

AAPT/ComPADRE

Supporting Physics Educators

Or

How can we help?



Thank you...



**Lyle Barbato: Technical Guru
and all-around Genius**

**Sam McKagan, Adrian Madsen, Michael
Thenhaus, Caroline Hall, Thad Lurie, Matt
Riggsbee**

**US National Science Foundation (NSF) &
American Association of Physics Teachers (AAPT)**

**MANY Dozens of collaborators, project managers, authors,
content developers, and our users.**



What we do:

Physics Educators

Projects/Collaborations:
Open Source Physics, PhysPort, PICUP, PER
Community, Labs, Physics for Life Sciences, ...

Services

Library: Organization, Search/Browse, OAI, DC
Account: Credentials, Personalization
Editorial: Submission, Review, Proceedings, DOI
Content: Sharing, Display, Customization

Infrastructure: Flexible and Adaptable Database and Web Technologies



Brief History

1997: AAPT Physical Sciences Resources Center

2003: ComPADRE – NSF Digital Library. Collection. AAPT, APS, AAS, AIP/SPS (MPTL 8, Prague CZ)

2005: ComPADRE – NSF/NSDL “Pathway” for Physics and Astronomy

2008: **OSP** – Web Services Provider for Open Source Simulation Resources

2009: The Physics Classroom – maintain access to highly-accessed High School Physics resources (millions of users)

2010: **PhysPORT** (PER User’s Guide) – Physics Education Research information for Everyone

2016: **PICUP** – Computation in Undergraduate Physics

2018: **Portals** – “Living Physics”, “Energy & Equity”

2018/2022: Interactive Video – Video for tutorials and problem solving



Answering Questions

What is better ...?

How do I ...?

Where can I find ...?

What background do I need ...?

How can I share ...?

What are others doing for ...?



Where are Research-Informed Practices?

PhysPort
Supporting physics teaching with research-based resources

Admin | My Account | Logout
About | Help | Contact

Search PhysPort...

Home Expert Recommendations Teaching Assessment Workshops

Welcome to PhysPort, the go-to place for physics faculty to find resources based on physics education research (PER) to support your teaching. [Learn more...](#)

Teaching
I want to...
• find a new teaching method
• find curricular materials
• train my LAs or TAs
• run a faculty workshop

Assessment
I want to...
• find an assessment
• analyze assessment results
• assess advanced physics content or skills

Troubleshooting
I need help with...
• engaging students
• arguments for skeptical colleagues
• something else

Featured Expert Recommendations

Best practices for whiteboarding in the physics classroom
by Sam McKagan and Daryl McPadden September 22, 2017

Whiteboards are an indispensable tool that physicists use to work out ideas individually and collaboratively, and to present those ideas, both for public discussion and critique of tentative ideas and for communication of more fully formed ideas. In this recommendation, we offer guidance on how to use whiteboarding effectively in your classroom.
[whiteboarding, best practices, SCALE-UP, Modeling Instruction](#) [Read more »](#)

What makes research-based teaching methods in physics work?
by Sam McKagan, PhysPort Director February 10, 2016

PhysPort contains guides to over 50 "PER-based teaching methods," also known as "interactive engagement" or "active learning" methods. We use "teaching method" in the broadest possible sense, to include curricula, techniques, resources, tools, and reform strategies. To implement these methods effectively, it is helpful to understand the essential features that make them work.
[active learning](#) [Read more »](#)

Where can I find good questions to use with clickers or Peer Instruction?
by Sam McKagan, PhysPort Director
[Read more »](#)

Latest news from PhysPort

Physics and Astronomy Faculty Teaching Institute (FTI): Learn about and register for this intensive professional development workshop June 26-29, 2023 in Washington, D.C.

Free open-source research-based curricula: PhysPort now hosts collections of curricula.

Use our Periscope collection of video lessons in your online LA/TA training class: [Contact us](#) for more details.

Find a physics education consultant: Find external evaluators, researchers, writers, editors, and more to help with your project.

Curated collection of free wave and optics resources for your online class: Simulations & models, virtual labs, data analysis tools, video collections, and free during COVID-19.

PhysPort Data Explorer

Histogram for your class: Physics for Engineers Fall 2013 SEMA

Non-normalized Data
Mean: 0.00
Median: 0.00
Mode: 0.00
N: 100 students

Explore assessment data

Research:

What do Faculty want?
What do Faculty need?
How are Faculty effective?

<https://www.Physport.org:>

Supporting physics teaching with research-based resources



What do Experts Recommend?

The screenshot shows the PhysPort website interface. At the top, there is a navigation bar with links for Home, Expert Recommendations (highlighted in red), Teaching, Assessment, and Workshops. The main content area features an article titled "How can I set clear expectations, and motivate students, so that they engage in active learning?" by Stephanie Chasteen, University of Colorado Boulder, posted June 20, 2017 and revised January 12, 2023. The article includes a photo of students in a classroom and text discussing active learning strategies. To the right of the article, there are sections for Tags (active learning, expectations, first day of class, productive engagement, student buy-in), Related Expert Recommendations (How can I assess the level of student engagement in my class?, What are some strategies for the first day of class, to set the stage for student engagement?, How can I help students become more expert learners? Metacognitive strategies for the classroom), and a link to download a PDF summary of all recommended engagement strategies.

Expert Recommendations

Descriptions of What Works for all of us non-PER
(Physics Education Research) people



Teaching Recommendations

- How can I set clear expectations, and motivate students, so that they engage in active learning?
- How can I help students work well in small groups, so they are more likely to engage?
- Where can I find good activities for small group discussions?
- Best practices for whiteboarding in the physics classroom
- I suddenly have to move my face-to-face physics/astronomy course online! What should I do?

