by on-site faculty for continued student engagement.



3. (For Students) PASCO Instructors provide a deep analysis of the Week 3 laboratory investigation using software tools and relevant simulations to help drive content development. Students will be provided with opportunities to examine their understanding of the content while learning from their own analyses of the laboratory investigation.

4. (Faculty only) An online community forum will be open for continuous discussions about the weekly topics, misconceptions, teaching tips and resources. The forum will be maintained and moderated by PASCO Academy's Instructional experts.

Mr. Boyd@Atlanta: *are there any simulations to help with this topic?*

Barbara @PASCO Faculty: *Absolutely, there is a great interactive equation on page 79 and a simulation that ties the math to the concept. We will be demonstrating this in the week 4 teacher discussion video*

Mr. Boyd@Atlanta: *Thank you! I look forward to watching and learning*

Mr. Johnson@Houston: *I use that simulation to highlight contributions to science.*

Mr. Boyd@Atlanta: *Great Idea! Thank you Mr. Johnson. I would enjoy knowing more about your lesson!*

Mr. Johnson@Houston: *I have a rough lesson plan that I would be happy to share it with you.*

PASCO Academy: Physics Weekly Syllabus (15 weeks)

1. **Laboratory and Analysis Skills: Lab - Introduction to some of the lab equipment that will be used.**
Introductory skill lab that introduces students to determining g from the weight and mass measurements of various objects.
2. **Constant Acceleration Kinematics: Lab – Essential Physics 4A Acceleration**
Motion graphs and slope/area relationships. The Instructors will demo lab 4A, then collect data for investigation 4B, Model of Accelerated Motion. The data set is shared for student analysis.
3. **Newton’s Second Law: Lab – Essential Physics 5A Newton’s Second Law**
Students are introduced to forces.
4. **Spring and Forces: Lab – Essential Physics 5B Hooke’s Law**
Students are introduced to forces from springs. Data collected during the lab is shared for student analysis.
5. **Friction Forces: Lab – Essential Physics 5C Static and Kinetic Friction**
The forces of static and kinetic friction are introduced. Data collected during the lab is shared student analysis.
6. **Two-Dimensional Motion: Lab – Essential Physics 6B Projectile Motion**
The Instructor discusses examples of two-dimensional motion. Data collected during the lab is shared for student analysis.
 - a. **Special Topic:** Two-Dimensional Motion: Lab 7B Orbits, Lab 7C Extrasolar planets. Circular orbital motion is explored with these two Essential Physics simulations.
7. **Acceleration on an Inclined Plane: Lab – Essential Physics 6C Acceleration on an Inclined Plane**
The Instructor discusses the physics of an object’s motion down a ramp. Data collected during the lab is shared for student analysis.
8. **Static Equilibrium and Torque: Lab – Essential Physics 8B Static Equilibrium & 12F Torque**
The Instructor discusses static systems and sets up lab 8B for students to solve. Data collected during lab 12F is shared for student analysis.
9. **Work: Lab – Essential Physics 9A Work and Force vs Distance Graph**
Students are introduced to the concept of work. Data collected during the lab is shared for student analysis.
10. **Work and Kinetic Energy: Lab – Essential Physics 10B Work and Kinetic Energy**
The Instructor discusses work kinetic energy theorem. Data collected during lab 10B is shared for student analysis.
11. **Conservation of Energy: Lab – Essential Physics 10A Inclined Plane and the Conservation of Energy, 10C Springs and the Conservation of Energy**
The Instructor will discuss GPE vs KE. Data collected during lab 10A is shared for student analysis. In 10C, Elastic PE is discussed, and data is collected to help students make predictions.
 - a. **Special Topic:** Solar Power Design Project: Experiment to find the effect of location, material, orientation, and lifetime on cost and performance of a solar power plant with this Essential Physics simulation.
12. **Work by Friction: Lab – Essential Physics 10D Work Done by Friction**
The Instructor will discuss energy dissipation. Data collected during the lab is shared for student analysis.
13. **Conservation of Momentum: Lab – Essential Physics 11A Conservation of Momentum**
The Instructor will introduce the concept of momentum. Data collected during lab 11A is shared for student analysis.
14. **Inelastic Collisions: Lab – Essential Physics 11B Inelastic collisions**
The Instructor will discuss inelastic collisions. Data collected during lab 11B is shared for student analysis.
15. **Elastic Collisions: Lab – Essential Physics 11C Elastic Collisions**
The Instructor will discuss elastic collisions. Data collected during lab 11C is shared for student analysis.
 - a. **Special Topic:** Supernovae: Supernova Bounce Lab: Investigate the source of energy in a supernova explosion using two Smart Carts.