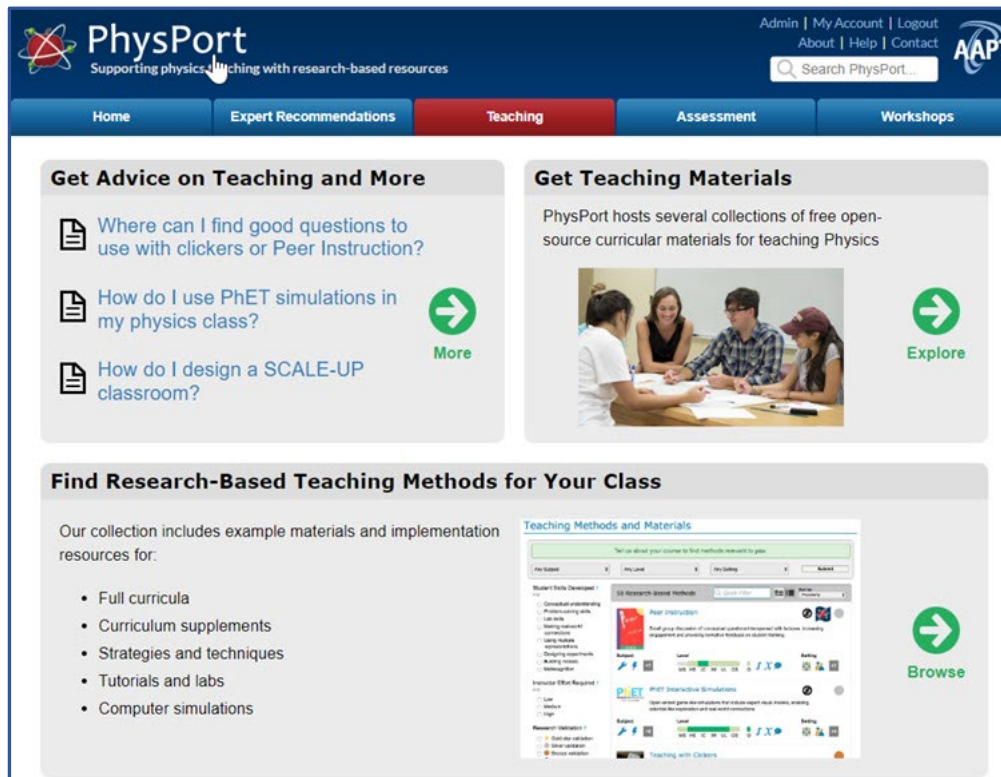


PER Background

- [Arguments for skeptical colleagues](#)
- [Ten results of physics education research that every physics instructor should know](#)
- [Best Practices for Administering Concept Inventories](#)
- [Addressing common concerns about concept inventories](#)
- [Normalized gain: What is it and when and how should I use it?](#)
- [Effect size: What is it and when and how should I use it?](#)



What can I use in class?



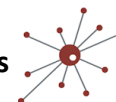
The screenshot shows the PhysPort website interface. At the top, there is a navigation bar with the PhysPort logo and the tagline "Supporting physics teaching with research-based resources". To the right, there are links for "Admin | My Account | Logout" and "About | Help | Contact", along with a search bar labeled "Search PhysPort...". Below the navigation bar, there are five tabs: "Home", "Expert Recommendations", "Teaching" (which is highlighted in red), "Assessment", and "Workshops".

The main content area is divided into three sections:

- Get Advice on Teaching and More:** This section contains three links with document icons: "Where can I find good questions to use with clickers or Peer Instruction?", "How do I use PhET simulations in my physics class?", and "How do I design a SCALE-UP classroom?". A green arrow icon labeled "More" is positioned to the right of the second link.
- Get Teaching Materials:** This section features a photograph of four students sitting around a table, engaged in a discussion. To the right of the photo is a green arrow icon labeled "Explore".
- Find Research-Based Teaching Methods for Your Class:** This section includes a list of resources: "Full curricula", "Curriculum supplements", "Strategies and techniques", "Tutorials and labs", and "Computer simulations". To the right of the list is a screenshot of the "Teaching Methods and Materials" search interface, which shows a search bar and a list of results. A green arrow icon labeled "Browse" is positioned to the right of the screenshot.

<https://www.physport.org/Teaching.cfm>

Recommendations, Content, Methods



Shared Teaching Resources?

- [ACORN](#) “Student Resources” based Physics Tutorials— Supporting student sense-making
- [Maryland Open Source Tutorials](#) – Interactive group exercises from Kinematics to Electric Potentials
- [Curricular Exercises for Quantum Mechanics](#) – Tutorials for standard Quantum topics, experiments to Computation
- [Graduate Physics Group Exercises](#) – Interactive Group resources for the Graduate Core Courses



What are my students Learning?

The screenshot shows the PhysPort website interface. At the top, there is a navigation bar with the PhysPort logo, the tagline "Supporting physics teaching with research-based resources", and the AAPT logo. The main navigation menu includes "Home", "Expert Recommendations", "Teaching", "Assessment" (highlighted in red), and "Workshops".

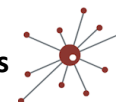
The "Assessment" section is divided into three main areas:

- Get Advice on Assessment and More:** This section lists three articles: "Best practices for administering concept inventories", "Best practices for administering attitudes and beliefs surveys", and "Administering research-based assessments online". A green arrow labeled "More" points to the right.
- Score and Compare Results:** This section features a bullet point: "Score, visualize, and analyze your students' results on [research-based assessments](#)". Below this is a small line graph showing a distribution of scores. A green arrow labeled "Explore" points to the right.
- Find Assessments for Your Class:** This section includes the text "Our collection includes example questions and full assessments* for:" followed by a list of categories: "Introductory physics concepts", "Upper-level physics concepts", "Scientific reasoning or problem solving", and "Student attitudes and beliefs". A green arrow labeled "Browse" points to the right. Below the list is a "Browse Assessments" interface showing a search bar and a list of assessment items with icons and star ratings.

* Full assessment download is only available for Verified Educators.

<https://www.physport.org/Assessment.cfm>

Recommendations, Search, Analysis



Find Assessments? (~100)

Browse Assessments Search Assessments...

Tell us about your course to find assessments relevant to you.

Any Subject Any Level Submit

Assessment Focus
Any
 Content knowledge
 Problem solving
 Scientific reasoning
 Lab skills
 Beliefs / Attitudes
 Teaching
 Department Climate

Format
Any
 Pre/post ?
 Multiple-choice
 Multiple-response ?
 Agree/disagree ?
 Short answer
 Rubric ?
 Observation protocol ?

Research Validation ?
 Gold star validation
 Silver validation
 Bronze validation
 Research-based

123 Research-Based Assessments Quick Filter Sort by: Subject

Content knowledge

- Force Concept Inventory (FCI)**
Mechanics Content knowledge (forces, kinematics)
Levels: Intro college, High school
Formats: Pre/post, Multiple-choice
30 min
- Force and Motion Conceptual Evaluation (FMCE)**
Mechanics Content knowledge (kinematics, forces, energy, graphing)
Levels: Intro college, High school
Formats: Pre/post, Multiple-choice
35 min
- Test of Understanding Graphs in Kinematics (TUG-K)**
Mechanics Content knowledge (kinematics, graphing)
Levels: Intro college, High school
Formats: Pre/post, Multiple-choice
45 min
- Energy Concept Assessment (ECA)**
Mechanics Content knowledge (energy principle, forms of energy, work and heat, absorption/emission spectrum, specifying appropriate)
30 min

Organized by:

- Subject
- Level
- Format
- Research
- Language
- Focus
 - Problem Solving
 - Lab Skills
 - Content Knowledge
 - ...

HOW to use

Czech Translations:

Force Concept Inventory, Calculus Concept Inventory

Others are welcome!



Understand Assessments?

Data Explorer
by PhysPort

Bruce Mason
About Us | Contact Us | Help

Visualizer

+ Upload

Learn more from your tests

The Assessment Data Explorer is an online tool for scoring, analyzing, and interpreting the results of your [research-based assessments](#). Compare to your peers and explore national data to help you understand your results.

Start learning more from your tests.

- Get 1-click statistics
- Compare to students like yours
- Get practical, personalized recommendations

Upload Now

Secure and confidential

We use the same security measures used by banks and financial institutions so you can have the utmost confidence that your data is safe.

Our database is carefully managed to ensure participants' anonymity is preserved from other users. **Only you have access to your data.**

[Learn more about how we safeguard your data in our FAQ »](#)

Visualize assessment data for your class

Select Data: Your Data: FCI - Physics 100 Fall 2010

Comparison Data: Students Like Yours National Median

Histogram For Your Class: Your Course Over Time: Breakdown By Question: Departmental Comparisons

Force Concept Inventory

Percent of Students

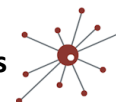
Effect Size

Data Explorer:
Upload Results and
Download Analysis

Statistics
Comparisons
Recommendations

Data Explorer:

<https://www.physport.org/dataexplorer/>



How can I teach teachers?