ESSA Support and Evidence:

The PASCO Academy provides opportunities supported by strong evidence in the areas of:

- Addressing at-risk students
- Development of academic language
- Providing rigor, PBL and technology
- Infusing progressive monitoring

The PASCO Academy and *Essential Physics* 3rd Edition are grounded in the constructivist theory of learning, which uses the 5E learning cycle, and encourages learners to actively construct their own knowledge as determined by their experiences. Research indicates that an educational experience built on constructivist learning theory tenets can change students' perceptions, attitudes, knowledge, and skills in the area of cultural competence (Hunter & Krantz, 2010). The Academy and *Essential Physics* 3rd Edition both emphasize active participatory learning.

Active participatory learning is based on constructivism, which encourages direct, hands-on experiences with people, objects, events, and ideas. Children in active learning settings construct their own knowledge through their interactions with the world and the people around them. PASCO's sensor-based investigations provide extensive opportunities for students to develop scientific literacy and familiarity with the practices of science through hands-on experiences that utilize tools similar to those used by scientists and engineers. It is our goal to provide high-quality student equipment at a low cost that helps stretch precious science education resources further.

As cited in the white paper "[21st Century Science](#)":

Research confirms the positive impact of inquiry-based instruction on student understanding of science (Bredderman, 1983; Furtak et al., 2012; Minner, Levy, & Century, 2010; Schroeder, Scott, Tolson, Huang, & Lee, 2007; Shymansky, Hedges, & Woodworth, 1990; Weinstein, Boulanger, & Walberg, 1982).

Research and expert opinion confirm the value of technology to support student data collection, analysis, and visualization, including sensors and probes (Linn & Hsi, 2000; Krajcik & Mun, 2014; Kulik, 2003; Rogers & Finlayson, 2004; Webb, 2008).

Education experts specify that such technology is most effective in supporting student learning when it is used in an inquiry context (Krajcik & Mun, 2014; National Research Council, 2006; Webb, 2008).

Technology use should support students in actively constructing meaning; be situated in an authentic, real-world context; provide cognitive tools; support specific learning goals; and scaffold student capabilities (Krajcik & Mun, 2014).

Research supports the motivational value of incorporating scientific inquiry activities and related engineering design activities into instruction (Barron et al., 1998; Crawford, 2014; Cunningham & Carlsen, 2014; Fraser, Giddings, & McRobbie, 1995; Kolodner et al., 2003; National Research Council, 2006; Scanlon, Jones, & Waycott, 2005; Webb, 2008; Wong & Fraser, 1995).

Survey data shows that many students find hands-on experiences using technology both motivating and memorable (Farris-Berg, 2008).

As cited in the [case study for Harmony Schools in Texas](#):

In 2015-2016 and 2016-2017, all Harmony schools met or exceeded state academic standards set by the Texas PASCO Academy - Physics & Chemistry

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Education Agency (TEA). In 2013, 100 percent of Harmony students passed the state's End-of-Course (EOC) assessment in physics, compared to the Texas statewide passing rate of 81.8 percent.