The screenshot shows the PhysPort website interface. At the top, there is a navigation bar with the PhysPort logo and tagline "Supporting physics teaching with research-based resources". On the right, there are links for "Admin | My Account | Logout" and "About | Help | Contact", along with a search bar and the AAPT logo. Below the navigation bar, there are tabs for "Home", "Expert Recommendations", "Teaching", "Assessment", and "Workshops". The main content area features a heading "PhysPort features two collections of video workshops that you can use for:" followed by a bulleted list: "training teaching assistants (TAs) or learning assistants (LAs) to use best practices in teaching physics", "professional development for other faculty in instructional best practices", and "learning to use research-based teaching in your own classes". Below this, there are two featured workshop cards. The first card is titled "Periscope: Looking into Learning" and includes a video thumbnail "What is Periscope?", a description "A collection of lessons for faculty and LAs/TAs to:", and a list of bullet points: "watch and discuss videos of best-practices physics classrooms", "apply lessons learned to actual teaching situations", "practice interpreting student behavior", and "become more effective teachers". The second card is titled "Virtual New Faculty Workshop" and includes a video thumbnail "New Faculty Workshop - Introduction", a description "Videos of presentations from the live Workshop for New Faculty in Physics and Astronomy feature:", and a list of bullet points: "leaders in physics education research and curriculum development", "teaching techniques proven to work in many environments", and "cutting-edge developments in physics/astronomy curriculum and pedagogy". Both cards have a "View Collection" button with a right-pointing arrow.

[Periscope Video Lessons](#): Class Videos and Discussion Worksheets

[New Faculty Workshop](#): Information from Experts



Periscope lessons

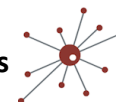
The screenshot shows the homepage of the Periscope Video Lessons website. At the top, there is a navigation bar with a logo on the left, the text "Periscope Video Lessons" and "part of PhysPort" in the center, and the name "Bruce Mason" and the "AAPT" logo on the right. Below the navigation bar are four tabs: "Home" (highlighted in red), "All Lessons", "FAQ", and "About". A search bar is located to the right of the tabs. The main content area is titled "Featured Lessons" and includes a "see all lessons" link with a right-pointing arrow. Below this, there are four featured lesson cards with titles and questions: "BEST PRACTICES: How can I bring out students' ideas?", "STUDENT IDEAS: What ideas do students have about tension and balancing?", "GROUP WORK: How can I encourage productive student debate?", and "SUPPORTING EQUITY: How can I assess group work in a way that is equitable?". Below the featured lessons is a "Browse by Collection" section with eight collection cards, each with an icon and a title: "Best of Periscope" (11 LESSONS), "Instructor Dos and Don'ts" (3 LESSONS), "Productive group work" (5 LESSONS), "Dissatisfied students" (6 LESSONS), "Equity in collaborative learning" (6 LESSONS), "Student ideas" (14 LESSONS), "How to Run a Prep Session" (3 LESSONS), and "Student perspectives" (3 LESSONS).

Lessons for Instructors (New or Experienced)

Video of Student/Student & Student/Instructor interactions

Lesson guide for participants and leaders

Explores some difficult questions/situations



Where can I get physics simulations?

The screenshot shows the Open Source Physics (OSP) website homepage. The header includes the OSP logo, a search bar, and navigation links like 'my profile', 'AAPT link', and 'logout'. The main content is organized into several sections:

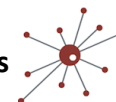
- Computational Resources for Teaching:** A section describing the OSP Collection and its purpose.
- Tracker:** A section describing the Tracker tool and its features.
- EJS Modeling:** A section describing the EJS Modeling tool and its features.
- Programming:** A section describing the programming resources available.
- Tools:** A section listing various tools like Launcher, Tracker, EJS, and Data Tool.
- Curriculum Packages:** A section describing the curriculum packages available.
- OSP News:** A section with news items, including Tracker Online and News archive.
- Newest OSP Materials:** A section listing the newest materials, such as Trajectories in Electric and Magnetic Fields JS Model.
- Recently Updated Materials:** A section listing recently updated materials, such as Acoustics supplement.
- Recent Library Comments:** A section listing recent library comments.
- Recent Discussions:** A section listing recent discussions.

On the left side, there are several award logos and descriptions, including the APS Excellence in Physics Education Award and the Science SPORE Prize.

Others, of course:
[PhET](#), [BU Simulations](#)

OSP: Open, Editable,
Sharable, Runnable

Open Source Physics:
<https://www.compadre.org/osp>



Open Simulations EJSS, WebEJS?

The image shows two overlapping screenshots. The background screenshot is the OSP website's detail page for the 'Trajectories in Electric and Magnetic Fields JS Model'. It includes a sidebar with navigation links like 'SIMULATIONS', 'EJS MODELING', and 'TOOLS'. The main content area contains the title, author 'Wolfgang Christian', a description of the simulation, and download links for a 352kb zip file. A blue double-headed arrow points from the 'Open Trajectories in Electric and Magnetic Fields Source Code in Web EJS' link to the foreground screenshot.

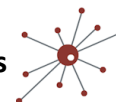
The foreground screenshot shows the WebEJS editor interface. The top bar has tabs for 'Description', 'Model', and 'View'. The main window is titled 'Trajectories In E and B' and contains the same text as the website. On the right, there is a 'PREVIEW: E-B Field Trajectories and Caustics' window with a 'Run the simulation' button and a plot area with a red dot and a 'Drag the source position' instruction. The bottom of the editor shows a 'Credits' section and a file path: 'HTML File: ./TrajectoriesInEB/TrajectoriesInEB.html'.

Download the Model

Edit Locally

EJSS Editor connects to the OSP Library

NEW DEVELOPMENT: Web EJS!



Video Analysis... for Free?

Welcome Bruce, ComPADRE Dir (bmason@ou.edu) - [my profile](#) - [AAPT link](#) - [logout](#)
[filing cabinet](#) - [suggest a resource](#) - [administrate](#)

Search the OSP Collection...

» home » [OSP Tools](#) » [Tracker](#)

OSP Tools

[Launcher and LaunchBuilder](#) · [Tracker](#) · [Easy Java Simulations \(EJS\)](#) · [Data Tool](#)

OSP provides several stand-alone applications for physics teaching and student activities. These tools are designed for the creation of curricular packages or to support student modeling and laboratories.

Tracker

Tracker is an image and video analysis package and modeling tool that is built upon the Open Source Physics Java code library. Features include object tracking with position, velocity and acceleration overlays and graphs, special effect filters, multiple reference frames, calibration points and line profiles for analysis of spectra and interference patterns. It is designed to be used in introductory college physics labs and lectures.

Tracker can overlay simple dynamic particle models on a video clip. In a typical video modeling experiment students capture and open a digital video file, calibrate the scale, and define appropriate coordinate axes just as for traditional video analysis. But instead of tracking objects with the mouse, students define theoretical force expressions and initial conditions for a dynamic model simulation that synchronizes with and draws itself on the video. The behavior of the model is thus compared directly with that of the real-world motion. Tracker uses the Open Source Physics code library so sophisticated models are possible. Video modeling offers advantages over both traditional video analysis and simulation-only modeling.

- [Tracker Video Analysis and Modeling Tool](#)
- [OSP User's Guide Chapter 16: Tracker](#)

APS Excellence in Physics Education Award
November 2019

Science
Science SPOR Prize
November 2011

Tracker Online

File Edit Video Tracks Controls Window Help

Track 100%

Main View: choose a file or drag it here to open

OSP Digital Library Browser

File Collections Help

URL: https://www.compadre.org/osp/services/REST/osp_tracker.cfm?verb=identify&OSPType=Tracker&OSPPrimary=Subject

OSP Tracker Collection

- ▶ About OSP and ComPADRE
- ▶ Astronomy
- ▶ Classical Mechanics
- ▶ Educational Practices
- ▶ Fluid Mechanics
- ▶ Mathematical Tools
- ▶ Modern Physics
- ▶ Optics
- ▶ Oscillations & Waves

open source physics modeling

OSP Tracker Collection

Resources in the OSP Tracker Collection are organized by subject in the table of contents tree on the left. Double-click red font folders to display their resources.

Click a resource in the tree to learn more about it in an html page here. Double-click the resource to open it in Tracker. For more information about a resource, including curricular materials, click the hyperlink at the bottom of its html page.

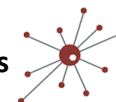
If you are unable to find a desired resource in the table of contents tree you may:

Search for resources using keywords and other criteria

Collection path: https://www.compadre.org/osp/services/REST/osp_tracker.cfm?verb=identify&OSPType=Tracker&OSPPrimary=Subject

Tracker and Tracker Online

Sophisticated modeling
Tracker examples in the
OSP Library



Can I share?

“Shared” File Cabinets

Your Materials

Other’s Materials

A few resources or
an entire course

Restricted to
Registered Users

The screenshot shows the OSP website interface. At the top, it says "Welcome Bruce, ComPADRE Dir (bmason@ou.edu)" and provides links for "my profile", "AAPT link", "logout", "filing cabinet", "suggest a resource", and "administrate". A search bar is also present. The left sidebar contains navigation menus for SIMULATIONS, EJS MODELING, CURRICULUM, PROGRAMMING, TOOLS, JS/HTML MATERIALS, BROWSE MATERIALS, RELATED SITES, DISCUSSION, and ABOUT OSP. The main content area shows "Mario Belloni's Shared Folder" with a subfolder "Astronomy 106". Under "Astronomy 106", there are two resources: "Astronomy 106 Course Home Page" and "Davidson College Astrophotography Project". The "Astronomy 106 Course Home Page" resource includes a description, two Moodle links, and a "website" link. The "Davidson College Astrophotography Project" resource includes a description and a "website" link. Below these resources is a "Copy selected into:" dropdown menu with a "Copy" button. At the bottom, there is a list of "Astronomy 106 Subfolders" including "Physlet-based Simulations for Astronomy", "Javascript Simulations for Astronomy", "Naked Eye Astronomy", "Optical (Classical) Astronomy", "Modern Astronomy", and "Stars and Stellar Properties".



Can I share?

» [home](#) » [Search Results](#) » [Detail Page](#)

Website Detail Page

[Singapore Open Source Physics](#)

written by [Loo Kang Wee](#)


The Singapore Open Source Physics site hosts a large collection of open educational resources for teaching including simulations created with Java or JavaScript Easy Java Simulation models and video analysis experiments created with Tracker. Simulations cataloged in the library have links to ready-to-run web pages and zip files with EJS source code.

The Singapore OSP editor, Loo Kang Wee, also maintains an [active blog](#) that reaches out to teachers about Open Source Physics and other technology innovations in education and learning.

<https://iwant2study.org/ospsq/index.php/interactive-resources/phys...>

Subjects	Levels	Resource Types
General Physics - Collections - Curriculum	- High School - Middle School - Elementary School - Informal Education	- Collection - Community = Weblog - Instructional Material = Interactive Simulation
Intended Users	Formats	Ratings
- Learners - Educators	- text/html	Physics

APs Excellence in Physics Education Award
 November 2019

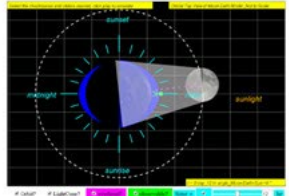


Science SPORE Prize
 November 2011

Contributors to the OSP Community from around the world

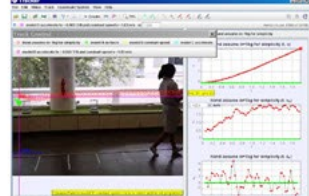
Click on the + button to expand the list of open educational resources.

Easy JavaScript/Java Simulation Authoring and Modeling Tool



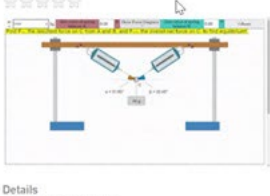
Details
 Written by Loo Kang Wee
 Parent Category: [Interactive Resources](#)
 Category: [Physics](#)
 Published: 01 September 2015

Tracker Video Analysis and Modelling Installer



Details
 Written by Loo Kang Wee
 Parent Category: [Interactive Resources](#)
 Category: [Physics](#)
 Published: 01 September 2015

Finding Vector Sum of Two Forces Acting on a Point JavaScript Simulation Applet HTML5



Details
 Written by Wei Chiong
 Parent Category: [Physics](#)
 Category: [01 Measurements](#)
 Published: 28 July 2021
 Created: 28 July 2021
 Last Updated: 03 August 2021
 Hits: 2389



Can I share “Books”?

Sound: An Interactive eBook by Kyle Forinash and Wolfgang Christian

1. Physics of Vibrations 2. Waves 3. Sound and Perception 4. Electromagnetism and...

Home » Sound and Perception

Sound and Perception

In this section we move from physical properties which can be measured in the lab such as amplitude, frequency and waveform to the corresponding subjective quantities loudness, pitch and timbre. Our hearing system is quite sophisticated but what we perceive does not have a strict correlation with what is measured with scientific instruments. Because of this there are many examples where our hearing system can be tricked which in some cases leads to a pleasant listening experience.

Chapter 8: Pitch, Loudness and Timbre

- [Pitch, Loudness and Timbre](#)

Chapter 9: Fourier Series

- [Sound Texture](#)
- [Fourier Series](#)
- [Microphone Sound Analyzer](#)

Chapter 10: The Ear and Perception

- [The Ear and Perception](#)
- [Beats](#)

Chapter 11: Strings

- [Driven String and Resonance](#)
- [Plucked String](#)
- [Vibrating Plates Simulation](#)

Chapter 12: Tubes

- [Standing Waves in a Tube](#)
- [Reflection of Waves at a Boundary](#)
- [Impedance](#)

Chapter 13: Percussion

- [Percussion and Drumheads](#)

Sound: An Interactive eBook by Kyle Forinash and Wolfgang Christian

1. Physics of V... Home » Sound...

Microphone Sound Analyzer

Share - Embed - Investigate - Fullscreen

Fourier Analysis of Microphone Data

This is not a simulation but rather software for an alternative version of the Mini-lab on [sound analysis](#) using [Audacity](#) in the Video/audio examples of the previous section.

The software records the sound from the microphone of a computer or mobile device and displays its amplitude (bottom graph) and frequency (top graph) as calculated by a Fast Fourier Transform (FFT) algorithm. The recording length can be varied by changing the number of data points. However, the number of data points must be a power of two for the algorithm to work. The total range of frequencies is from 20 Hz to 20 kHz. The minimum and maximum values displayed on the frequency graph can be adjusted to see a more narrow range of frequencies.