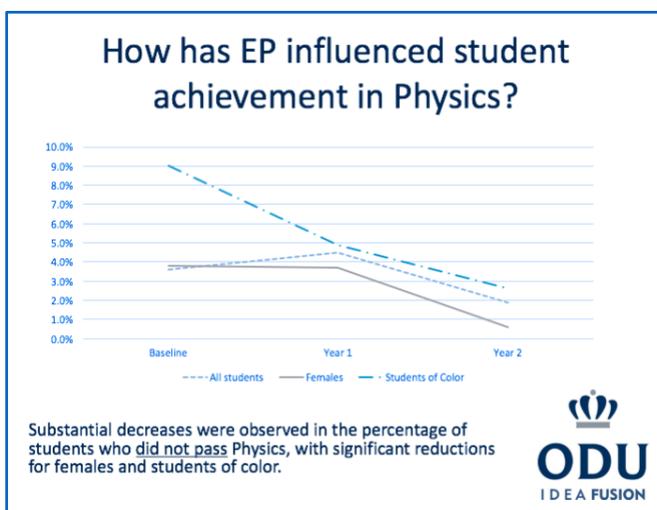
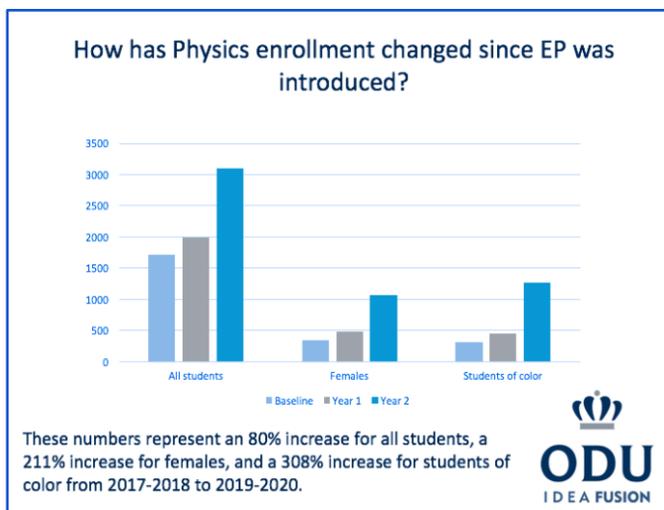
With a college acceptance rate of 100 percent, Harmony Public Schools has earned a well-deserved reputation for providing a high-quality education. In addition, thanks to its powerful PBL approach to personalized STEM education, the number of Harmony graduates choosing STEM majors in college increased from 19 percent in 2010 to 60 percent in 2016. *Essential Chemistry* and *Essential Physics* are built on the same philosophical foundations.

As cited in the white paper "[Brighton Gramm School Increases Student Learning](#)":

They have found three distinct areas that are impacted by the shift in instruction: (1) Student engagement has increased learning; (2) There has been a positive impact on faculty as the tools and processes have changed their pedagogy; (3) The style of questioning has changed for both students and educators, which has led to much deeper learning.

Current Research funded by the Office of Naval Research (ONR):

Current research being conducted by Old Dominion University shows significant improvements in both enrollment and passing rates in schools across the sample group in Virginia. Old Dominion University is a public research university in Norfolk, Virginia. The use of *Essential Physics* and PASCO training is being studied over a 5-year period. The 2-year data is showing significant and measurable gains. *Essential Chemistry* and *Essential Physics* are built on the same philosophical foundations.



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Dr. JP Keener

Dr. JP Keener is a 30-year educator and the former K-20 Director for Mathematics, Science and STEM +C programs for the State of Florida. He holds degrees in chemistry, physics and education with an emphasis on curriculum development. He has worked on several state, national and international STEM projects and has published in several environmental, and educational venues as well as the Journal of the American Chemical Society. Dr. Keener has authored and co-authored books, e- courses, and extensive curricula for various institutions. His work, "Reading Across Science," was adopted by the State of Florida in 2009 as an essential supplemental curriculum to develop reading and learning strategies in science. Currently, Dr. Keener is the Lead Author for "Fundamentals of Science and Engineering," a national initiative for the country of Qatar. In higher education, Dr. Keener has served as the Department Chairman and Lead Faculty for the U.S. Air Force contracted University for the

Asia-Pacific region and has coordinated the development of STEM schools in Korea, Okinawa and Japan. Prior to that, Dr. Keener served as the Director of STEM programs for the Broward County School District in Ft. Lauderdale, Florida (5th largest District in the Nation). Dr. Keener has been an associate and adjunct professor of math, science and education for several universities, including Florida Atlantic University, Nova Southeastern University, Barry University, The University of Phoenix, Western Governors College and the University of Pittsburgh. He is a recipient of the Stafford Award of Teaching Excellence from the University of Pittsburgh. Currently, Dr. Keener serves as the Director of Curriculum and Professional Development for PASCO scientific. Dr. Keener holds a current instructional certification from the State of Florida.



Mr. Dan Burns

Mr. Burns taught physics and AP Physics at Los Gatos High School in the San Francisco Bay Area for 27 years. Dan was a Faculty Scholar at the Lawrence Livermore National Laboratory for 18 years where he conducted teacher workshops and presented scientific talks for the general public that highlighted lab research. Dan leads PTSOS, an organization providing support to new physics teachers. A video of one of the PTSOS workshops called, "Gravity Visualized," went viral on YouTube and now has over 69 million views. Dan has done workshops and developed curriculum for NASA, the United States Geological Survey, the SETI Institute, the Santa Clara County Office of Education, EnCorps, and the National Math

and Science Initiative. Dan was selected by NASA to be an Airborne Ambassador for Astronomy and flew into the stratosphere aboard NASA's Sofia 747. He now serves on the NASA advisory board that is responsible for selecting teachers to fly on SOFIA. Dan is a Fellow of the American Association of Physics Teachers and was selected by AAPT for the Homer Dodge Distinguished Service Citation. Prior to becoming a teacher, Dan was an aerospace engineer for Lockheed/Martin where he developed advanced space systems. Dan has a B.S. in aerospace engineering from the University of Illinois, a physical science teaching credential from San Jose State University, and a master's in instructional technology from the American College of Education. Mr. Burns is currently the Physics Curriculum and Training Specialist for PASCO scientific. Dan was selected twice as Educator of the Year by the students of Los Gatos High and the senior class dedicated the yearbook to him twice. Mr. Burns holds a valid California science teaching credential.

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Mr. JJ Plank

Mr. J.J. Plank serves as PASCO's K-12 Physics Product Manager, a role in which he manages over 700 of PASCO's new, existing, and legacy products for primary and secondary Physics education worldwide. Before becoming Product Manager, J.J. developed PASCO scientific's physics curriculum for all education levels and coordinated the delivery and facilitation of PASCO product and curriculum training. J.J. has been a part of the PASCO team for over 15 years, during which he has delivered more than 600 hours of in-person training. He has designed hundreds of laboratory experiments that can be found in more than 16 different PASCO lab manuals, experiment guides, and the *Essential Physics 3rd Edition* textbook. He has delivered highly successful training and demonstration sessions

to a broad audience of PASCO users that range from elementary school students and California State Highway Patrol investigators to international instructors and university professors. Prior to joining PASCO, Mr. Plank worked as a supplemental Physics and Mathematics Instructor at Lake Tahoe Community College in California where he honed his teaching skills to deliver science curriculum most effectively in the classroom. Mr. Plank holds a B.S. in Applied Physics with an emphasis in Quantum Optics from the University of California, Davis, and a M.N.S. degree in Physics from Arizona State University.



Boomer

Meet the official PASCO "lab"! At 10-years old, Boomer is by far our youngest employee and the proud mascot of PASCO Laboratories. When he isn't sleeping, Boomer is actively bringing smiles and paw-shakes to the staff at PASCO scientific. It is most probable that Boomer will not be providing any of the instruction, but he may make a guest appearance while suited up with motion, light or sound sensors. According to Boomer, "There is great science to be experienced chasing birds!"