Microphone Sound Analyzer Show: audio freq. both

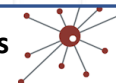
Frequency Spectrum

audio level (dB)

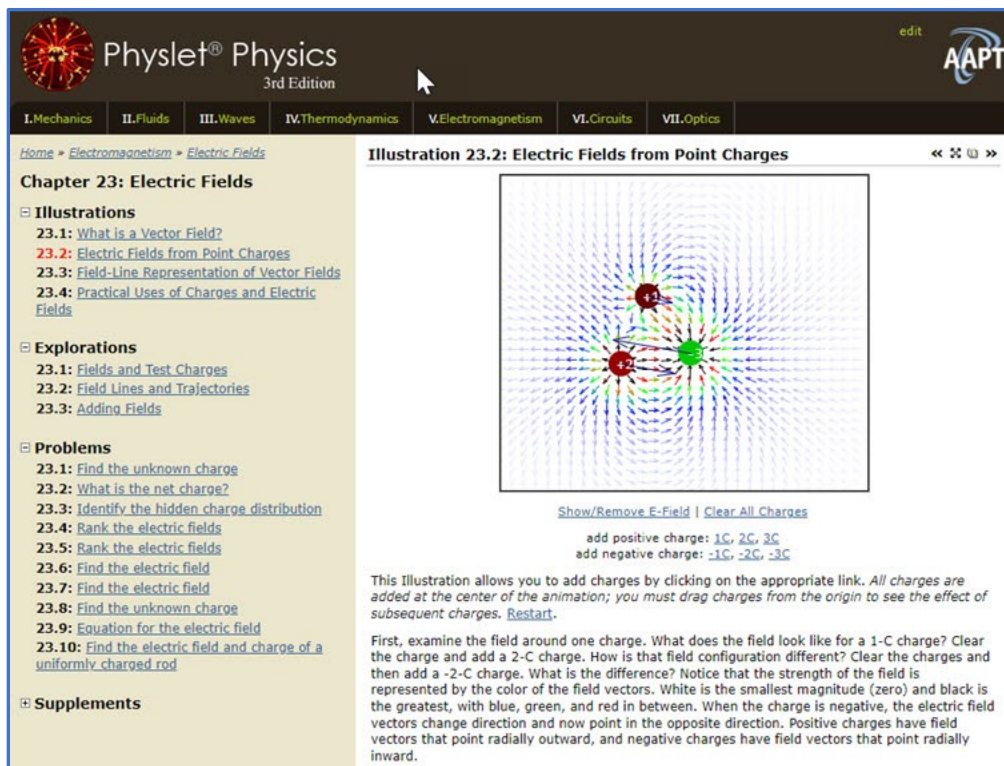
f (kHz)

Microphone Signal

amplitude



What is ready-to use?



The screenshot shows the Physlet Physics 3rd Edition interface. The top navigation bar includes categories: I. Mechanics, II. Fluids, III. Waves, IV. Thermodynamics, V. Electromagnetism, VI. Circuits, and VII. Optics. The current page is 'Illustration 23.2: Electric Fields from Point Charges'. The left sidebar lists various sections: Illustrations (23.1: What is a Vector Field?, 23.2: Electric Fields from Point Charges, 23.3: Field-Line Representation of Vector Fields, 23.4: Practical Uses of Charges and Electric Fields), Explorations (23.1: Fields and Test Charges, 23.2: Field Lines and Trajectories, 23.3: Adding Fields), Problems (23.1: Find the unknown charge, 23.2: What is the net charge?, 23.3: Identify the hidden charge distribution, 23.4: Rank the electric fields, 23.5: Rank the electric fields, 23.6: Find the electric field, 23.7: Find the electric field, 23.8: Find the unknown charge, 23.9: Equation for the electric field, 23.10: Find the electric field and charge of a uniformly charged rod), and Supplements.

The main content area displays a vector field plot for three point charges: two positive charges (red) and one negative charge (green). The field vectors are color-coded by magnitude, ranging from white (zero) to black (greatest). Below the plot, there are controls: 'Show/Remove E-Field | Clear All Charges', 'add positive charge: 1C, 2C, 3C', and 'add negative charge: -1C, -2C, -3C'. A paragraph of text explains the illustration's functionality: 'This illustration allows you to add charges by clicking on the appropriate link. All charges are added at the center of the animation; you must drag charges from the origin to see the effect of subsequent charges. Restart.' Below this, a paragraph of text provides a tutorial: 'First, examine the field around one charge. What does the field look like for a 1-C charge? Clear the charge and add a 2-C charge. How is that field configuration different? Clear the charges and then add a -2-C charge. What is the difference? Notice that the strength of the field is represented by the color of the field vectors. White is the smallest magnitude (zero) and black is the greatest, with blue, green, and red in between. When the charge is negative, the electric field vectors change direction and now point in the opposite direction. Positive charges have field vectors that point radially outward, and negative charges have field vectors that point radially inward.'

In use since 1995. Each very specific.

Online & runnable:

Illustrations: Look/move around, create, guided, with answers

Explorations: Tutorial, students seek answers, students decide measurements

Problems: Conceptual to numerical, require information from physlet

[Physlet Physics](#)

[Physlet Quantum Physics](#)

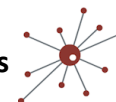
[STP Book \(Stat Mech\)](#)



Adding computation to my course?

The screenshot shows the PICUP website homepage. At the top, there is a navigation bar with the PICUP logo, a search bar, and links for 'My Account | Logout', 'My Reviews | My Bookmarks', and 'Feedback'. Below the navigation bar is a main menu with tabs for 'Home', 'Exercise Sets', 'Faculty Commons', 'Resources', 'Community', 'Events', and 'About PICUP'. The main content area features a 'Welcome to PICUP!' section with a sub-header 'View the PICUP Collections - materials and support for integrating computation:'. This section is divided into three columns: 'Exercise Sets' with 'Browse' and 'Author' buttons; 'Faculty Commons' with 'Explore' and 'Contribute' buttons; and 'Videos' with 'Conferences' and 'Webinars' buttons. Below this is a section for 'All E&M Exercise Sets' with several physics diagrams. There are also video thumbnails for 'Introduction to GO...' and 'About PICUP - Sum...'. On the right side, there is a 'Join the PICUP Community on Slack' link and a 'Sign up to receive PICUP Announcements' button. An 'Upcoming Events' section lists the 'Joint UMN/Twin Cities + PICUP Regional Workshop 2023' with details about the date and content.

Partnership for Integrating Computation into Undergraduate Physics: An active community



What can I use?

The screenshot shows the PICUP website interface. At the top, there is a navigation bar with tabs for Home, Exercise Sets, Faculty Commons, Resources, Community, Events, and About PICUP. The main content area is titled "Falling Sphere with Air Resistance Proportional to v^2 ". It includes a description of the exercise set, a list of subject areas and levels, available implementations, and learning objectives. On the right side, there are sections for "Download Options" (Download Exercises - Word, Full Download - Zip), "Share a Variation" (Creating a Variation), and "Credits and Licensing" (Creative Commons Attribution-NonCommercial-ShareAlike 4.0 license). At the bottom, there is a sidebar with tabs for Instructor's Guide, Theory, Exercises, Code, Solutions, 1 Comment, and Add Errata. The Exercises tab is selected, showing a list of links for Pseudocode, Code Templates, Completed Code, Additional Resources, and Data Files.

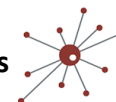
Created for, used in and by classes:

Student Activities
Physical Problems
Peer Reviewed

Restricted:

Instructor Guide
Physics/Computational
Theory
Code (Multiple)

PICUP Exercise Sets



What can I use?

The screenshot shows the PICUP Faculty Commons interface. At the top, there is a search bar and navigation links for 'My Account', 'Logout', 'My Reviews', 'My Bookmarks', and 'Feedback'. The main navigation menu includes 'Home', 'Exercise Sets', 'Faculty Commons', 'Resources', 'Community', 'Events', and 'About PICUP'. The current page is titled 'Introductory Python Tutorials in Jupyter' and is categorized under 'Faculty Commons Materials'. It includes a description of the material, its subject area (Programming Introductions), levels (High School, First Year, and Beyond the First Year), available implementation (IPython/Jupyter Notebook), and time to complete (180 min). There are also tabs for 'Instructor's Notes', 'Materials', 'Add Comment', and 'Add Errata'. The 'Materials' tab is active, showing a list of documents, code templates, completed code, and data files. A 'Credits and Licensing' section at the bottom right provides information about the author (Joshua Samani) and the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 license.

Examples from Faculty:

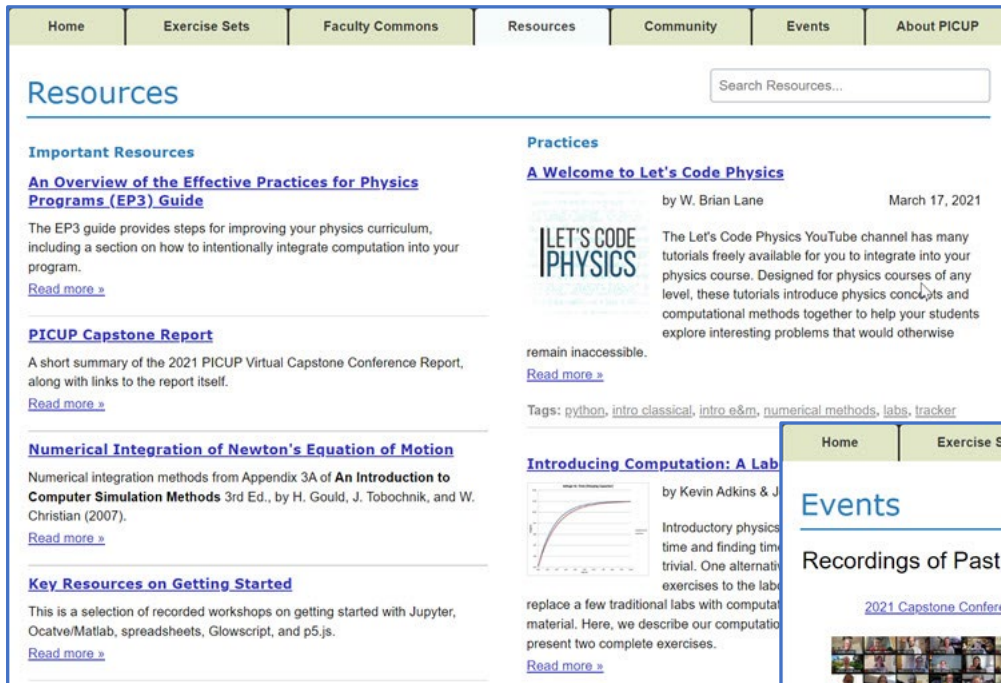
Simpler submission
Less information
Editor reviewed

Restricted to Instructors
Only

PICUP Faculty Commons



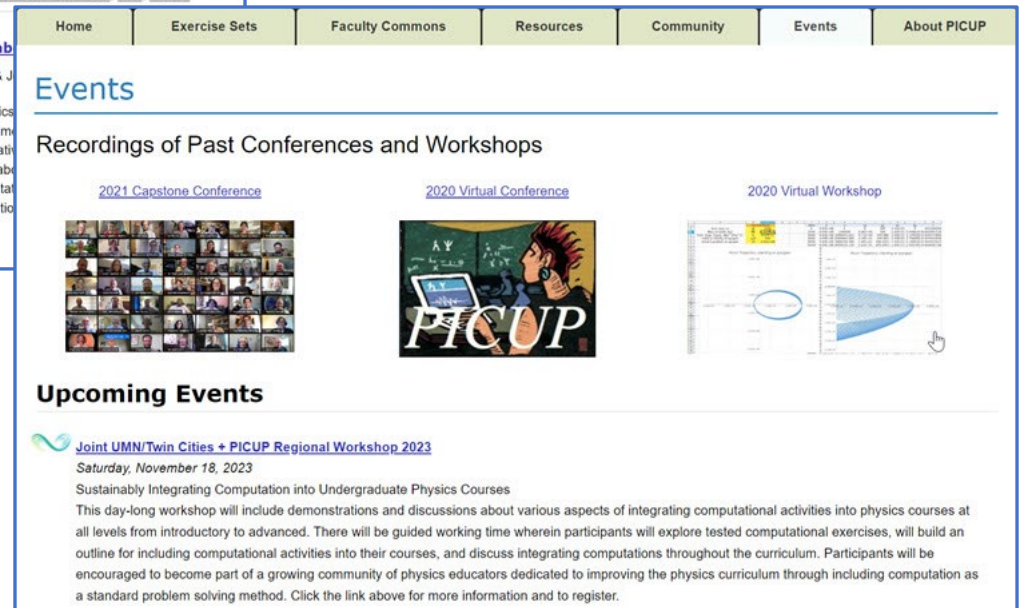
How do I start with computation?



The screenshot shows the 'Resources' section of the PICUP website. It features a navigation bar with links to Home, Exercise Sets, Faculty Commons, Resources, Community, Events, and About PICUP. Below the navigation bar is a search box for resources. The main content is divided into two columns. The left column lists 'Important Resources' including 'An Overview of the Effective Practices for Physics Programs (EP3) Guide', 'PICUP Capstone Report', and 'Numerical Integration of Newton's Equation of Motion'. The right column lists 'Practices' including 'A Welcome to Let's Code Physics' and 'Introducing Computation: A Lab'. Each resource entry includes a brief description and a 'Read more' link.

PICUP Resources

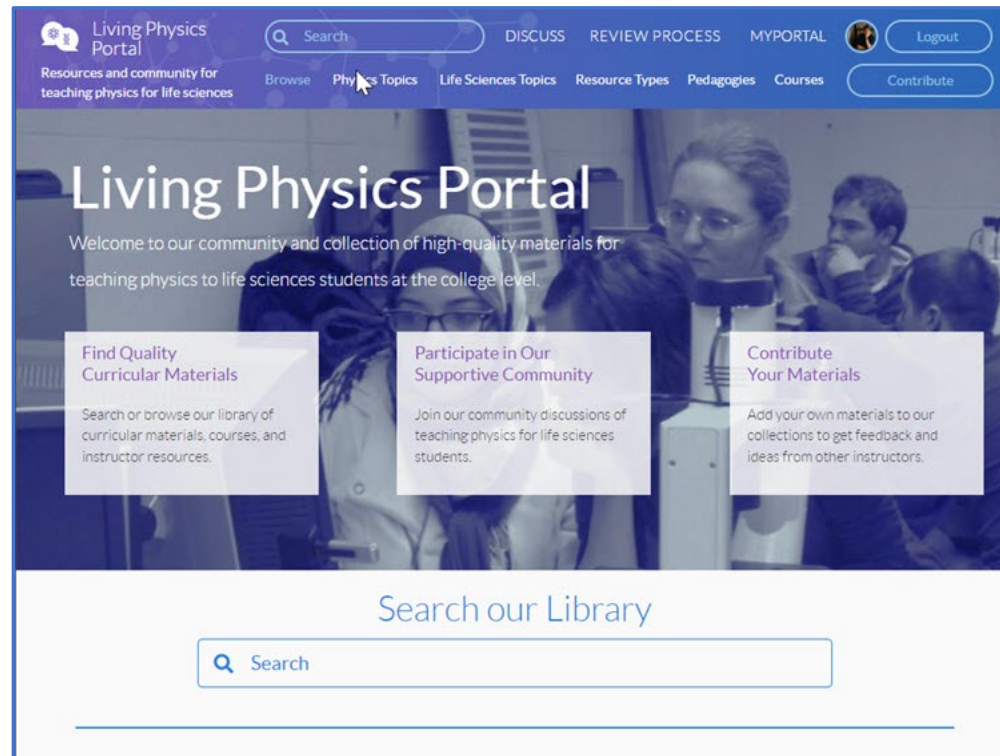
PICUP Events



The screenshot shows the 'Events' section of the PICUP website. It features a navigation bar with links to Home, Exercise Sets, Faculty Commons, Resources, Community, Events, and About PICUP. Below the navigation bar is the 'Events' section, which is divided into two sub-sections. The first sub-section is 'Recordings of Past Conferences and Workshops', which includes links to '2021 Capstone Conference', '2020 Virtual Conference', and '2020 Virtual Workshop'. Each link is accompanied by a representative image: a grid of video thumbnails for the 2021 conference, a cartoon character for the 2020 virtual conference, and a plot for the 2020 virtual workshop. The second sub-section is 'Upcoming Events', which includes a link to 'Joint UMN/Twin Cities + PICUP Regional Workshop 2023' on Saturday, November 18, 2023. The description for this event states: 'Sustainably Integrating Computation into Undergraduate Physics Courses. This day-long workshop will include demonstrations and discussions about various aspects of integrating computational activities into physics courses at all levels from introductory to advanced. There will be guided working time wherein participants will explore tested computational exercises, will build an outline for including computational activities into their courses, and discuss integrating computations throughout the curriculum. Participants will be encouraged to become part of a growing community of physics educators dedicated to improving the physics curriculum through including computation as a standard problem solving method. Click the link above for more information and to register.'



What do I know about Biology?



Living Physics Portal

<https://www.livingphysicsportal.org/>

Changes in Bioscience Education
Experienced Instructors Sharing their work



What interests life science students?

The screenshot shows the Living Physics Portal search results for the term 'fluid'. The page has a blue header with navigation links: DISCUSS, REVIEW PROCESS, MYPORTAL, and a search bar. Below the header, there are tabs for CURRICULAR RESOURCES (43), COURSES (0), INSTRUCTOR RESOURCES (4), PEOPLE (5), and ALL (52). A left sidebar contains various filters like Physics Topics, Life Sciences Topics, Resource Types, Remote Learning, Pedagogical Approach, Skill / Competency, Equipment Needed, Commercially Available, and Library. The main content area displays three search results, each with a 'Vetted' badge and author information. The first result is 'Fluid dynamics with applications to cardiology' by Catherine Crouch and Ben Geller. The second is 'Fluid Statics with Applications to Cardiology and Respiration' by Ben Geller and Catherine Crouch. The third is 'Physics of the Cardiovascular System - Five Section Module'.

Less!

Frictionless Incline Plane
Ballistic Motion w/o Air
Lightbulbs

More!

Fluid Dynamics
Animal movement
Nerves
Medical Machines



How do I structure my stuff?

The screenshot shows a file management interface with a sidebar on the left containing a folder named 'Physical Therapy'. Inside this folder, there are several subfolders and files, including 'PT_1_Glossary.docx', 'PT_2_Textbook.docx', 'PT_3_VideoSummaries.docx', 'PT_4_VideoQuestions.docx', 'Homework and Solutions', and several homework question and solution files. The main window displays the content of 'PT_1_Glossary.docx', which is a glossary of key terms in physical therapy. The glossary is organized into a table with three columns: 'Term', 'Definition', and 'Pg #'. The terms listed include physical therapy, American Physical Therapy Association (APTA), kinematics, position, velocity, acceleration, Newton's laws, free body diagrams (FBD), torque (τ), momentum, impulse, point of mass/point mass, and center of mass.

Term	Definition	Pg #
physical therapy	The treatment of disease, injury, or deformity by physical methods such as massage, heat treatment, and exercise rather than by drugs or surgery.	2
American Physical Therapy Association (APTA)	A U.S.-based individual membership professional organization representing more than 100,000 member physical therapists, physical therapist assistants, and students of physical therapy.	2
kinematics	The branch of physics and a subdivision of classical mechanics concerned with the geometrically possible motion of a body or system of bodies without consideration of the forces involved (i.e., causes and effects of the motion).	3
position	A place where someone or something is located or has been put. Typically expressed as a number on an axis or a vector.	3
velocity	The rate of change of its position with respect to a frame of reference and is a function of time.	3
acceleration	A vector quantity that is defined as the rate at which an object changes its velocity.	3
Newton's laws	Three physical laws that, together, laid the foundation for classical mechanics. They describe the relationship between a body and the forces acting upon it, and its motion in response to those forces.	3
free body diagrams (FBD)	Diagrams used to show the relative magnitude and direction of all forces acting upon an object in a given situation.	3,6
torque (τ)	A measure of how much a force acting on an object causes that object to rotate.	3,11
momentum	Product of the mass of a particle and its velocity.	3
impulse	The integral of a force, F , over the time interval, t , for which it acts.	3
point of mass/point mass	An idealization of particles heavily used in physics. Its defining feature is that it lacks spatial extension; being dimensionless, it does not take up space.	3
center of mass	A position of a body that acts as a point mass representing the body's mass.	3,7

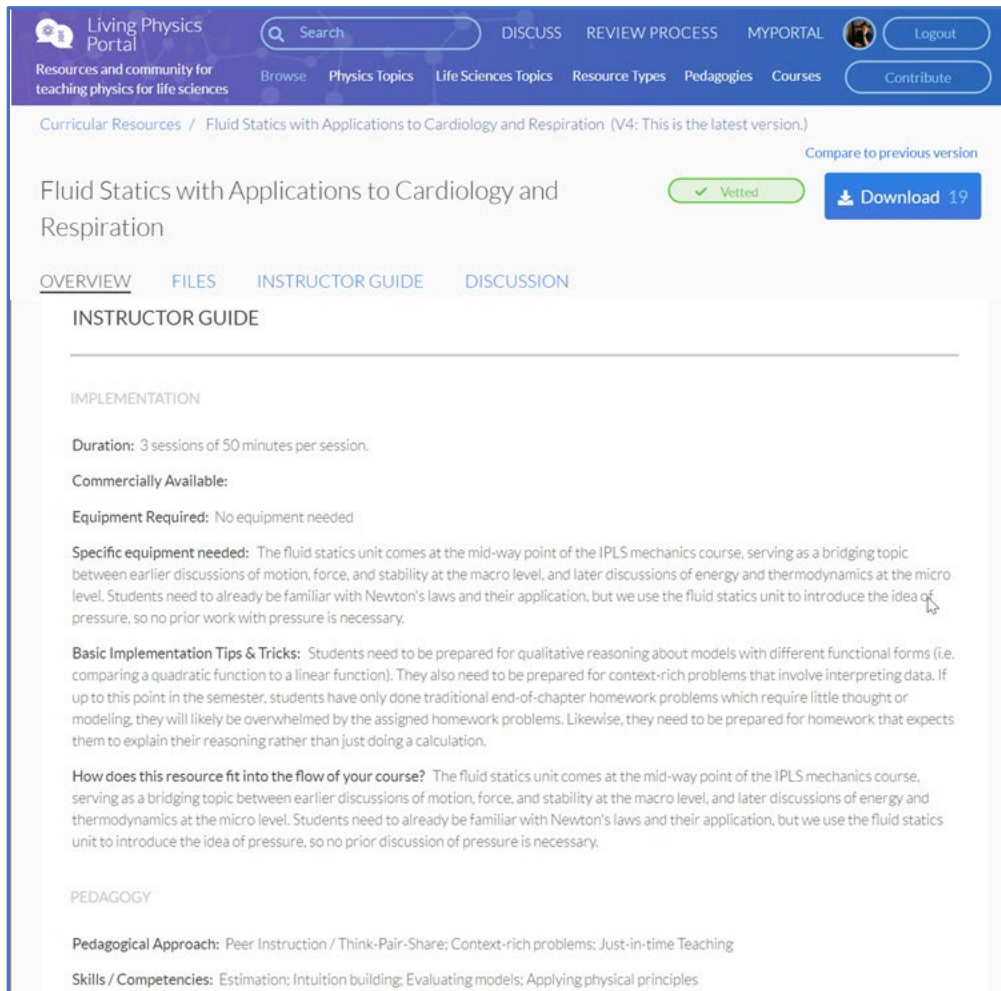
Folders/Subfolders
Editable/Formatted files
URLs if needed
Instructor Resources

Highlights & Abstract
Resource Types
Physics, Bio, Chem, and
Math topics

Community Library: Contributions with minimal information
Available only for Logged-in Verified Educators
No or very quick check by editors



What do other instructors need?



The screenshot shows the Living Physics Portal interface. At the top, there is a navigation bar with a search bar, 'DISCUSS', 'REVIEW PROCESS', 'MYPORTAL', and 'Logout' buttons. Below the navigation bar, there are tabs for 'Browse', 'Physics Topics', 'Life Sciences Topics', 'Resource Types', 'Pedagogies', and 'Courses'. The main content area displays the title 'Fluid Statics with Applications to Cardiology and Respiration (V4: This is the latest version.)' and a 'Download 19' button. The 'INSTRUCTOR GUIDE' section is highlighted, containing the following text:

IMPLEMENTATION

Duration: 3 sessions of 50 minutes per session.

Commercially Available:

Equipment Required: No equipment needed.

Specific equipment needed: The fluid statics unit comes at the mid-way point of the IPLS mechanics course, serving as a bridging topic between earlier discussions of motion, force, and stability at the macro level, and later discussions of energy and thermodynamics at the micro level. Students need to already be familiar with Newton's laws and their application, but we use the fluid statics unit to introduce the idea of pressure, so no prior work with pressure is necessary.

Basic Implementation Tips & Tricks: Students need to be prepared for qualitative reasoning about models with different functional forms (i.e. comparing a quadratic function to a linear function). They also need to be prepared for context-rich problems that involve interpreting data. If up to this point in the semester, students have only done traditional end-of-chapter homework problems which require little thought or modeling, they will likely be overwhelmed by the assigned homework problems. Likewise, they need to be prepared for homework that expects them to explain their reasoning rather than just doing a calculation.

How does this resource fit into the flow of your course? The fluid statics unit comes at the mid-way point of the IPLS mechanics course, serving as a bridging topic between earlier discussions of motion, force, and stability at the macro level, and later discussions of energy and thermodynamics at the micro level. Students need to already be familiar with Newton's laws and their application, but we use the fluid statics unit to introduce the idea of pressure, so no prior discussion of pressure is necessary.

PEDAGOGY

Pedagogical Approach: Peer Instruction / Think-Pair-Share; Context-rich problems; Just-in-time Teaching

Skills / Competencies: Estimation; Intuition building; Evaluating models; Applying physical principles

Research Results:

Duration, Equipment,
Basic Tips & Tricks,
Course Fit, Pedagogical
Approach, Skills
Addressed, Insight
from the Resource,
Life-Science
Connections

Vetted Library: Teaching Info., Editorial Review



What are some numbers?

File Count	Resource Count	Description
1149	164	In-class activity
145	45	Clicker question
365	98	Lecture materials
566	104	Lab
91	31	Demonstration
247	52	Video
689	137	Pre-class assignment
2272	280	Homework
273	78	Exam problem
451	134	Student reading
34	14	Project
1346	332	Instructor supplement
1368	292	Restricted access

Resource Count	Description
208	Human and Animal Physiology
165	Medical Applications
149	Cross-cutting Biological Concepts
128	Biomechanics
84	Molecular and Cellular Biology
84	None
23	Biochemistry
6	Evolution
4	Ecology
3	Botany

Resource Count	Description
243	Classical Mechanics
139	Thermo & Stat Mech
133	Fluid Mechanics
123	Electricity & Magnetism
114	Optics
107	Oscillations & Waves
56	Modern Physics
43	None



What more is there?

- [PER Central](#):

[Getting started in PER](#), [Annual PER Conferences](#), [PER Dissertations](#), Research literature, etc.

- [Advanced Labs](#):

[Lab “Immersion”](#), [Lab Conferences](#), Manuals, Software, etc.

- [Adopt-a-Physicist](#):

Connect with High School classes around the world.



Challenges & the Future?

- Moving infrastructure to the cloud
- Encouraging and aiding authors to submit
- Editorial processes
- Supporting new partners/projects
- Handling legacy content/legacy code
- Funding

A Few References

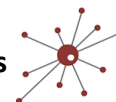
[PhysPort as professional development to foster creativity in teaching](#), Linda E. Strubbe, Adrian M. Madsen, Sarah B. McKagan, and Eleanor C. Sayre. Physics Education Research Conference 2020

[Beyond teaching methods: Highlighting physics faculty's strengths and agency](#), Linda E. Strubbe, Adrian M. Madsen, Sarah B. McKagan, and Eleanor C. Sayre. Phys. Rev. Phys. Educ. Res. **16**, 020105 (2020)

[The Physlet Approach to Simulation Design](#), Wolfgang Christian, Mario Belloni, Francisco Esquembre, Bruce A. Mason, Lyle Barbato, Matt Riggsbee. Phys. Teach. **53**, 419–422 (2015)

[Examining course syllabi: Introductory physics for life sciences](#), Remy Dou, Raluca Teodorescu, Adrian Madsen, Edward F. Redish, and Mark Reeves. Phys. Rev. Phys. Educ. Res. **15**, 020143 (2019)

[Teaching strategies predict instructors' perceptions of their effectiveness in engaging students in introductory physics for life sciences courses](#), Ellen Altermatt, Raluca Teodorescu, and Ellen R. Iverson. Phys. Rev. Phys. Educ. Res. **17**, 020133 (2021)



What Are Your Questions?

(Thank you)

